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SAR EVALUATION REPORT

Applicant Name:
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Gyeonggi-do 443-742, Korea

Date of Testing:
07/08/13 - 08/21/13
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1307081221-R1.A3L

FCC ID: A3LSMN900P

APPLICANT: SAMSUNG ELECTRONICS, CO. LTD.

DUT Type: Portable Handset
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): SM-N900P

Equipment Class	Band & Mode	Tx Frequency	Measured Conducted Power [dBm]	SAR			
				1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)	10 gm Extremity (W/kg)
PCE	GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	33.03	0.30	0.41	0.55	
PCE	GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	30.36	0.13	0.31	0.70	
PCE	UMTS 850	826.40 - 846.60 MHz	23.39	0.20	0.29	0.29	
PCE	UMTS 1900	1852.4 - 1907.6 MHz	23.43	0.23	0.45	0.84	
PCE	CDMA/EVDO BC10 (§90S)	817.90 - 822.75 MHz	24.72	0.50	0.64	0.67	
PCE	CDMA/EVDO BC0 (§22H)	824.70 - 848.31 MHz	24.64	0.35	0.57	0.58	
PCE	PCS CDMA/EVDO	1851.25 - 1908.75 MHz	24.72	0.45	0.48	1.05	
PCE	LTE Band 25 (PCS)	1852.5 - 1912.5 MHz	24.32	0.30	1.09	1.09	
DTS	2.4 GHz WLAN	2412 - 2462 MHz	17.34	0.37	0.16	0.16	
DTS	5.8 GHz WLAN	5745 - 5825 MHz	13.83	< 0.1	0.10	0.10	
NII	5.2 GHz WLAN	5180 - 5240 MHz	13.87	< 0.1	< 0.1		0.22
NII	5.3 GHz WLAN	5260 - 5320 MHz	13.50	< 0.1	< 0.1		0.20
NII	5.5 GHz WLAN	5500 - 5700 MHz	14.22	< 0.1	< 0.1		0.14
DSS/DTS	Bluetooth	2402 - 2480 MHz	8.78	N/A			
Simultaneous SAR per KDB 690783 D01v01r02:				0.98	1.50	1.47	0.22

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

Note: This revised test report (S/N: 0Y1307081221-R1.A3L) supersedes and replaces the previously issued test report on the same subject DUT for the same type of testing indicated. Please discard or destroy the previously issued test report(s) and dispose of accordingly.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.9 of this report; for North American frequency bands only.

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

Randy Ortanez
President

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
CDMA/EVDO BC10 (§90S)	Voice/Data	817.90 - 822.75 MHz
CDMA/EVDO BC0 (§22H)	Voice/Data	824.70 - 848.31 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 25 (PCS)	Data	1852.5 - 1912.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5700 MHz
Bluetooth	Data	2402 - 2480 MHz
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Nominal and Maximum Output Power Specifications

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

Mode / Band		Voice (dBm)	Burst Average GMSK (dBm)				Burst Average 8-PSK (dBm)			
		1 TX Slot	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*	*1 TX Slots*	*2 TX Slots*	*3 TX Slots*	*4 TX Slots*
GSM/GPRS/EDGE 850	Maximum	**33.5**	**33.5**	**32.5**	**31.0**	**29.5**	**27.5**	**27.5**	**24.5**	**22.5**
	Nominal	**33.0**	**33.0**	**32.0**	**30.5**	**29.0**	**27.0**	**27.0**	**24.0**	**22.0**
GSM/GPRS/EDGE 1900	Maximum	**30.5**	**30.5**	**29.5**	**27.5**	**26.5**	**26.5**	**26.5**	**21.5**	**20.5**
	Nominal	**30.0**	**30.0**	**29.0**	**27.0**	**26.0**	**26.0**	**26.0**	**21.0**	**20.0**

Mode / Band		Modulated Average		
		3GPP RMC	*3GPP HSDPA*	*3GPP HSUPA*
UMTS Band 5 (850 MHz)	Maximum	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**
UMTS Band 2 (1900 MHz)	Maximum	**23.5**	**23.5**	**23.5**
	Nominal	**23.0**	**23.0**	**23.0**

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Mode / Band		Modulated Average (dBm)
CDMA/EVDO BC10 (§90S)	Maximum	**25.0**
	Nominal	**24.5**
CDMA/EVDO BC0 (§22H)	Maximum	**25.0**
	Nominal	**24.5**
PCS CDMA/EVDO BC1 (§24E)	Maximum	**25.0**
	Nominal	**24.5**

Mode / Band			Modulated Average (dBm)
CDMA/EVDO BC10 (§90S)	SVLTE Threshold LTE is not reducing	Maximum	**18.5**
		Nominal	**18.0**
CDMA/EVDO BC0 (§22H)	SVLTE Threshold LTE is not reducing	Maximum	**18.5**
		Nominal	**18.0**
PCS CDMA/EVDO BC1 (§24E)	SVLTE Threshold LTE is not reducing	Maximum	**18.5**
		Nominal	**18.0**

Mode / Band	Power Reduction (CDMA Power ≥ SVLTE Threshold)	Modulated Average (dBm)	
LTE Band 25 (PCS)	Inactive	Maximum	**24.5**
		Nominal	**24.0**
	Active	Maximum	**19.5**
		Nominal	**19.0**

Mode / Band		Modulated Average (dBm)
IEEE 802.11b (2.4 GHz)	Maximum	**17.5**
	Nominal	**17.0**
IEEE 802.11g (2.4 GHz)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (2.4 GHz)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11a (5 GHz)	Maximum	**14.5**
	Nominal	**14.0**
IEEE 802.11n (5 GHz 20 MHz Bandwidth)	Maximum	**13.5**
	Nominal	**13.0**
IEEE 802.11n (5 GHz 40 MHz Bandwidth)	Maximum	**13.0**
	Nominal	**12.5**
IEEE 802.11ac (5 GHz 80 MHz Bandwidth)	Maximum	**11.5**
	Nominal	**11.0**
Bluetooth	Maximum	**9.5**
	Nominal	**9.0**

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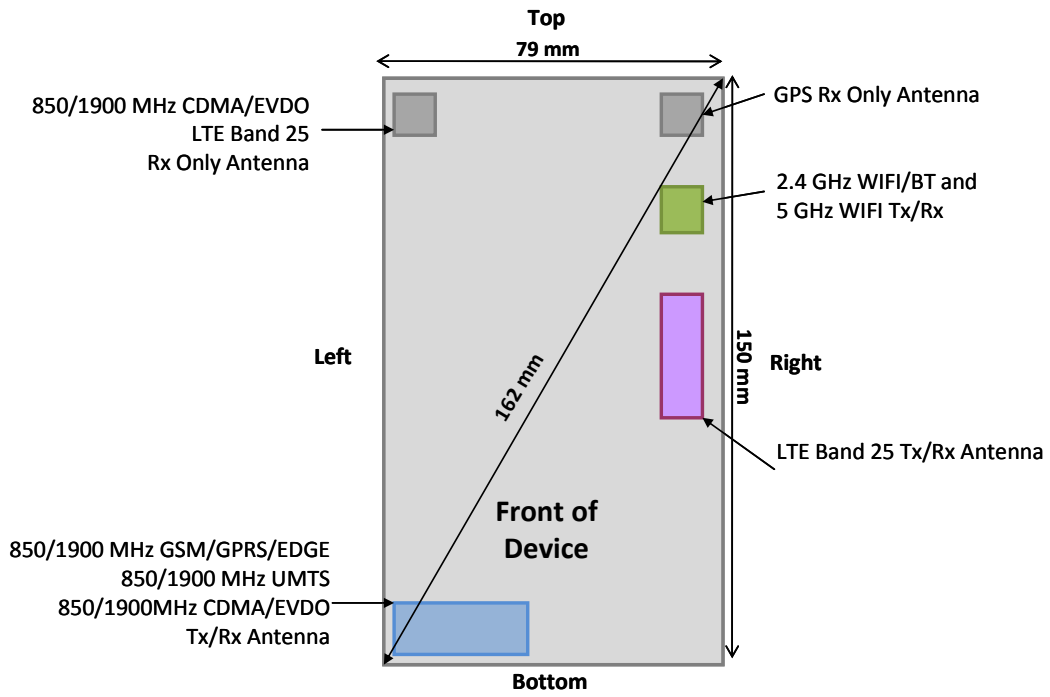
1.3 DUT Antenna Locations



Notes:
1. Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC Filing.
2. Since the diagonal distance of the device is > 160 mm, it is considered a "phablet."

Figure 1-1
DUT Antenna Locations

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mode	Exposure Condition	Back	Front	Top	Bottom	Right	Left
GPRS 850	Hotspot	Yes	Yes	No	Yes	No	Yes
GPRS 1900	Hotspot	Yes	Yes	No	Yes	No	Yes
UMTS 850	Hotspot	Yes	Yes	No	Yes	No	Yes
UMTS 1900	Hotspot	Yes	Yes	No	Yes	No	Yes
CDMA/EVDO BC10 (§90S)	Hotspot	Yes	Yes	No	Yes	No	Yes
CDMA/EVDO BC0 (§22H)	Hotspot	Yes	Yes	No	Yes	No	Yes
PCS CDMA/EVDO	Hotspot	Yes	Yes	No	Yes	No	Yes
LTE Band 25 (PCS)	Hotspot	Yes	Yes	No	No	Yes	No
2.4 GHz WLAN	Hotspot	Yes	Yes	Yes	No	Yes	No
5.2-5.7 GHz WLAN	Hand	Yes	Yes	Yes	No	Yes	No
5.8 GHz WLAN	Hotspot	Yes	Yes	Yes	No	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router or Extremity SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2 and FCC KDB Publication 648474 D04v01r01. When the wireless router mode is enabled, all 5 GHz bands except 5.8 are disabled.

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1.4 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the specialized battery. The SAR tests were performed with the specialized battery (model: B800BU).

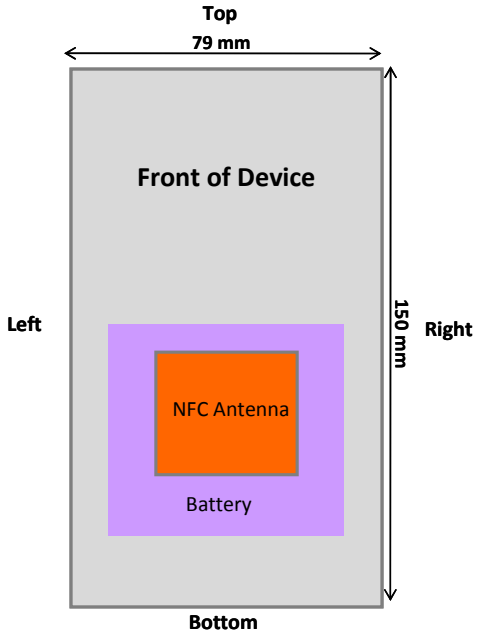

Figure 1-2
NFC Antenna Locations

1.5 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-3 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

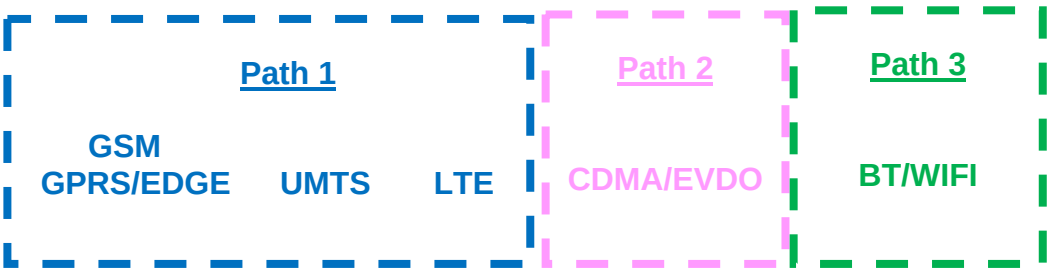

Figure 1-3
Simultaneous Transmission Paths

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

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configurations	Head	Body-Worn Accessory	Hot Spot	Hand	Note
		IEEE 1528, Supp C	Supplement C	FCC KDB 941225 D06 edges/sides	FCC KDB 648474 D04	
1	**1X CDMA Voice + LTE Data**	√	√	N/A	√	SVLTE
2	**1X CDMA Voice + LTE Data + 2.4 GHz WIFI**	√	√	√	√	Voice and LTE+WIFI Hotspot
3	**1X CDMA Voice + LTE Data + 5.8 GHz WIFI**	√	√	√	√	Voice and LTE+WIFI Hotspot
4	**1X CDMA Voice + LTE Data + 2.4 GHz Bluetooth**	N/A	√	N/A	√	Voice and LTE+Bluetooth
5	**1X CDMA Voice + 2.4 GHz WIFI**	√	√	N/A	√	1X voice and WiFi Data
6	**1X CDMA Voice + 2.4 GHz Bluetooth**	N/A	√	N/A	√	1X voice and Bluetooth
7	**1X CDMA Voice + 5 GHz WIFI**	√	√	N/A	√	1X voice and WiFi Data
8	**GSM Voice + 2.4 GHz WIFI**	√	√	N/A	√	
9	**GSM Voice + 2.4 GHz Bluetooth**	N/A	√	N/A	√	
10	**GSM Voice + 5 GHz WIFI**	√	√	N/A	√	
11	**UMTS Voice + 2.4 GHz WIFI**	√	√	N/A	√	
12	**UMTS Voice + 2.4 GHz Bluetooth**	N/A	√	N/A	√	
13	**UMTS Voice + 5 GHz WIFI**	√	√	N/A	√	
14	**1X/EVDO Data + 2.4 GHz WIFI**	√	√	√	√	EVDO+WIFI Hotspot
15	**1X/EVDO Data + 2.4 GHz Bluetooth**	N/A	√	N/A	√	EVDO+Bluetooth
16	**1X/EVDO Data + 5.8 GHz WIFI**	√	√	√	√	EVDO+WIFI Hotspot
17	**GPRS/EDGE Data + 2.4 GHz WIFI**	N/A	N/A	√	√	
18	**GPRS/EDGE Data + 5.8 GHz WIFI**	N/A	N/A	√	√	
19	**UMTS Data + 2.4 GHz WIFI**	√	√	√	√	
20	**UMTS Data + 5.8 GHz WIFI**	√	√	√	√	
21	**LTE Data + 2.4 GHz WIFI**	√	√	√	√	LTE+WIFI Hotspot
22	**LTE Data + 2.4 GHz Bluetooth**	N/A	√	N/A	√	LTE+Bluetooth
23	**LTE Data + 5.8 GHz WIFI**	√	√	√	√	LTE+WIFI Hotspot
24	1X CDMA Voice + LTE Data + 5.2-5.5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by SW
25	1X/EVDO Data + 5.2-5.5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by SW
26	LTE Data + 5.2-5.5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by SW
27	1X CDMA Voice + EVDO	N/A	N/A	N/A	N/A	Not supported by HW
28	EVDO data + LTE Data	N/A	N/A	N/A	N/A	Not supported by SW

Notes:

1. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
2. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no simultaneous transmission scenarios involving WIFI direct beyond that listed in the above table.

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1.6 SAR Test Exclusions Applied

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using 5.2 - 5.7 GHz WIFI, only 2.4 and 5.8 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations according to FCC KDB 941225 D06v01.

Per FCC KDB 447498 D01v05, the 1g SAR exclusion threshold for distances <50mm is defined by the following equation:

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

Based on the maximum conducted power of Bluetooth (rounded to the nearest mW) and the antenna to user separation distance, Bluetooth SAR was not required; [(9/10)* √2.441] = 1.4< 3.0. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.

Per FCC KDB 447498 D01v05r01, the SAR exclusion threshold for 10g Extremity SAR for distances <50mm is defined by the following equation:

$$\frac{Max\ Power\ of\ Channel\ (mW)}{Separation\ Dist(mm)} * \sqrt{Frequency\ (GHz)} \leq 7.5$$

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 < 7.5. Per KDB Publication 447498 D01v05r01, the maximum power of the channel was rounded to the nearest mW before calculation.

Per FCC KDB Publication 648474 D03-D04, this device is considered a "phablet" since its diagonal distance is greater than 160 mm. Therefore hand SAR tests are required. Because wireless router operations are not supported for 5.2-5.7 GHz WIFI, hand SAR was evaluated for 5.2-5.7 GHz WIFI. However, hand SAR was not evaluated for 2.4 GHz WIFI and 5.8 GHz WIFI since Hotspot SAR for 2.4 GHz WIFI and 5.8 GHz WIFI when scaled up to the maximum output power tolerances is < 1.2 W/kg.

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.

This device supports IEEE 802.11ac with the following features:

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

Per April 2013 TCB Workshop notes, full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.

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(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.

CDMA 1X Advanced technology was not required for SAR since the maximum output powers for 1x Advanced was not more than 0.25 dB higher than the maximum measured powers for 1x and the measured SAR in any 1x mode exposure conditions was not greater than 1.2 W/kg.

Per FCC KDB Publication 648474 D03-D04, this device is considered a "phablet" since its diagonal distance is greater than 160 mm. Therefore hand SAR tests are required, however hand SAR was not evaluated for GSM/GPRS/EDGE/UMTS/CDMA/EVDO 850/1900 MHz and LTE B25 since Hotspot SAR for these bands/modes when scaled up to the maximum output power tolerances is < 1.2 W/kg.

1.7 Power Reduction for SAR

This device uses power reduction mechanisms for LTE during SVLTE operation (1x-RTT CDMA voice + LTE data) for SAR compliance. See Section 10 for more details.

1.8 Wireless Charging Battery Cover

This DUT may be used with a standard battery cover or with an optional wireless charging battery cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging battery cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. Since reported SAR did not exceed 1.2 W/kg, additional testing with the wireless charging battery cover was not required.

1.9 Guidance Applied

- FCC OET Bulletin 65 Supplement C [June 2001]
- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (2G/3G/4G, 1x Advanced and Hotspot)
- 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 648474 D03-D04 (Phablet Procedures, Wireless Charging Cover)
- April 2013 TCB Workshop Notes (IEEE 802.11ac)

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1.10 Device Serial Numbers

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

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number	Extremity Serial Number
GSM/GPRS/EDGE 850	34272	84	84	-
GSM/GPRS/EDGE 1900	34272	34272	34272	-
UMTS 850	3426E	84	84	-
UMTS 1900	3426E	3426E	3426E	-
CDMA/EVDO BC10 (§90S) - Max Power	342C2	342C2	342C2	-
CDMA/EVDO BC10 (§90S) - Reduced Power	82	3445A	3445A	-
CDMA/EVDO BC0 (§22H) - Max Power	342C2	342C2	342C2	-
CDMA/EVDO BC0 (§22H) - Reduced Power	82	3445A	3445A	-
PCS CDMA/EVDO - Max Power	342AF	342AF	342AF	-
PCS CDMA/EVDO - Reduced Power	87	342C4	342C4	-
LTE Band 25 (PCS) - Max Power	83	34280	34280	-
LTE Band 25 (PCS) - Reduced Power	88	342E0	342E0	-
2.4 GHz WLAN	34287	89	89	-
5.2-5.7 GHz WLAN	320FC	320FC	-	320FC
5.8 GHz WLAN	320FC	320FC	320FC	-

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2 LTE INFORMATION

LTE Information			
FCC ID	**A3LSMN900P**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 25 (PCS) (1852.5 - 1912.5 MHz)		
Channel Bandwidths	LTE Band 25 (PCS): 5 MHz, 10 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 25 (PCS): 5 MHz	1852.5 (26065)	1882.5 (26365)	1912.5 (26665)
LTE Band 25 (PCS): 10 MHz	1855 (26090)	1882.5 (26365)	1910 (26640)
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 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

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

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

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

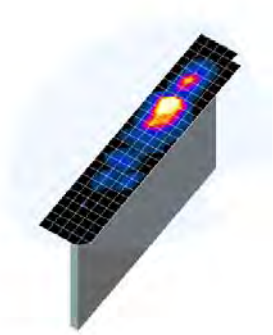

Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1).
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1). On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

   a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

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

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

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

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

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5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

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

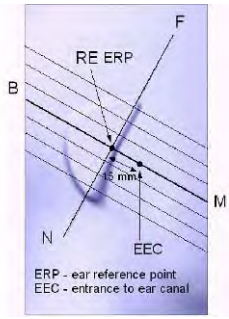

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

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

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

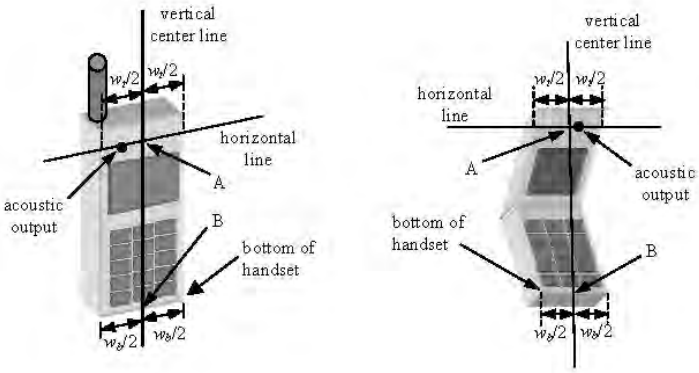

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

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

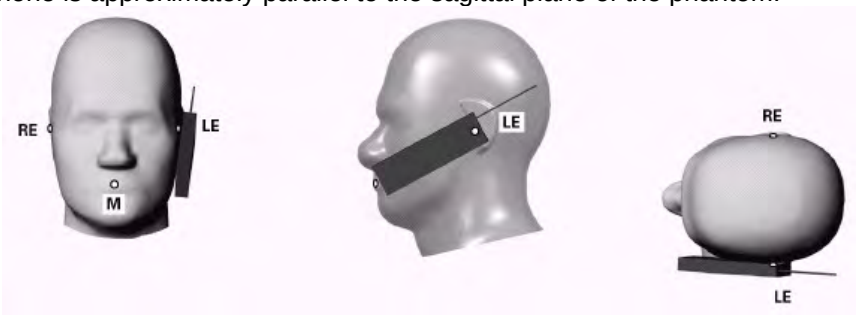

Figure 6-1 Front, Side and Top View of Cheek Position

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

6.3 Positioning for Ear / 15º Tilt

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

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

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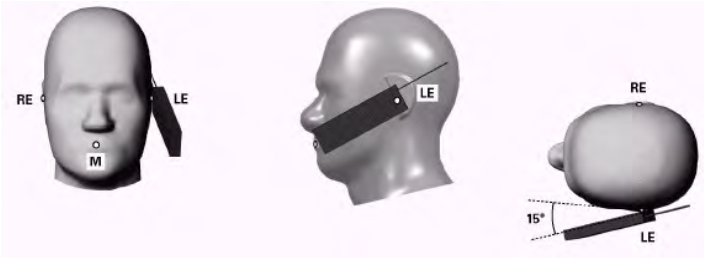

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

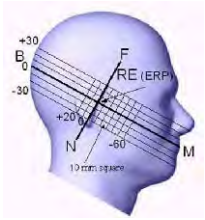

Figure 6-3
Side view w/ relevant markings

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

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

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04_v01. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

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

Figure 6-4 Twin SAM Chin20

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6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-5). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

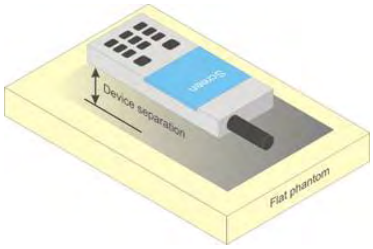

Figure 6-5
Sample Body-Worn Diagram

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

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

6.6 Extremity Exposure Configurations

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

For smart phones with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC minitablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04 v01r01DR04 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna <=25 mm from that surface or edge, in direct contact with the

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phantom, for 10-g SAR. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg.

6.7 Wireless Router Configurations

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

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

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7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

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

7.2 Controlled Environment

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

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

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *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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8 FCC MEASUREMENT PROCEDURES

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

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

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

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

8.3 SAR Measurement Conditions for CDMA2000

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

8.3.1 Output Power Verification

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

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 8-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse SCH_0 and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 8-2 was applied.

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Table 8-1
Parameters for Max. Power for RC1

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

Table 8-2
Parameters for Max. Power for RC3

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

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

8.3.2 CDMA2000 1x Advanced

This device additionally supports 1x Advanced. Conducted powers were measured using SO75 with RC8 on the uplink and RC11 on the downlink per FCC KDB Publication 941225 D02. Smart blanking was disabled for all measurements. The EUT was configured with forward power control Mode 000 and reverse power control at 400 bps. Conducted powers were measured on an Agilent 8960 Series 10 Wireless Communications Test Set, Model E5515C using the CDMA2000 1x Advanced application, Option E1962B-410.

Based on the maximum output power measured for 1x Advanced, SAR is required for 1x advanced when if the maximum output for 1x Advanced is more than 0.25 dB higher than the maximum measured for 1x. Also, if the measured SAR in any 1x mode exposure conditions (head, body etc.) is larger than 1.2 W/kg, the highest of those configurations above 1.2 W/kg for each exposure condition in 1x Advanced has to be repeated. All measured SAR in 1x mode higher than 1.5 W/kg must be repeated for 1x Advanced.

8.3.3 Head SAR Measurements

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

Head SAR was additionally evaluated using EVDO Rev. A to support compliance for VoIP operations. See Section 8.3.5 for EVDO Rev. A configuration parameters.

8.3.4 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + SCH_n) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + SCH_n) with FCH at full rate and SCH_0 enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only. When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the "All Up"

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

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8.3.5 Handsets with EVDO

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

8.3.6 Body SAR Measurements for EVDO Hotspot

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

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

8.4 SAR Measurement Conditions for UMTS

8.4.1 Output Power Verification

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

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

8.4.2 Head SAR Measurements for Handsets

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

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8.4.3 Body SAR Measurements

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

8.4.4 SAR Measurements for Handsets with Rel 5 HSDPA

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

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

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

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 8 ⇔ $A_{hs} = \beta_{hs}/\beta_c = 30/15$ ⇔ $\beta_{hs} = 30/15 * \beta_c$.

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 Δ_{NACK} = 8 (A_{hs} = 30/15) with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 7 (A_{hs} = 24/15) with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

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

8.4.5 SAR Measurements for Handsets with Rel 6 HSUPA

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

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

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

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

8.5 SAR Measurement Conditions for LTE

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

8.5.1 Spectrum Plots for RB Configurations

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

8.5.2 MPR

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

8.5.3 A-MPR

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

8.5.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 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.

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

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

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

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

8.6 SAR Testing with 802.11 Transmitters

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

8.6.1 General Device Setup

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

8.6.2 Frequency Channel Configurations [27]

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 0.25 dB or higher than the 802.11a mode. 802.11ac SAR was evaluated for highest 802.11a configuration in each 5 GHz band and each exposure condition. 802.11ac modes were additionally evaluated for SAR if the output power for the respective mode was more than 0.25 dB higher than powers of 802.11a modes.

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

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9 RF CONDUCTED POWERS

9.1 CDMA Conducted Powers

Band	Channel	Rule Part	Frequency	SO55 [dBm]	SO55 [dBm]	SO75 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]	1x EvDO Rev. 0 [dBm]	1x EvDO Rev. A [dBm]
	F-RC		MHz	RC1	RC3	RC11	FCH+SCH	FCH	(RTAP)	(RETAP)
Cellular	564	90S	820.1	24.58	24.63	24.58	24.60	24.61	24.72	24.70
Cellular	1013	22H	824.7	24.52	24.56	24.49	24.53	24.53	24.65	24.64
	384	22H	836.52	24.53	24.56	24.51	24.53	24.55	24.64	24.63
	777	22H	848.31	24.44	24.52	24.44	24.47	24.41	24.60	24.56
PCS	25	24E	1851.25	24.62	24.67	24.63	24.71	24.72	24.69	24.61
	600	24E	1880	24.28	24.35	24.32	24.35	24.36	24.36	24.30
	1175	24E	1908.75	24.35	24.40	24.44	24.41	24.43	24.54	24.47

General Notes:

1. RC1 is only applicable for IS-95 compatibility.
2. For FCC Rule Part 90S, Per FCC KDB Publication 447498 D01v05 4.1.6, only one channel is required since the device operates within the transmission range of 817.90 – 823.10 MHz**.**

Per KDB Publication 941225 D01v02:

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

1x Advanced Considerations per KDB Publication 941225 D02

1. CDMA 1X Advanced technology was not required for SAR since the maximum output powers for 1x Advanced was not more than 0.25 dB higher than the maximum measured powers for 1x and the measured SAR in any 1x mode exposure conditions was not greater than 1.2 W/kg. See Section 8.3.2 for 1x Advanced test set up.

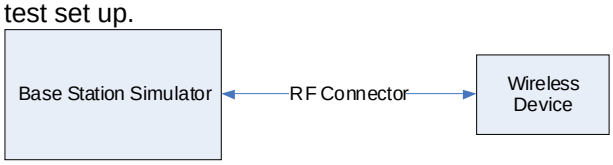

Figure 9-1
Power Measurement Setup

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9.2 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	*GPRS/EDGE Data (GMSK)*				*EDGE Data (8-PSK)*			
Band	**Channel**	**GSM [dBm] CS (1 Slot)**	**GPRS [dBm] 1 Tx Slot**	**GPRS [dBm] 2 Tx Slot**	**GPRS [dBm] 3 Tx Slot**	**GPRS [dBm] 4 Tx Slot**	**EDGE [dBm] 1 Tx Slot**	**EDGE [dBm] 2 Tx Slot**	**EDGE [dBm] 3 Tx Slot**	**EDGE [dBm] 4 Tx Slot**
GSM 850	128	33.05	33.18	31.54	**30.62**	29.27	27.32	27.24	23.46	22.18
	190	33.03	33.22	31.49	**30.61**	29.35	27.35	27.27	23.54	22.21
	251	33.14	33.19	31.87	**30.81**	29.41	27.46	27.39	23.64	22.29
GSM 1900	512	30.22	30.25	28.39	**27.26**	25.83	25.59	25.51	21.15	19.85
	661	30.36	30.23	28.41	**27.25**	25.95	25.65	25.60	21.26	20.04
	810	29.91	29.96	28.57	**27.33**	25.92	25.66	25.61	21.29	20.13

		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	24.02	24.15	25.52	**26.36**	26.26	18.29	21.22	19.20	19.17
	190	24.00	24.19	25.47	**26.35**	26.34	18.32	21.25	19.28	19.20
	251	24.11	24.16	25.85	**26.55**	26.40	18.43	21.37	19.38	19.28
GSM 1900	512	21.19	21.22	22.37	**23.00**	22.82	16.56	19.49	16.89	16.84
	661	21.33	21.20	22.39	**22.99**	22.94	16.62	19.58	17.00	17.03
	810	20.88	20.93	22.55	**23.07**	22.91	16.63	19.59	17.03	17.12

Note: 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.

The bolded GPRS modes were selected for SAR testing according to the highest frame-averaged output power table according to KDB 941225 D03v01.

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.

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 9-2
Power Measurement Setup

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9.3 UMTS 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	23.23	23.39	23.37	23.38	23.43	23.32	-
99		12.2 kbps AMR	23.23	23.40	23.37	23.32	23.45	23.27	-
6	HSDPA	Subtest 1	22.30	22.48	22.38	22.28	22.49	22.31	0
6		Subtest 2	22.38	22.45	22.40	22.37	22.51	22.56	0
6		Subtest 3	21.78	21.95	21.97	21.94	22.11	22.13	0.5
6		Subtest 4	21.81	21.99	21.90	21.87	21.98	21.91	0.5
6	HSUPA	Subtest 1	21.89	22.58	22.21	21.97	22.08	21.71	0
6		Subtest 2	21.35	21.36	21.43	21.45	21.56	21.46	2
6		Subtest 3	21.05	21.55	21.28	20.97	21.28	21.34	1
6		Subtest 4	21.79	21.47	21.82	21.81	21.82	21.88	2
6		Subtest 5	21.70	21.59	21.98	22.10	21.98	21.63	0

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.

This device does not support DC-HSDPA.

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

Figure 9-3
Power Measurement Setup

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9.4 LTE Conducted Powers

9.4.1 LTE Band 25 (PCS)

Table 9-1
LTE Band 25 (PCS) Conducted Powers - 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1855	26090	10	QPSK	1	0	23.89	0	0
	1855	26090	10	QPSK	1	25	24.04	0	0
	1855	26090	10	QPSK	1	49	23.95	0	0
	1855	26090	10	QPSK	25	0	23.27	1	0-1
	1855	26090	10	QPSK	25	12	23.26	1	0-1
	1855	26090	10	QPSK	25	25	23.14	1	0-1
	1855	26090	10	QPSK	50	0	23.11	1	0-1
	1855	26090	10	16QAM	1	0	22.99	1	0-1
	1855	26090	10	16QAM	1	25	23.26	1	0-1
	1855	26090	10	16QAM	1	49	23.18	1	0-1
	1855	26090	10	16QAM	25	0	22.19	2	0-2
	1855	26090	10	16QAM	25	12	22.26	2	0-2
	1855	26090	10	16QAM	25	25	22.14	2	0-2
	1855	26090	10	16QAM	50	0	22.13	2	0-2
Mid	1882.5	26365	10	QPSK	1	0	24.05	0	0
	1882.5	26365	10	QPSK	1	25	23.99	0	0
	1882.5	26365	10	QPSK	1	49	23.95	0	0
	1882.5	26365	10	QPSK	25	0	23.12	1	0-1
	1882.5	26365	10	QPSK	25	12	23.15	1	0-1
	1882.5	26365	10	QPSK	25	25	23.11	1	0-1
	1882.5	26365	10	QPSK	50	0	23.16	1	0-1
	1882.5	26365	10	16QAM	1	0	23.17	1	0-1
	1882.5	26365	10	16QAM	1	25	23.19	1	0-1
	1882.5	26365	10	16QAM	1	49	23.07	1	0-1
	1882.5	26365	10	16QAM	25	0	22.17	2	0-2
	1882.5	26365	10	16QAM	25	12	22.19	2	0-2
	1882.5	26365	10	16QAM	25	25	22.11	2	0-2
	1882.5	26365	10	16QAM	50	0	22.04	2	0-2
High	1910	26640	10	QPSK	1	0	**24.32**	0	0
	1910	26640	10	QPSK	1	25	24.15	0	0
	1910	26640	10	QPSK	1	49	24.18	0	0
	1910	26640	10	QPSK	25	0	**23.46**	1	0-1
	1910	26640	10	QPSK	25	12	23.41	1	0-1
	1910	26640	10	QPSK	25	25	23.40	1	0-1
	1910	26640	10	QPSK	50	0	23.34	1	0-1
	1910	26640	10	16QAM	1	0	23.33	1	0-1
	1910	26640	10	16QAM	1	25	23.19	1	0-1
	1910	26640	10	16QAM	1	49	23.21	1	0-1
	1910	26640	10	16QAM	25	0	22.34	2	0-2
	1910	26640	10	16QAM	25	12	22.46	2	0-2
	1910	26640	10	16QAM	25	25	22.33	2	0-2
	1910	26640	10	16QAM	50	0	22.41	2	0-2

Table 9-2
LTE Band 25 (PCS) Conducted Powers - 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	26065	5	QPSK	1	0	24.16	0	0
	1852.5	26065	5	QPSK	1	12	24.21	0	0
	1852.5	26065	5	QPSK	1	24	24.14	0	0
	1852.5	26065	5	QPSK	12	0	23.36	1	0-1
	1852.5	26065	5	QPSK	12	6	23.34	1	0-1
	1852.5	26065	5	QPSK	12	13	23.36	1	0-1
	1852.5	26065	5	QPSK	25	0	23.33	1	0-1
	1852.5	26065	5	16-QAM	1	0	23.25	1	0-1
	1852.5	26065	5	16-QAM	1	12	23.34	1	0-1
	1852.5	26065	5	16-QAM	1	24	23.25	1	0-1
	1852.5	26065	5	16-QAM	12	0	22.29	2	0-2
	1852.5	26065	5	16-QAM	12	6	22.35	2	0-2
	1852.5	26065	5	16-QAM	12	13	22.27	2	0-2
	1852.5	26065	5	16-QAM	25	0	22.18	2	0-2
Mid	1882.5	26365	5	QPSK	1	0	24.12	0	0
	1882.5	26365	5	QPSK	1	12	24.04	0	0
	1882.5	26365	5	QPSK	1	24	24.00	0	0
	1882.5	26365	5	QPSK	12	0	23.24	1	0-1
	1882.5	26365	5	QPSK	12	6	23.32	1	0-1
	1882.5	26365	5	QPSK	12	13	23.33	1	0-1
	1882.5	26365	5	QPSK	25	0	23.21	1	0-1
	1882.5	26365	5	16-QAM	1	0	23.38	1	0-1
	1882.5	26365	5	16-QAM	1	12	23.39	1	0-1
	1882.5	26365	5	16-QAM	1	24	23.37	1	0-1
	1882.5	26365	5	16-QAM	12	0	22.19	2	0-2
	1882.5	26365	5	16-QAM	12	6	22.27	2	0-2
	1882.5	26365	5	16-QAM	12	13	22.32	2	0-2
	1882.5	26365	5	16-QAM	25	0	22.15	2	0-2
High	1912.5	26665	5	QPSK	1	0	24.28	0	0
	1912.5	26665	5	QPSK	1	12	24.22	0	0
	1912.5	26665	5	QPSK	1	24	24.18	0	0
	1912.5	26665	5	QPSK	12	0	23.25	1	0-1
	1912.5	26665	5	QPSK	12	6	23.34	1	0-1
	1912.5	26665	5	QPSK	12	13	23.24	1	0-1
	1912.5	26665	5	QPSK	25	0	23.35	1	0-1
	1912.5	26665	5	16-QAM	1	0	23.31	1	0-1
	1912.5	26665	5	16-QAM	1	12	23.29	1	0-1
	1912.5	26665	5	16-QAM	1	24	23.25	1	0-1
	1912.5	26665	5	16-QAM	12	0	22.42	2	0-2
	1912.5	26665	5	16-QAM	12	6	22.40	2	0-2
	1912.5	26665	5	16-QAM	12	13	22.34	2	0-2
	1912.5	26665	5	16-QAM	25	0	22.36	2	0-2

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9.5 WLAN Conducted Powers

Table 9-3
IEEE 802.11b Average RF Power

Mode	Freq	Channel	802.11b (2.4 GHz) Conducted Power [dBm]			
			Data Rate [Mbps]			
	[MHz]		1	2	5.5	11
802.11b	2412	1*	**17.34**	17.38	17.41	17.49
802.11b	2437	6*	17.18	17.31	17.36	17.38
802.11b	2462	11*	15.96	16.05	16.06	16.10

Table 9-4
IEEE 802.11g Average RF Power

Mode	Freq	Channel	802.11g (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11g	2412	1	14.31	14.37	14.39	14.50	14.28	14.38	14.49	14.36
802.11g	2437	6	13.43	13.32	13.36	13.32	13.45	13.50	13.66	13.47
802.11g	2462	11	13.56	13.74	13.73	13.60	13.59	13.70	13.79	13.55

Table 9-5
IEEE 802.11n Average RF Power

Mode	Freq	Channel	802.11n (2.4 GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	20	26	39	52	58	65
802.11n	2412	1	13.26	13.27	13.26	13.32	13.19	13.36	13.35	13.39
802.11n	2437	6	13.20	13.26	13.35	13.38	13.38	13.39	13.34	13.50
802.11n	2462	11	12.24	12.37	12.22	12.37	12.22	12.31	12.34	12.43

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Table 9-6
IEEE 802.11a Average RF Power

Mode	Freq	Channel	802.11a (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6	9	12	18	24	36	48	54
802.11a	5180	36*	**13.87**	13.87	13.98	13.92	13.93	14.04	14.08	14.02
802.11a	5200	40	13.71	14.01	14.06	13.91	13.97	13.94	14.05	13.92
802.11a	5220	44	13.84	13.88	13.95	14.04	13.97	13.93	14.06	14.01
802.11a	5240	48*	13.82	13.85	13.88	13.95	13.99	14.03	14.09	14.07
802.11a	5260	52*	13.46	13.55	13.57	13.58	13.63	13.50	13.70	13.41
802.11a	5280	56	**13.50**	13.54	13.54	13.64	13.70	13.61	13.60	13.74
802.11a	5300	60	13.47	13.56	13.59	13.69	13.53	13.70	13.60	13.62
802.11a	5320	64*	13.45	13.46	13.40	13.44	13.39	13.49	13.74	13.62
802.11a	5500	100	14.22	14.18	14.21	14.28	14.36	14.37	14.33	14.13
802.11a	5520	104*	14.14	14.10	14.24	14.18	14.20	14.30	14.37	14.29
802.11a	5540	108	14.19	14.17	14.14	14.32	14.20	14.18	14.40	14.12
802.11a	5560	112	13.99	13.59	13.69	13.61	13.61	13.69	13.73	13.59
802.11a	5580	116*	13.76	13.75	13.84	13.68	13.85	13.84	13.95	13.86
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	13.95	13.88	14.15	14.09	14.13	14.11	14.35	14.12
802.11a	5680	136*	14.10	14.20	14.29	14.28	14.21	14.17	14.36	14.10
802.11a	5700	140	**14.22**	14.27	14.25	14.19	14.24	14.16	14.46	14.35
802.11a	5745	149*	13.09	13.02	13.21	13.22	13.21	13.26	13.31	13.25
802.11a	5765	153	13.20	13.10	13.10	13.08	13.25	13.13	13.20	13.03
802.11a	5785	157*	12.97	13.05	13.04	13.10	13.04	13.01	13.22	13.12
802.11a	5805	161*	13.38	13.15	13.25	13.35	13.20	13.24	13.38	13.28
802.11a	5825	165	**13.83**	13.86	13.75	13.89	13.87	13.97	14.02	13.88

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

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

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Table 9-7
IEEE 802.11n Average RF Power – 20 MHz Bandwidth

Mode	Freq	Channel	20MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		6.5	13	19.5	26	39	52	58.5	65
802.11n	5180	36	12.90	12.91	13.02	13.02	13.06	13.12	13.07	13.12
802.11n	5200	40	12.91	12.93	13.09	12.96	13.11	13.07	13.09	13.18
802.11n	5220	44	12.84	12.90	12.89	12.98	13.05	13.07	12.96	13.09
802.11n	5240	48	12.83	12.86	12.93	12.91	13.04	13.03	13.00	13.04
802.11n	5260	52	12.48	12.49	12.58	12.59	12.51	12.46	12.56	12.56
802.11n	5280	56	12.34	12.34	12.50	12.39	12.37	12.30	12.46	12.37
802.11n	5300	60	12.26	12.28	12.31	12.44	12.29	12.25	12.37	12.32
802.11n	5320	64	12.23	12.22	12.35	12.34	12.28	12.16	12.28	12.33
802.11n	5500	100	13.03	13.13	13.14	13.09	13.21	13.18	13.17	13.17
802.11n	5520	104	12.97	13.06	13.11	13.06	13.16	13.15	13.08	13.18
802.11n	5540	108	13.02	13.13	13.09	13.02	13.24	13.17	13.20	13.13
802.11n	5560	112	12.93	13.02	13.03	12.96	13.12	13.12	13.04	13.06
802.11n	5580	116	12.86	13.04	12.94	12.93	13.12	13.01	13.02	12.97
802.11n	5600	120	N/A	NA	NA	NA	NA	NA	NA	NA
802.11n	5620	124	N/A	NA	NA	NA	NA	NA	NA	NA
802.11n	5640	128	N/A	NA	NA	NA	NA	NA	NA	NA
802.11n	5660	132	12.68	12.81	12.79	12.80	12.83	12.81	12.81	12.82
802.11n	5680	136	12.74	12.76	12.89	12.78	12.95	12.83	12.88	12.86
802.11n	5700	140	12.73	12.83	12.89	12.75	12.89	12.88	12.87	12.79
802.11n	5745	149	12.64	12.67	12.71	12.65	12.79	12.75	12.80	12.75
802.11n	5765	153	12.65	12.62	12.76	12.65	12.89	12.81	12.80	12.77
802.11n	5785	157	12.62	12.64	12.70	12.56	12.81	12.70	12.80	12.69
802.11n	5805	161	12.57	12.60	12.63	12.65	12.79	12.66	12.66	12.74
802.11n	5825	165	12.68	12.74	12.73	12.74	12.83	12.81	12.89	12.82

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.

Table 9-8
IEEE 802.11n Average RF Power – 40 MHz Bandwidth

Mode	Freq	Channel	40MHz BW 802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
	[MHz]		13.5	27	40.5	54	81	108	121.5	135
802.11n	5190	38	11.76	12.03	12.04	11.95	12.04	12.05	12.15	12.15
802.11n	5230	46	11.87	12.16	12.21	12.08	12.11	12.16	12.28	12.27
802.11n	5270	54	11.45	11.59	11.48	11.43	11.45	11.53	11.48	11.46
802.11n	5310	62	11.19	11.36	11.24	11.16	11.14	11.33	11.21	11.22
802.11n	5510	102	12.15	12.48	12.46	12.57	12.46	12.50	12.43	12.54
802.11n	5550	110	12.35	12.66	12.73	12.85	12.66	12.68	12.66	12.71
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	12.05	12.37	12.35	12.49	12.31	12.37	12.38	12.48
802.11n	5755	151	11.94	12.00	11.93	12.09	11.89	11.98	11.97	12.11
802.11n	5795	159	11.81	11.88	11.78	12.02	11.70	11.87	11.84	11.97

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.

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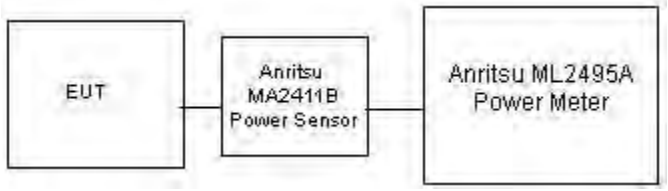
Table 9-9
IEEE 802.11ac Average RF Power – 80 MHz Bandwidth

Mode	Freq [MHz]	Channel	80MHz BW 802.11ac (5GHz) Conducted Power [dBm]									
			Data Rate [Mbps]									
			29.3	58.5	87.8	117	175.5	234	263.3	292.5	351	390
			MCS0	MCS1	MCS2	MCS3	MCS4	MCS5	MCS6	MCS7	MCS8	MCS9
802.11ac	5210	42	**11.04**	11.08	11.04	11.02	11.09	11.10	11.13	11.15	11.17	11.04
802.11ac	5290	58	**10.69**	10.67	10.68	10.74	10.82	10.75	10.70	10.76	10.79	10.64
802.11ac	5530	106	**10.63**	10.61	10.66	10.70	10.70	10.63	10.72	10.63	10.77	10.67
802.11ac	5775	155	**10.91**	10.92	10.98	10.97	11.00	10.95	11.01	11.04	10.89	11.06

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

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

Power measurement for signal < 50 MHz



Power measurement for signal > 50 MHz

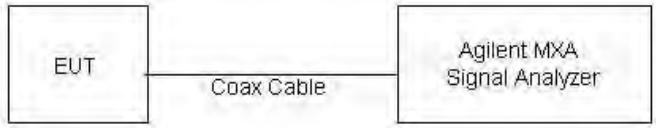


Figure 9-4
Power Measurement Setup

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10 LTE POWER REDUCTION

10.1 Introduction to LTE Power Reduction

This device is capable of Simultaneous Voice and LTE (SVLTE) calls, with the voice call supported by a CDMA 1x-RTT transmitter and the data connection supported by a separate LTE transmitter. A LTE power reduction scheme is applied during a LTE connection operating simultaneously with 1x-RTT voice calls. The maximum transmit power of LTE is limited depending on the CDMA 1x voice transmit power level. When CDMA 1x Voice is operating at a certain range of high power levels, the maximum LTE transmit power is limited. When CDMA 1x Voice transmit power is below a certain threshold transmit power level, LTE can transmit at the maximum power. Target levels of power reduction and CDMA voice threshold levels are provided in Table 10-1.

Table 10-1
SVLTE Power Reduction Scheme

Mode	Voice Avg Power(P) 1x 850/1900 MHz (dBm)	Max. B25 LTE Data Avg Power (dBm)
SVLTE	$P \geq 18$	19
	$P < 18$	24

10.2 Output Power Verification

Per KDB Publication 941225 D05v02 Section 4.4, output powers were measured in SVLTE mode to determine that the power reduction mechanism was operating reliably and consistently. The power reduction was investigated by simultaneously connecting the device to both LTE and CDMA base station simulators. LTE output powers were measured through conducted RF connections by first connecting the device in a LTE data call and subsequently a CDMA 1x-RTT call. CDMA powers were controlled by configuring the CDMA base station simulator to active bits. The LTE output power was monitored while changing the cell output power level.

The power reduction targets and threshold level described in **Table 10-1** were confirmed. Please see results in **Table 10-2** .

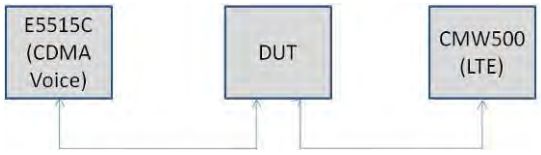

Figure 10-1
SVLTE Conducted Test Setup Diagram

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Table 10-2
SVLTE Power Reduction Verification Results

1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB 0RB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB 0RB offset
800 MHz	384	25	19.32	19.29	19.30	19.31	19.36	19.31	19.38	19.15	19.10	19.08	19.28	19.32	19.22	19.35
		24	19.33	19.27	19.32	19.35	19.34	19.29	19.33	19.20	19.11	19.04	19.27	19.31	19.18	19.33
		23	19.34	19.28	19.30	19.34	19.35	19.30	19.35	19.14	19.14	19.06	19.24	19.32	19.19	19.34
		22	19.32	19.29	19.31	19.37	19.36	19.28	19.31	19.20	19.14	19.10	19.23	19.31	19.20	19.33
		21	19.34	19.29	19.29	19.32	19.35	19.28	19.37	19.17	19.09	19.07	19.26	19.32	19.21	19.31
		20	19.34	19.30	19.28	19.30	19.37	19.27	19.34	19.21	19.10	19.03	19.25	19.31	19.22	19.32
		19	19.33	19.29	29.28	19.33	19.36	19.28	19.33	19.18	19.11	19.02	19.26	19.29	19.23	19.33
		18	19.33	19.30	19.29	19.31	19.37	19.29	19.36	19.18	19.09	19.06	19.28	19.30	19.22	19.33
		17	24.08	24.09	24.02	23.46	23.49	23.32	23.38	23.30	23.22	23.15	22.41	22.39	22.30	22.41
		16	24.41	24.42	24.33	23.44	23.47	23.33	23.40	23.31	23.23	23.14	22.42	22.40	22.31	22.41
		15	24.41	24.42	24.24	23.45	23.45	23.34	23.39	23.28	23.24	23.15	22.43	22.39	22.29	22.43
		14	24.40	24.43	24.35	23.45	23.43	23.33	23.38	23.26	23.27	23.16	22.43	22.40	22.30	22.42
		13	24.41	24.42	24.34	23.43	23.44	23.34	23.39	23.25	23.25	23.14	22.44	22.40	22.29	22.43
		12	24.41	24.43	24.24	23.44	23.45	23.34	23.39	23.26	23.24	23.13	22.43	22.41	22.30	22.44
		11	24.40	24.42	24.35	23.46	23.46	23.35	23.38	23.24	23.23	23.16	22.42	22.41	22.30	22.43

1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB 0RB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB 0RB offset
1900 MHz	600	25	19.34	19.32	19.28	19.41	19.36	19.32	19.31	19.13	19.12	19.04	19.25	19.31	19.21	19.31
		24	19.32	19.31	19.29	19.39	19.40	19.31	19.38	19.14	19.11	19.05	19.25	19.32	19.22	19.33
		23	19.33	19.30	19.27	19.39	19.39	19.30	19.35	19.18	19.10	19.06	19.26	19.31	19.22	19.33
		22	19.34	19.29	19.29	19.37	19.39	19.34	19.36	19.15	19.,08	19.07	19.25	19.27	19.21	19.31
		21	19.34	19.28	19.30	19.42	19.34	19.26	19.35	19.20	19.10	19.09	19.24	19.33	19.23	19.33
		20	19.33	19.30	19.28	19.43	19.35	19.28	19.34	19.16	19.09	19.04	19.26	19.29	19.18	19.30
		19	19.34	19.30	19.31	19.39	19.40	19.27	19.35	19.18	19.14	19.06	19.25	19.28	19.20	19.31
		18	19.32	19.31	19.27	19.40	19.37	19.30	19.33	19.19	19.15	19.09	19.26	19.29	19.21	19.32
		17	24.10	24.09	24.02	23.45	23.46	23.38	23.39	23.25	23.24	23.13	22.35	22.40	22.29	22.44
		16	24.41	24.42	24.33	23.50	23.50	23.34	23.39	23.28	23.25	23.16	22.39	22.42	22.28	22.45
		15	24.41	24.41	24.34	23.48	23.49	23.35	23.38	23.27	23.23	23.14	22.38	22.41	22.30	22.44
		14	24.43	24.42	24.31	23.49	23.47	23.37	23.39	23.25	23.27	23.15	22.39	22.37	22.29	22.45
		13	24.44	24.43	24.32	23.48	23.48	23.38	23.38	23.26	23.26	23.18	22.40	22.39	22.30	22.46
		12	24.42	24.43	24.30	23.46	23.49	23.32	23.39	23.26	23.21	23.17	22.41	22.40	22.30	22.43
		11	24.43	24.42	24.28	23.48	23.46	23.35	23.39	23.30	23.24	23.16	22.42	22.37	22.30	22.45

1xRTT CDMA Voice Band	BC10 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB 0RB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB 0RB offset
800 MHz	564	25	19.33	19.33	19.28	19.41	19.42	19.30	19.31	19.18	19.11	19.04	19.27	19.32	19.22	19.33
		24	19.32	19.34	19.27	19.40	19.36	19.28	19.37	19.20	19.,12	19.05	19.30	19.31	19.24	19.32
		23	19.33	19.32	19.28	19.39	19.42	19.32	19.38	19.22	19.14	19.05	19.28	19.28	19.21	19.35
		22	19.34	19.33	19.29	19.37	19.38	19.27	19.34	19.16	19.09	19.01	19.26	19.29	19.20	19.34
		21	19.32	19.33	19.27	19.36	19.41	19.29	19.33	19.18	19.14	19.05	19.25	19.30	19.23	19.29
		20	19.34	19.33	19.27	19.37	19.34	19.30	19.32	19.17	19.06	19.01	19.23	19.29	19.22	19.30
		19	19.32	19.34	19.28	19.37	19.38	19.32	19.34	19.15	19.10	19.06	19.24	19.31	19.20	19.31
		18	19.35	19.35	19.27	19.39	19.35	19.32	19.33	19.17	19.13	19.05	19,23	19.30	19.21	19.30
		17	24.09	24.41	24.05	23.44	23.47	23.37	23.42	23.28	23.23	23.10	22.39	22.43	22.28	22.43
		16	24.39	24.43	24.31	23.45	23.45	23.39	23.41	23.27	23.24	23.14	22.37	22.42	22.29	22.41
		15	24.38	24.46	24.30	23.45	23.44	23.36	23.38	23.30	23.25	23.15	22.41	22.39	22.30	22.42
		14	24.39	24.43	24.31	23.46	23.43	23.35	23.39	23.31	23.26	23.13	22.39	22.40	22.29	22.44
		13	24.40	24.42	24.29	23.45	23.27	23.38	23.40	23.26	23.24	23.16	22.41	22.38	22.29	22.43
		12	24.40	24.43	24.32	23.47	23.48	23.33	23.39	23.28	23.20	23.14	22.40	22.40	22.28	22.43
		11	24.41	24.42	24.30	23.46	23.45	23.34	23.39	23.29	23.22	23.15	22.40	22.41	22.28	22.43

Note: The low and high channels were additionally confirmed to operate according to the SVLTE Power Reduction scheme.

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10.3 SVLTE SAR Testing Procedures

Per KDB 941225 D05v02 Section 4.4 B), SAR testing was additionally performed at the reduced CDMA and LTE power levels with respect to the simultaneous transmission scenarios. Additional samples were tuned to fixed reduced power levels to represent the SVLTE condition in a standalone environment. While the power reduction mechanism is activated at the CDMA Voice power level of 18 dBm, simultaneous SAR summations of maximum power LTE were evaluated at this reduced fixed CDMA voice power level. SAR was additionally evaluated at reduced power LTE levels to perform simultaneous SAR analysis when CDMA voice is at maximum power.

10.3.1 Reduced LTE Band 25 Conducted Powers

Table 10-3
Reduced LTE Band 25 Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1855	26090	10	QPSK	1	0	19.23	0	0
	1855	26090	10	QPSK	1	25	**19.26**	0	0
	1855	26090	10	QPSK	1	49	19.03	0	0
	1855	26090	10	QPSK	25	0	19.27	0	0-1
	1855	26090	10	QPSK	25	12	19.25	0	0-1
	1855	26090	10	QPSK	25	25	19.11	0	0-1
	1855	26090	10	QPSK	50	0	19.14	0	0-1
	1855	26090	10	16QAM	1	0	19.08	0	0-1
	1855	26090	10	16QAM	1	25	19.05	0	0-1
	1855	26090	10	16QAM	1	49	18.95	0	0-1
	1855	26090	10	16QAM	25	0	19.26	0	0-2
	1855	26090	10	16QAM	25	12	19.15	0	0-2
	1855	26090	10	16QAM	25	25	19.04	0	0-2
	1855	26090	10	16QAM	50	0	19.10	0	0-2
Mid	1882.5	26365	10	QPSK	1	0	19.21	0	0
	1882.5	26365	10	QPSK	1	25	19.18	0	0
	1882.5	26365	10	QPSK	1	49	19.16	0	0
	1882.5	26365	10	QPSK	25	0	19.22	0	0-1
	1882.5	26365	10	QPSK	25	12	**19.30**	0	0-1
	1882.5	26365	10	QPSK	25	25	19.24	0	0-1
	1882.5	26365	10	QPSK	50	0	19.18	0	0-1
	1882.5	26365	10	16QAM	1	0	19.12	0	0-1
	1882.5	26365	10	16QAM	1	25	19.05	0	0-1
	1882.5	26365	10	16QAM	1	49	19.09	0	0-1
	1882.5	26365	10	16QAM	25	0	19.21	0	0-2
	1882.5	26365	10	16QAM	25	12	19.22	0	0-2
	1882.5	26365	10	16QAM	25	25	19.19	0	0-2
	1882.5	26365	10	16QAM	50	0	19.11	0	0-2
High	1910	26640	10	QPSK	1	0	19.15	0	0
	1910	26640	10	QPSK	1	25	19.16	0	0
	1910	26640	10	QPSK	1	49	19.08	0	0
	1910	26640	10	QPSK	25	0	19.10	0	0-1
	1910	26640	10	QPSK	25	12	19.06	0	0-1
	1910	26640	10	QPSK	25	25	19.09	0	0-1
	1910	26640	10	QPSK	50	0	19.12	0	0-1
	1910	26640	10	16QAM	1	0	19.01	0	0-1
	1910	26640	10	16QAM	1	25	19.06	0	0-1
	1910	26640	10	16QAM	1	49	19.03	0	0-1
	1910	26640	10	16QAM	25	0	19.12	0	0-2
	1910	26640	10	16QAM	25	12	19.07	0	0-2
	1910	26640	10	16QAM	25	25	19.07	0	0-2
	1910	26640	10	16QAM	50	0	19.04	0	0-2

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Table 10-4
Reduced LTE Band 25 Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	Target MPR [dB]	MPR Allowed per 3GPP [dB]
Low	1852.5	26065	5	QPSK	1	0	19.22	0	0
	1852.5	26065	5	QPSK	1	12	19.29	0	0
	1852.5	26065	5	QPSK	1	24	19.15	0	0
	1852.5	26065	5	QPSK	12	0	19.26	0	0-1
	1852.5	26065	5	QPSK	12	6	19.24	0	0-1
	1852.5	26065	5	QPSK	12	13	19.27	0	0-1
	1852.5	26065	5	QPSK	25	0	19.19	0	0-1
	1852.5	26065	5	16-QAM	1	0	19.08	0	0-1
	1852.5	26065	5	16-QAM	1	12	19.06	0	0-1
	1852.5	26065	5	16-QAM	1	24	18.98	0	0-1
	1852.5	26065	5	16-QAM	12	0	19.29	0	0-2
	1852.5	26065	5	16-QAM	12	6	19.23	0	0-2
	1852.5	26065	5	16-QAM	12	13	19.28	0	0-2
	1852.5	26065	5	16-QAM	25	0	19.24	0	0-2
Mid	1882.5	26365	5	QPSK	1	0	19.30	0	0
	1882.5	26365	5	QPSK	1	12	19.12	0	0
	1882.5	26365	5	QPSK	1	24	19.15	0	0
	1882.5	26365	5	QPSK	12	0	19.26	0	0-1
	1882.5	26365	5	QPSK	12	6	19.31	0	0-1
	1882.5	26365	5	QPSK	12	13	19.20	0	0-1
	1882.5	26365	5	QPSK	25	0	19.26	0	0-1
	1882.5	26365	5	16-QAM	1	0	19.31	0	0-1
	1882.5	26365	5	16-QAM	1	12	19.33	0	0-1
	1882.5	26365	5	16-QAM	1	24	19.32	0	0-1
	1882.5	26365	5	16-QAM	12	0	19.24	0	0-2
	1882.5	26365	5	16-QAM	12	6	19.25	0	0-2
	1882.5	26365	5	16-QAM	12	13	19.17	0	0-2
	1882.5	26365	5	16-QAM	25	0	19.19	0	0-2
High	1912.5	26665	5	QPSK	1	0	19.25	0	0
	1912.5	26665	5	QPSK	1	12	19.26	0	0
	1912.5	26665	5	QPSK	1	24	19.23	0	0
	1912.5	26665	5	QPSK	12	0	19.20	0	0-1
	1912.5	26665	5	QPSK	12	6	19.08	0	0-1
	1912.5	26665	5	QPSK	12	13	19.11	0	0-1
	1912.5	26665	5	QPSK	25	0	19.09	0	0-1
	1912.5	26665	5	16-QAM	1	0	19.04	0	0-1
	1912.5	26665	5	16-QAM	1	12	19.00	0	0-1
	1912.5	26665	5	16-QAM	1	24	19.03	0	0-1
	1912.5	26665	5	16-QAM	12	0	19.13	0	0-2
	1912.5	26665	5	16-QAM	12	6	19.08	0	0-2
	1912.5	26665	5	16-QAM	12	13	19.05	0	0-2
	1912.5	26665	5	16-QAM	25	0	19.07	0	0-2

LTE Notes:

1. Please refer to Section 8.5.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.

Figure 10-2
Power Measurement Setup

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10.3.2 Threshold CDMA Conducted Powers

Table 10-5
Threshold CDMA Conducted Powers

Band	Channel	Rule Part	Frequency	SO55 [dBm]	SO55 [dBm]	SO75 [dBm]	TDSO SO32 [dBm]	TDSO SO32 [dBm]
	F-RC		MHz	RC1	RC3	RC11	FCH+SCH	FCH
Cellular	564	90S	820.1	18.18	18.11	18.30	18.10	18.12
Cellular	1013	22H	824.7	18.43	18.40	18.33	18.36	18.39
	384	22H	836.52	18.46	18.45	18.46	18.44	18.45
	777	22H	848.31	18.48	18.45	18.49	18.45	18.48
PCS	25	24E	1851.25	17.72	17.70	17.69	17.75	17.77
	600	24E	1880	18.17	18.12	18.29	18.14	18.15
	1175	24E	1908.75	18.35	18.43	18.44	18.38	18.35

General Notes:

1. RC1 is only applicable for IS-95 compatibility.
2. For FCC Rule Part 90S, Per FCC KDB Publication 447498 D01v05 4.1.6, only one channel is required since the device operates within the transmission range of 817.90 – 823.10 MHz.
3. There is no power reduction applied to the CDMA Voice modes, however the device with output powers represented in the table above was tuned down (for SAR Test purposes only) to analyze simultaneous SAR scenarios in the SVLTE condition where LTE is operating at maximum output power in conjunction with a lower CDMA voice level (see Table 10-1).

Per FCC KDB Publication 941225 D01v02:

1. Head SAR was tested with SO55 RC3. SO55 RC1 was not required since the average output power was not more than 0.25 dB than the SO55 RC3 powers.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers.
3. CDMA 1x-RTT SAR was required to be evaluated for Hotspot exposure conditions to support simultaneous transmission capabilities.

Per FCC KDB Publication 941225 D02:

1. CDMA 1X Advanced technology was not required for SAR since the maximum output powers for 1x Advanced was not more than 0.25 dB higher than the maximum measured powers for 1x and the measured SAR in any 1x mode exposure conditions was not greater than 1.2 W/kg. See Section 8.3.2 for 1x Advanced test set up.

Figure 10-3
Power Measurement Setup

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11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
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
8/15/2013	835H	22.2	820	0.901	40.842	0.898	41.571	0.33%	-1.75%
			835	0.915	40.673	0.900	41.500	1.67%	-1.99%
			850	0.932	40.462	0.916	41.500	1.75%	-2.50%
8/21/2013	835H	22.3	820	0.875	40.822	0.898	41.571	-2.56%	-1.80%
			835	0.886	40.641	0.900	41.500	-1.56%	-2.07%
			850	0.899	40.564	0.916	41.500	-1.86%	-2.26%
7/15/2013	1900H	23.4	1850	1.332	40.096	1.400	40.000	-4.86%	0.24%
			1880	1.365	39.987	1.400	40.000	-2.50%	-0.03%
			1910	1.398	39.883	1.400	40.000	-0.14%	-0.29%
8/13/2013	1900H	22.8	1850	1.390	38.926	1.400	40.000	-0.71%	-2.69%
			1880	1.417	38.834	1.400	40.000	1.21%	-2.91%
			1910	1.444	38.728	1.400	40.000	3.14%	-3.18%
8/19/2013	2450H	24.0	2401	1.815	38.455	1.758	39.298	3.24%	-2.15%
			2450	1.874	38.250	1.800	39.200	4.11%	-2.42%
			2499	1.927	38.024	1.852	39.135	4.05%	-2.84%
7/17/2013	5200H-5800H	24.0	5180	4.609	35.672	4.639	36.020	-0.65%	-0.97%
			5200	4.625	35.672	4.660	36.000	-0.75%	-0.91%
			5220	4.660	35.594	4.680	35.980	-0.43%	-1.07%
			5280	4.712	35.391	4.740	35.920	-0.59%	-1.47%
			5300	4.744	35.374	4.760	35.900	-0.34%	-1.47%
			5500	4.974	34.870	4.965	35.650	0.18%	-2.19%
			5520	4.999	34.807	4.986	35.620	0.26%	-2.28%
			5540	5.026	34.735	5.007	35.590	0.38%	-2.40%
			5600	5.104	34.593	5.070	35.500	0.67%	-2.55%
			5765	5.318	34.219	5.235	35.335	1.59%	-3.16%
			5785	5.344	34.181	5.255	35.315	1.69%	-3.21%
			5800	5.365	34.169	5.270	35.300	1.80%	-3.20%
			5825	5.402	34.096	5.296	35.275	2.00%	-3.34%
7/8/2013	835B	23.5	820	1.000	55.872	0.969	55.258	3.20%	1.11%
			835	1.014	55.695	0.970	55.200	4.54%	0.90%
			850	1.030	55.507	0.988	55.154	4.25%	0.64%
7/15/2013	835B	22.9	820	0.996	55.657	0.969	55.258	2.79%	0.72%
			835	1.011	55.520	0.970	55.200	4.23%	0.58%
			850	1.026	55.376	0.988	55.154	3.85%	0.40%
8/19/2013	835B	22.8	820	0.988	55.313	0.969	55.258	1.96%	0.10%
			835	1.014	55.115	0.970	55.200	4.54%	-0.15%
			850	1.031	54.724	0.988	55.154	4.35%	-0.78%
8/15/2013	1900B	22.9	1850	1.490	53.221	1.520	53.300	-1.97%	-0.15%
			1880	1.522	53.128	1.520	53.300	0.13%	-0.32%
			1910	1.553	53.037	1.520	53.300	2.17%	-0.49%
8/19/2013	1900B	22.0	1850	1.491	54.818	1.520	53.300	-1.91%	2.85%
			1880	1.528	54.724	1.520	53.300	0.53%	2.67%
			1910	1.560	54.670	1.520	53.300	2.63%	2.57%
8/21/2013	1900B	22.9	1850	1.501	52.177	1.520	53.300	-1.25%	-2.11%
			1880	1.531	52.073	1.520	53.300	0.72%	-2.30%
			1910	1.561	51.969	1.520	53.300	2.70%	-2.50%
7/16/2013	2450B	23.1	2401	1.860	52.041	1.903	52.765	-2.26%	-1.37%
			2450	1.925	51.887	1.950	52.700	-1.28%	-1.54%
			2499	1.991	51.718	2.019	52.638	-1.39%	-1.75%
7/22/2013	5200B-5800B	24.0	5180	5.470	49.079	5.276	49.041	3.68%	0.08%
			5200	5.505	48.968	5.299	49.014	3.89%	-0.09%
			5220	5.495	48.894	5.323	48.987	3.23%	-0.19%
			5280	5.580	48.936	5.393	48.879	3.47%	0.12%
			5300	5.593	48.806	5.416	48.851	3.27%	-0.09%
			5500	5.816	48.430	5.650	48.580	2.94%	-0.31%
			5520	5.832	48.368	5.673	48.553	2.80%	-0.38%
			5540	5.861	48.331	5.696	48.526	2.90%	-0.40%
			5600	5.933	48.234	5.766	48.444	2.90%	-0.43%
			5765	6.215	47.951	5.959	48.220	4.30%	-0.56%
			5785	6.244	47.942	5.982	48.242	4.38%	-0.62%
			5800	6.296	47.918	6.000	48.200	4.93%	-0.59%
			5825	6.319	47.820	6.029	48.132	4.81%	-0.65%

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

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11.2 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 11-2
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)	$Deviation_{1g}$ (%)
C	835	HEAD	08/15/2013	23.5	22.2	0.100	4d119	3263	1.010	9.680	10.100	4.34%
H	835	HEAD	08/21/2013	22.6	22.3	0.100	4d119	3318	0.943	9.680	9.430	-2.58%
C	1900	HEAD	07/15/2013	22.1	22.5	0.100	5d080	3022	3.950	39.400	39.500	0.25%
H	1900	HEAD	08/13/2013	23.8	22.8	0.100	5d148	3318	4.140	39.700	41.400	4.28%
C	2450	HEAD	08/19/2013	23.5	23.5	0.100	882	3263	5.440	51.700	54.400	5.22%
A	5200	HEAD	07/17/2013	24.3	23.7	0.100	1057	3589	7.280	75.900	72.800	-4.08%
A	5300	HEAD	07/17/2013	24.3	23.7	0.100	1057	3589	7.270	76.900	72.700	-5.46%
A	5500	HEAD	07/17/2013	24.3	23.7	0.100	1057	3589	7.750	80.100	77.500	-3.25%
A	5600	HEAD	07/17/2013	24.4	23.8	0.100	1057	3589	7.870	80.400	78.700	-2.11%
A	5800	HEAD	07/17/2013	24.4	23.8	0.100	1057	3589	7.320	76.100	73.200	-3.81%
G	835	BODY	07/08/2013	24.9	23.5	0.100	4d132	3209	0.978	9.360	9.780	4.49%
G	835	BODY	07/15/2013	24.4	23.0	0.100	4d132	3209	1.000	9.360	10.000	6.84%
G	835	BODY	08/19/2013	24.1	22.8	0.100	4d026	3209	0.998	9.580	9.980	4.18%
E	1900	BODY	08/15/2013	24.5	22.9	0.100	5d148	3920	4.220	40.800	42.200	3.43%
B	1900	BODY	08/19/2013	23.5	22.0	0.100	5d141	3287	4.320	41.500	43.200	4.10%
E	1900	BODY	08/21/2013	24.1	23.0	0.100	5d148	3920	4.360	40.800	43.600	6.86%
E	2450	BODY	07/16/2013	23.3	23.1	0.100	882	3920	4.940	49.900	49.400	-1.00%
A	5200	BODY	07/22/2013	24.3	23.6	0.100	1057	3589	7.360	75.500	73.600	-2.52%
A	5300	BODY	07/22/2013	24.3	23.6	0.100	1057	3589	8.000	75.300	80.000	6.24%
A	5500	BODY	07/22/2013	24.5	23.6	0.100	1057	3589	7.900	80.800	79.000	-2.23%
A	5600	BODY	07/22/2013	24.5	23.6	0.100	1057	3589	8.210	80.300	82.100	2.24%
A	5800	BODY	07/22/2013	24.5	23.6	0.100	1057	3589	7.480	75.100	74.800	-0.40%

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Table 11-3
System Verification Results - Extremity

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_{10g} (W/kg)	1 W Target SAR_{10g} (W/kg)	1 W Normalized SAR_{10g} (W/kg)	$Deviation_{10g}$ (%)
A	5200	BODY	07/22/2013	24.3	23.6	0.100	1057	3589	2.080	21.100	20.800	-1.42%
A	5300	BODY	07/22/2013	24.3	23.6	0.100	1057	3589	2.240	21.100	22.400	6.16%
A	5500	BODY	07/22/2013	24.5	23.6	0.100	1057	3589	2.190	22.400	21.900	-2.23%
A	5600	BODY	07/22/2013	24.5	23.6	0.100	1057	3589	2.270	22.300	22.700	1.79%

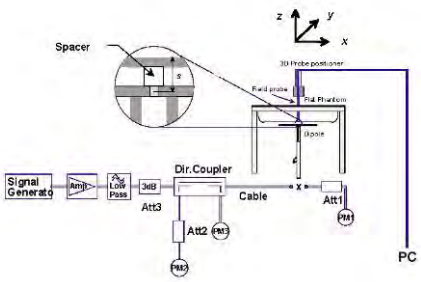

Figure 11-1
System Verification Setup Diagram

Figure 11-2
System Verification Setup Photo

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12 SAR DATA SUMMARY

12.1 Standalone Head SAR Data

Table 12-1
GSM 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	33.03	-0.02	Right	Cheek	Standard	34272	1:8.3	0.171	1.114	0.190	
836.60	190	GSM 850	GSM	33.5	33.03	0.00	Right	Tilt	Standard	34272	1:8.3	0.132	1.114	0.147	
836.60	190	GSM 850	GSM	33.5	33.03	0.04	Left	Cheek	Standard	34272	1:8.3	0.271	1.114	0.302	A1
836.60	190	GSM 850	GSM	33.5	33.03	-0.01	Left	Cheek	Wireless Charging	34272	1:8.3	0.237	1.114	0.264	
836.60	190	GSM 850	GSM	33.5	33.03	0.00	Left	Tilt	Standard	34272	1:8.3	0.145	1.114	0.162	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

Table 12-2
GSM 1900 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	661	GSM 1900	GSM	30.5	30.36	0.05	Right	Cheek	Standard	34272	1:8.3	0.054	1.033	0.056	
1880.00	661	GSM 1900	GSM	30.5	30.36	0.06	Right	Tilt	Standard	34272	1:8.3	0.063	1.033	0.065	
1880.00	661	GSM 1900	GSM	30.5	30.36	0.12	Left	Cheek	Standard	34272	1:8.3	0.127	1.033	0.131	A2
1880.00	661	GSM 1900	GSM	30.5	30.36	0.13	Left	Cheek	Wireless Charging	34272	1:8.3	0.113	1.033	0.117	
1880.00	661	GSM 1900	GSM	30.5	30.36	-0.02	Left	Tilt	Standard	34272	1:8.3	0.047	1.033	0.049	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

Table 12-3
UMTS 850 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.60	4183	UMTS 850	RMC	23.5	23.39	0.05	Right	Cheek	Standard	3426E	1:1	0.135	1.026	0.139	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.02	Right	Tilt	Standard	3426E	1:1	0.087	1.026	0.089	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.07	Left	Cheek	Standard	3426E	1:1	0.185	1.026	0.190	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.03	Left	Cheek	Wireless Charging	3426E	1:1	0.191	1.026	0.196	A3
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.04	Left	Tilt	Standard	3426E	1:1	0.100	1.026	0.103	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

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Table 12-4
UMTS 1900 Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.00	Right	Cheek	Standard	3426E	1:1	0.107	1.016	0.109	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.06	Right	Tilt	Standard	3426E	1:1	0.126	1.016	0.128	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.00	Left	Cheek	Standard	3426E	1:1	0.225	1.016	0.229	A4
1880.00	9400	UMTS 1900	RMC	23.5	23.43	-0.03	Left	Cheek	Wireless Charging	3426E	1:1	0.210	1.016	0.213	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.09	Left	Tilt	Standard	3426E	1:1	0.094	1.016	0.096	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

Table 12-5
CDMA BC10 (§90S) Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	25.0	24.63	0.03	Right	Cheek	Standard	342C2	1:1	0.286	1.089	0.311	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	25.0	24.63	-0.17	Right	Tilt	Standard	342C2	1:1	0.193	1.089	0.210	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	25.0	24.63	-0.19	Left	Cheek	Standard	342C2	1:1	0.406	1.089	0.442	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	25.0	24.63	-0.06	Left	Cheek	Wireless Charging	342C2	1:1	0.370	1.089	0.403	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	25.0	24.63	-0.11	Left	Tilt	Standard	342C2	1:1	0.225	1.089	0.245	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	18.5	18.11	0.04	Right	Cheek	Standard	82	1:1	0.049	1.094	0.054	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	18.5	18.11	0.02	Right	Tilt	Standard	82	1:1	0.032	1.094	0.035	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	18.5	18.11	0.08	Left	Cheek	Standard	82	1:1	0.061	1.094	0.067	
820.10	564	CDMA BC10 (§90S)	RC3 / SO55	18.5	18.11	0.06	Left	Tilt	Standard	82	1:1	0.039	1.094	0.043	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. A	25.0	24.70	0.00	Right	Cheek	Standard	342C2	1:1	0.296	1.072	0.317	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. A	25.0	24.70	-0.01	Right	Tilt	Standard	342C2	1:1	0.232	1.072	0.249	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. A	25.0	24.70	-0.06	Left	Cheek	Standard	342C2	1:1	0.394	1.072	0.422	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. A	25.0	24.70	0.11	Left	Cheek	Wireless Charging	342C2	1:1	0.469	1.072	**0.503**	A5
820.10	564	CDMA BC10 (§90S)	EVDO Rev. A	25.0	24.70	0.02	Left	Tilt	Standard	342C2	1:1	0.251	1.072	0.269	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

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Table 12-6
CDMA BC0 (§22H) Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	25.0	24.56	0.06	Right	Cheek	Standard	342C2	1:1	0.219	1.107	0.242	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	25.0	24.56	0.06	Right	Tilt	Standard	342C2	1:1	0.133	1.107	0.147	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	25.0	24.56	0.02	Left	Cheek	Standard	342C2	1:1	0.317	1.107	0.351	A6
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	25.0	24.56	0.07	Left	Cheek	Wireless Charging	342C2	1:1	0.288	1.107	0.319	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	25.0	24.56	-0.04	Left	Tilt	Standard	342C2	1:1	0.157	1.107	0.174	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	18.5	18.45	0.17	Right	Cheek	Standard	82	1:1	0.048	1.012	0.049	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	18.5	18.45	-0.05	Right	Tilt	Standard	82	1:1	0.032	1.012	0.032	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	18.5	18.45	0.07	Left	Cheek	Standard	82	1:1	0.066	1.012	0.067	
836.52	384	CDMA BC0 (§22H)	RC3 / SO55	18.5	18.45	0.08	Left	Tilt	Standard	82	1:1	0.041	1.012	0.041	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. A	25.0	24.63	0.04	Right	Cheek	Standard	342C2	1:1	0.178	1.089	0.194	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. A	25.0	24.63	0.16	Right	Tilt	Standard	342C2	1:1	0.121	1.089	0.132	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. A	25.0	24.63	0.12	Left	Cheek	Standard	342C2	1:1	0.242	1.089	0.264	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. A	25.0	24.63	0.04	Left	Cheek	Wireless Charging	342C2	1:1	0.299	1.089	0.326	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. A	25.0	24.63	0.08	Left	Tilt	Standard	342C2	1:1	0.149	1.089	0.162	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

Table 12-7
PCS CDMA Head SAR

MEASUREMENT RESULTS															
FREQUENCY		Mode/Band	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.35	0.10	Right	Cheek	Standard	342AF	1:1	0.200	1.161	0.232	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.35	-0.08	Right	Tilt	Standard	342AF	1:1	0.206	1.161	0.239	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.35	-0.04	Left	Cheek	Standard	342AF	1:1	0.317	1.161	0.368	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.35	-0.15	Left	Cheek	Wireless Charging	342AF	1:1	0.328	1.161	0.381	
1880.00	600	PCS CDMA	RC3 / SO55	25.0	24.35	-0.02	Left	Tilt	Standard	342AF	1:1	0.137	1.161	0.159	
1908.75	1175	PCS CDMA	RC3 / SO55	18.5	18.43	-0.06	Right	Cheek	Standard	87	1:1	0.046	1.016	0.047	
1908.75	1175	PCS CDMA	RC3 / SO55	18.5	18.43	0.13	Right	Tilt	Standard	87	1:1	0.038	1.016	0.039	
1908.75	1175	PCS CDMA	RC3 / SO55	18.5	18.43	-0.04	Left	Cheek	Standard	87	1:1	0.058	1.016	0.059	
1908.75	1175	PCS CDMA	RC3 / SO55	18.5	18.43	0.07	Left	Tilt	Standard	87	1:1	0.031	1.016	0.031	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.30	0.07	Right	Cheek	Standard	342AF	1:1	0.162	1.175	0.190	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.30	0.00	Right	Tilt	Standard	342AF	1:1	0.210	1.175	0.247	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.30	-0.01	Left	Cheek	Standard	342AF	1:1	0.386	1.175	0.454	A7
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.30	-0.01	Left	Cheek	Wireless Charging	342AF	1:1	0.336	1.175	0.395	
1880.00	600	PCS CDMA	EVDO Rev. A	25.0	24.30	0.12	Left	Tilt	Standard	342AF	1:1	0.150	1.175	0.176	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram								

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Table 12-8
LTE Band 25 (PCS) Head SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Cover Type	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.																(W/kg)		(W/kg)	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	-0.13	0	Right	Cheek	QPSK	1	0	83	1:1	0.163	1.042	0.170	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.19	1	Right	Cheek	QPSK	25	0	83	1:1	0.118	1.009	0.119	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.11	0	Right	Tilt	QPSK	1	0	83	1:1	0.126	1.042	0.131	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	-0.05	1	Right	Tilt	QPSK	25	0	83	1:1	0.100	1.009	0.101	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.06	0	Left	Cheek	QPSK	1	0	83	1:1	0.290	1.042	0.302	A8
1910.00	26640	High	LTE Band 25 (PCS)	10	Wireless Charging	24.5	24.32	-0.01	0	Left	Cheek	QPSK	1	0	83	1:1	0.283	1.042	0.295	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.07	1	Left	Cheek	QPSK	25	0	83	1:1	0.210	1.009	0.212	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.02	0	Left	Tilt	QPSK	1	0	83	1:1	0.095	1.042	0.099	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.08	1	Left	Tilt	QPSK	25	0	83	1:1	0.069	1.009	0.070	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	-0.19	0	Right	Cheek	QPSK	1	25	88	1:1	0.085	1.057	0.090	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	-0.03	0	Right	Cheek	QPSK	25	12	88	1:1	0.074	1.047	0.077	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	-0.10	0	Right	Tilt	QPSK	1	25	88	1:1	0.079	1.057	0.084	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.07	0	Right	Tilt	QPSK	25	12	88	1:1	0.065	1.047	0.068	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	0.04	0	Left	Cheek	QPSK	1	25	88	1:1	0.163	1.057	0.172	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	-0.02	0	Left	Cheek	QPSK	25	12	88	1:1	0.141	1.047	0.148	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	0.01	0	Left	Tilt	QPSK	1	25	88	1:1	0.061	1.057	0.064	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.03	0	Left	Tilt	QPSK	25	12	88	1:1	0.046	1.047	0.048	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 12-9
DTS Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.04	Right	Cheek	Standard	34287	1	1:1	0.155	1.038	0.161	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.00	Right	Tilt	Standard	34287	1	1:1	0.151	1.038	0.157	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.14	Left	Cheek	Standard	34287	1	1:1	0.352	1.038	0.365	A9
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.06	Left	Cheek	Wireless Charging	34287	1	1:1	0.336	1.038	0.349	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.04	Left	Tilt	Standard	34287	1	1:1	0.191	1.038	0.198	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.10	Right	Cheek	Standard	320FC	6	1:1	0.030	1.167	0.035	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	-0.04	Right	Tilt	Standard	320FC	6	1:1	0.012	1.167	0.014	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.03	Left	Cheek	Standard	320FC	6	1:1	0.048	1.167	0.056	A10
5775	155	IEEE 802.11ac	OFDM	11.5	10.91	0.08	Left	Cheek	Standard	320FC	29.3	1:1	0.030	1.146	0.034	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	-0.14	Left	Cheek	Wireless Charging	320FC	6	1:1	0.038	1.167	0.044	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.06	Left	Tilt	Standard	320FC	6	1:1	0.036	1.167	0.042	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 12-10
NII Head SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Cover Type	Device Serial Number	Data Rate (Mbps)	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.20	Right	Cheek	Standard	320FC	6	1:1	0.007	1.156	0.008	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.00	Right	Tilt	Standard	320FC	6	1:1	0.016	1.156	0.018	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.08	Left	Cheek	Standard	320FC	6	1:1	0.032	1.156	0.037	A11
5210	42	IEEE 802.11ac	OFDM	11.5	11.04	0.03	Left	Cheek	Standard	320FC	29.3	1:1	0.014	1.112	0.016	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.00	Left	Tilt	Standard	320FC	6	1:1	0.004	1.156	0.005	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.03	Right	Cheek	Standard	320FC	6	1:1	0.006	1.259	0.008	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	-0.19	Right	Tilt	Standard	320FC	6	1:1	0.016	1.259	0.020	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.05	Left	Cheek	Standard	320FC	6	1:1	0.029	1.259	0.037	
5290	58	IEEE 802.11ac	OFDM	11.5	10.69	0.16	Left	Cheek	Standard	320FC	29.3	1:1	0.015	1.205	0.018	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.00	Left	Tilt	Standard	320FC	6	1:1	0.000	1.259	0.000	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.03	Right	Cheek	Standard	320FC	6	1:1	0.016	1.067	0.017	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.07	Right	Tilt	Standard	320FC	6	1:1	0.025	1.067	0.027	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.14	Left	Cheek	Standard	320FC	6	1:1	0.026	1.067	0.028	
5530	106	IEEE 802.11ac	OFDM	11.5	10.63	0.21	Left	Cheek	Standard	320FC	29.3	1:1	0.015	1.222	0.018	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.00	Left	Tilt	Standard	320FC	6	1:1	0.012	1.067	0.013	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Head 1.6 W/kg (mW/g) averaged over 1 gram									

12.2 Standalone Body-Worn SAR Data

Table 12-11
GSM/UMTS/CDMA Body-Worn SAR Data

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	# of Time Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
836.60	190	GSM 850	GSM	33.5	33.03	0.00	10 mm	Standard	84	1	1:8.3	back	0.364	1.114	0.405	A12
836.60	190	GSM 850	GSM	33.5	33.03	0.02	10 mm	Wireless Charging	84	1	1:8.3	back	0.281	1.114	0.313	
1880.00	661	GSM 1900	GSM	30.5	30.36	-0.09	10 mm	Standard	34272	1	1:8.3	back	0.303	1.033	0.313	A14
1880.00	661	GSM 1900	GSM	30.5	30.36	-0.05	10 mm	Wireless Charging	34272	1	1:8.3	back	0.238	1.033	0.246	
836.60	4183	UMTS 850	RMC	23.5	23.39	0.01	10 mm	Standard	84	N/A	1:1	back	0.282	1.026	0.289	A16
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.06	10 mm	Wireless Charging	84	N/A	1:1	back	0.216	1.026	0.222	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.00	10 mm	Standard	3426E	N/A	1:1	back	0.440	1.016	0.447	A17
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.03	10 mm	Wireless Charging	3426E	N/A	1:1	back	0.303	1.016	0.308	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	-0.05	10 mm	Standard	342C2	N/A	1:1	back	0.584	1.094	0.639	A19
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	-0.09	10 mm	Wireless Charging	342C2	N/A	1:1	back	0.583	1.094	0.638	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	18.5	18.12	0.04	10 mm	Standard	3445A	N/A	1:1	back	0.108	1.091	0.118	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	-0.07	10 mm	Standard	342C2	N/A	1:1	back	0.512	1.109	0.568	A21
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	-0.03	10 mm	Wireless Charging	342C2	N/A	1:1	back	0.431	1.109	0.478	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	18.5	18.45	-0.05	10 mm	Standard	3445A	N/A	1:1	back	0.114	1.012	0.115	
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	-0.03	10 mm	Standard	342AF	N/A	1:1	back	0.412	1.159	0.478	A23
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	0.18	10 mm	Wireless Charging	342AF	N/A	1:1	back	0.380	1.159	0.440	
1908.75	1175	PCS CDMA	TDSO / SO32	18.5	18.35	0.01	10 mm	Standard	342C4	N/A	1:1	back	0.212	1.035	0.219	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 12-12
LTE Body-Worn SAR

MEASUREMENT RESULTS																				
FREQUENCY			Mode	Bandwidth [MHz]	Cover Type	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)	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	24.5	24.04	0.18	0	34280	QPSK	1	25	10 mm	back	1:1	0.663	1.112	0.737	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	24.5	24.05	0.11	0	34280	QPSK	1	0	10 mm	back	1:1	0.633	1.109	0.702	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.17	0	34280	QPSK	1	0	10 mm	back	1:1	1.050	1.042	1.094	A25
1910.00	26640	High	LTE Band 25 (PCS)	10	Wireless Charging	24.5	24.32	0.12	0	34280	QPSK	1	0	10 mm	back	1:1	0.859	1.042	0.895	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.04	1	34280	QPSK	25	0	10 mm	back	1:1	0.757	1.009	0.764	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.34	0.15	1	34280	QPSK	50	0	10 mm	back	1:1	0.660	1.038	0.685	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	-0.05	0	342E0	QPSK	1	25	10 mm	back	1:1	0.528	1.057	0.558	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.04	0	342E0	QPSK	25	12	10 mm	back	1:1	0.529	1.047	0.554	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	-0.01	0	34280	QPSK	1	0	10 mm	back	1:1	1.040	1.042	1.084	
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 represent variability measurements.

Table 12-13
DTS Body-Worn SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	-0.13	10 mm	Standard	89	1	back	1:1	0.152	1.038	0.158	A26
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.01	10 mm	Wireless Charging	89	1	back	1:1	0.122	1.038	0.127	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	-0.03	10 mm	Standard	320FC	6	back	1:1	0.081	1.167	0.095	A27
5775	155	IEEE 802.11ac	OFDM	11.5	10.91	-0.15	10 mm	Standard	320FC	29.3	back	1:1	0.030	1.146	0.034	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.03	10 mm	Wireless Charging	320FC	6	back	1:1	0.025	1.167	0.029	
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 12-14
NII Body-Worn SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.12	10 mm	Standard	320FC	6	back	1:1	0.044	1.156	0.051	
5210	42	IEEE 802.11ac	OFDM	11.5	11.04	-0.06	10 mm	Standard	320FC	29.3	back	1:1	0.012	1.112	0.013	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	-0.02	10 mm	Standard	320FC	6	back	1:1	0.041	1.259	0.052	
5290	58	IEEE 802.11ac	OFDM	11.5	10.69	0.00	10 mm	Standard	320FC	29.3	back	1:1	0.007	1.205	0.008	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.10	10 mm	Standard	320FC	6	back	1:1	0.049	1.067	0.052	A28
5530	106	IEEE 802.11ac	OFDM	11.5	10.63	0.00	10 mm	Standard	320FC	29.3	back	1:1	0.017	1.222	0.021	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram								

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12.3 Standalone Wireless Router SAR Data

Table 12-15
GPRS/UMTS Hotspot SAR Data

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	# of GPRS Slots	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
836.60	190	GSM 850	GPRS	31.0	30.61	0.06	10 mm	Standard	84	3	1:2.76	back	0.500	1.094	0.547	A13
836.60	190	GSM 850	GPRS	31.0	30.61	0.06	10 mm	Wireless Charging	84	3	1:2.76	back	0.432	1.094	0.473	
836.60	190	GSM 850	GPRS	31.0	30.61	0.03	10 mm	Standard	84	3	1:2.76	front	0.339	1.094	0.371	
836.60	190	GSM 850	GPRS	31.0	30.61	0.00	10 mm	Standard	84	3	1:2.76	bottom	0.223	1.094	0.244	
836.60	190	GSM 850	GPRS	31.0	30.61	0.09	10 mm	Standard	84	3	1:2.76	left	0.410	1.094	0.449	
1880.00	661	GSM 1900	GPRS	27.5	27.25	-0.09	10 mm	Standard	34272	3	1:2.76	back	0.394	1.059	0.417	
1880.00	661	GSM 1900	GPRS	27.5	27.25	-0.07	10 mm	Standard	34272	3	1:2.76	front	0.660	1.059	0.699	A15
1880.00	661	GSM 1900	GPRS	27.5	27.25	-0.03	10 mm	Wireless Charging	34272	3	1:2.76	front	0.348	1.059	0.369	
1880.00	661	GSM 1900	GPRS	27.5	27.25	-0.07	10 mm	Standard	34272	3	1:2.76	bottom	0.399	1.059	0.423	
1880.00	661	GSM 1900	GPRS	27.5	27.25	-0.11	10 mm	Standard	34272	3	1:2.76	left	0.207	1.059	0.219	
836.60	4183	UMTS 850	RMC	23.5	23.39	0.01	10 mm	Standard	84	N/A	1:1	back	0.282	1.026	0.289	A16
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.06	10 mm	Wireless Charging	84	N/A	1:1	back	0.216	1.026	0.222	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.01	10 mm	Standard	84	N/A	1:1	front	0.161	1.026	0.165	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.11	10 mm	Standard	84	N/A	1:1	bottom	0.105	1.026	0.108	
836.60	4183	UMTS 850	RMC	23.5	23.39	-0.05	10 mm	Standard	84	N/A	1:1	left	0.205	1.026	0.210	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.00	10 mm	Standard	3426E	N/A	1:1	back	0.440	1.016	0.447	
1852.40	9262	UMTS 1900	RMC	23.5	23.38	-0.07	10 mm	Standard	3426E	N/A	1:1	front	0.792	1.028	0.814	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	-0.17	10 mm	Standard	3426E	N/A	1:1	front	0.827	1.016	0.840	A18
1907.60	9538	UMTS 1900	RMC	23.5	23.32	-0.03	10 mm	Standard	3426E	N/A	1:1	front	0.557	1.042	0.580	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	-0.01	10 mm	Wireless Charging	3426E	N/A	1:1	front	0.692	1.016	0.703	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	-0.11	10 mm	Standard	3426E	N/A	1:1	bottom	0.468	1.016	0.475	
1880.00	9400	UMTS 1900	RMC	23.5	23.43	0.00	10 mm	Standard	3426E	N/A	1:1	left	0.272	1.016	0.276	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

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Table 12-16
CDMA/EVDO Hotspot SAR Data

MEASUREMENT RESULTS															
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Duty Cycle	Side	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.											(W/kg)		(W/kg)	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	-0.05	10 mm	Standard	342C2	1:1	back	0.584	1.094	0.639	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	-0.09	10 mm	Wireless Charging	342C2	1:1	back	0.583	1.094	0.638	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	0.04	10 mm	Standard	342C2	1:1	front	0.273	1.094	0.299	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	-0.02	10 mm	Standard	342C2	1:1	bottom	0.189	1.094	0.207	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	25.0	24.61	0.02	10 mm	Standard	342C2	1:1	left	0.416	1.094	0.455	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	18.5	18.12	0.04	10 mm	Standard	3445A	1:1	back	0.108	1.091	0.118	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	18.5	18.12	0.00	10 mm	Standard	3445A	1:1	front	0.066	1.091	0.072	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	18.5	18.12	0.02	10 mm	Standard	3445A	1:1	bottom	0.044	1.091	0.048	
820.10	564	CDMA BC10 (§90S)	TDSO / SO32	18.5	18.12	-0.13	10 mm	Standard	3445A	1:1	left	0.089	1.091	0.097	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. 0	25.0	24.72	-0.05	10 mm	Standard	342C2	1:1	back	0.629	1.067	0.671	A20
820.10	564	CDMA BC10 (§90S)	EVDO Rev. 0	25.0	24.72	-0.09	10 mm	Wireless Charging	342C2	1:1	back	0.440	1.067	0.469	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. 0	25.0	24.72	0.01	10 mm	Standard	342C2	1:1	front	0.273	1.067	0.291	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. 0	25.0	24.72	-0.11	10 mm	Standard	342C2	1:1	bottom	0.188	1.067	0.201	
820.10	564	CDMA BC10 (§90S)	EVDO Rev. 0	25.0	24.72	0.02	10 mm	Standard	342C2	1:1	left	0.385	1.067	0.411	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	-0.07	10 mm	Standard	342C2	1:1	back	0.512	1.109	0.568	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	0.01	10 mm	Wireless Charging	342C2	1:1	back	0.431	1.109	0.478	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	-0.04	10 mm	Standard	342C2	1:1	front	0.237	1.109	0.263	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	0.06	10 mm	Standard	342C2	1:1	bottom	0.169	1.109	0.187	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	25.0	24.55	-0.05	10 mm	Standard	342C2	1:1	left	0.346	1.109	0.384	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	18.5	18.45	-0.05	10 mm	Standard	3445A	1:1	back	0.114	1.012	0.115	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	18.5	18.45	-0.04	10 mm	Standard	3445A	1:1	front	0.057	1.012	0.058	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	18.5	18.45	0.08	10 mm	Standard	3445A	1:1	bottom	0.045	1.012	0.046	
836.52	384	CDMA BC0 (§22H)	TDSO / SO32	18.5	18.45	-0.07	10 mm	Standard	3445A	1:1	left	0.079	1.012	0.080	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. 0	25.0	24.64	-0.07	10 mm	Standard	342C2	1:1	back	0.535	1.086	0.581	A22
836.52	384	CDMA BC0 (§22H)	EVDO Rev. 0	25.0	24.64	-0.03	10 mm	Wireless Charging	342C2	1:1	back	0.452	1.086	0.491	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. 0	25.0	24.64	0.01	10 mm	Standard	342C2	1:1	front	0.240	1.086	0.261	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. 0	25.0	24.64	-0.06	10 mm	Standard	342C2	1:1	bottom	0.170	1.086	0.185	
836.52	384	CDMA BC0 (§22H)	EVDO Rev. 0	25.0	24.64	0.04	10 mm	Standard	342C2	1:1	left	0.271	1.086	0.294	
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	-0.03	10 mm	Standard	342AF	1:1	back	0.412	1.159	0.478	
1851.25	25	PCS CDMA	TDSO / SO32	25.0	24.72	-0.10	10 mm	Standard	342AF	1:1	front	0.963	1.067	1.028	
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	0.04	10 mm	Standard	342AF	1:1	front	0.837	1.159	0.970	
1908.75	1175	PCS CDMA	TDSO / SO32	25.0	24.43	-0.03	10 mm	Standard	342AF	1:1	front	0.642	1.140	0.732	
1851.25	25	PCS CDMA	TDSO / SO32	25.0	24.72	-0.05	10 mm	Wireless Charging	342AF	1:1	front	0.921	1.067	0.983	
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	-0.03	10 mm	Standard	342AF	1:1	bottom	0.419	1.159	0.486	
1880.00	600	PCS CDMA	TDSO / SO32	25.0	24.36	-0.03	10 mm	Standard	342AF	1:1	left	0.312	1.159	0.362	
1908.75	1175	PCS CDMA	TDSO / SO32	18.5	18.35	0.01	10 mm	Standard	342C4	1:1	back	0.212	1.035	0.219	
1908.75	1175	PCS CDMA	TDSO / SO32	18.5	18.35	-0.01	10 mm	Standard	342C4	1:1	front	0.343	1.035	0.355	
1908.75	1175	PCS CDMA	TDSO / SO32	18.5	18.35	0.01	10 mm	Standard	342C4	1:1	bottom	0.254	1.035	0.263	
1908.75	1175	PCS CDMA	TDSO / SO32	18.5	18.35	0.11	10 mm	Standard	342C4	1:1	left	0.086	1.035	0.089	
1880.00	600	PCS CDMA	EVDO Rev. 0	25.0	24.36	0.11	10 mm	Standard	342AF	1:1	back	0.397	1.159	0.460	
1851.25	25	PCS CDMA	EVDO Rev. 0	25.0	24.69	0.03	10 mm	Standard	342AF	1:1	front	0.975	1.074	1.047	A24
1880.00	600	PCS CDMA	EVDO Rev. 0	25.0	24.36	0.00	10 mm	Standard	342AF	1:1	front	0.824	1.159	0.955	
1908.75	1175	PCS CDMA	EVDO Rev. 0	25.0	24.54	-0.15	10 mm	Standard	342AF	1:1	front	0.725	1.112	0.806	
1851.25	25	PCS CDMA	EVDO Rev. 0	25.0	24.69	0.03	10 mm	Wireless Charging	342AF	1:1	front	0.946	1.074	1.016	
1880.00	600	PCS CDMA	EVDO Rev. 0	25.0	24.36	0.03	10 mm	Standard	342AF	1:1	bottom	0.392	1.159	0.454	
1880.00	600	PCS CDMA	EVDO Rev. 0	25.0	24.36	-0.02	10 mm	Standard	342AF	1:1	left	0.308	1.159	0.357	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Body 1.6 W/kg (mW/g) averaged over 1 gram**								

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Table 12-17
LTE Band 25 (PCS) Hotspot SAR

MEASUREMENT RESULTS																					
FREQUENCY			Mode	Bandwidth [MHz]	Cover Type	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)	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	24.5	24.04	0.18	0	34280	QPSK	1	25	10 mm	back	1:1	0.663	1.112	0.737	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	24.5	24.05	0.11	0	34280	QPSK	1	0	10 mm	back	1:1	0.633	1.109	0.702	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.17	0	34280	QPSK	1	0	10 mm	back	1:1	1.050	1.042	1.094	A25
1910.00	26640	High	LTE Band 25 (PCS)	10	Wireless Charging	24.5	24.32	0.12	0	34280	QPSK	1	0	10 mm	back	1:1	0.859	1.042	0.895	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.04	1	34280	QPSK	25	0	10 mm	back	1:1	0.757	1.009	0.764	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.34	0.15	1	34280	QPSK	50	0	10 mm	back	1:1	0.660	1.038	0.685	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	0.05	0	34280	QPSK	1	0	10 mm	front	1:1	0.191	1.042	0.199	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.08	1	34280	QPSK	25	0	10 mm	front	1:1	0.138	1.009	0.139	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	-0.05	0	34280	QPSK	1	0	10 mm	right	1:1	0.666	1.042	0.694	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	23.5	23.46	0.06	1	34280	QPSK	25	0	10 mm	right	1:1	0.467	1.009	0.471	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	-0.05	0	342E0	QPSK	1	25	10 mm	back	1:1	0.528	1.057	0.558	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.04	0	342E0	QPSK	25	12	10 mm	back	1:1	0.529	1.047	0.554	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	0.09	0	342E0	QPSK	1	25	10 mm	front	1:1	0.062	1.057	0.066	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.08	0	342E0	QPSK	25	12	10 mm	front	1:1	0.047	1.047	0.049	
1855.00	26090	Low	LTE Band 25 (PCS)	10	Standard	19.5	19.26	0.00	0	342E0	QPSK	1	25	10 mm	right	1:1	0.373	1.057	0.394	
1882.50	26365	Mid	LTE Band 25 (PCS)	10	Standard	19.5	19.30	0.06	0	342E0	QPSK	25	12	10 mm	right	1:1	0.349	1.047	0.365	
1910.00	26640	High	LTE Band 25 (PCS)	10	Standard	24.5	24.32	-0.01	0	34280	QPSK	1	0	10 mm	back	1:1	1.040	1.042	1.084	
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 represent variability measurements.

Table 12-18
WLAN Hotspot SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	-0.13	10 mm	Standard	89	1	back	1:1	0.152	1.038	0.158	A26
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.01	10 mm	Wireless Charging	89	1	back	1:1	0.122	1.038	0.127	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	-0.03	10 mm	Standard	89	1	front	1:1	0.055	1.038	0.057	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.05	10 mm	Standard	89	1	top	1:1	0.044	1.038	0.046	
2412	1	IEEE 802.11b	DSSS	17.5	17.34	0.06	10 mm	Standard	89	1	right	1:1	0.048	1.038	0.050	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	-0.03	10 mm	Standard	320FC	6	back	1:1	0.081	1.167	0.095	A27
5775	155	IEEE 802.11ac	OFDM	11.5	10.91	-0.15	10 mm	Standard	320FC	29.3	back	1:1	0.030	1.146	0.034	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.03	10 mm	Wireless Charging	320FC	6	back	1:1	0.025	1.167	0.029	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.06	10 mm	Standard	320FC	6	front	1:1	0.004	1.167	0.005	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	0.06	10 mm	Standard	320FC	6	top	1:1	0.032	1.167	0.037	
5825	165	IEEE 802.11a	OFDM	14.5	13.83	-0.03	10 mm	Standard	320FC	6	right	1:1	0.061	1.167	0.071	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram									

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12.4 Standalone Hand SAR Data

Table 12-19
WLAN Hand SAR

MEASUREMENT RESULTS																
FREQUENCY		Mode	Service	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	Spacing	Cover Type	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle	SAR (10g)	Scaling Factor	Scaled SAR (10g)	Plot #
MHz	Ch.												(W/kg)		(W/kg)	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.11	0 mm	Standard	320FC	6	back	1:1	0.193	1.156	**0.223**	A29
5210	42	IEEE 802.11ac	OFDM	11.5	11.04	0.17	0 mm	Standard	320FC	29.3	back	1:1	0.100	1.112	0.111	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	-0.01	0 mm	Wireless Charging	320FC	6	back	1:1	0.083	1.156	0.096	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	0.03	0 mm	Standard	320FC	6	front	1:1	0.027	1.156	0.031	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	-0.03	0 mm	Standard	320FC	6	right	1:1	0.090	1.156	0.104	
5180	36	IEEE 802.11a	OFDM	14.5	13.87	-0.15	0 mm	Standard	320FC	6	top	1:1	0.015	1.156	0.017	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.03	0 mm	Standard	320FC	6	back	1:1	0.158	1.259	0.199	
5290	58	IEEE 802.11ac	OFDM	11.5	10.69	-0.16	0 mm	Standard	320FC	29.3	back	1:1	0.079	1.205	0.095	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	-0.15	0 mm	Standard	320FC	6	front	1:1	0.020	1.259	0.025	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.01	0 mm	Standard	320FC	6	right	1:1	0.079	1.259	0.099	
5280	56	IEEE 802.11a	OFDM	14.5	13.50	0.03	0 mm	Standard	320FC	6	top	1:1	0.014	1.259	0.018	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	0.03	0 mm	Standard	320FC	6	back	1:1	0.134	1.067	0.143	
5530	106	IEEE 802.11ac	OFDM	11.5	10.63	-0.05	0 mm	Standard	320FC	29.3	back	1:1	0.080	1.222	0.098	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	-0.05	0 mm	Standard	320FC	6	front	1:1	0.018	1.067	0.019	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	-0.18	0 mm	Standard	320FC	6	right	1:1	0.070	1.067	0.075	
5700	140	IEEE 802.11a	OFDM	14.5	14.22	-0.20	0 mm	Standard	320FC	6	top	1:1	0.024	1.067	0.026	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							**Hand 4.0 W/kg (mW/g)** averaged over 10 grams									

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12.5 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, FCC/OET Bulletin 65, Supplement C [June 2001] and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements. A specialized battery (with NFC antenna) was used for all SAR measurements (battery model: B800BU).
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01, SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
8. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 14 for variability analysis.
9. During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
10. Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal distance is greater than 160 mm and less than 200 mm. Therefore, hand SAR tests are required when hotspot mode does not apply or if hotspot 1g SAR > 1.2 W/kg. Extremity SAR was not evaluated for the licensed transmitter since Hotspot SAR is < 1.2 W/kg.
11. This DUT may be used with a standard battery cover or with an optional wireless charging battery cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging battery cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. No other additional testing with the wireless charging battery cover was not required since all reported SAR were under 1.2 W/kg.

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR.
2. Justification for reduced test configurations per KDB Publication 941225 D03v01: The source-based time-averaged output power was evaluated for all multi-slot operations. The multi-slot configuration with the highest frame averaged output power was evaluated for SAR for hotspot SAR.
3. Per FCC KDB Publication 447498 D01v05, since the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration was ≤ 0.8 W/kg, testing at the other channels was not required for such test configuration(s). If the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel is used.

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CDMA Notes:

1. Head SAR for CDMA2000 mode was tested under RC3/SO55 per FCC KDB Publication 941225 D01v02.
2. Body-Worn SAR was tested with 1x RTT with TDSO / SO32 FCH Only. EVDO and TDSO / SO32 FCH+SCH SAR tests were not required since the average output power was not more than 0.25 dB higher than the TDSO / SO32 FCH only powers, per FCC KDB Publication 941225 D01v02.
3. CDMA Wireless Router SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0 according to KDB 941225 D01 procedures for data devices. Since the average output power of Subtype 2 for Rev. A is less than the Rev. 0 power levels, then EVDO Rev. A SAR is not required. CDMA 1x-RTT SAR was additionally required to be evaluated for Hotspot exposure conditions to support simultaneous transmission capabilities.
4. Head SAR was additionally evaluated using EVDO Rev. A to determine compliance for VoIP operations.
5. Per FCC KDB Publication 447498 D01v05, when the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is > 0.8 W/kg then testing at the other channels was required for such test configuration(s). When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel was used.

UMTS Notes:

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

LTE Notes:

1. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. The general test procedures used for testing can be found in Section 8.5.4.
2. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
3. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator.

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WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 D01v01r02 and October 2012 FCC/TCB Meeting Notes for 2.4 GHz WIFI: 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 20 MHz and 40 MHz bandwidths) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. Per April 2013 TCB Workshop notes, full SAR tests for all IEEE 802.11ac configurations were not required because the average output power was not more than 0.25 dB higher than IEEE 802.11a mode. IEEE 802.11ac was evaluated for the highest IEEE 802.11a position in each 5 GHz band and exposure condition.
4. When Hotspot is enabled, 5.2 - 5.7 GHz WLAN bands are disabled. Therefore only 5.8 GHz WIFI Wireless Router SAR Data was required.
5. WIFI transmission was verified using an uncalibrated spectrum analyzer.
6. Since 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, or the reported 10g averaged SAR is <2.0 W/kg, SAR testing on other default channels was not required.
7. Per FCC KDB Publication 648474 D04v01r01, this device is considered a "phablet" since the diagonal distance is greater than 160 mm and less than 200mm. Therefore, hand SAR tests are required when hotspot mode does not apply or if hotspot 1g SAR > 1.2 W/kg. Because wireless router operations are not supported for 5.2-5.7 GHz WLAN Extremity SAR was evaluated for 5.2-5.7 GHz WIFI. Extremity SAR was not evaluated for 5.8 GHz WIFI and 2.4 GHz WIFI since Hotspot SAR for 2.4 GHz WIFI < 1.2 W/kg.

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13 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 Introduction

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

13.2 Simultaneous Transmission Procedures

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

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

Table 13-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	9.50	10	**0.187**

Notes:

1. Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
2. Main antenna SAR testing was not required per FCC KDB 648474 for extremity exposure conditions. Therefore, no further analysis was required to determine that possible simultaneous scenarios would not exceed the SAR limit.

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13.3 Head SAR Simultaneous Transmission Analysis

Table 13-2
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.190	0.161	0.351
	Right Tilt	0.147	0.157	0.304
	Left Cheek	0.302	0.365	0.667
	Left Tilt	0.162	0.198	0.360

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.056	0.161	0.217
	Right Tilt	0.065	0.157	0.222
	Left Cheek	0.131	0.365	0.496
	Left Tilt	0.049	0.198	0.247

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.139	0.161	0.300
	Right Tilt	0.089	0.157	0.246
	Left Cheek	0.196	0.365	0.561
	Left Tilt	0.103	0.198	0.301

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.109	0.161	0.270
	Right Tilt	0.128	0.157	0.285
	Left Cheek	0.229	0.365	0.594
	Left Tilt	0.096	0.198	0.294

Simult Tx	Configuration	CDMA BC10 (§90S) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.311	0.161	0.472
	Right Tilt	0.210	0.157	0.367
	Left Cheek	0.442	0.365	0.807
	Left Tilt	0.245	0.198	0.443

Simult Tx	Configuration	CDMA BC0 (§22H) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.242	0.161	0.403
	Right Tilt	0.147	0.157	0.304
	Left Cheek	0.351	0.365	0.716
	Left Tilt	0.174	0.198	0.372

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.232	0.161	0.393
	Right Tilt	0.239	0.157	0.396
	Left Cheek	0.381	0.365	0.746
	Left Tilt	0.159	0.198	0.357

Simult Tx	Configuration	EVDO BC10 (§90S) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.317	0.161	0.478
	Right Tilt	0.249	0.157	0.406
	Left Cheek	0.503	0.365	0.868
	Left Tilt	0.269	0.198	0.467

Simult Tx	Configuration	EVDO BC0 (§22H) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.194	0.161	0.355
	Right Tilt	0.132	0.157	0.289
	Left Cheek	0.326	0.365	0.691
	Left Tilt	0.162	0.198	0.360

Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.190	0.161	0.351
	Right Tilt	0.247	0.157	0.404
	Left Cheek	0.454	0.365	0.819
	Left Tilt	0.176	0.198	0.374

Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.170	0.161	0.331
	Right Tilt	0.131	0.157	0.288
	Left Cheek	0.302	0.365	0.667
	Left Tilt	0.099	0.198	0.297

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Table 13-3
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.190	0.035	0.225
	Right Tilt	0.147	0.027	0.174
	Left Cheek	0.302	0.056	0.358
	Left Tilt	0.162	0.042	0.204

Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.056	0.035	0.091
	Right Tilt	0.065	0.027	0.092
	Left Cheek	0.131	0.056	0.187
	Left Tilt	0.049	0.042	0.091

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.139	0.035	0.174
	Right Tilt	0.089	0.027	0.116
	Left Cheek	0.196	0.056	0.252
	Left Tilt	0.103	0.042	0.145

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.109	0.035	0.144
	Right Tilt	0.128	0.027	0.155
	Left Cheek	0.229	0.056	0.285
	Left Tilt	0.096	0.042	0.138

Simult Tx	Configuration	CDMA BC10 (§90S) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.311	0.035	0.346
	Right Tilt	0.210	0.027	0.237
	Left Cheek	0.442	0.056	0.498
	Left Tilt	0.245	0.042	0.287

Simult Tx	Configuration	CDMA BC0 (§22H) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.242	0.035	0.277
	Right Tilt	0.147	0.027	0.174
	Left Cheek	0.351	0.056	0.407
	Left Tilt	0.174	0.042	0.216

Simult Tx	Configuration	PCS CDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.232	0.035	0.267
	Right Tilt	0.239	0.027	0.266
	Left Cheek	0.381	0.056	0.437
	Left Tilt	0.159	0.042	0.201

Simult Tx	Configuration	EVDO BC10 (§90S) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.317	0.035	0.352
	Right Tilt	0.249	0.027	0.276
	Left Cheek	0.503	0.056	0.559
	Left Tilt	0.269	0.042	0.311

Simult Tx	Configuration	EVDO BC0 (§22H) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.194	0.035	0.229
	Right Tilt	0.132	0.027	0.159
	Left Cheek	0.326	0.056	0.382
	Left Tilt	0.162	0.042	0.204

Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.190	0.035	0.225
	Right Tilt	0.247	0.027	0.274
	Left Cheek	0.454	0.056	0.510
	Left Tilt	0.176	0.042	0.218

Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.170	0.035	0.205
	Right Tilt	0.131	0.027	0.158
	Left Cheek	0.302	0.056	0.358
	Left Tilt	0.099	0.042	0.141

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

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13.4 Body-Worn Simultaneous Transmission Analysis

Table 13-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.405	0.158	0.563
Back Side	GSM 1900	0.313	0.158	0.471
Back Side	UMTS 850	0.289	0.158	0.447
Back Side	UMTS 1900	0.447	0.158	0.605
Back Side	CDMA BC10 (§90S)	0.639	0.158	0.797
Back Side	CDMA BC0 (§22H)	0.568	0.158	0.726
Back Side	PCS CDMA	0.478	0.158	0.636
Back Side	LTE Band 25 (PCS)	1.094	0.158	1.252

Table 13-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.405	0.095	0.500
Back Side	GSM 1900	0.313	0.095	0.408
Back Side	UMTS 850	0.289	0.095	0.384
Back Side	UMTS 1900	0.447	0.095	0.542
Back Side	CDMA BC10 (§90S)	0.639	0.095	0.734
Back Side	CDMA BC0 (§22H)	0.568	0.095	0.663
Back Side	PCS CDMA	0.478	0.095	0.573
Back Side	LTE Band 25 (PCS)	1.094	0.095	1.189

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

Table 13-6
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 10 mm)

Configuration	Mode	2G/3G/4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.405	0.187	0.592
Back Side	GSM 1900	0.313	0.187	0.500
Back Side	UMTS 850	0.289	0.187	0.476
Back Side	UMTS 1900	0.447	0.187	0.634
Back Side	CDMA BC10 (§90S)	0.639	0.187	0.826
Back Side	CDMA BC0 (§22H)	0.568	0.187	0.755
Back Side	PCS CDMA	0.478	0.187	0.665
Back Side	LTE Band 25 (PCS)	1.094	0.187	1.281

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

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13.5 Hotspot SAR Simultaneous Transmission Analysis

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

Table 13-7
Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.547	0.158	0.705	Body SAR	Back	0.417	0.158	0.575
	Front	0.371	0.057	0.428		Front	0.699	0.057	0.756
	Top	-	0.046	0.046		Top	-	0.046	0.046
	Bottom	0.244	-	0.244		Bottom	0.423	-	0.423
	Right	-	0.050	0.050		Right	-	0.050	0.050
	Left	0.449	-	0.449		Left	0.219	-	0.219
Simult Tx	Configuration	UMTS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.289	0.158	0.447	Body SAR	Back	0.447	0.158	0.605
	Front	0.165	0.057	0.222		Front	0.840	0.057	0.897
	Top	-	0.046	0.046		Top	-	0.046	0.046
	Bottom	0.108	-	0.108		Bottom	0.475	-	0.475
	Right	-	0.050	0.050		Right	-	0.050	0.050
	Left	0.210	-	0.210		Left	0.276	-	0.276
Simult Tx	Configuration	CDMA BC10 (§90S) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	EVDO BC0 (§22H) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.671	0.158	0.829	Body SAR	Back	0.581	0.158	0.739
	Front	0.291	0.057	0.348		Front	0.261	0.057	0.318
	Top	-	0.046	0.046		Top	-	0.046	0.046
	Bottom	0.201	-	0.201		Bottom	0.185	-	0.185
	Right	-	0.050	0.050		Right	-	0.050	0.050
	Left	0.411	-	0.411		Left	0.294	-	0.294
Simult Tx	Configuration	PCS EVDO SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.460	0.158	0.618	Body SAR	Back	1.094	0.158	1.252
	Front	1.047	0.057	1.104		Front	0.199	0.057	0.256
	Top	-	0.046	0.046		Top	-	0.046	0.046
	Bottom	0.454	-	0.454		Bottom	-	-	0.000
	Right	-	0.050	0.050		Right	0.694	0.050	0.744
	Left	0.357	-	0.357		Left	-	-	0.000

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Table 13-8
Simultaneous Transmission Scenario (5.8 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.547	0.095	0.642
	Front	0.371	0.005	0.376
	Top	-	0.037	0.037
	Bottom	0.244	-	0.244
	Right	-	0.071	0.071
	Left	0.449	-	0.449

Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.417	0.095	0.512
	Front	0.699	0.005	0.704
	Top	-	0.037	0.037
	Bottom	0.423	-	0.423
	Right	-	0.071	0.071
	Left	0.219	-	0.219

Simult Tx	Configuration	UMTS 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.289	0.095	0.384
	Front	0.165	0.005	0.170
	Top	-	0.037	0.037
	Bottom	0.108	-	0.108
	Right	-	0.071	0.071
	Left	0.210	-	0.210

Simult Tx	Configuration	UMTS 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.447	0.095	0.542
	Front	0.840	0.005	0.845
	Top	-	0.037	0.037
	Bottom	0.475	-	0.475
	Right	-	0.071	0.071
	Left	0.276	-	0.276

Simult Tx	Configuration	CDMA BC10 (§90S) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.671	0.095	0.766
	Front	0.291	0.005	0.296
	Top	-	0.037	0.037
	Bottom	0.201	-	0.201
	Right	-	0.071	0.071
	Left	0.411	-	0.411

Simult Tx	Configuration	EVDO BC0 (§22H) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.581	0.095	0.676
	Front	0.261	0.005	0.266
	Top	-	0.037	0.037
	Bottom	0.185	-	0.185
	Right	-	0.071	0.071
	Left	0.294	-	0.294

Simult Tx	Configuration	PCS EVDO SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.460	0.095	0.555
	Front	1.047	0.005	1.052
	Top	-	0.037	0.037
	Bottom	0.454	-	0.454
	Right	-	0.071	0.071
	Left	0.357	-	0.357

Simult Tx	Configuration	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	1.094	0.095	1.189
	Front	0.199	0.005	0.204
	Top	-	0.037	0.037
	Bottom	-	-	0.000
	Right	0.694	0.071	0.765
	Left	-	-	0.000

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13.6 SVLTE Simultaneous Transmission Analysis

Table 13-9
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC10 (§90S) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5		
Head SAR	P ≥ 18.5	Right Cheek	0.311	0.090	0.161	0.401	0.562
		Right Tilt	0.210	0.084	0.157	0.294	0.451
		Left Cheek	0.442	0.172	0.365	0.614	0.979
		Left Tilt	0.245	0.064	0.198	0.309	0.507
		Maximum Allowed Power (dBm)	18.5	24.5	17.5		
	P < 18.5	Right Cheek	0.054	0.170	0.161	0.224	0.385
		Right Tilt	0.035	0.131	0.157	0.166	0.323
		Left Cheek	0.067	0.302	0.365	0.369	0.734
		Left Tilt	0.043	0.099	0.198	0.142	0.340

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC0 (§22H) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5		
Head SAR	P ≥ 18.5	Right Cheek	0.242	0.090	0.161	0.332	0.493
		Right Tilt	0.147	0.084	0.157	0.231	0.388
		Left Cheek	0.351	0.172	0.365	0.523	0.888
		Left Tilt	0.174	0.064	0.198	0.238	0.436
		Maximum Allowed Power (dBm)	18.5	24.5	17.5		
	P < 18.5	Right Cheek	0.049	0.170	0.161	0.219	0.380
		Right Tilt	0.032	0.131	0.157	0.163	0.320
		Left Cheek	0.067	0.302	0.365	0.369	0.734
		Left Tilt	0.041	0.099	0.198	0.140	0.338

Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5		
Head SAR	P ≥ 18.5	Right Cheek	0.232	0.090	0.161	0.322	0.483
		Right Tilt	0.239	0.084	0.157	0.323	0.480
		Left Cheek	0.381	0.172	0.365	0.553	0.918
		Left Tilt	0.159	0.064	0.198	0.223	0.421
		Maximum Allowed Power (dBm)	18.5	24.5	17.5		
	P < 18.5	Right Cheek	0.047	0.170	0.161	0.217	0.378
		Right Tilt	0.039	0.131	0.157	0.170	0.327
		Left Cheek	0.059	0.302	0.365	0.361	0.726
		Left Tilt	0.031	0.099	0.198	0.130	0.328

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Table 13-10
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC10 (§90S) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5		
Head SAR	P ≥ 18.5	Right Cheek	0.311	0.090	0.035	0.401	0.436
		Right Tilt	0.210	0.084	0.027	0.294	0.321
		Left Cheek	0.442	0.172	0.056	0.614	0.670
		Left Tilt	0.245	0.064	0.042	0.309	0.351
		Maximum Allowed Power (dBm)	18.5	24.5	14.5		
	P < 18.5	Right Cheek	0.054	0.170	0.035	0.224	0.259
		Right Tilt	0.035	0.131	0.027	0.166	0.193
		Left Cheek	0.067	0.302	0.056	0.369	0.425
		Left Tilt	0.043	0.099	0.042	0.142	0.184

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC0 (§22H) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5		
Head SAR	P ≥ 18.5	Right Cheek	0.242	0.090	0.035	0.332	0.367
		Right Tilt	0.147	0.084	0.027	0.231	0.258
		Left Cheek	0.351	0.172	0.056	0.523	0.579
		Left Tilt	0.174	0.064	0.042	0.238	0.280
		Maximum Allowed Power (dBm)	18.5	24.5	14.5		
	P < 18.5	Right Cheek	0.049	0.170	0.035	0.219	0.254
		Right Tilt	0.032	0.131	0.027	0.163	0.190
		Left Cheek	0.067	0.302	0.056	0.369	0.425
		Left Tilt	0.041	0.099	0.042	0.140	0.182

Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5		
Head SAR	P ≥ 18.5	Right Cheek	0.232	0.090	0.035	0.322	0.357
		Right Tilt	0.239	0.084	0.027	0.323	0.350
		Left Cheek	0.381	0.172	0.056	0.553	0.609
		Left Tilt	0.159	0.064	0.042	0.223	0.265
		Maximum Allowed Power (dBm)	18.5	24.5	14.5		
	P < 18.5	Right Cheek	0.047	0.170	0.035	0.217	0.252
		Right Tilt	0.039	0.131	0.027	0.170	0.197
		Left Cheek	0.059	0.302	0.056	0.361	0.417
		Left Tilt	0.031	0.099	0.042	0.130	0.172

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

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Table 13-11
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 10 mm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
Back Side	P ≥ 18.5	Maximum Allowed Power (dBm)	25	19.5	17.5		
		CDMA BC10 (§90S)	0.639	0.558	0.158	1.197	1.355
		CDMA BC0 (§22H)	0.568	0.558	0.158	1.126	1.284
		PCS CDMA	0.478	0.558	0.158	1.036	1.194
Back Side	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	17.5		
		CDMA BC10 (§90S)	0.118	1.094	0.158	1.212	1.370
		CDMA BC0 (§22H)	0.115	1.094	0.158	1.209	1.367
		PCS CDMA	0.219	1.094	0.158	1.313	1.471

Table 13-12
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth (Body-Worn at 10 mm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
Back Side	P ≥ 18.5	Maximum Allowed Power (dBm)	25	19.5	9.5		
		CDMA BC10 (§90S)	0.639	0.558	0.187	1.197	1.384
		CDMA BC0 (§22H)	0.568	0.558	0.187	1.126	1.313
		PCS CDMA	0.478	0.558	0.187	1.036	1.223
Back Side	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	9.5		
		CDMA BC10 (§90S)	0.118	1.094	0.187	1.212	1.399
		CDMA BC0 (§22H)	0.115	1.094	0.187	1.209	1.396
		PCS CDMA	0.219	1.094	0.187	1.313	**1.500**

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

Table 13-13
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 10 mm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
Back Side	P ≥ 18.5	Maximum Allowed Power (dBm)	25	19.5	14.5		
		CDMA BC10 (§90S)	0.639	0.558	0.095	1.197	1.292
		CDMA BC0 (§22H)	0.568	0.558	0.095	1.126	1.221
		PCS CDMA	0.478	0.558	0.095	1.036	1.131
Back Side	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	14.5		
		CDMA BC10 (§90S)	0.118	1.094	0.095	1.212	1.307
		CDMA BC0 (§22H)	0.115	1.094	0.095	1.209	1.304
		PCS CDMA	0.219	1.094	0.095	1.313	1.408

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

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Table 13-14
Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC10 (§90S) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5	
Body SAR	P ≥ 18.5	Back	0.639	0.558	0.158	1.355
		Front	0.299	0.066	0.057	0.422
		Top	-	-	0.046	0.046
		Bottom	0.207	-	-	0.207
		Right	-	0.394	0.050	0.444
		Left	0.455	-	-	0.455
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	17.5	
		Back	0.118	1.094	0.158	1.370
		Front	0.072	0.199	0.057	0.328
		Top	-	-	0.046	0.046
		Bottom	0.048	-	-	0.048
		Right	-	0.694	0.050	0.744
		Left	0.097	-	-	0.097

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC0 (§22H) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5	
Body SAR	P ≥ 18.5	Back	0.568	0.558	0.158	1.284
		Front	0.263	0.066	0.057	0.386
		Top	-	-	0.046	0.046
		Bottom	0.187	-	-	0.187
		Right	-	0.394	0.050	0.444
		Left	0.384	-	-	0.384
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	17.5	
		Back	0.115	1.094	0.158	1.367
		Front	0.058	0.199	0.057	0.314
		Top	-	-	0.046	0.046
		Bottom	0.046	-	-	0.046
		Right	-	0.694	0.050	0.744
		Left	0.080	-	-	0.080

Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	17.5	
Body SAR	P ≥ 18.5	Back	0.478	0.558	0.158	1.194
		Front	1.028	0.066	0.057	1.151
		Top	-	-	0.046	0.046
		Bottom	0.486	-	-	0.486
		Right	-	0.394	0.050	0.444
		Left	0.362	-	-	0.362
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	17.5	
		Back	0.219	1.094	0.158	1.471
		Front	0.355	0.199	0.057	0.611
		Top	-	-	0.046	0.046
		Bottom	0.263	-	-	0.263
		Right	-	0.694	0.050	0.744
		Left	0.089	-	-	0.089

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Table 13-15
Simultaneous Transmission Scenario (5.8 GHz Hotspot at 1.0 cm)

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC10 (§90S) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5	
Body SAR	P ≥ 18.5	Back	0.639	0.558	0.095	1.292
		Front	0.299	0.066	0.005	0.370
		Top	-	-	0.037	0.037
		Bottom	0.207	-	-	0.207
		Right	-	0.394	0.071	0.465
		Left	0.455	-	-	0.455
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	14.5	
		Back	0.118	1.094	0.095	1.307
		Front	0.072	0.199	0.005	0.276
		Top	-	-	0.037	0.037
		Bottom	0.048	-	-	0.048
		Right	-	0.694	0.071	0.765
		Left	0.097	-	-	0.097

Simult Tx	CDMA Power Level (dBm)	Configuration	CDMA BC0 (§22H) SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5	
Body SAR	P ≥ 18.5	Back	0.568	0.558	0.095	1.221
		Front	0.263	0.066	0.005	0.334
		Top	-	-	0.037	0.037
		Bottom	0.187	-	-	0.187
		Right	-	0.394	0.071	0.465
		Left	0.384	-	-	0.384
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	14.5	
		Back	0.115	1.094	0.095	1.304
		Front	0.058	0.199	0.005	0.262
		Top	-	-	0.037	0.037
		Bottom	0.046	-	-	0.046
		Right	-	0.694	0.071	0.765
		Left	0.080	-	-	0.080

Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA SAR (W/kg)	LTE Band 25 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Maximum Allowed Power (dBm)	25	19.5	14.5	
Body SAR	P ≥ 18.5	Back	0.478	0.558	0.095	1.131
		Front	1.028	0.066	0.005	1.099
		Top	-	-	0.037	0.037
		Bottom	0.486	-	-	0.486
		Right	-	0.394	0.071	0.465
		Left	0.362	-	-	0.362
	P < 18.5	Maximum Allowed Power (dBm)	18.5	24.5	14.5	
		Back	0.219	1.094	0.095	1.408
		Front	0.355	0.199	0.005	0.559
		Top	-	-	0.037	0.037
		Bottom	0.263	-	-	0.263
		Right	-	0.694	0.071	0.765
		Left	0.089	-	-	0.089

13.7 Simultaneous Transmission Conclusion

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

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14 SAR MEASUREMENT VARIABILITY

14.1 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 14-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1900	1910.00	26640	LTE Band 25 (PCS)	QPSK, 1 RB, 0 RB Offset	back	10 mm	1.050	1.040	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							

14.2 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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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
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	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/17/2013	Annual	4/17/2014	3629U00687
Agilent	85070C	Dielectric Probe Kit	2/14/2013	Annual	2/14/2014	MY44300633
Agilent	N9020A	MXA Signal Analyzer	10/9/2013	Annual	10/9/2013	US46470561
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Agilent	E5515C	Wireless Communications Test Set	5/9/2013	Biennial	5/9/2015	GB43304447
Anritsu	ML2438A	Power Meter	2/14/2013	Annual	2/14/2014	1190013
Anritsu	ML2495A	Power Meter	10/11/2012	Annual	10/11/2013	1039008
Anritsu	MA2411B	Pulse Sensor	3/5/2012	Annual	3/5/2013	846215
Anritsu	MA2411B	Pulse Sensor	9/19/2012	Annual	9/19/2013	1027293
Anritsu	MT8820C	Radio Communication Analyzer	6/28/2013	Annual	6/28/2014	6201240328
Anritsu	MT8820C	Radio Communication Tester	11/6/2012	Annual	11/6/2013	6200901190
Anritsu	MA2481D	Universal Sensor	12/17/2012	Annual	12/17/2013	1204343
Anritsu	MA24106A	USB Power Sensor	8/22/2012	Annual	8/22/2013	1231538
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122541143
Control Company	36934-158	Wall-Mounted Thermometer	1/4/2012	Biennial	1/4/2014	122014488
Fisher Scientific	15-077-960	Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/10/2012	Annual	10/10/2013	1833460
Gigatronics	8651A	Universal Power Meter	10/10/2012	Annual	10/10/2013	8650319
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	5/3/2013	Annual	5/3/2014	836371/0079
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	10/7/2011	Biennial	10/7/2013	103962
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	SME06	Signal Generator	10/11/2012	Annual	10/11/2013	832026
Rohde & Schwarz	SMIQ03B	Signal Generator	4/17/2013	Annual	4/17/2014	DE27259
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	5/2/2013	Annual	5/2/2014	5d141
SPEAG	D1900V2	1900 MHz SAR Dipole	7/20/2012	Annual	7/20/2013	5d080
SPEAG	D1900V2	1900 MHz SAR Dipole	2/6/2013	Annual	2/6/2014	5d148
SPEAG	D2450V2	2450 MHz SAR Dipole	2/11/2013	Annual	2/11/2014	882
SPEAG	D5GHzV2	5 GHz SAR Dipole	1/11/2013	Annual	1/11/2014	1057
SPEAG	D835V2	835 MHz SAR Dipole	8/23/2012	Annual	8/23/2013	4d026
SPEAG	D835V2	835 MHz SAR Dipole	4/25/2013	Annual	4/25/2014	4d119
SPEAG	D835V2	835 MHz SAR Dipole	1/7/2013	Annual	1/7/2014	4d132
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/22/2013	Annual	4/22/2014	1364
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/6/2013	Annual	2/6/2014	649
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/13/2013	Annual	5/13/2014	859
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/17/2013	Annual	1/17/2014	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/13/2012	Annual	11/13/2013	1333
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/24/2012	Annual	8/24/2013	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/8/2013	Annual	3/8/2014	1334
SPEAG	DAK-3.5	Dielectric Assessment Kit	12/11/2012	Annual	12/11/2013	1091
SPEAG	ES3DV2	SAR Probe	8/28/2012	Annual	8/28/2013	3022
SPEAG	ES3DV3	SAR Probe	3/15/2013	Annual	3/15/2014	3209
SPEAG	ES3DV3	SAR Probe	5/16/2013	Annual	5/16/2014	3263
SPEAG	ES3DV3	SAR Probe	11/15/2012	Annual	11/15/2013	3287
SPEAG	ES3DV3	SAR Probe	4/29/2013	Annual	4/29/2014	3318
SPEAG	EX3DV4	SAR Probe	1/17/2013	Annual	1/17/2014	3589
SPEAG	EX3DV4	SAR Probe	2/27/2013	Annual	2/27/2014	3920
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/17/2013	Annual	4/17/2014	B010177
VWR	62344-925	Mini-Thermometer	10/24/2011	Biennial	10/24/2013	111886441
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

Notes:

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. All equipment was used within its calibration period.

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16 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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17 CONCLUSION

17.1 Measurement Conclusion

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

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

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

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

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

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

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

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

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

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

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

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34272

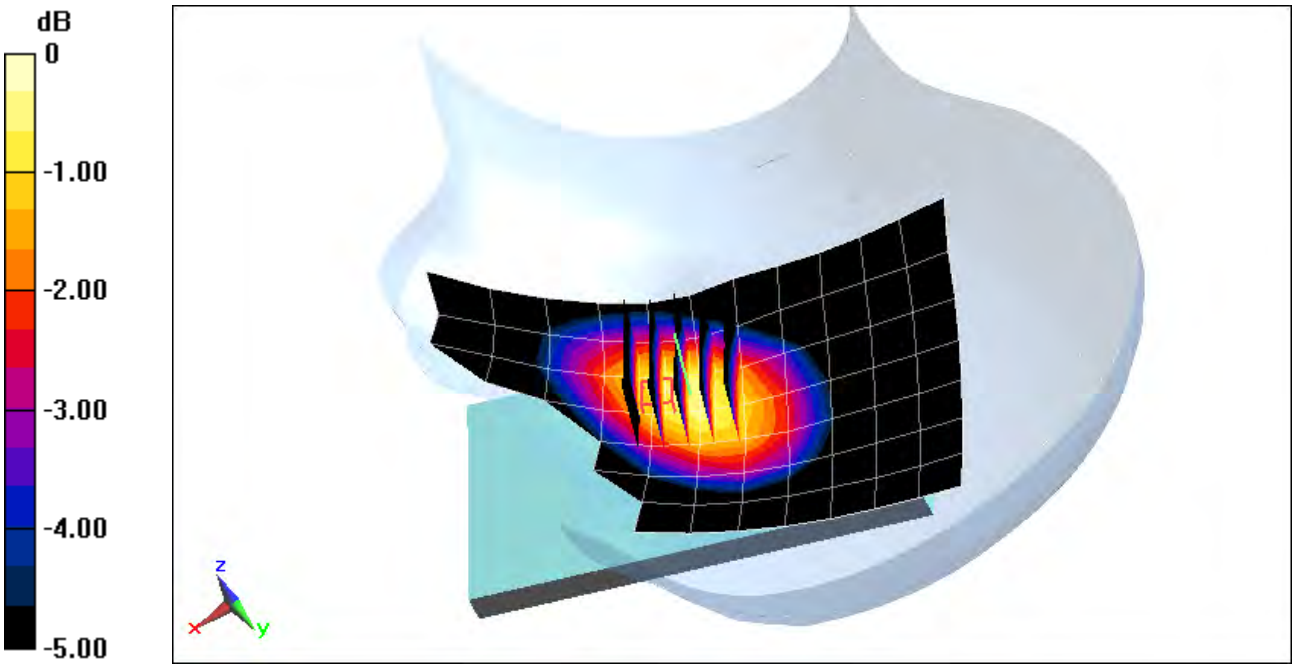
Communication System: GSM; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.887 S/m; ε_r = 40.633; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-21-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3318; ConvF(6.33, 6.33, 6.33); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: GSM 850, Left Head, Cheek, Mid.ch, Standard Cover

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.734 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.399 W/kg
SAR(1 g) = 0.271 W/kg



0 dB = 0.266 W/kg = -5.75 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34272

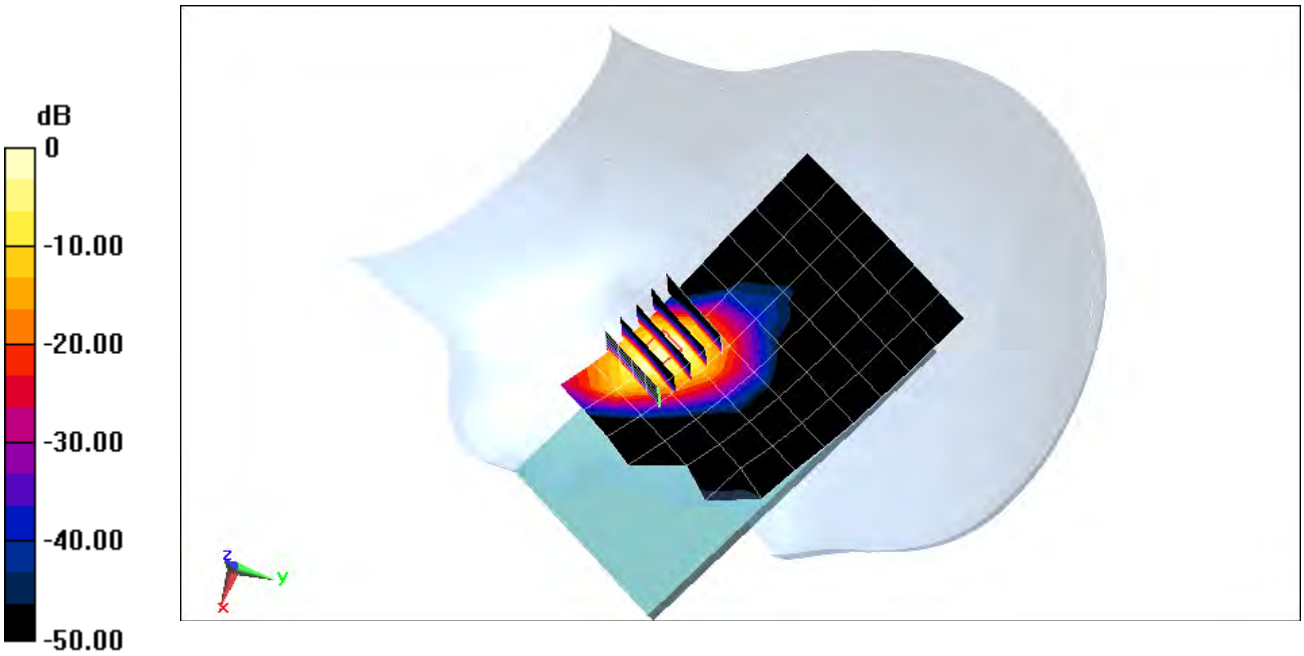
Communication System: GSM; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.417 S/m; ε_r = 38.834; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-13-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3318; ConvF(5.22, 5.22, 5.22); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.838 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.192 W/kg
SAR(1 g) = 0.127 W/kg



0 dB = 0.126 W/kg = -8.99 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 3426E

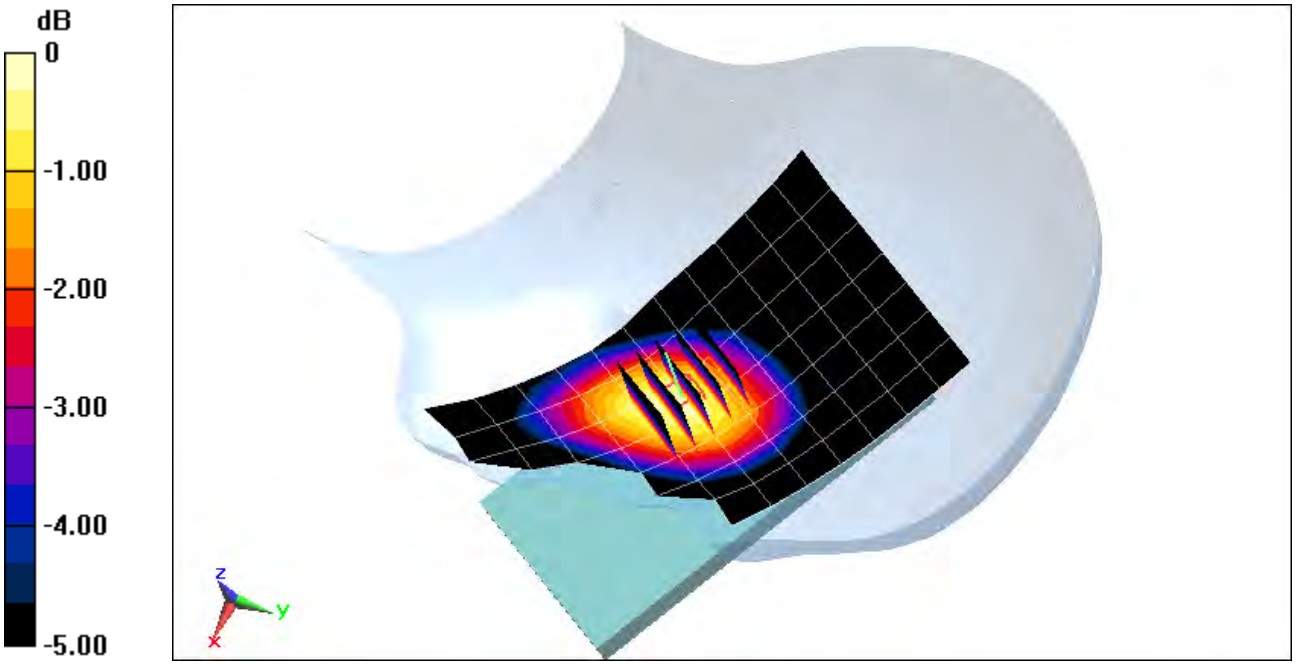
Communication System: UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.6 MHz; σ = 0.887 S/m; ε_r = 40.633; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-21-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3318; ConvF(6.33, 6.33, 6.33); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: UMTS 850, Left Head, Cheek, Mid.ch, Wireless Charging Cover

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.970 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.240 W/kg
SAR(1 g) = 0.191 W/kg



0 dB = 0.201 W/kg = -6.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 3426E

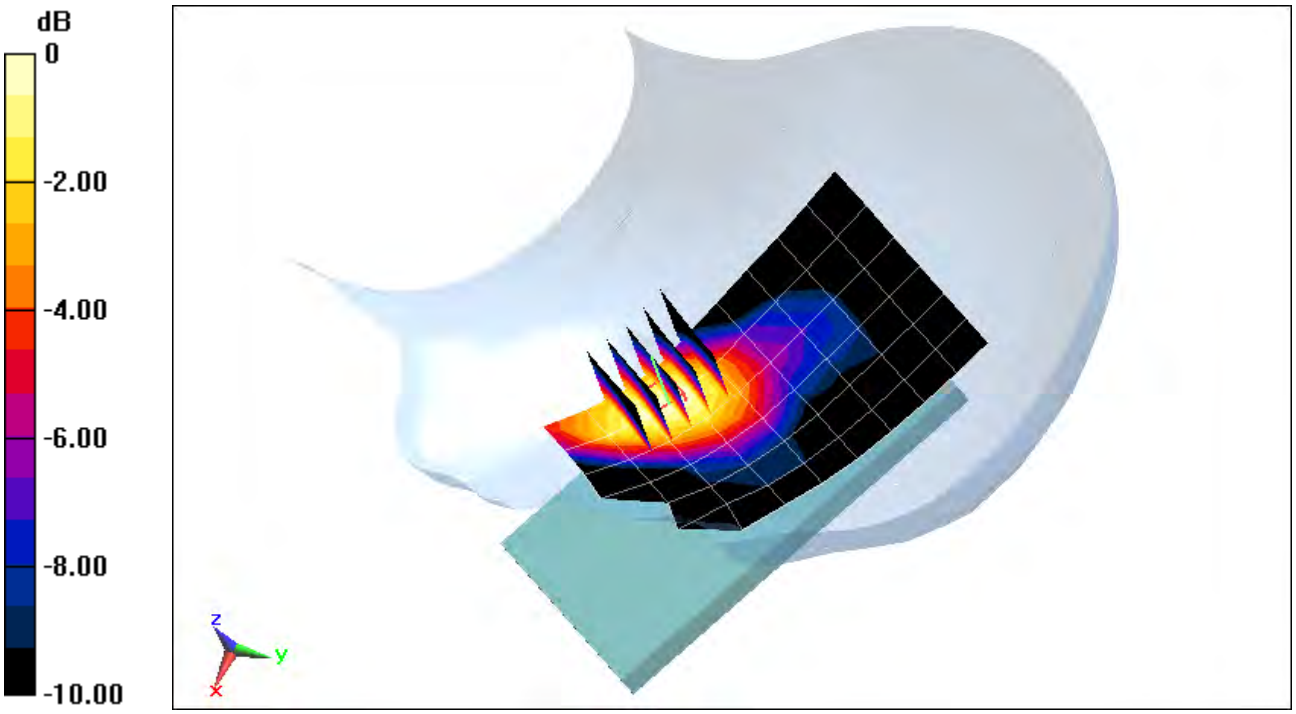
Communication System: UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.417 S/m; ε_r = 38.834; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-13-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3318; ConvF(5.22, 5.22, 5.22); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 12.706 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.333 W/kg
SAR(1 g) = 0.225 W/kg



0 dB = 0.241 W/kg = -6.18 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

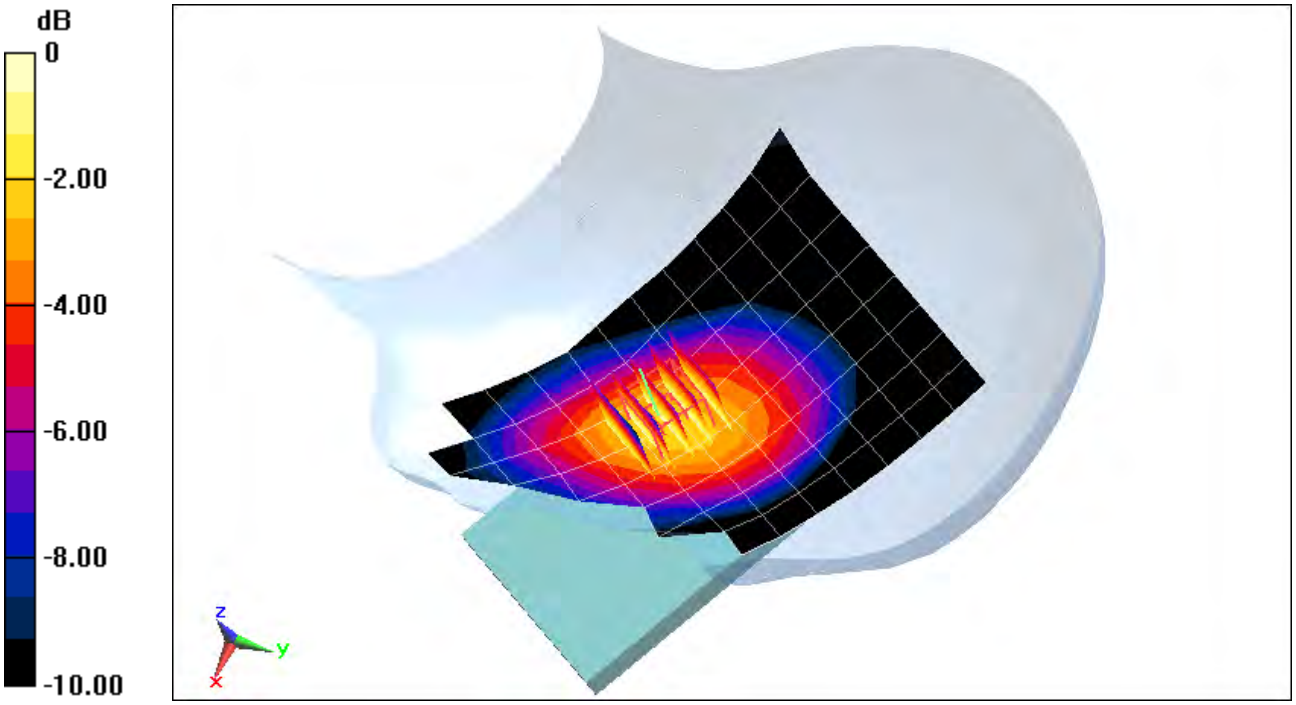
Communication System: CDMA; Frequency: 820.1 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 820.1 MHz; σ = 0.875 S/m; ε_r = 40.821; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-21-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3318; ConvF(6.33, 6.33, 6.33); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. EVDO Rev.A BC10 (§90S), Left Head, Cheek, Mid.ch, Wireless Charging Cover

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.957 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.592 W/kg
SAR(1 g) = 0.469 W/kg



0 dB = 0.490 W/kg = -3.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

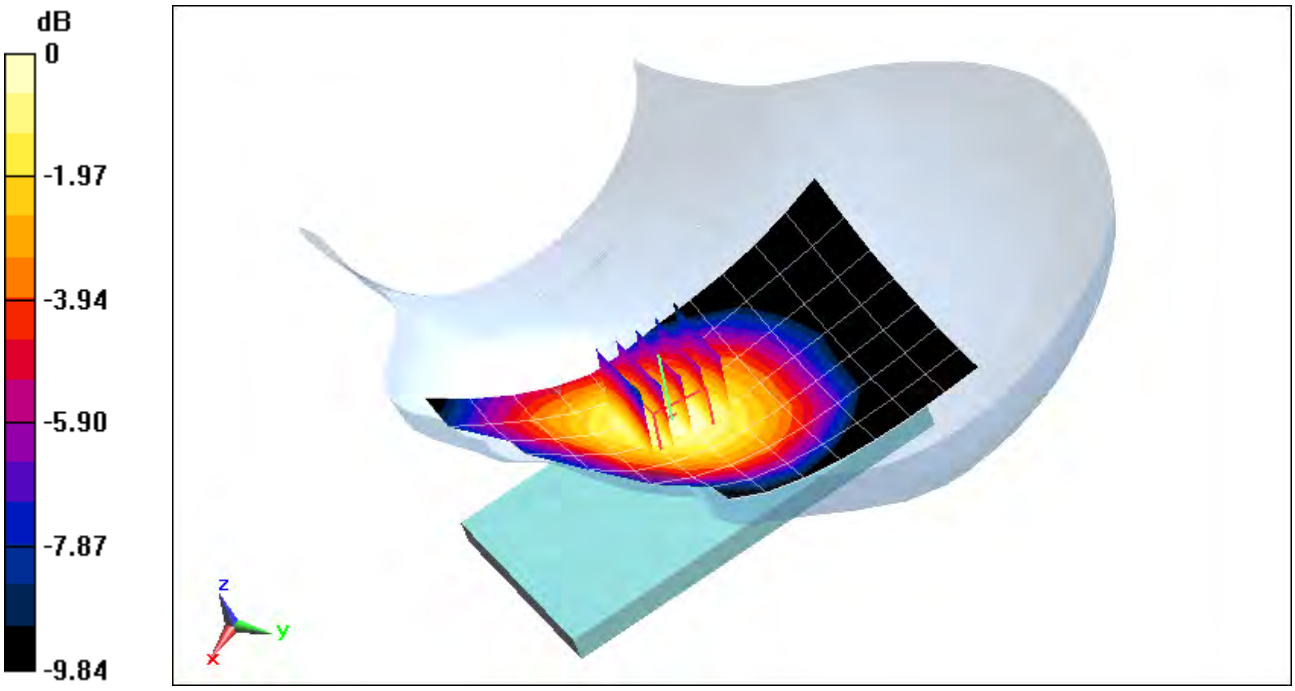
Communication System: Cellular CDMA; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used (interpolated):
f = 836.52 MHz; σ = 0.917 S/m; ε_r = 40.652; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-15-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3263; ConvF(6.29, 6.29, 6.29); Calibrated: 5/16/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/13/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. CDMA BC0 (§22H), Left Head, Cheek, Mid.ch, Standard Cover

Area Scan (8x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.547 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.408 W/kg
SAR(1 g) = 0.317 W/kg



0 dB = 0.338 W/kg = -4.71 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342AF

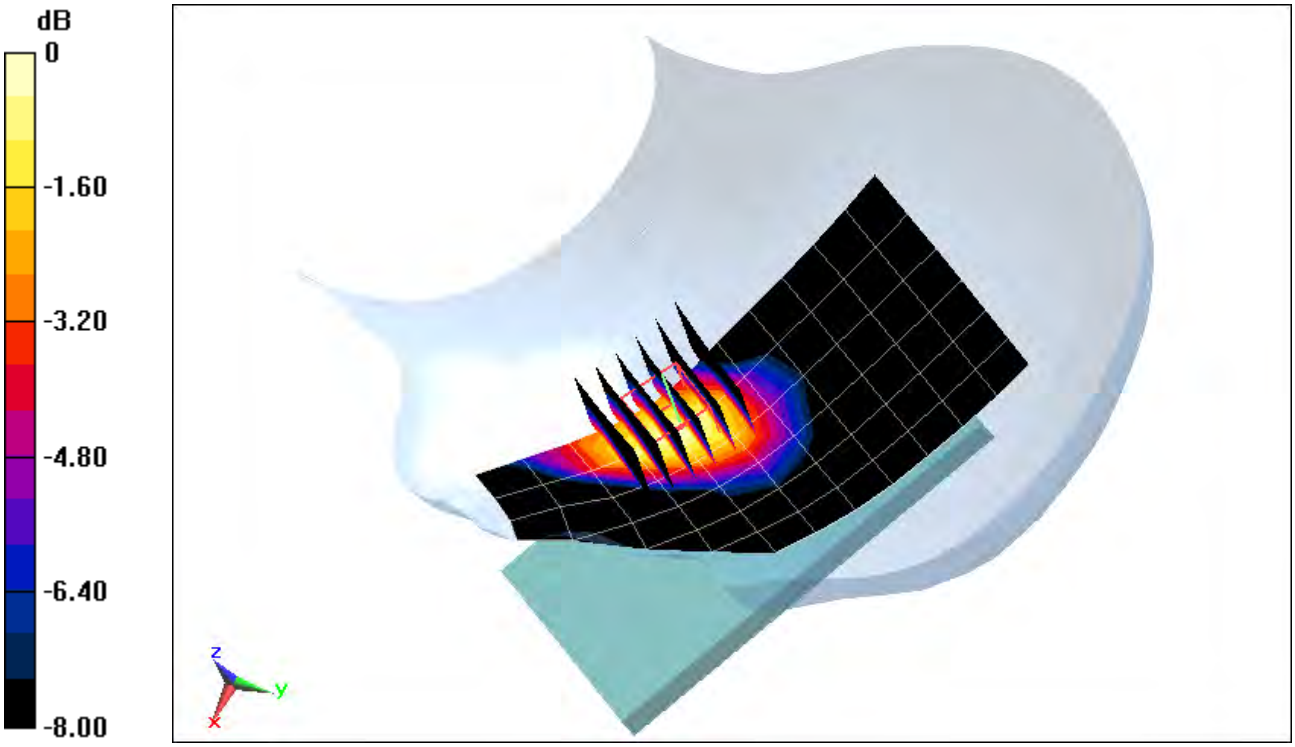
Communication System: CDMA; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1880 MHz; σ = 1.417 S/m; ε_r = 38.834; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-13-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3318; ConvF(5.22, 5.22, 5.22); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.10 (7164)

Mode: PCS EVDO Rev.A, Left Head, Cheek, Mid.ch, Standard Cover

Area Scan (7x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.302 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.579 W/kg
SAR(1 g) = 0.386 W/kg



0 dB = 0.414 W/kg = -3.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 83

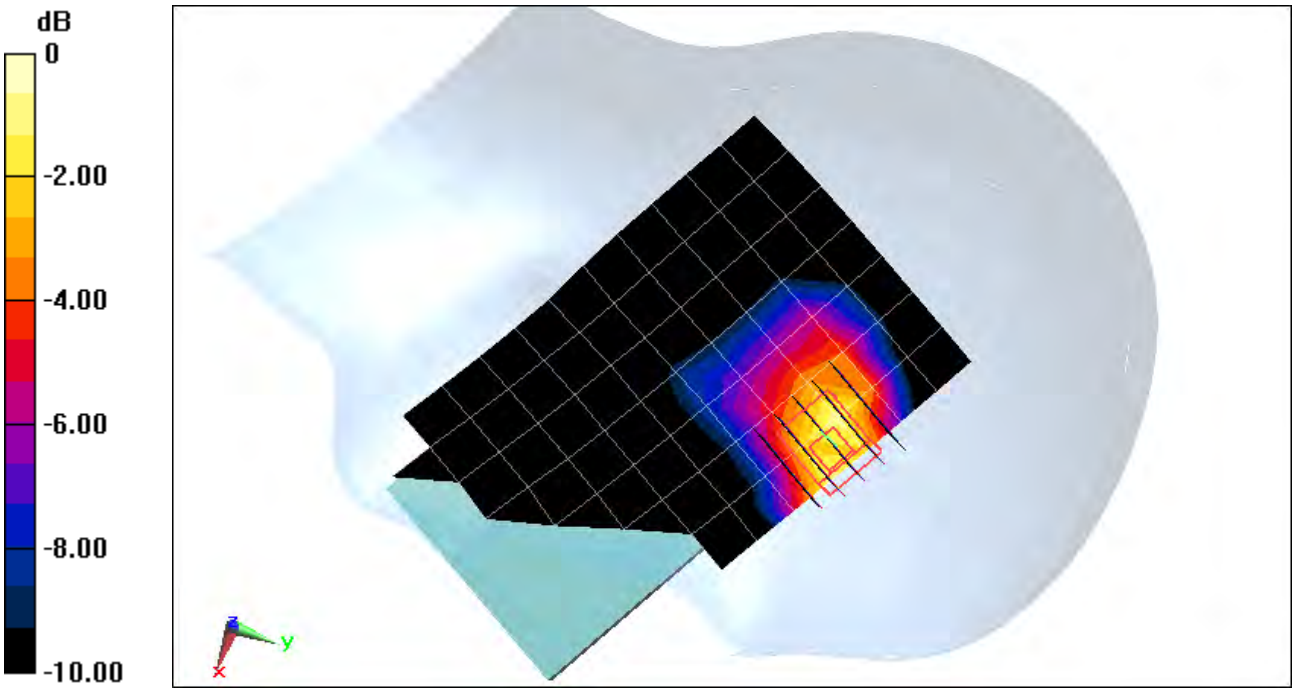
Communication System: LTE B25 10 MHz; Frequency: 1910 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used:
f = 1910 MHz; σ = 1.398 S/m; ε_r = 39.883; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-15-2013; Ambient Temp: 22.1°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 25 (PCS), Left Head, Cheek, High.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset, Standard Cover

Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.656 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.537 W/kg
SAR(1 g) = 0.290 W/kg



0 dB = 0.325 W/kg = -4.88 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34287

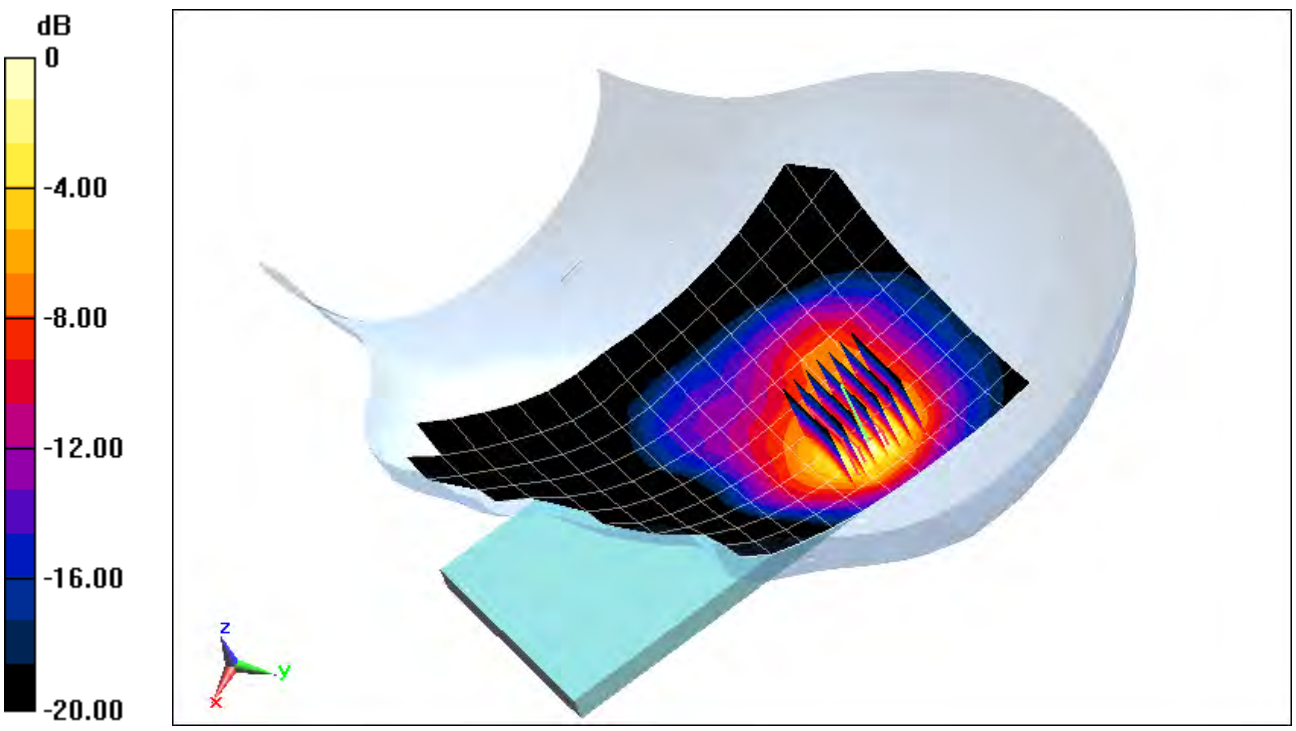
Communication System: IEEE 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.828 S/m; ε_r = 38.409; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 08-19-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3263; ConvF(4.47, 4.47, 4.47); Calibrated: 5/16/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/13/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11b, Left Head, Cheek, Ch 01, 1 Mbps, Standard Cover

Area Scan (11x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 14.028 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.787 W/kg
SAR(1 g) = 0.352 W/kg



0 dB = 0.472 W/kg = -3.26 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 320FC

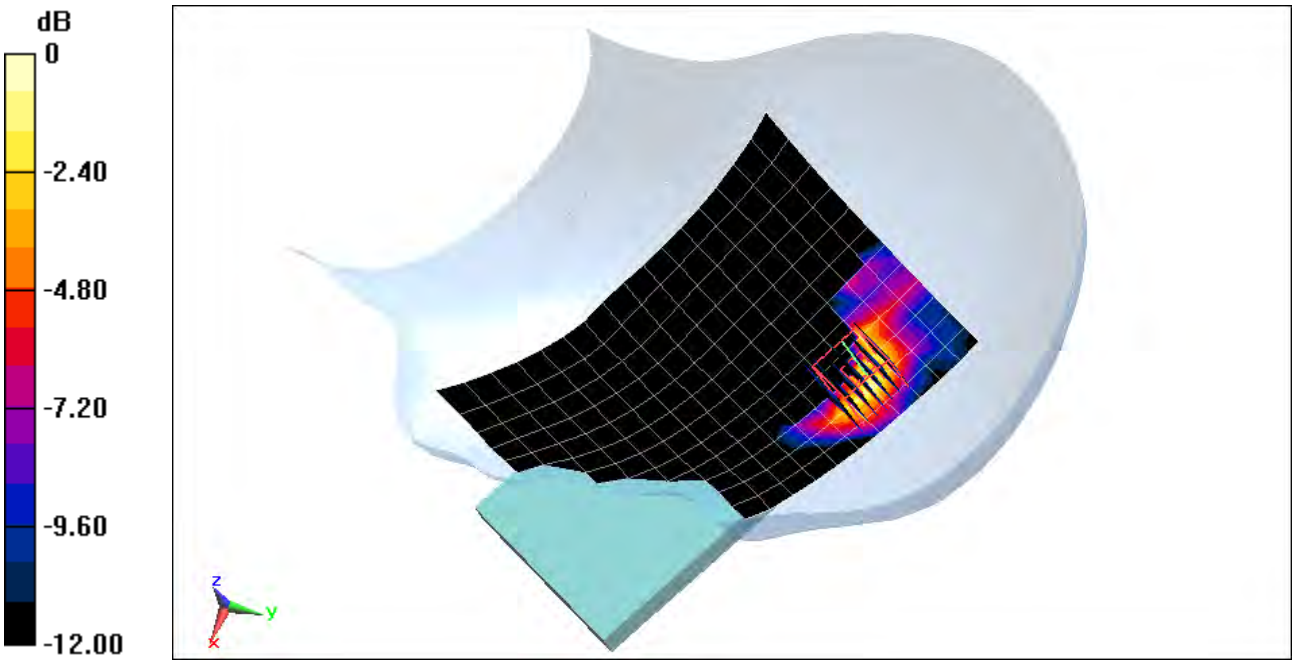
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5825 MHz; σ = 5.402 S/m; ε_r = 34.096; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-17-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.8°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz Left Head, Cheek, Ch 165, 6 Mbps, Standard Cover

Area Scan (13x17x1): 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 = 2.282 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.657 W/kg
SAR(1 g) = 0.048 W/kg



0 dB = 0.154 W/kg = -8.12 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 320FC

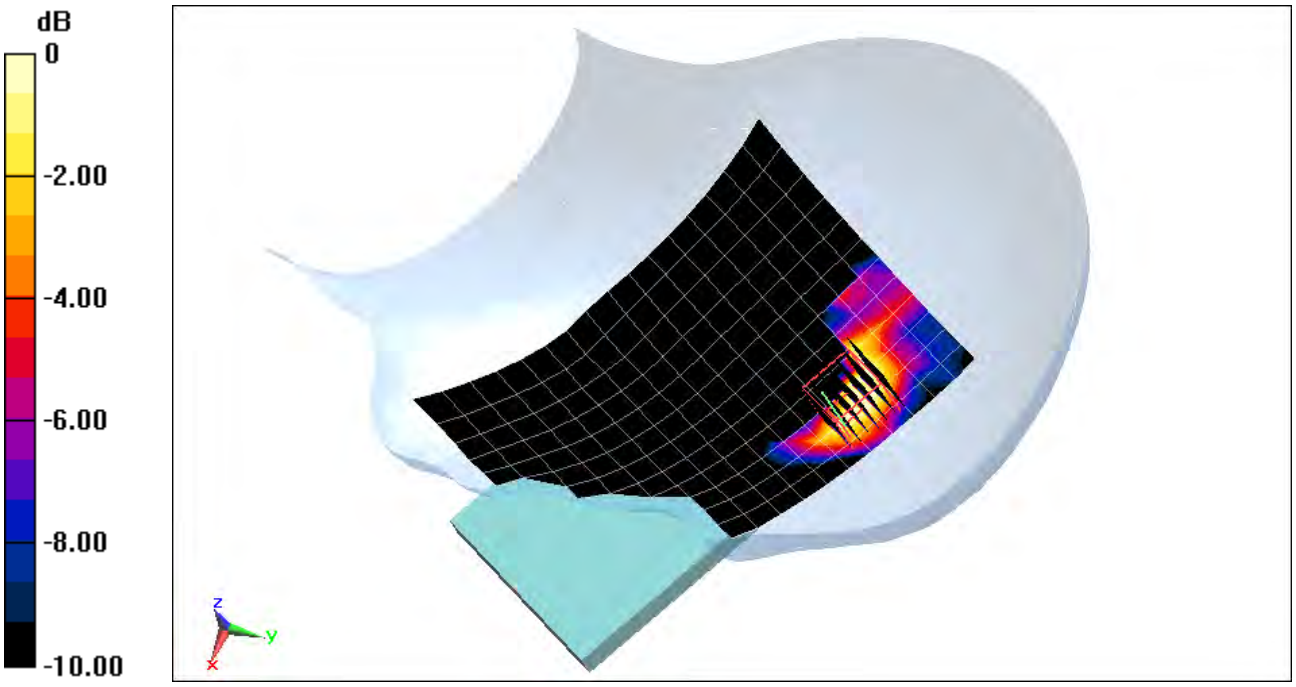
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5180 MHz; σ = 4.609 S/m; ε_r = 35.672; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3589; ConvF(4.48, 4.48, 4.48); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.2 GHz Left Head, Cheek, Ch 36, 6 Mbps, Standard Cover

Area Scan (13x17x1): 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 = 2.450 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.299 W/kg
SAR(1 g) = 0.032 W/kg



0 dB = 0.101 W/kg = -9.96 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 84

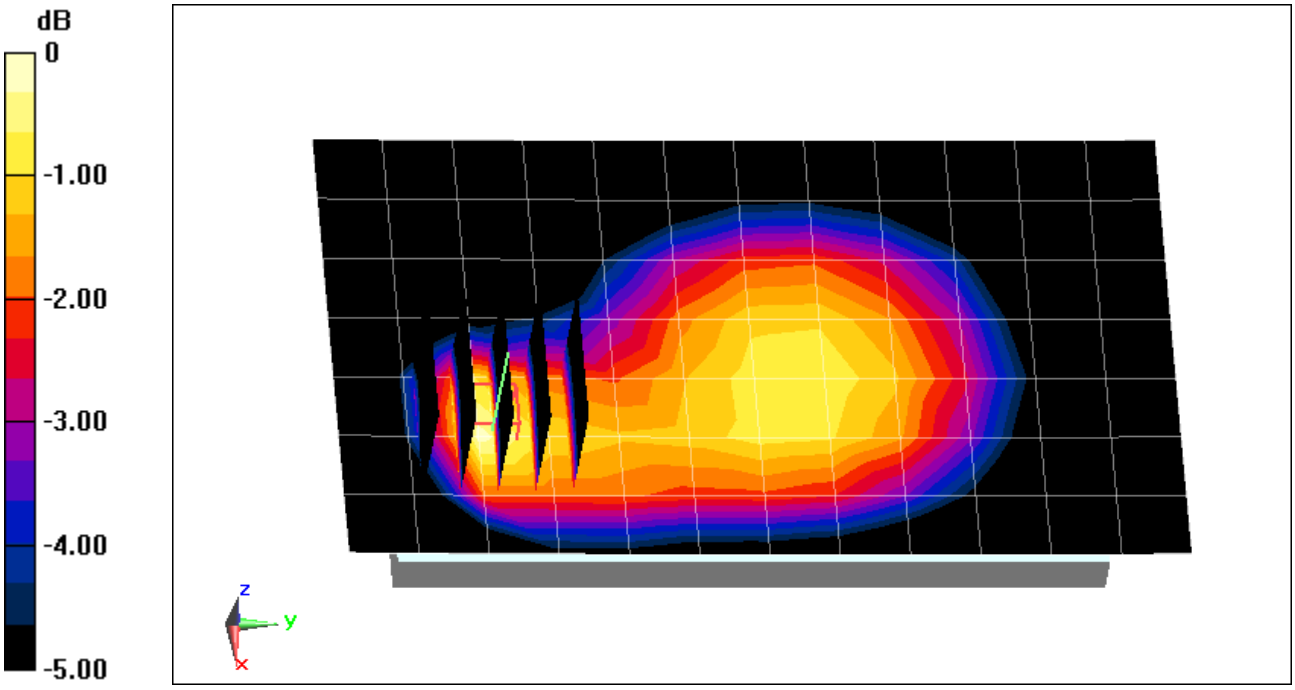
Communication System: GSM; Frequency: 836.6 MHz;Duty Cycle: 1:8.3
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.013 S/m; ε_r = 55.505; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: GSM 850, Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.687 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.585 W/kg
SAR(1 g) = 0.364 W/kg



0 dB = 0.397 W/kg = -4.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 84

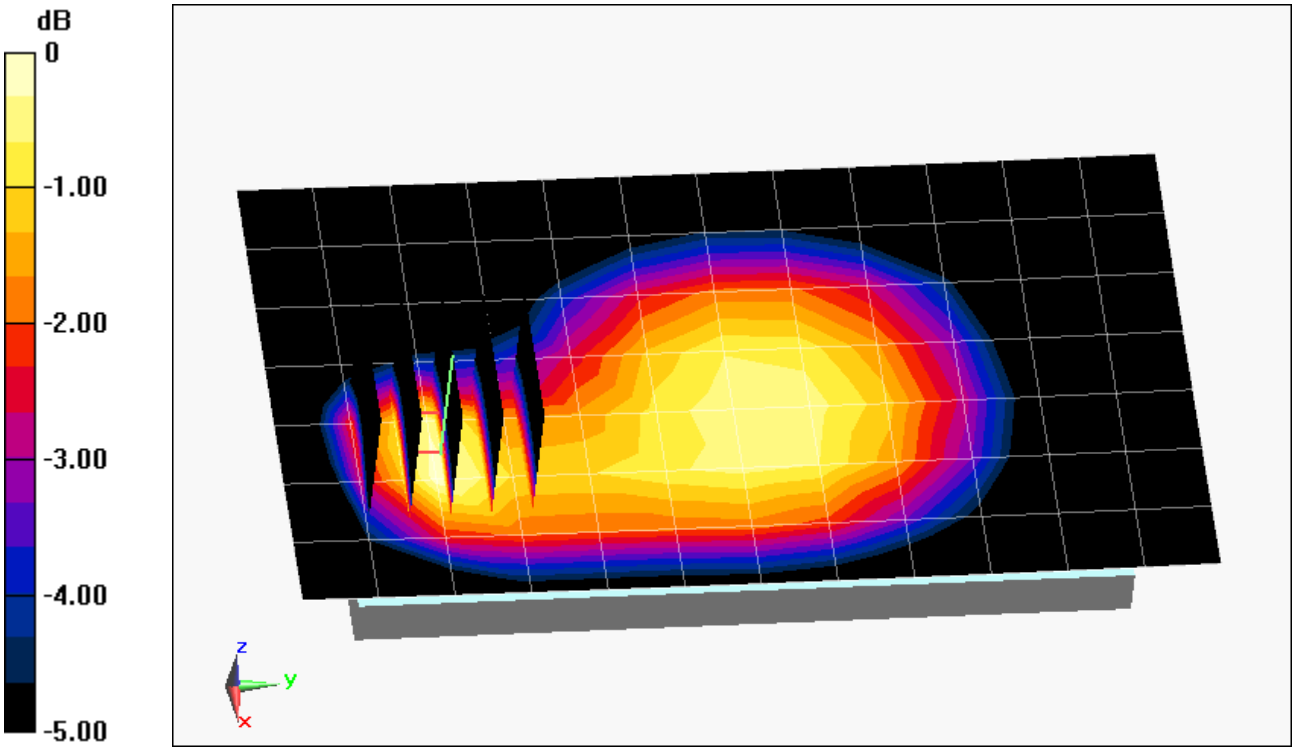
Communication System: GSM GPRS; 3 Tx slots; Frequency: 836.6 MHz;Duty Cycle: 1:2.76
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.013 S/m; ε_r = 55.505; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 850, Body SAR, Back side, Mid.ch, 3 Tx Slots, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.716 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.800 W/kg
SAR(1 g) = 0.500 W/kg



0 dB = 0.534 W/kg = -2.72 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34272

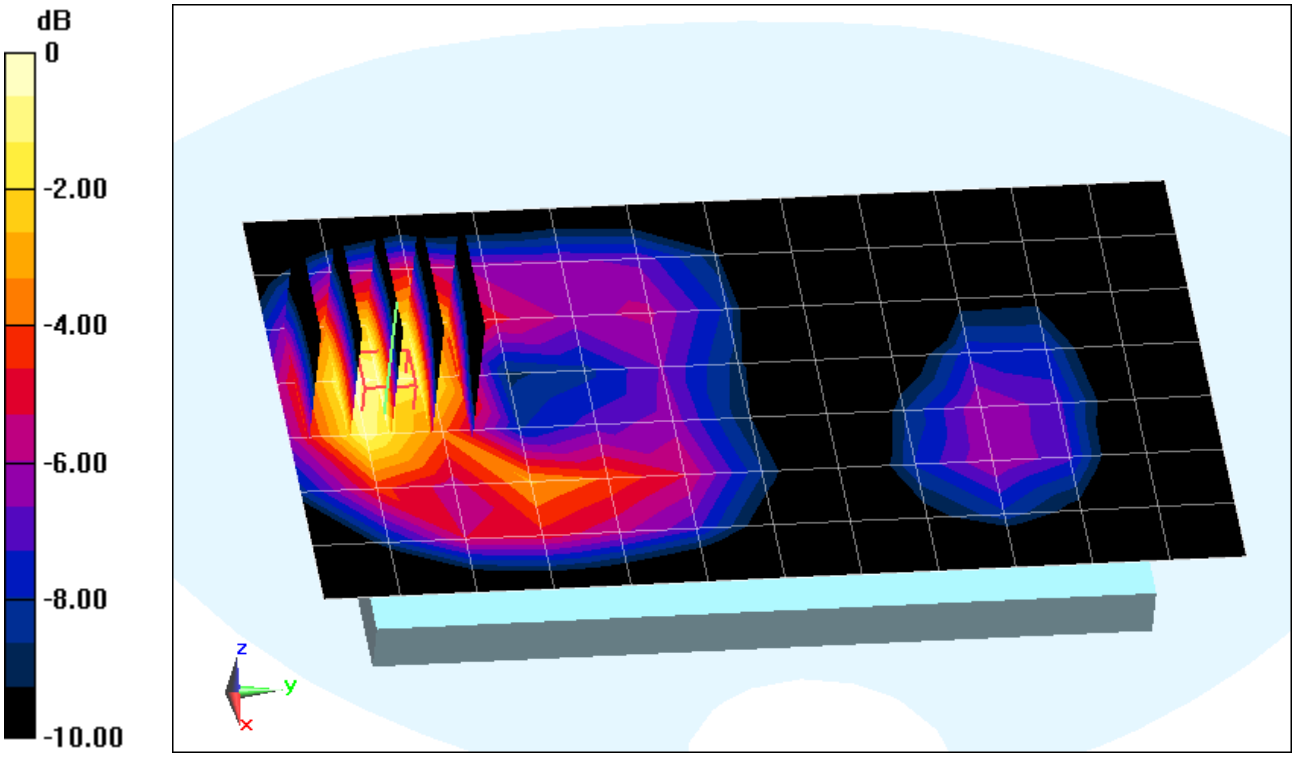
Communication System: GSM; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.522 S/m; ε_r = 53.128; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-15-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: GSM 1900, Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.818 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 0.486 W/kg
SAR(1 g) = 0.303 W/kg



0 dB = 0.324 W/kg = -4.89 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34272

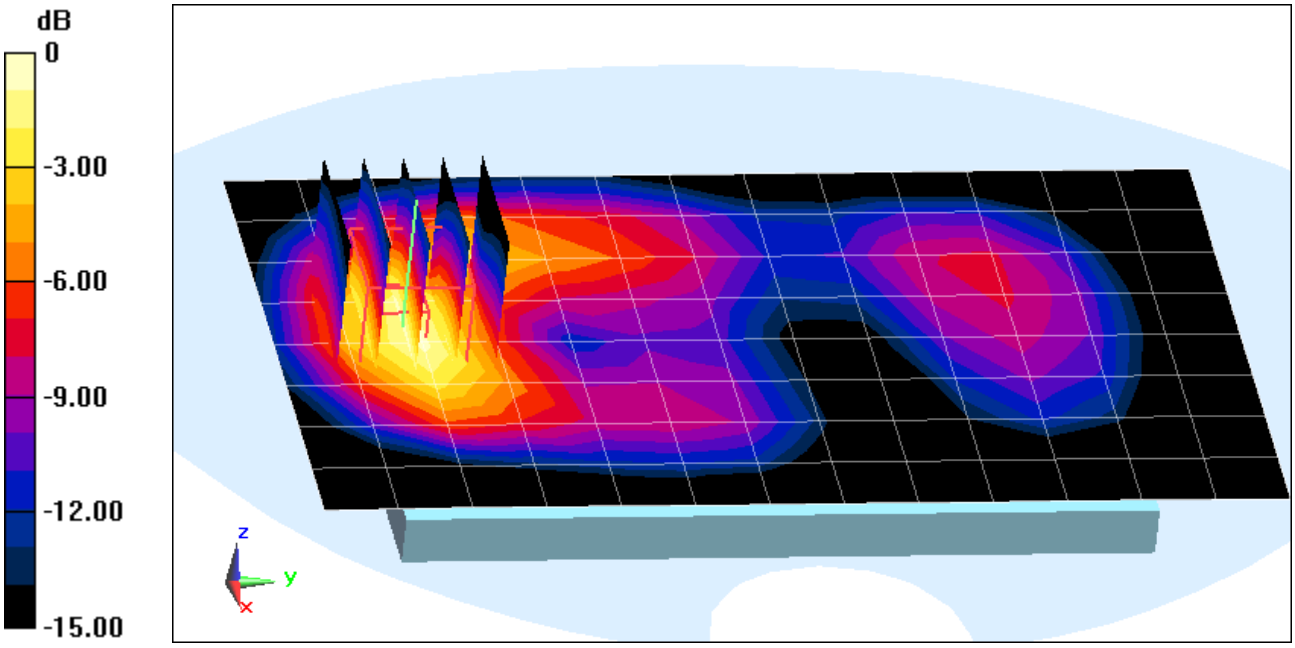
Communication System: GSM1900 GPRS 3 Tx Slots; Frequency: 1880 MHz;Duty Cycle: 1:2.76
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.528 S/m; ε_r = 54.724; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: GPRS 1900, Body SAR, Front side, Mid.ch, 3 Tx Slots, Standard Cover

Area Scan (9x14x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.380 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.15 W/kg
SAR(1 g) = 0.660 W/kg



0 dB = 0.745 W/kg = -1.28 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 84

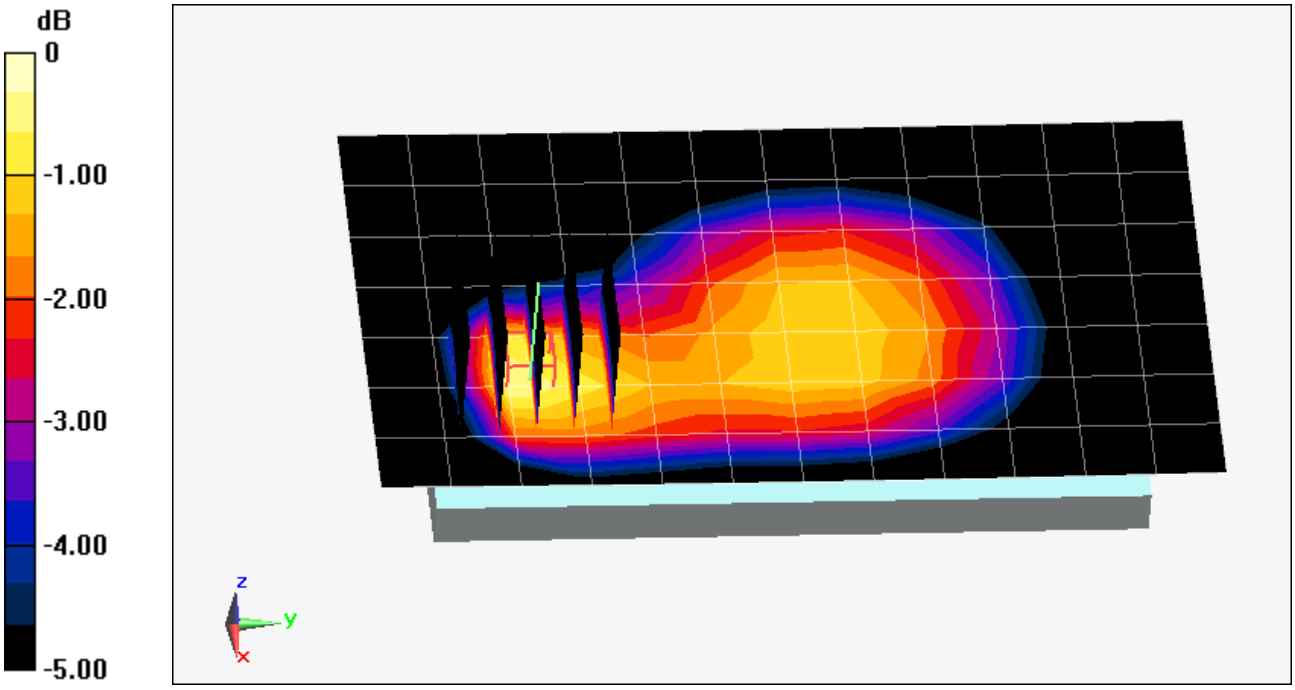
Communication System: UMTS; Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.6 MHz; σ = 1.016 S/m; ε_r = 55.675; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-08-2013; Ambient Temp: 24.9°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.018 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.456 W/kg
SAR(1 g) = 0.282 W/kg



0 dB = 0.303 W/kg = -5.19 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 3426E

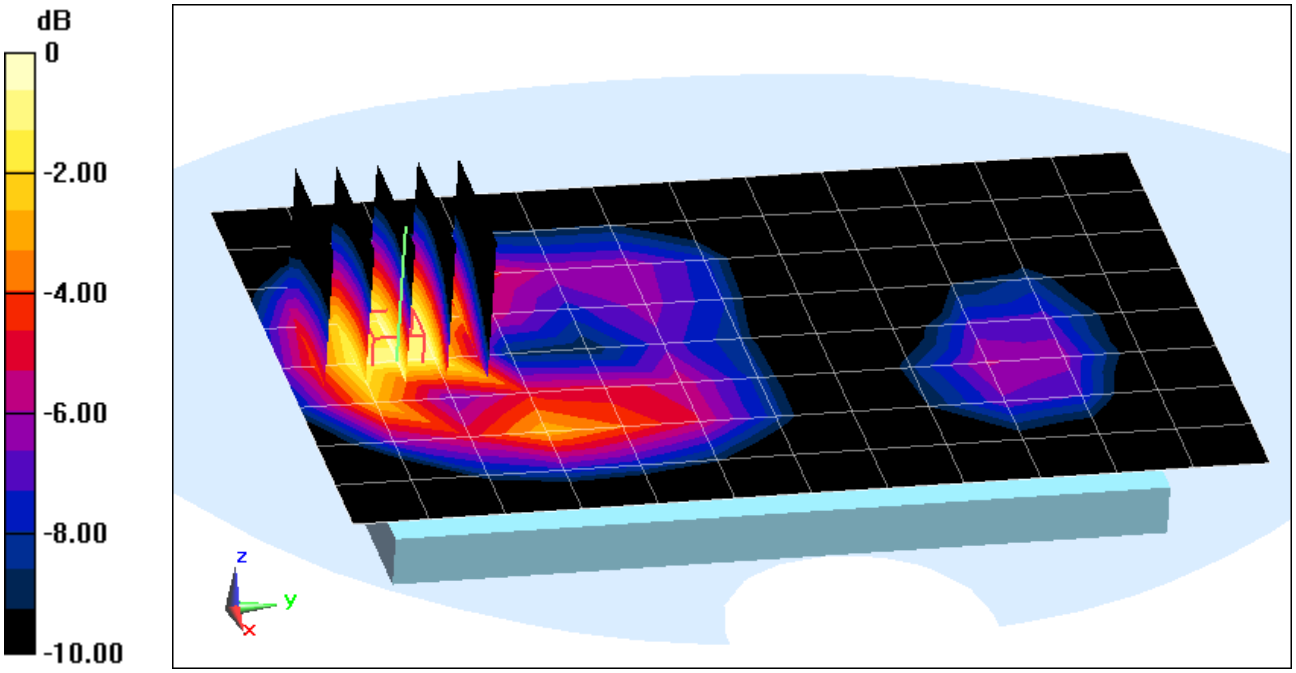
Communication System: UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.522 S/m; ε_r = 53.128; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-15-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: UMTS 1900, Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.167 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.708 W/kg
SAR(1 g) = 0.440 W/kg



0 dB = 0.476 W/kg = -3.22 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 3426E

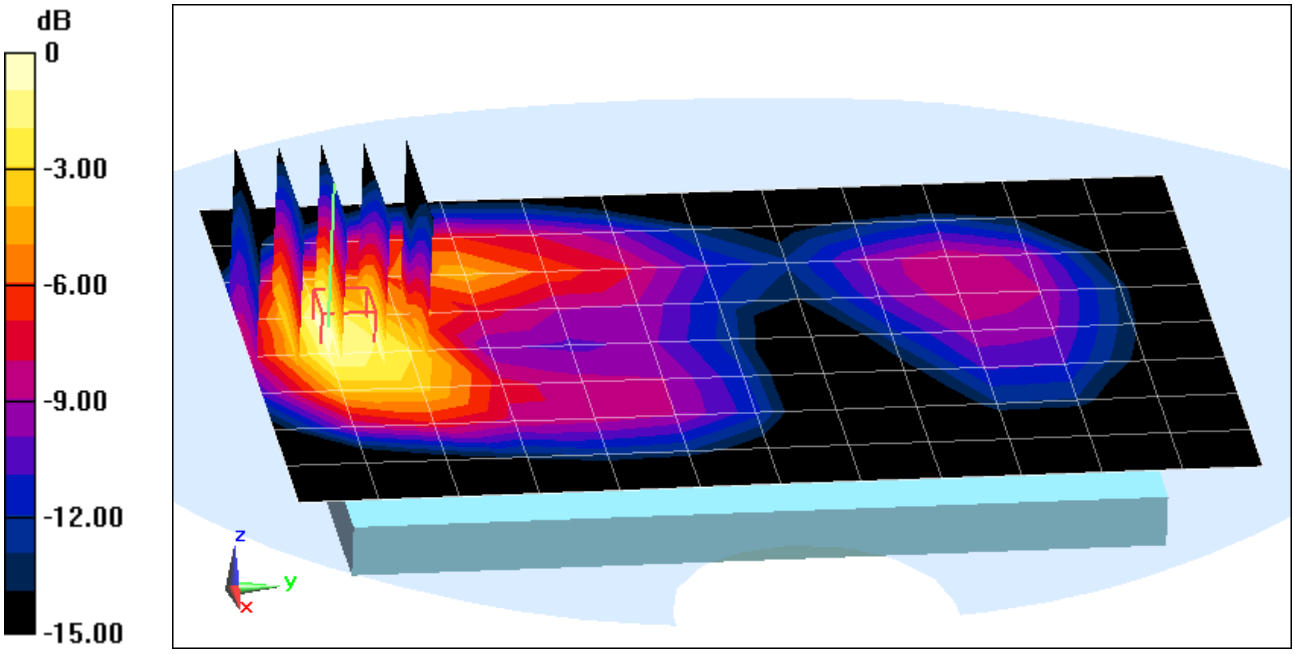
Communication System: UMTS; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used :
f = 1880 MHz; σ = 1.522 S/m; ε_r = 53.128; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-15-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: UMTS 1900, Body SAR, Front side, Mid.ch, Standard Cover

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.389 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 1.44 W/kg
SAR(1 g) = 0.827 W/kg



0 dB = 0.883 W/kg = -0.54 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

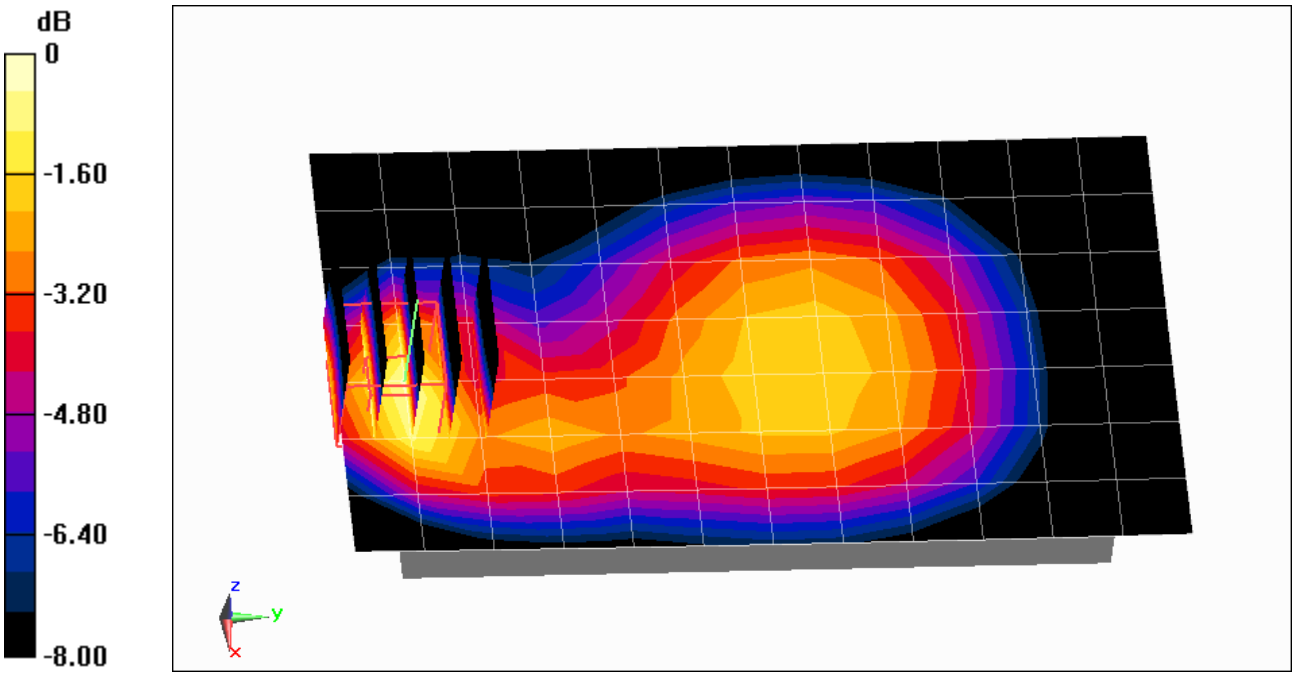
Communication System: CDMA, Frequency: 820.1 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 820.1 MHz; σ = 0.988 S/m; ε_r = 55.312; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. CDMA BC10 (§90S), Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.075 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.980 W/kg
SAR(1 g) = 0.584 W/kg



0 dB = 0.607 W/kg = -2.17 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

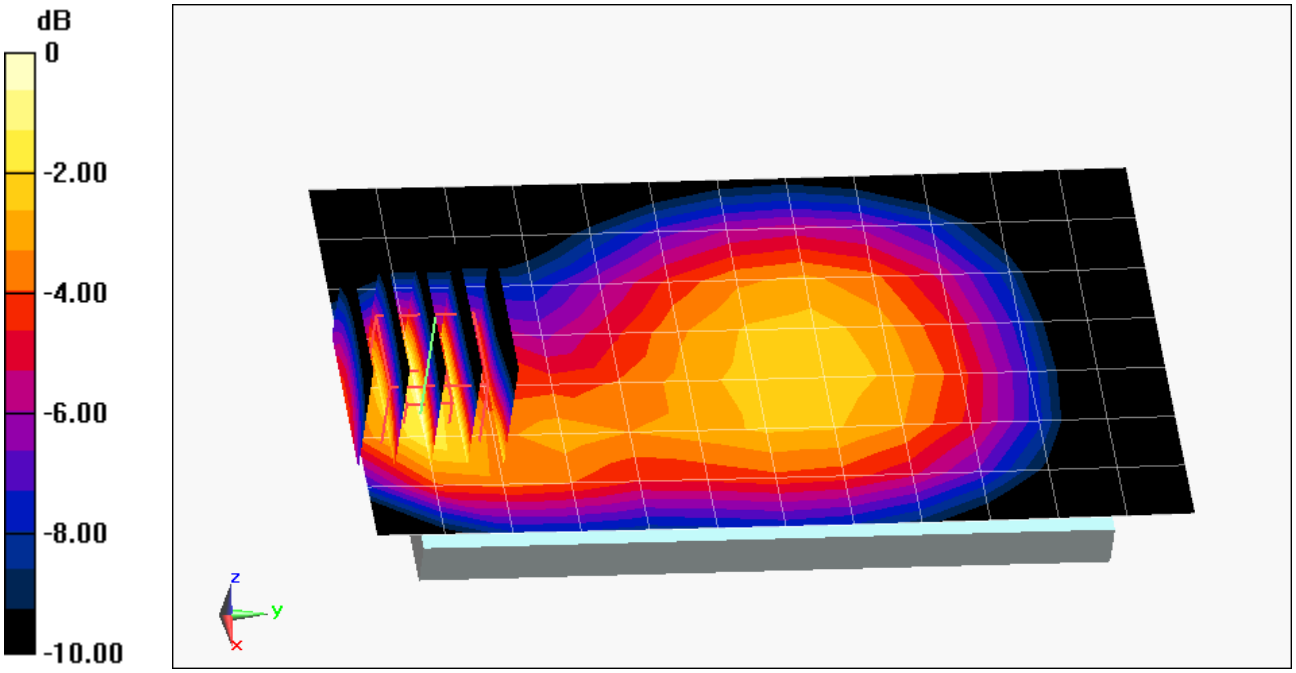
Communication System: CDMA; Frequency: 820.1 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 820.1 MHz; σ = 0.988 S/m; ε_r = 55.312; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. EVDO Rev.0 BC10 (§90S), Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (6x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.697 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.12 W/kg
SAR(1 g) = 0.629 W/kg



0 dB = 0.717 W/kg = -1.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

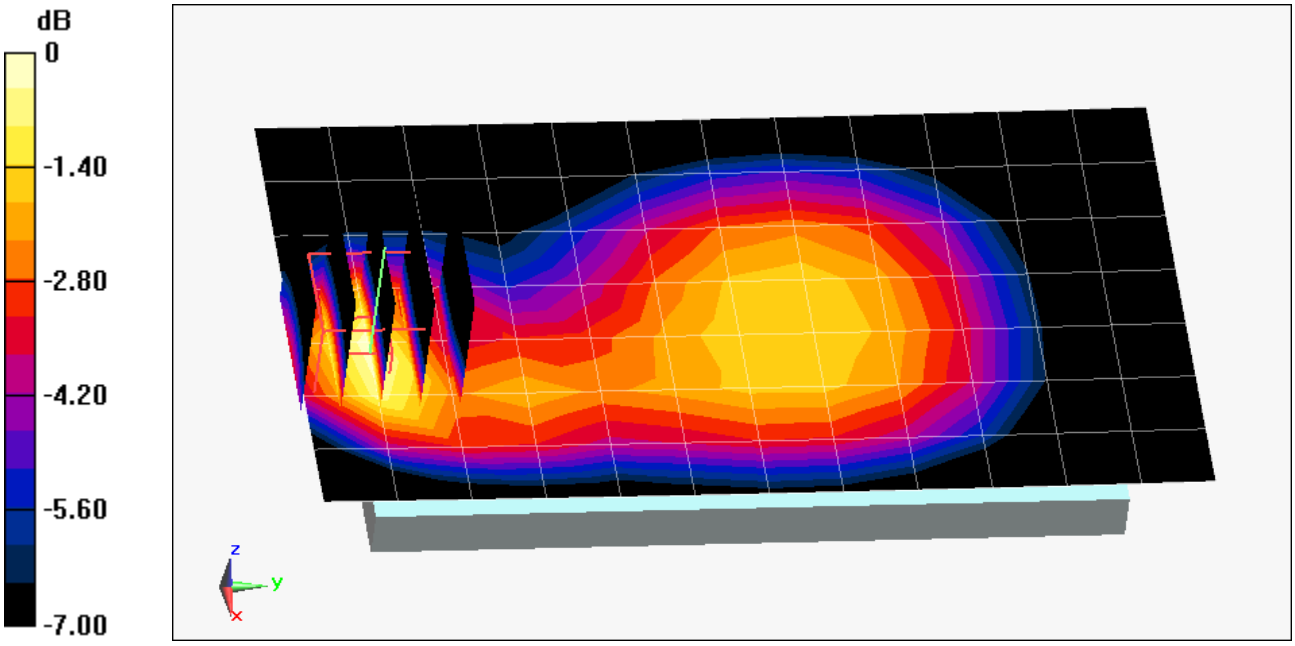
Communication System: CDMA; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.52 MHz; σ = 1.016 S/m; ε_r = 55.075; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. CDMA BC0 (§22H), Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.744 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.894 W/kg
SAR(1 g) = 0.512 W/kg



0 dB = 0.565 W/kg = -2.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342C2

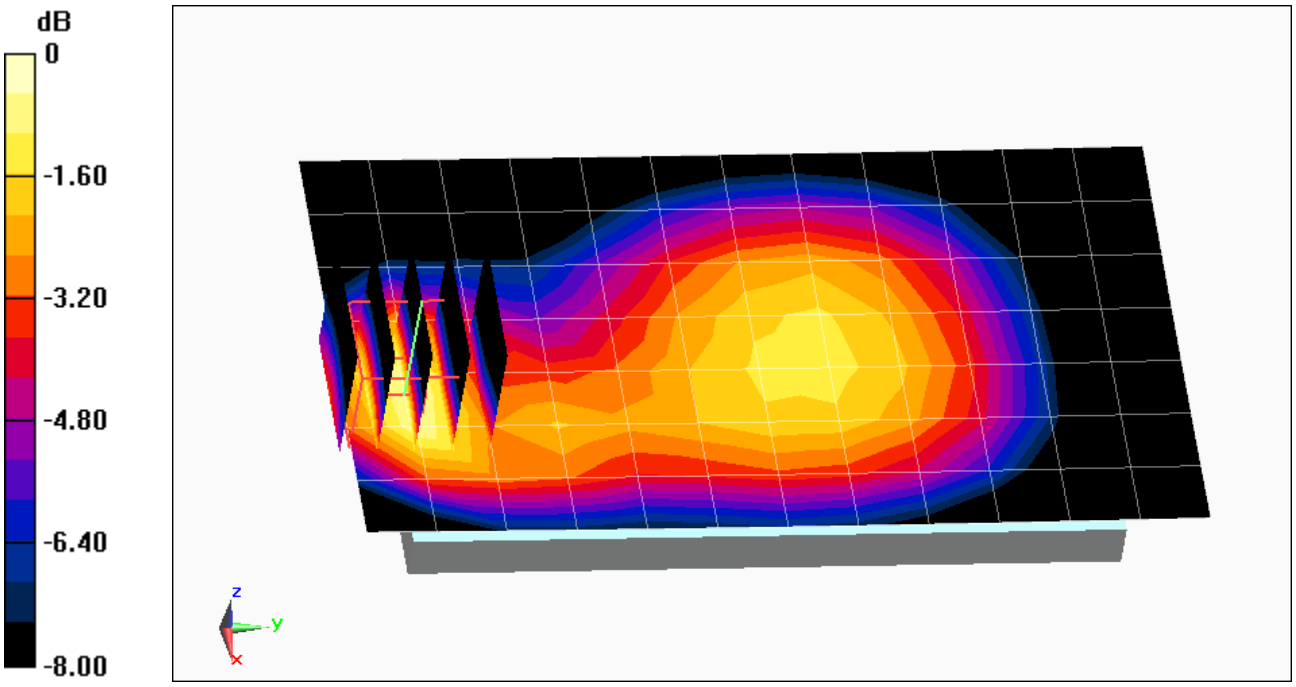
Communication System: CDMA; Frequency: 836.52 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used (interpolated):
f = 836.52 MHz; σ = 1.016 S/m; ε_r = 55.075; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: Cell. EVDO Rev.0 BC0 (§22H), Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.834 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.930 W/kg
SAR(1 g) = 0.535 W/kg



0 dB = 0.590 W/kg = -2.29 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342AF

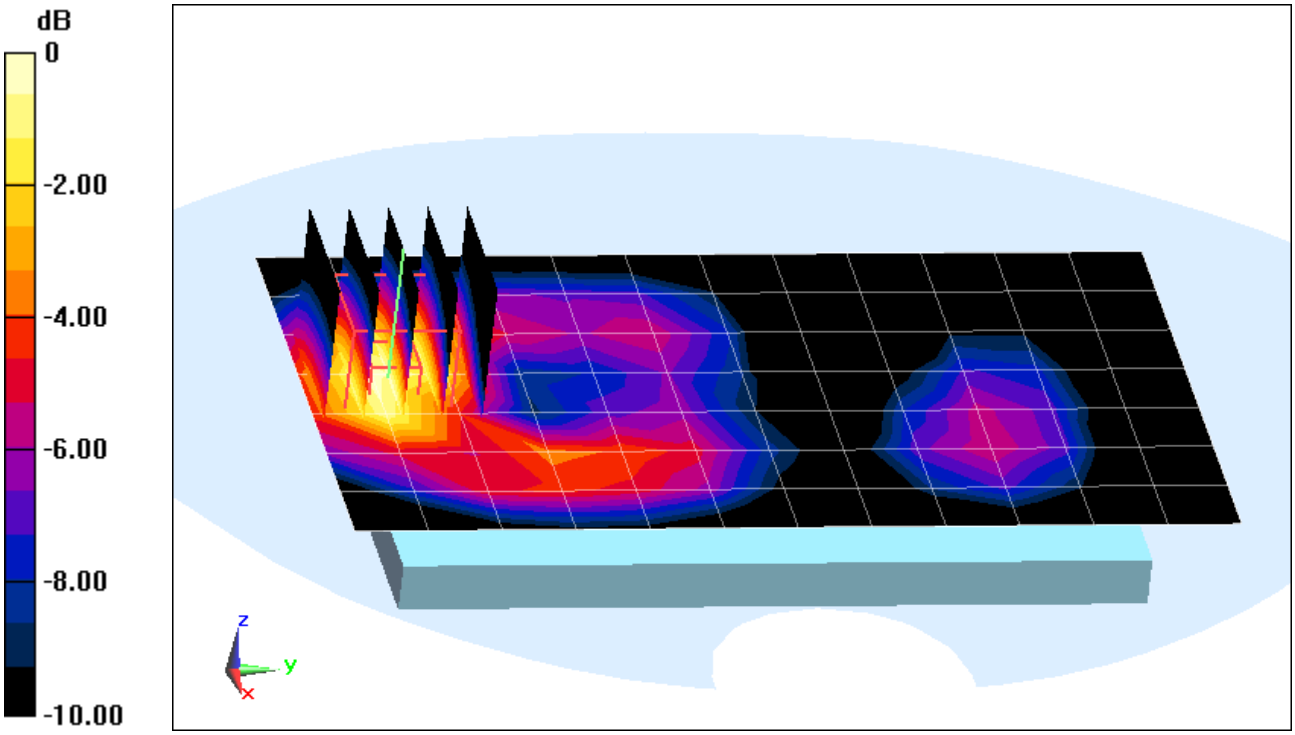
Communication System: CDMA; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1880 MHz; σ = 1.531 S/m; ε_r = 52.073; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: PCS CDMA, Body SAR, Back side, Mid.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.768 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.667 W/kg
SAR(1 g) = 0.412 W/kg



0 dB = 0.450 W/kg = -3.47 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 342AF

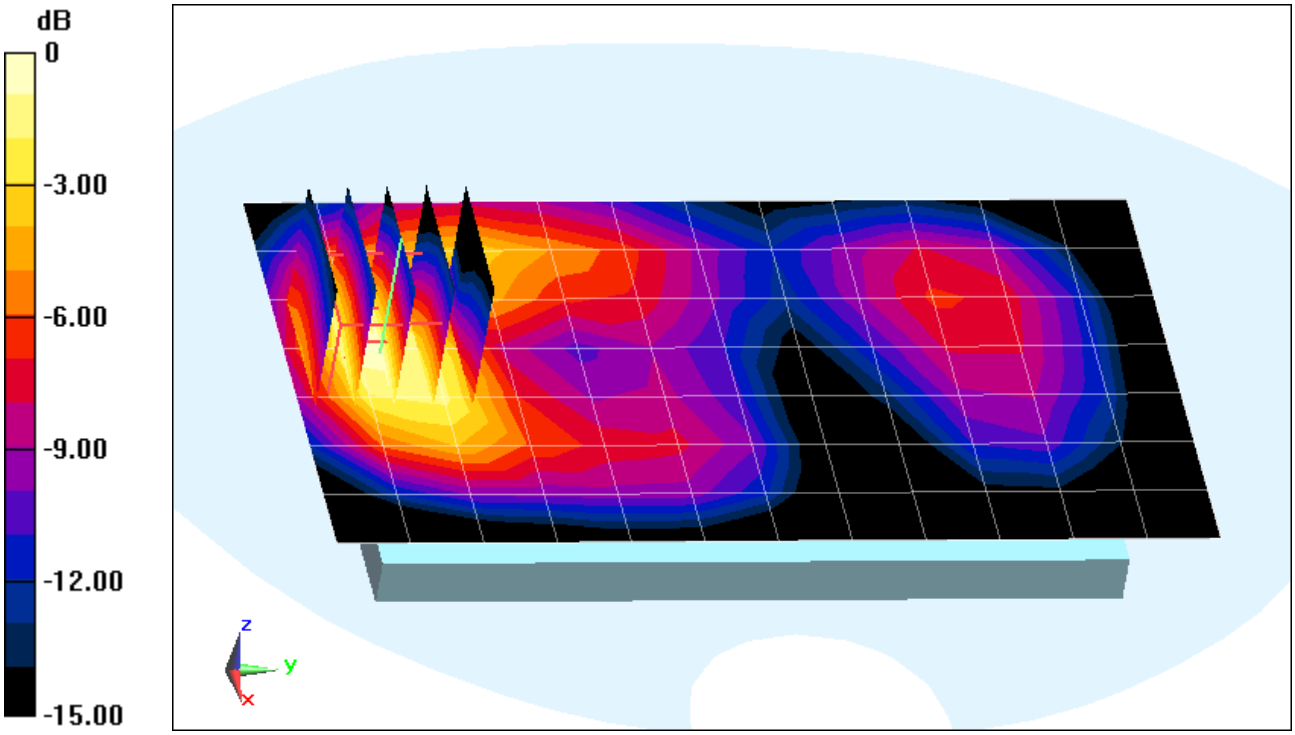
Communication System: CDMA; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1851.25 MHz; σ = 1.491 S/m; ε_r = 53.217; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-15-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: PCS EVDO Rev.0, Body SAR, Front side, Low.ch, Standard Cover

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.582 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.69 W/kg
SAR(1 g) = 0.975 W/kg



0 dB = 1.06 W/kg = 0.25 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 34280

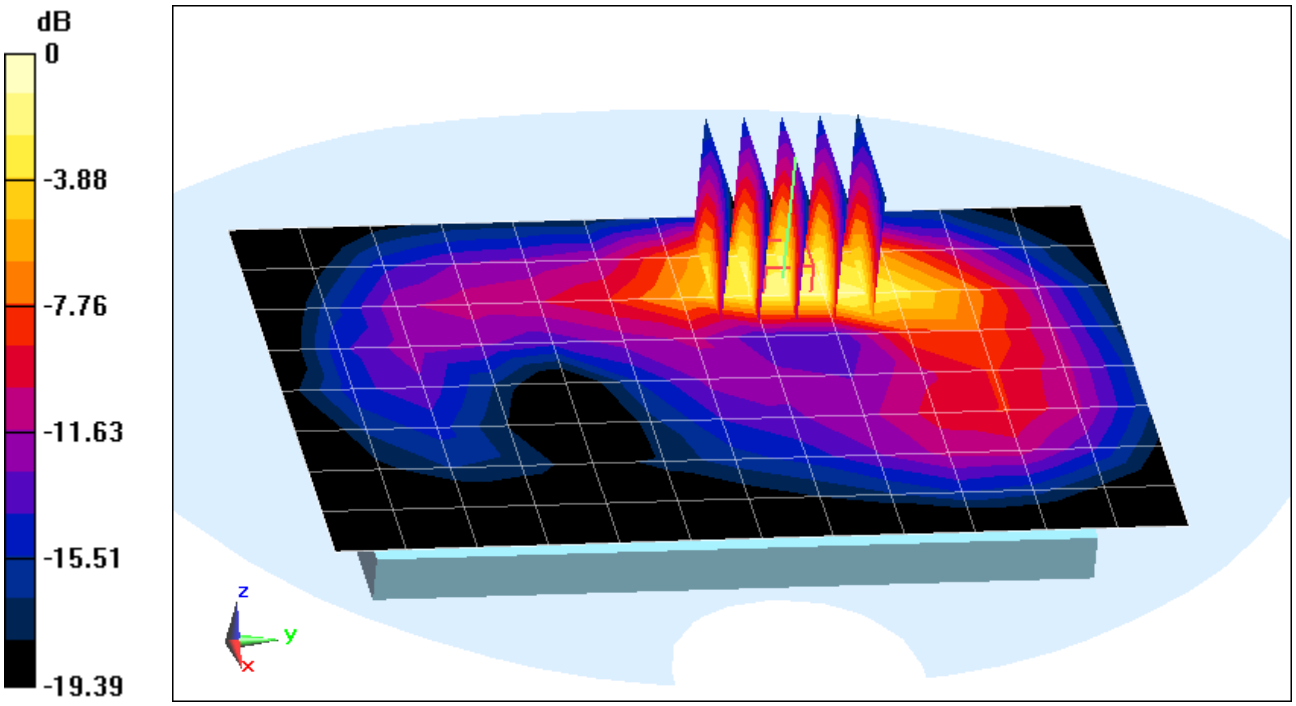
Communication System: LTE Band 25 (PCS); Frequency: 1910 MHz;Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used:
f = 1910 MHz; σ = 1.553 S/m; ε_r = 53.037; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-15-2013; Ambient Temp: 24.5°C; Tissue Temp: 22.9°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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: LTE Band 25 (PCS), Body SAR, Back side, High.ch
10 MHz Bandwidth, QPSK, 1 RB, 0 RB Offset, Standard Cover

Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.209 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 1.95 W/kg
SAR(1 g) = 1.05 W/kg



0 dB = 1.21 W/kg = 0.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 89

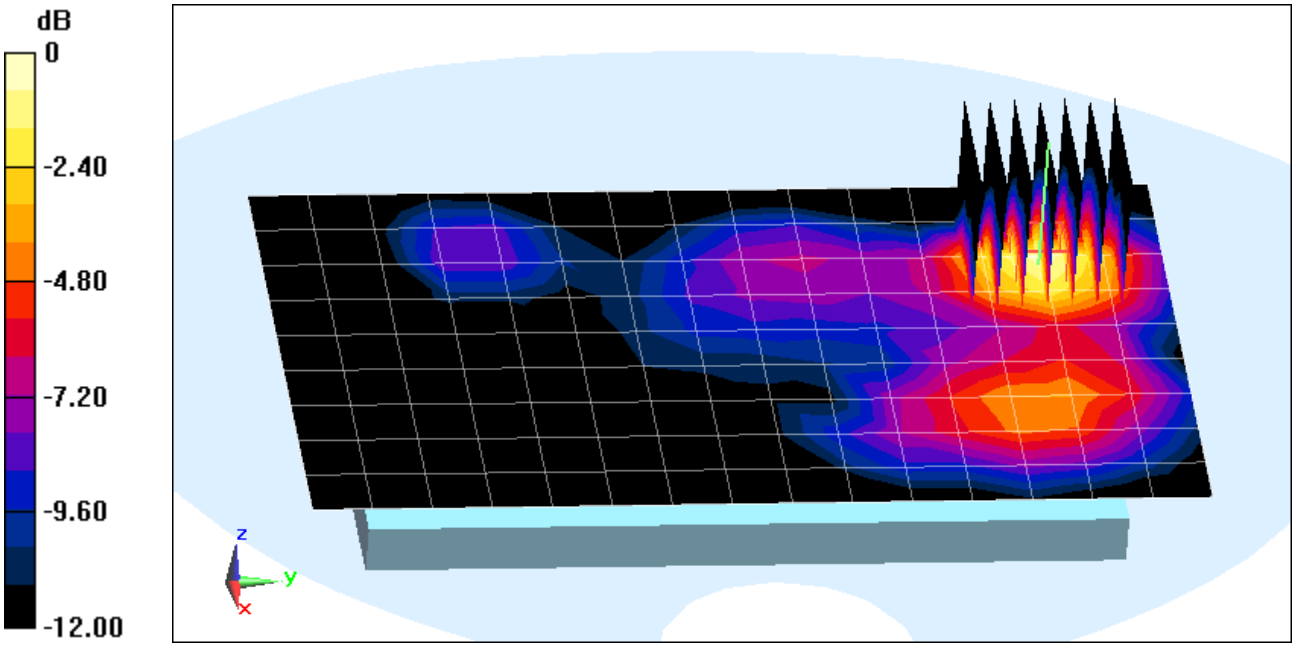
Communication System: IEEE 802.11b; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used (interpolated):
f = 2412 MHz; σ = 1.875 S/m; ε_r = 52.006; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-16-2013; Ambient Temp: 23.3°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(7.07, 7.07, 7.07); Calibrated: 2/27/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
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 802.11b, Body SAR, Ch 01, 1 Mbps, Back Side, Standard Cover

Area Scan (10x16x1): Measurement grid: dx=12mm, dy=12mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.467 V/m; Power Drift = -0.13 dB
Peak SAR (extrapolated) = 0.300 W/kg
SAR(1 g) = 0.152 W/kg



0 dB = 0.201 W/kg = -6.97 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 320FC

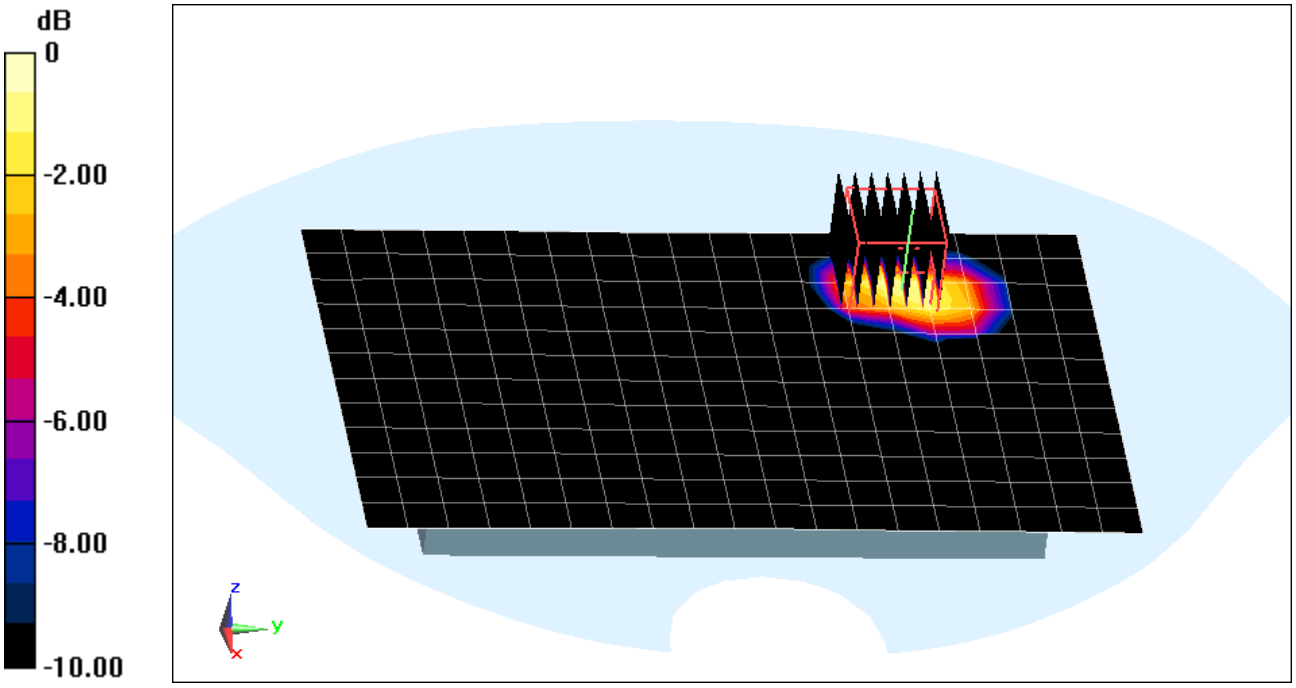
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5825 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5825 MHz; σ = 6.319 S/m; ε_r = 47.82; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.8 GHz, Body SAR, Ch 165, 6 Mbps, Back Side, Standard Cover

Area Scan (13x20x1): 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 = 3.673 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.389 W/kg
SAR(1 g) = 0.081 W/kg



0 dB = 0.247 W/kg = -6.07 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 320FC

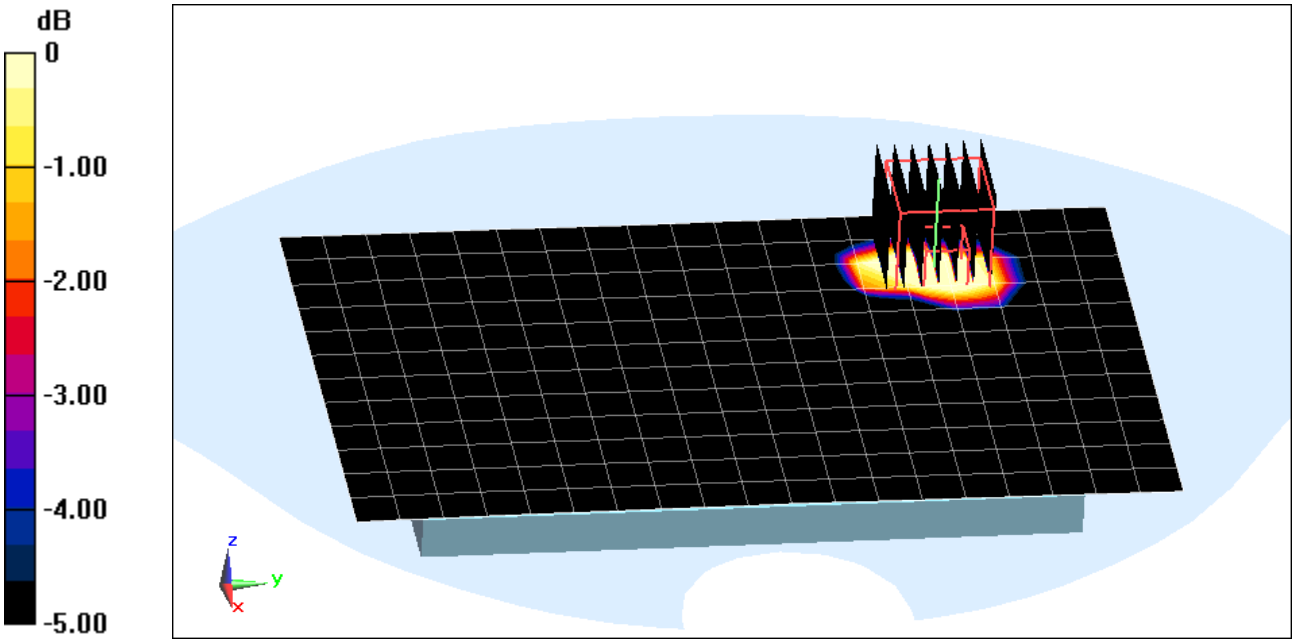
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5700 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5700 MHz; σ = 6.106 S/m; ε_r = 48.06; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.5 GHz, Body SAR, Ch 140, 6 Mbps, Back Side, Standard Cover

Area Scan (13x20x1): 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 = 2.192 V/m; Power Drift = 0.1 dB
Peak SAR (extrapolated) = 0.488 W/kg
SAR(1 g) = 0.049 W/kg



0 dB = 0.150 W/kg = -8.24 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMN900P; Type: Portable Handset; Serial: 320FC

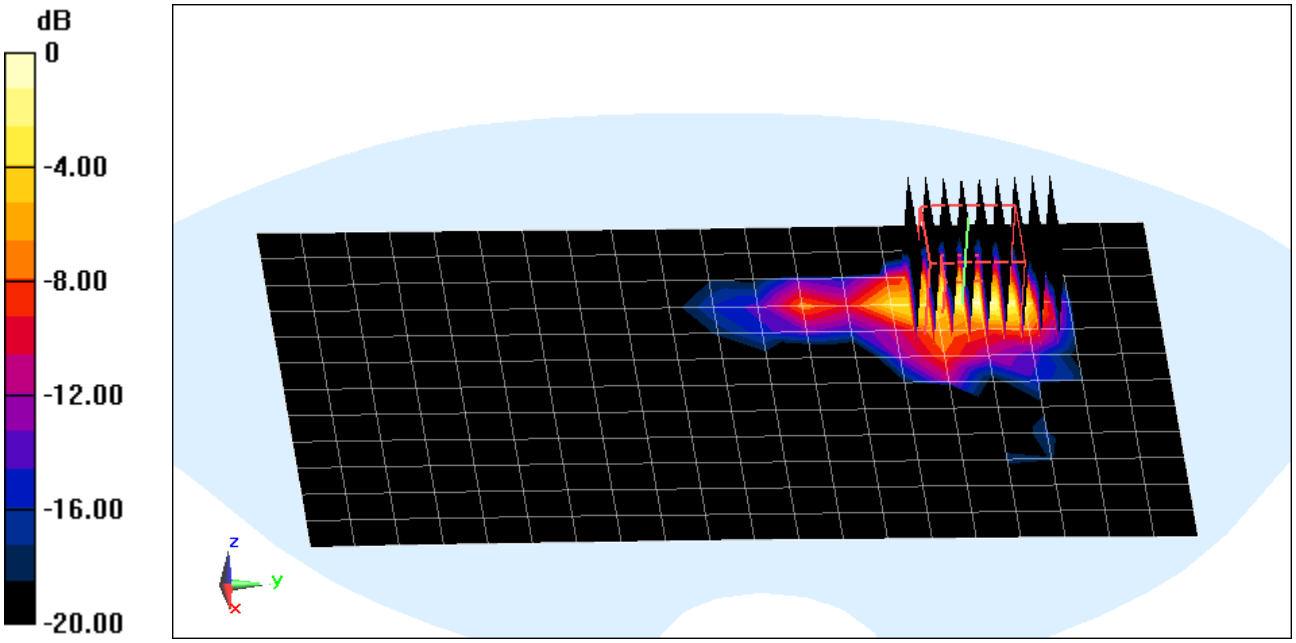
Communication System: IEEE 802.11a 5.2-5.8 GHz Band; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5180 MHz; σ = 5.47 S/m; ε_r = 49.079; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 0.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.99, 3.99, 3.99); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

Mode: IEEE 802.11a, 5.2 GHz, Hand SAR, Ch 36, 6 Mbps, Back Side, Standard Cover

Area Scan (13x21x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Reference Value = 10.680 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 5.54 W/kg
SAR(10 g) = 0.193 W/kg



0 dB = 1.66 W/kg = 2.20 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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PCTEST ENGINEERING LABORATORY, INC.

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

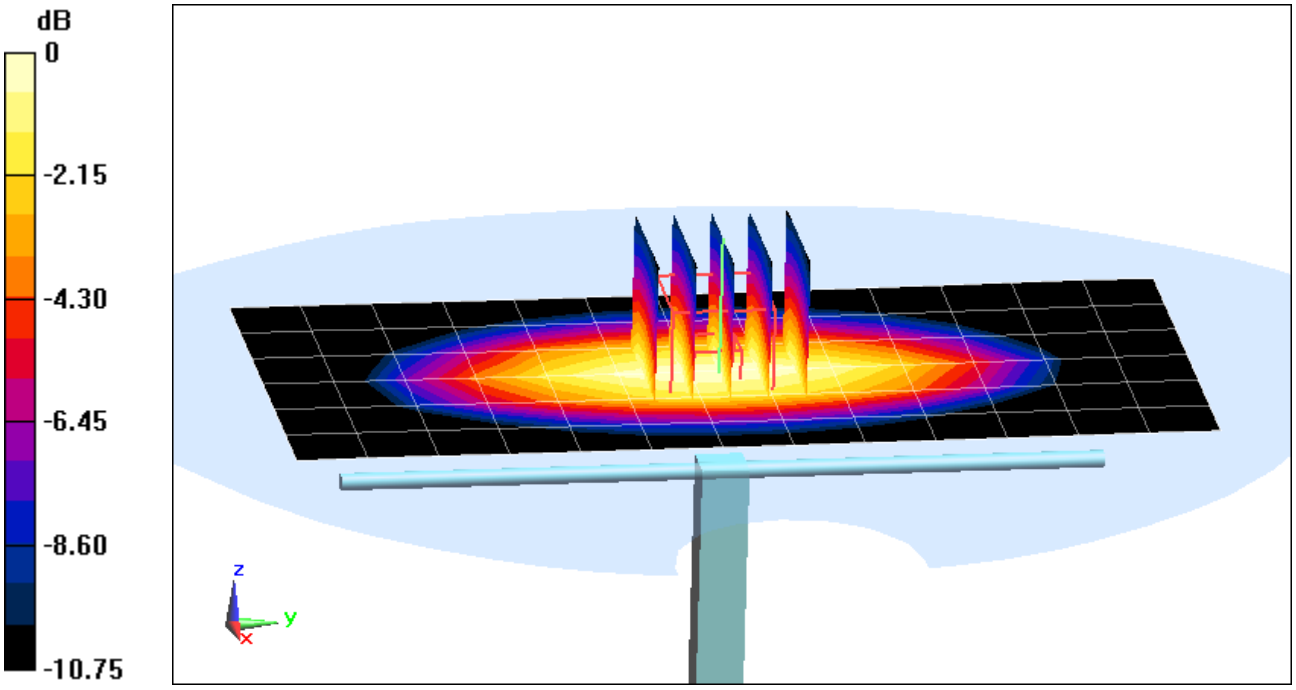
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.915 S/m; ε_r = 40.673; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-15-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3263; ConvF(6.29, 6.29, 6.29); Calibrated: 5/16/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/13/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80); 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) = 1.51 W/kg
SAR(1 g) = 1.01 W/kg
Deviation = 4.34 %



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

PCTEST ENGINEERING LABORATORY, INC.

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

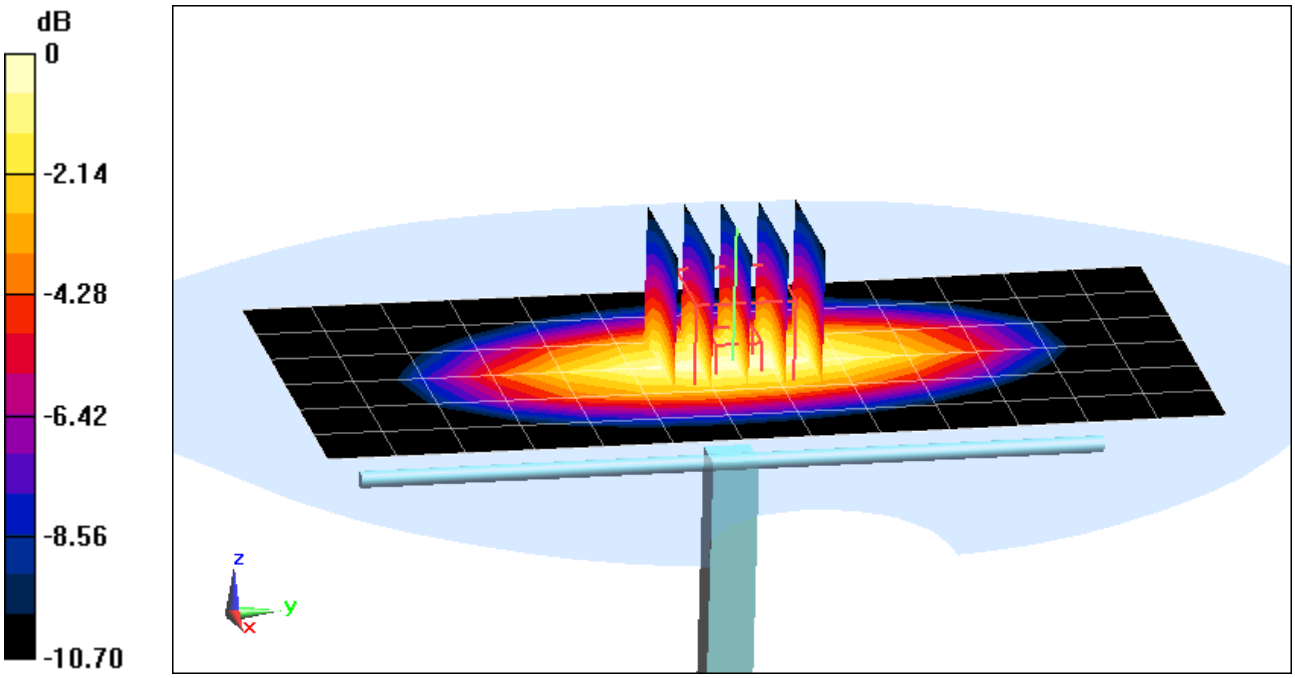
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Head Medium parameters used:
f = 835 MHz; σ = 0.886 S/m; ε_r = 40.641; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-21-2013; Ambient Temp: 22.6°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3318; ConvF(6.33, 6.33, 6.33); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
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) = 1.40 W/kg
SAR(1 g) = 0.943 W/kg
Deviation = -2.58 %



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d080

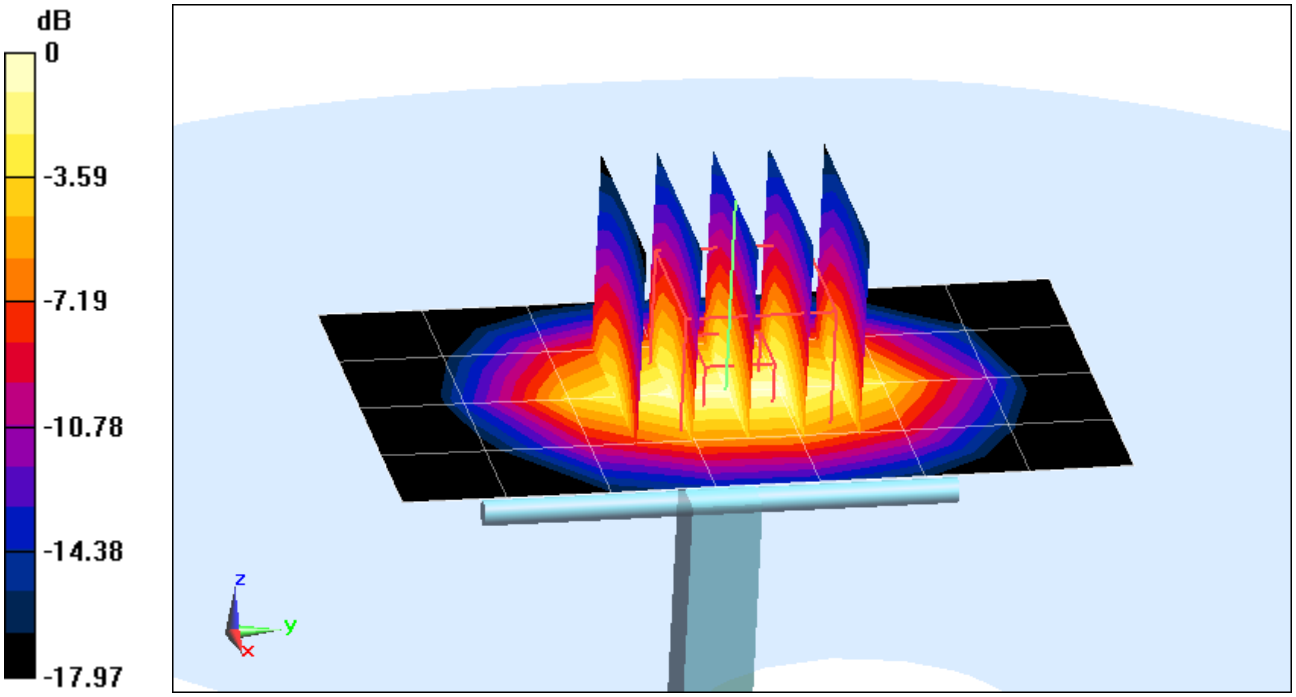
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.387 S/m; ε_r = 39.918; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-15-2013; Ambient Temp: 22.1°C; Tissue Temp: 22.5°C

Probe: ES3DV2 - SN3022; ConvF(4.86, 4.86, 4.86); Calibrated: 8/28/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1322; Calibrated: 8/24/2012
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1403
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (5x8x1): 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) = 7.20 W/kg
SAR(1 g) = 3.95 W/kg
Deviation = 0.25 %



0 dB = 4.41 W/kg = 6.44 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

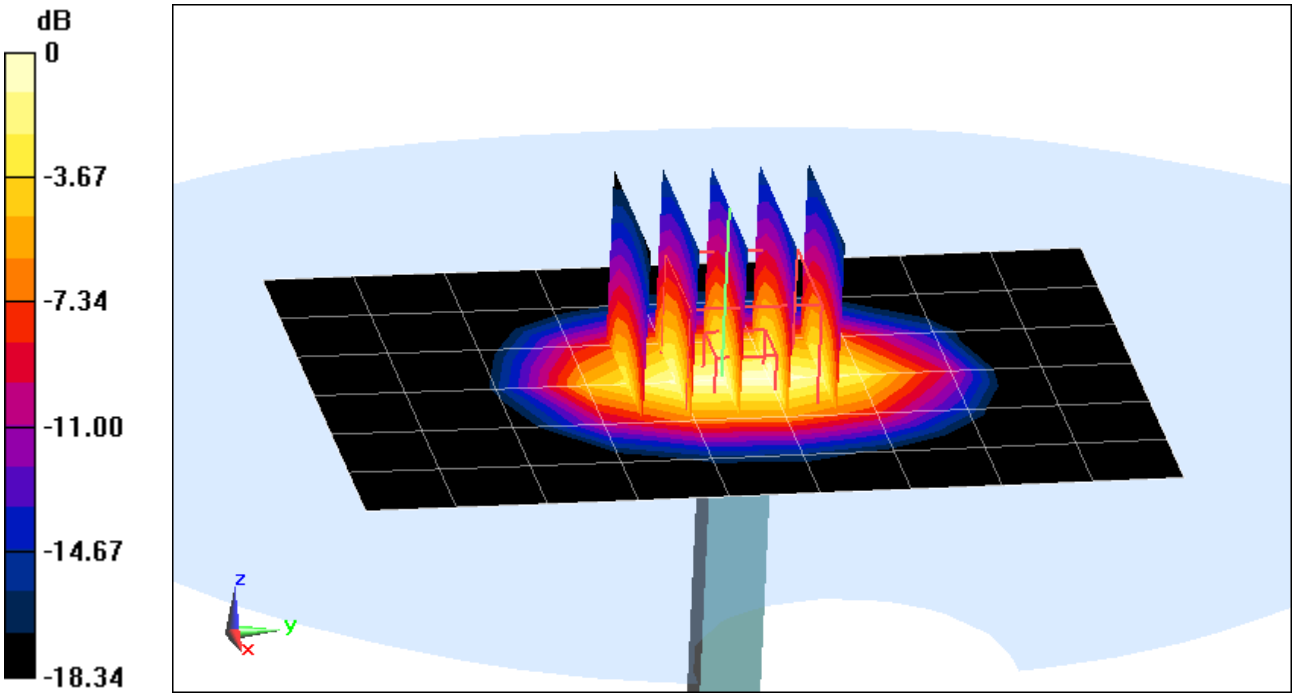
Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: 1900 Head Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.435 S/m; ε_r = 38.763; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-13-2013; Ambient Temp: 23.8°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3318; ConvF(5.22, 5.22, 5.22); Calibrated: 4/29/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1364; Calibrated: 4/22/2013
Phantom: SAM; Type: QD000P40CD; Serial: TP:1758
Measurement SW: DASY52, Version 52.8 (6); 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) = 7.64 W/kg
SAR(1 g) = 4.14 W/kg
Deviation = 4.28 %



0 dB = 4.61 W/kg = 6.64 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 882

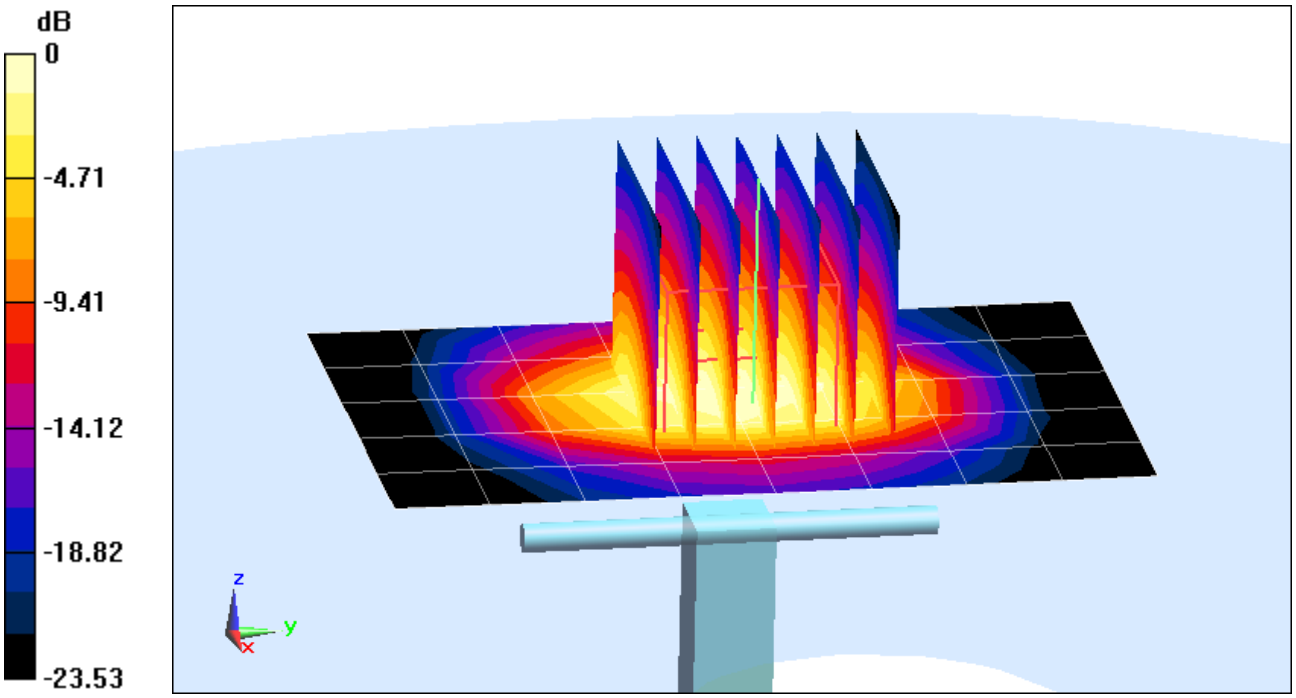
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Head Medium parameters used:
f = 2450 MHz; σ = 1.874 S/m; ε_r = 38.25; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 23.5°C; Tissue Temp: 23.5°C

Probe: ES3DV3 - SN3263; ConvF(4.47, 4.47, 4.47); Calibrated: 5/16/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/13/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1406
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

2450 MHz System Verification

Area Scan (6x9x1): 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) = 10.9 W/kg
SAR(1 g) = 5.44 W/kg
Deviation = 5.22 %



0 dB = 6.73 W/kg = 8.28 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1057

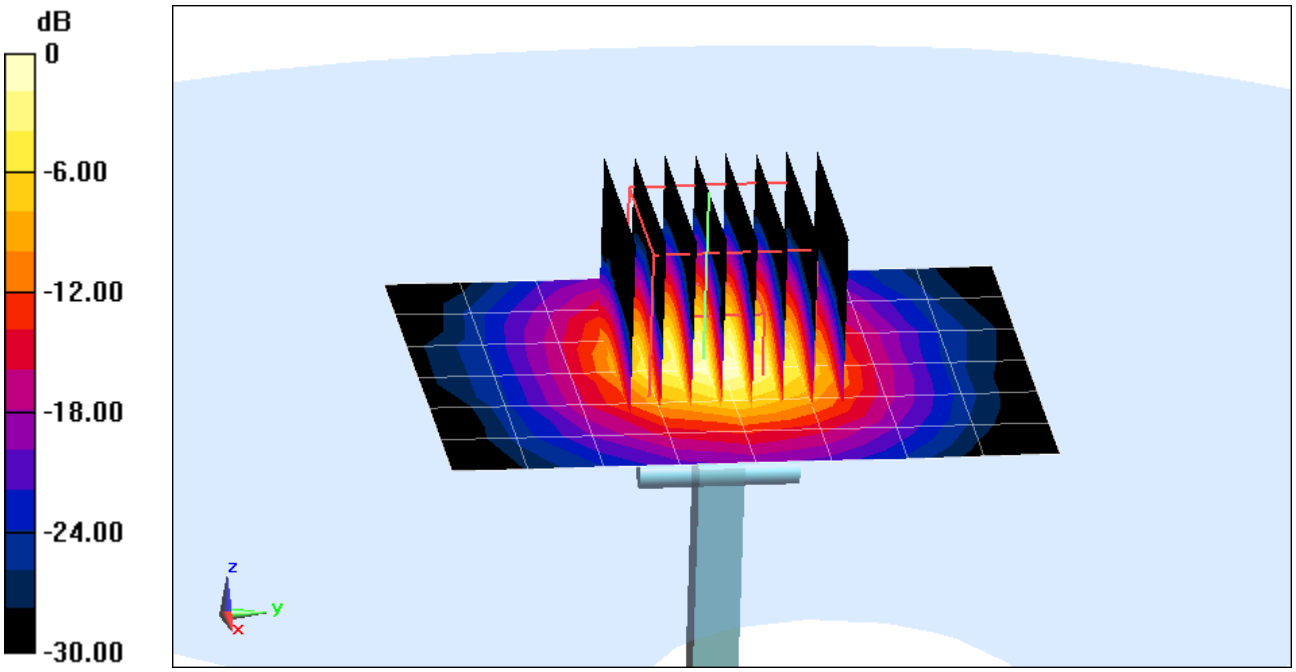
Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5200 MHz; σ = 4.625 S/m; ε_r = 35.672; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3589; ConvF(4.48, 4.48, 4.48); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5200 MHz System Verification

Area Scan (7x9x1): 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) = 30.0 W/kg
SAR(1 g) = 7.28 W/kg
Deviation (1 g) = -4.08 %



0 dB = 17.7 W/kg = 12.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057

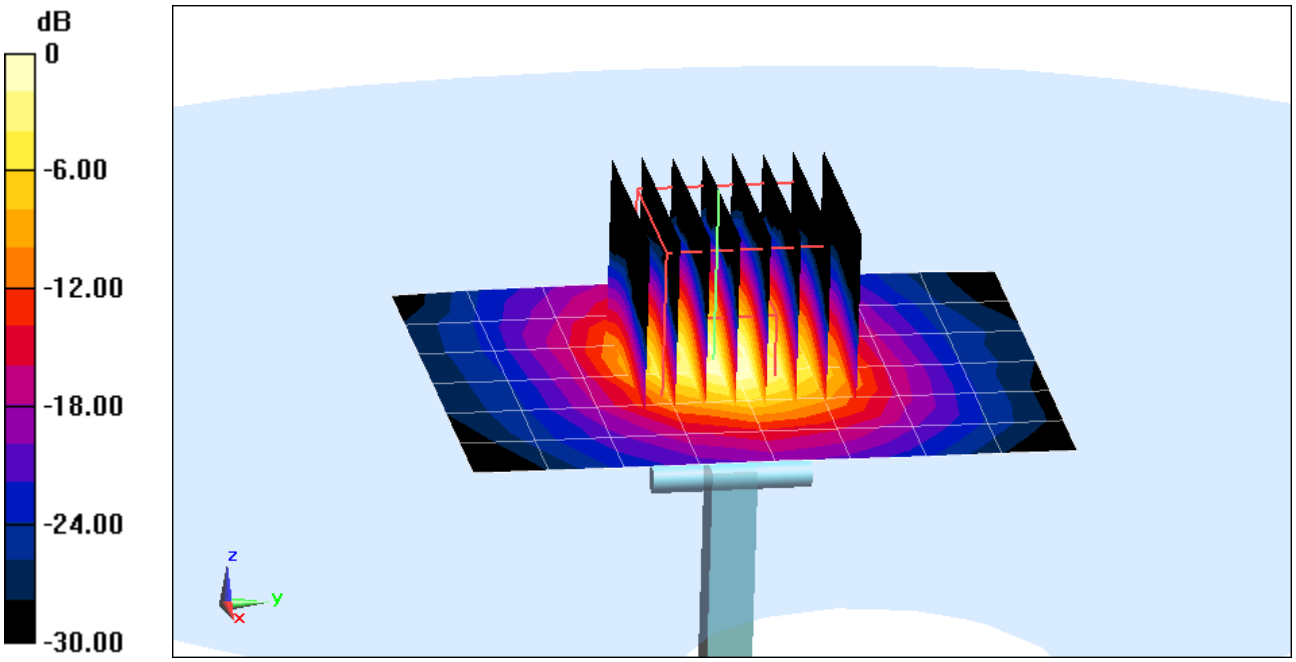
Communication System: CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5300 MHz; σ = 4.744 S/m; ε_r = 35.374; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3589; ConvF(4.27, 4.27, 4.27); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5300 MHz System Verification

Area Scan (7x9x1): 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) = 30.9 W/kg
SAR(1 g) = 7.27 W/kg
Deviation (1 g) = -5.46 %



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057

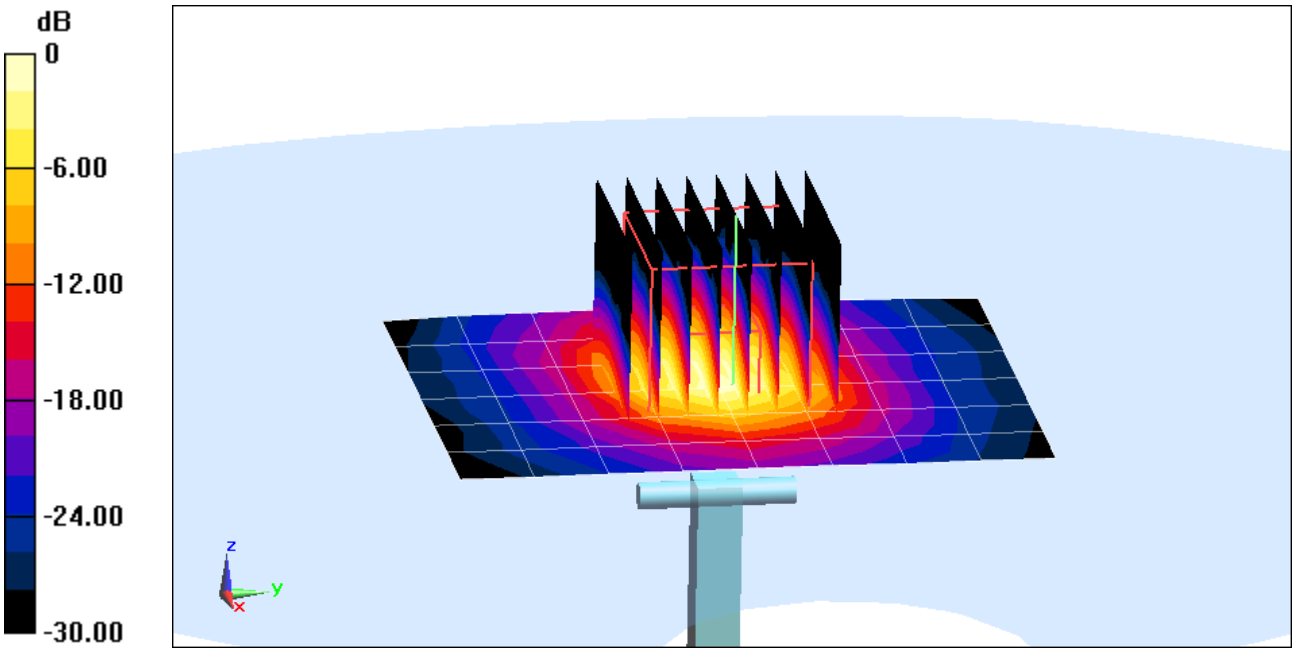
Communication System: CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5500 MHz; σ = 4.974 S/m; ε_r = 34.87; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.7°C

Probe: EX3DV4 - SN3589; ConvF(4.14, 4.14, 4.14); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5500 MHz System Verification

Area Scan (7x9x1): 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) = 36.9 W/kg
SAR(1 g) = 7.75 W/kg
Deviation (1 g) = -3.25 %



0 dB = 17.4 W/kg = 12.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1057

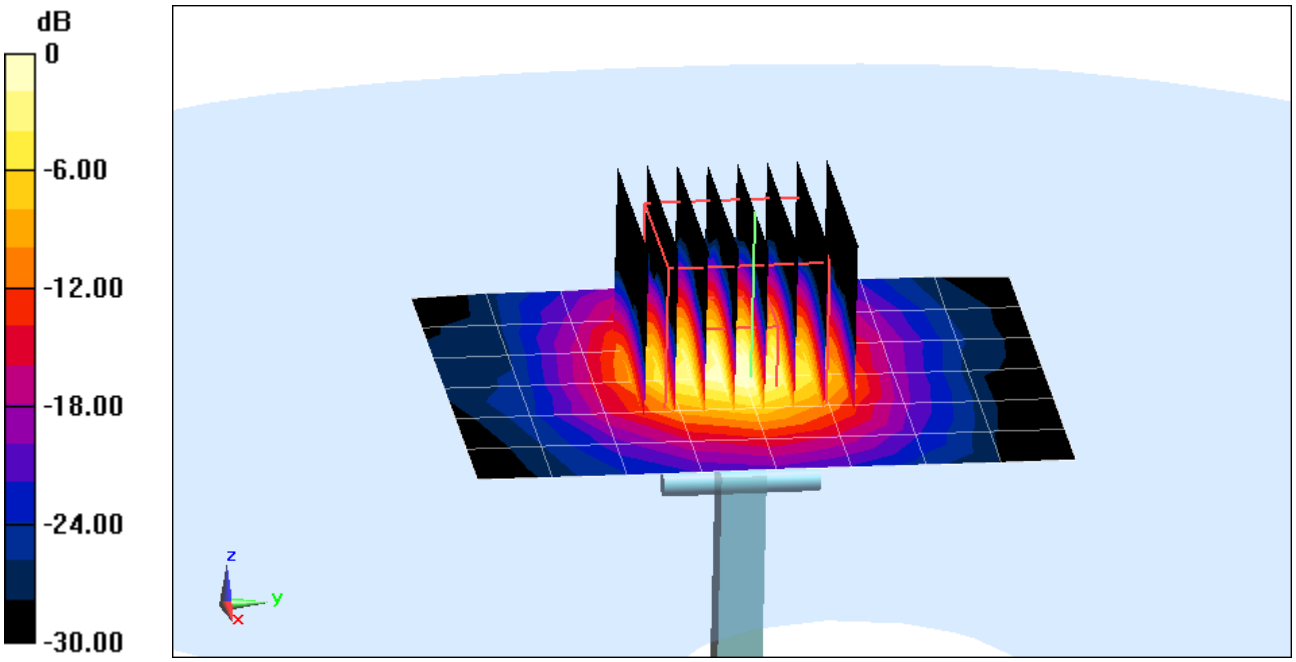
Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5600 MHz; σ = 5.104 S/m; ε_r = 34.593; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.8°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5600 MHz System Verification

Area Scan (7x9x1): 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) = 37.3 W/kg
SAR(1 g) = 7.87 W/kg
Deviation (1 g) = -2.11 %



0 dB = 18.1 W/kg = 12.58 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057

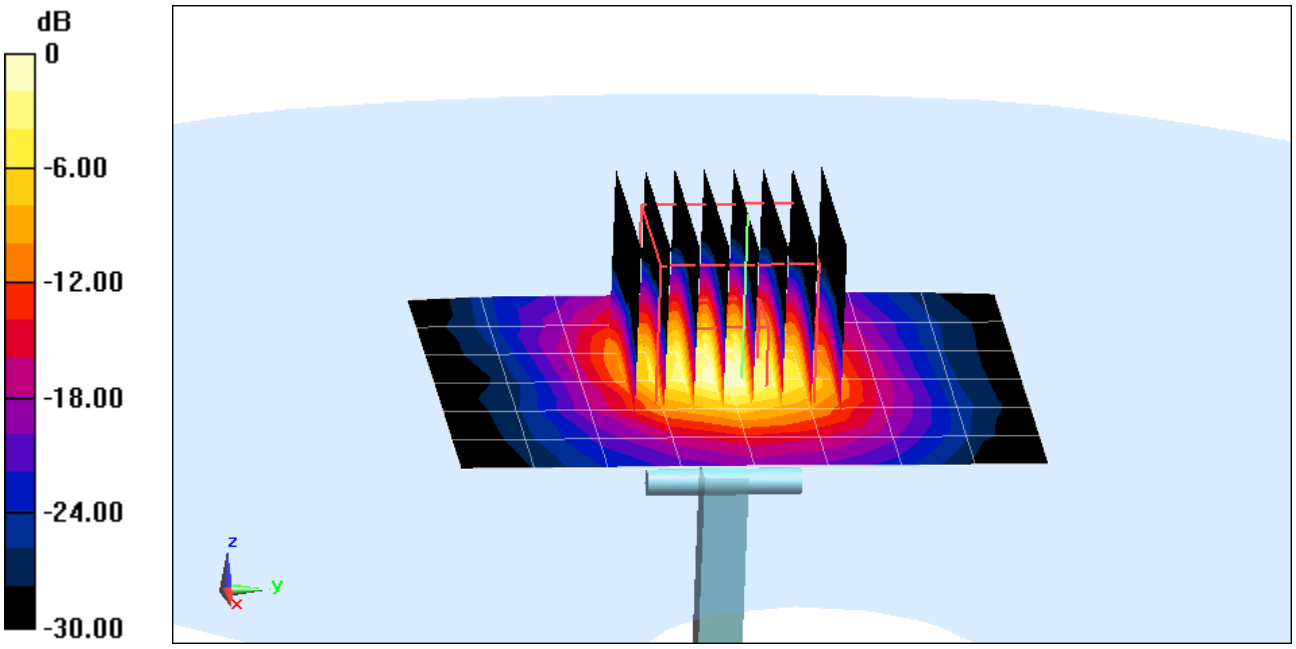
Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Head Medium parameters used:
f = 5800 MHz; σ = 5.365 S/m; ε_r = 34.169; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-17-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.8°C

Probe: EX3DV4 - SN3589; ConvF(3.85, 3.85, 3.85); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Main; Type: SAM 4.0; Serial: TP-1114
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

5800 MHz System Verification

Area Scan (7x9x1): 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) = 37.3 W/kg
SAR(1 g) = 7.32 W/kg
Deviation (1 g) = -3.81 %



0 dB = 17.4 W/kg = 12.41 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

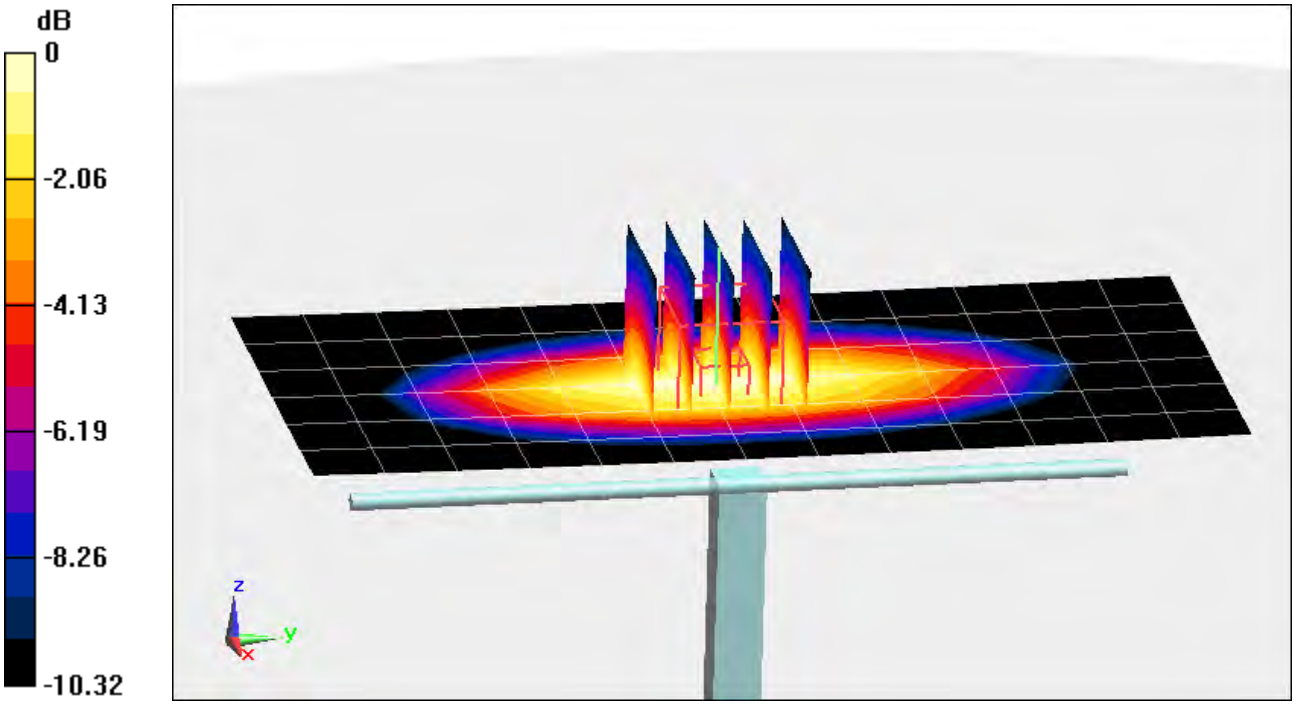
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 1.011 S/m; ε_r = 55.52; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 07-15-2013; Ambient Temp: 24.4°C; Tissue Temp: 23.0°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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) = 1.45 W/kg
SAR(1 g) = 1 W/kg
Deviation = 6.84 %



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 835 MHz; Type: D835V2; Serial: 4d026

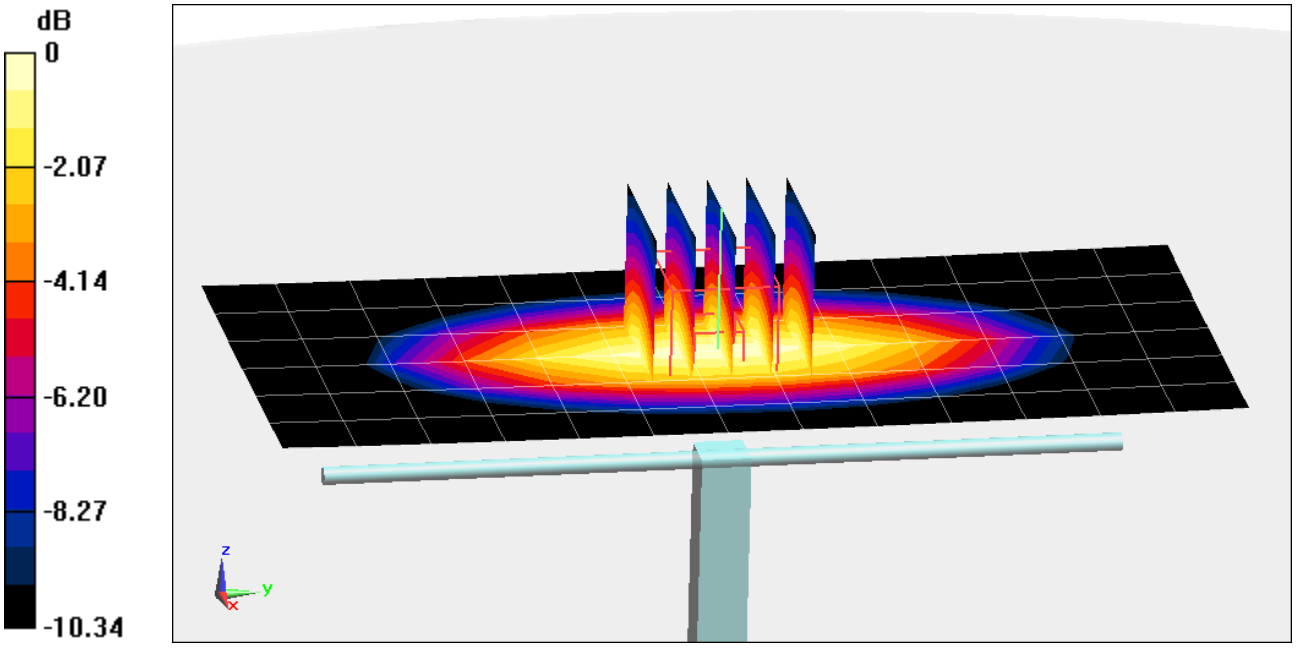
Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: 835 Body Medium parameters used:
f = 835 MHz; σ = 1.014 S/m; ε_r = 55.115; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.5 cm

Test Date: 08-19-2013; Ambient Temp: 24.1°C; Tissue Temp: 22.8°C

Probe: ES3DV3 - SN3209; ConvF(6.28, 6.28, 6.28); Calibrated: 3/15/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1334; Calibrated: 3/8/2013
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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) = 1.45 W/kg
SAR(1 g) = 0.998 W/kg
Deviation = 4.18 %



0 dB = 1.08 W/kg = 0.33 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

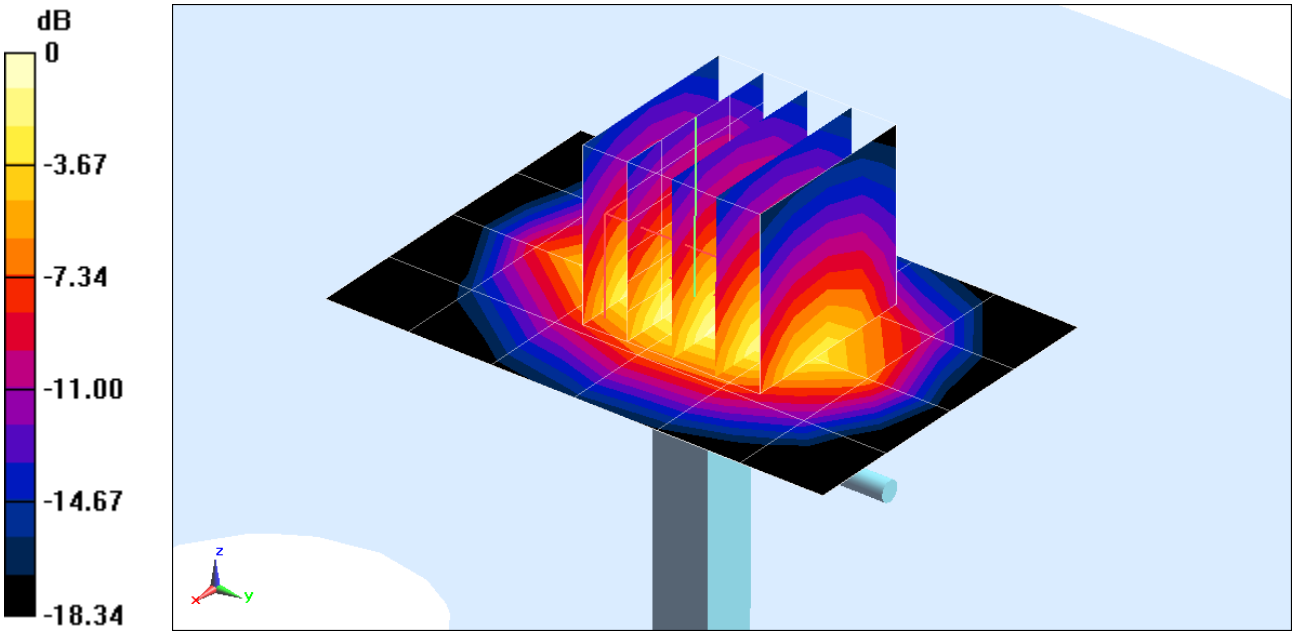
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.549 S/m; ε_r = 54.688; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-19-2013; Ambient Temp: 23.5°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3287; ConvF(4.69, 4.69, 4.69); Calibrated: 11/15/2012;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1333; Calibrated: 11/13/2012
Phantom: SAM with CRP; Type: SAM 4.0; Serial: TP1375
Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (5x7x1): 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) = 7.64 W/kg
SAR(1 g) = 4.32 W/kg
Deviation = 4.10%



0 dB = 4.71 W/kg = 6.73 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

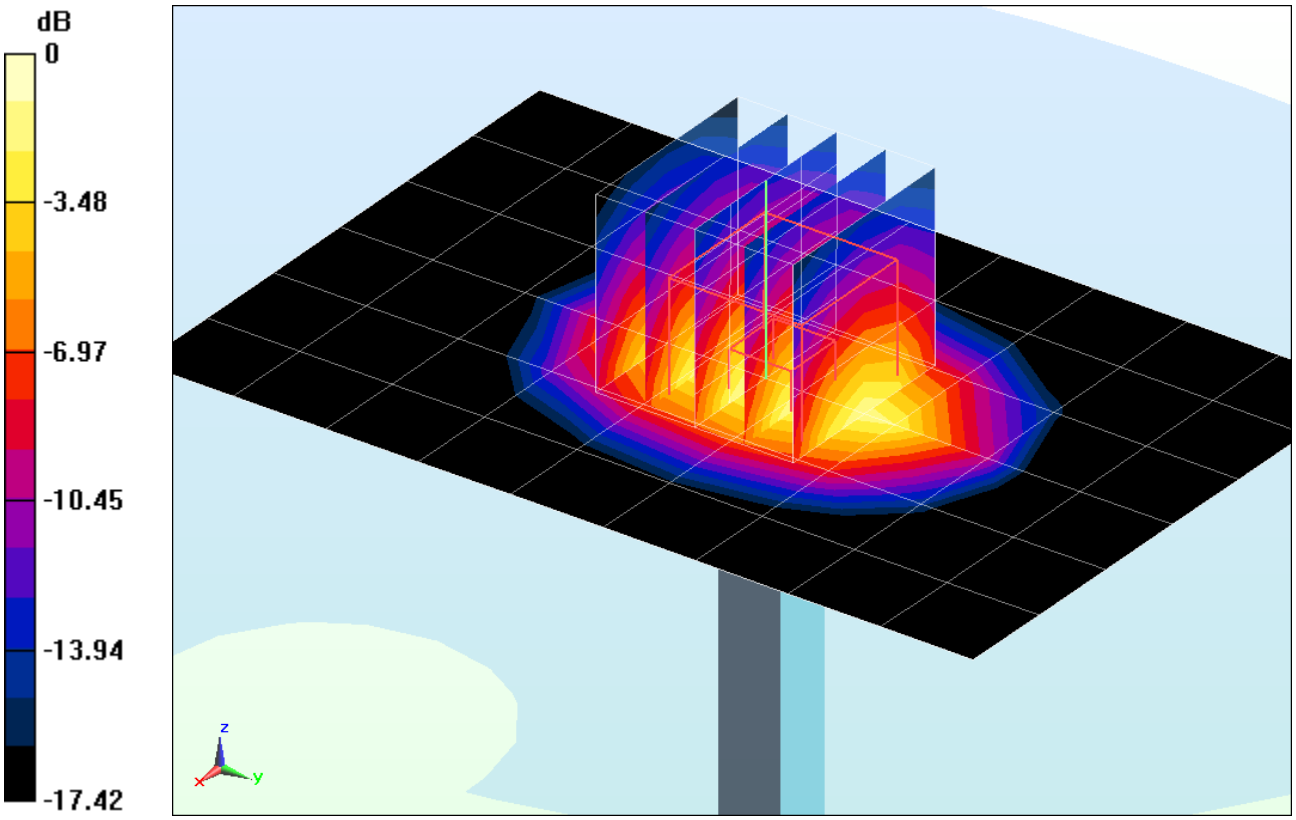
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body; Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.551 S/m; ε_r = 52.004; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 08-21-2013; Ambient Temp: 24.1°C; Tissue Temp: 23.0°C

Probe: EX3DV4 - SN3920; ConvF(7.38, 7.38, 7.38); Calibrated: 2/27/2013;
Sensor-Surface: 4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

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) = 7.88 W/kg
SAR(1 g) = 4.36 W/kg
Deviation = 6.86%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 882

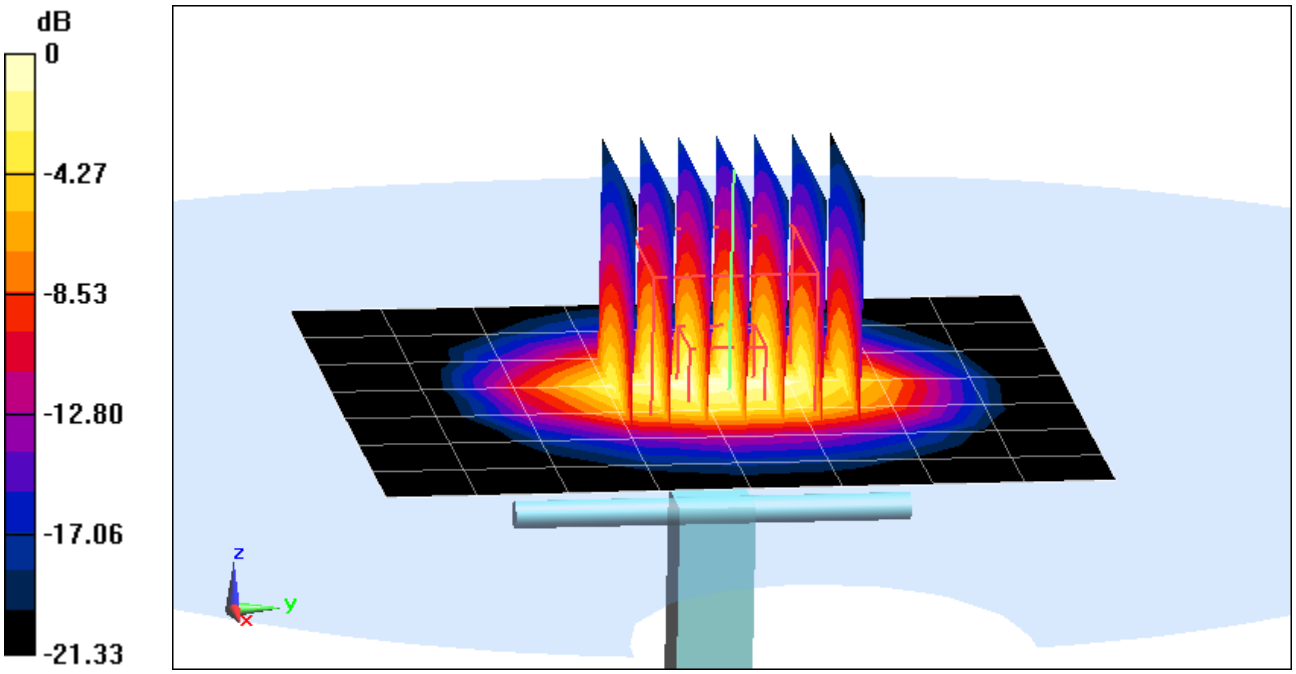
Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: 2450 Body Medium parameters used:
f = 2450 MHz; σ = 1.925 S/m; ε_r = 51.887; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-16-2013; Ambient Temp: 23.3°C; Tissue Temp: 23.1°C

Probe: EX3DV4 - SN3920; ConvF(7.07, 7.07, 7.07); Calibrated: 2/27/2013;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn649; Calibrated: 2/6/2013
Phantom: SAM 5.0 front; Type: QD000P40CD; Serial: TP:-1648
Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

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) = 10.2 W/kg
SAR(1 g) = 4.94 W/kg
Deviation = -1.00 %



0 dB = 6.45 W/kg = 8.10 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5200 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5200 MHz; σ = 5.505 S/m; ε_r = 48.968; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

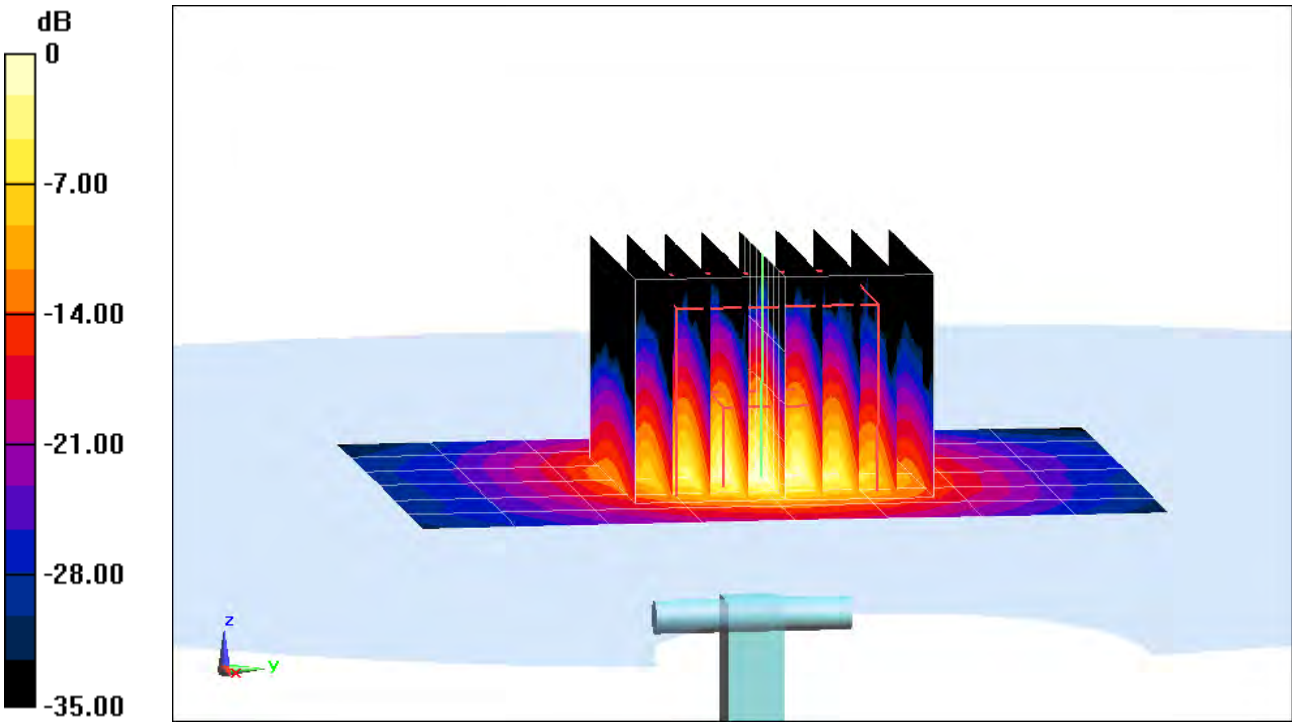
Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.99, 3.99, 3.99); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80);SEMCAD X Version 14.6.10 (7164)

5200MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 27.4 W/kg
SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.08 W/kg
Deviation (1g) = -2.52%; Deviation (10g) = -1.42%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5300 MHz; Type: D5GHzV2; Serial: 1057

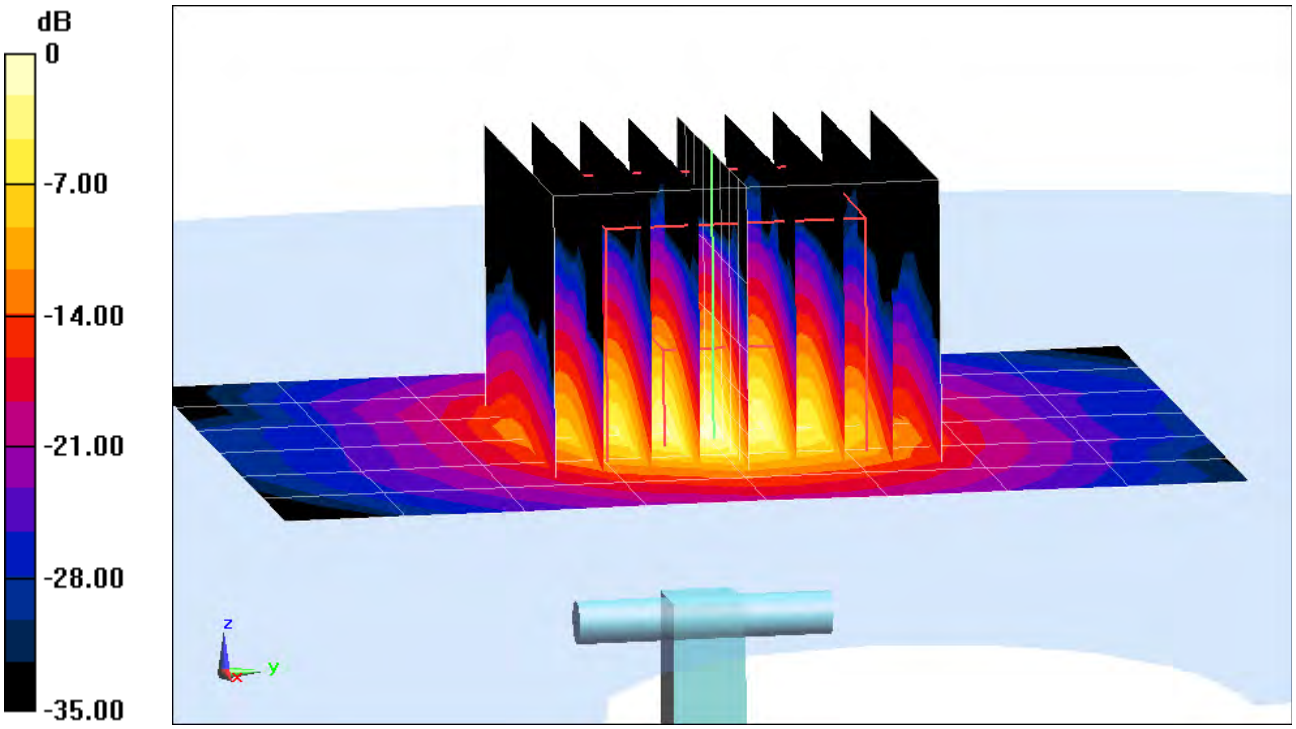
Communication System: CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5300 MHz; σ = 5.593 S/m; ε_r = 48.806; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.3°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.81, 3.81, 3.81); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80);SEMCAD X Version 14.6.10 (7164)

5300MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 31.5 W/kg
SAR(1 g) = 8 W/kg; SAR(10 g) = 2.24 W/kg
Deviation (1g) = 6.24%; Deviation (10g) = 6.16%



0 dB = 19.2 W/kg = 12.83 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5500 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5500 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5500 MHz; σ = 5.816 S/m; ε_r = 48.43; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

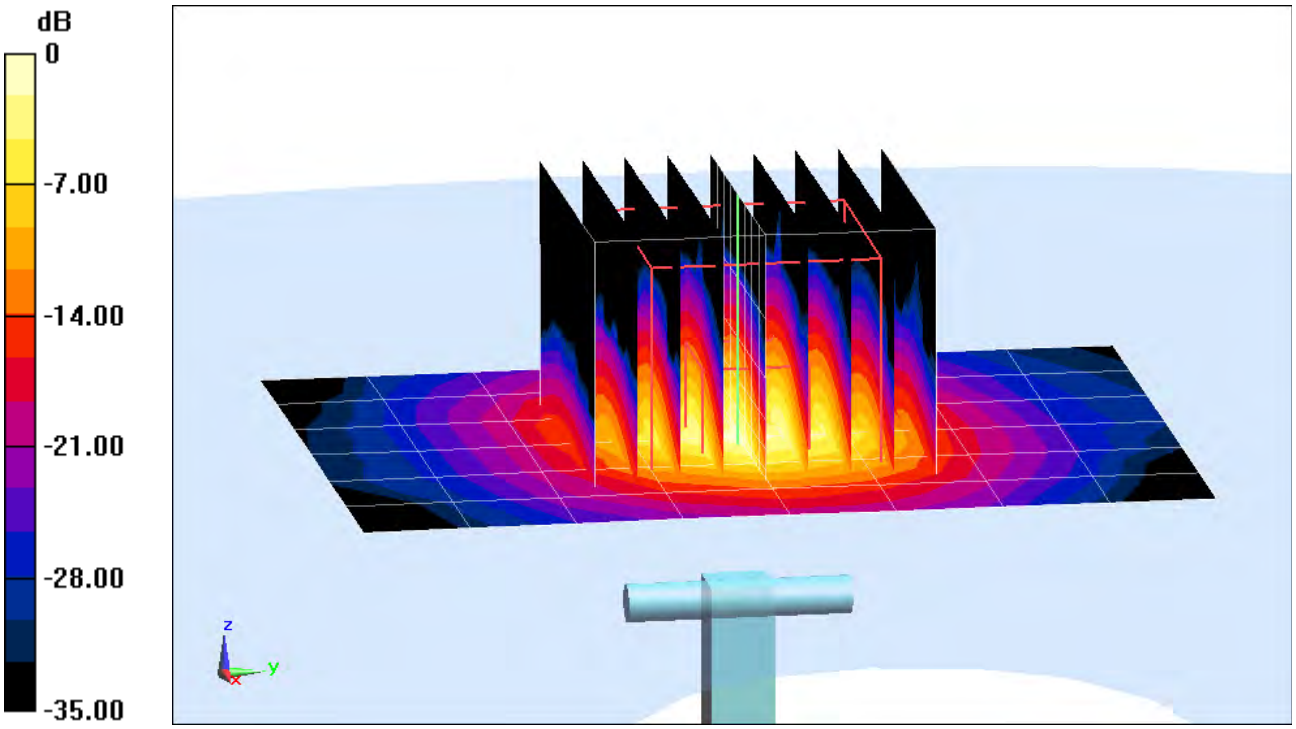
Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.52, 3.52, 3.52); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80);SEMCAD X Version 14.6.10 (7164)

5500MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.1 W/kg
SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.19 W/kg
Deviation (1g) = -2.23%; Deviation (10g) = -2.23%



0 dB = 20.0 W/kg = 13.01 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: 1057

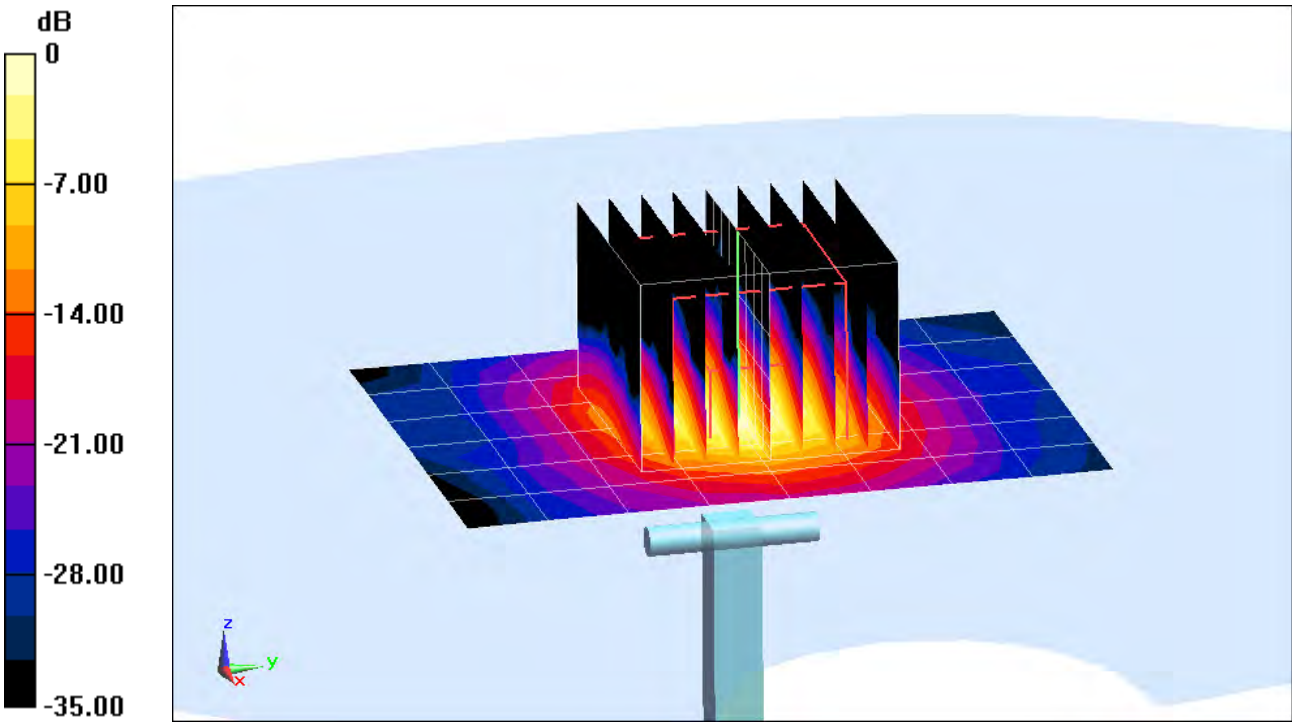
Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5600 MHz; σ = 5.933 S/m; ε_r = 48.234; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.32, 3.32, 3.32); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80);SEMCAD X Version 14.6.10 (7164)

5600MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 33.4 W/kg
SAR(1 g) = 8.21 W/kg; SAR(10 g) = 2.27 W/kg
Deviation (1g) = 2.24%; Deviation (10g) = 1.79%



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

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 5800 MHz; Type: D5GHzV2; Serial: 1057

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: 5 GHz Body Medium parameters used:
f = 5800 MHz; σ = 6.296 S/m; ε_r = 47.918; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-22-2013; Ambient Temp: 24.5°C; Tissue Temp: 23.6°C

Probe: EX3DV4 - SN3589; ConvF(3.66, 3.66, 3.66); Calibrated: 1/17/2013;
Sensor-Surface: 1.4mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1272; Calibrated: 1/17/2013
Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357
Measurement SW: DASY4, Version 4.7 (80);SEMCAD X Version 14.6.10 (7164)

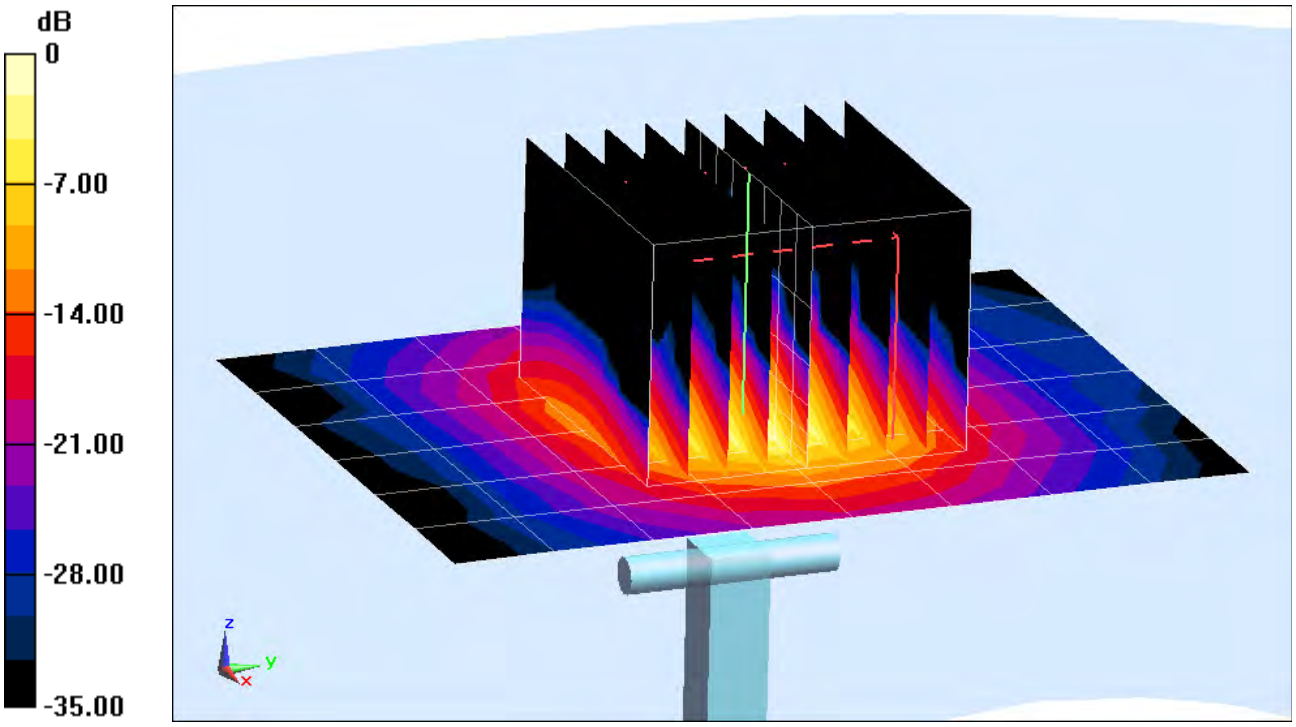
5800MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Zoom Scan (9x9x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm; Graded Ratio=1.4
Input Power = 20 dBm (100 mW)
Peak SAR (extrapolated) = 32.0 W/kg

SAR(1 g) = 7.48 W/kg

Deviation (1g) = -0.40%



0 dB = 18.8 W/kg = 12.74 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: ES3-3287_Nov12

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3287
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	November 15, 2012

✓ KOK 11/20/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 16, 2012

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	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, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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:3287

Manufactured: June 7, 2010
Calibrated: November 15, 2012

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.31	1.25	1.25	± 10.1 %
DCP (mV)[B]	102.9	103.6	101.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.0	0.0	1.0	116.8	±3.5 %
			Y	0.0	0.0	1.0	118.5	
			Z	0.0	0.0	1.0	154.1	

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:3287

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.40	6.40	6.40	0.20	2.54	± 12.0 %
835	41.5	0.90	6.17	6.17	6.17	0.34	1.68	± 12.0 %
1750	40.1	1.37	5.16	5.16	5.16	0.63	1.30	± 12.0 %
1900	40.0	1.40	4.96	4.96	4.96	0.48	1.55	± 12.0 %
2450	39.2	1.80	4.30	4.30	4.30	0.79	1.31	± 12.0 %
2600	39.0	1.96	4.19	4.19	4.19	0.80	1.31	± 12.0 %

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

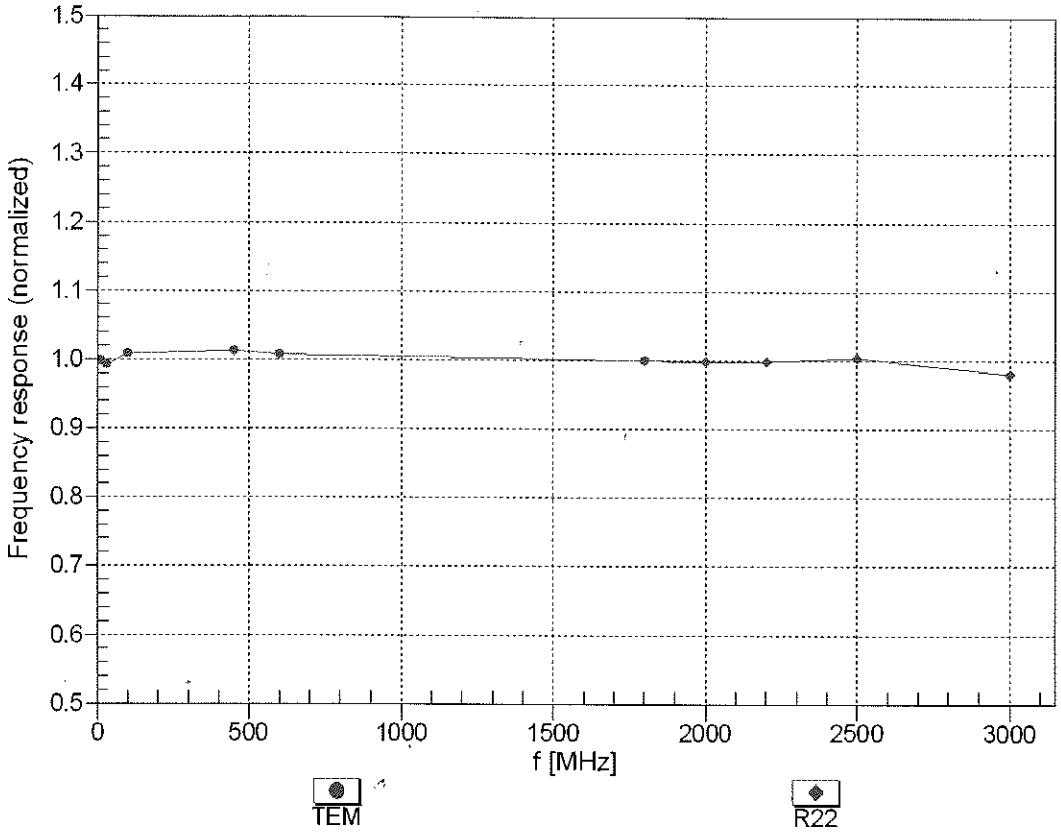
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.14	6.14	6.14	0.28	2.06	± 12.0 %
835	55.2	0.97	6.06	6.06	6.06	0.42	1.63	± 12.0 %
1750	53.4	1.49	4.86	4.86	4.86	0.43	1.64	± 12.0 %
1900	53.3	1.52	4.69	4.69	4.69	0.56	1.54	± 12.0 %
2450	52.7	1.95	4.29	4.29	4.29	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.12	4.12	4.12	0.64	0.92	± 12.0 %

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

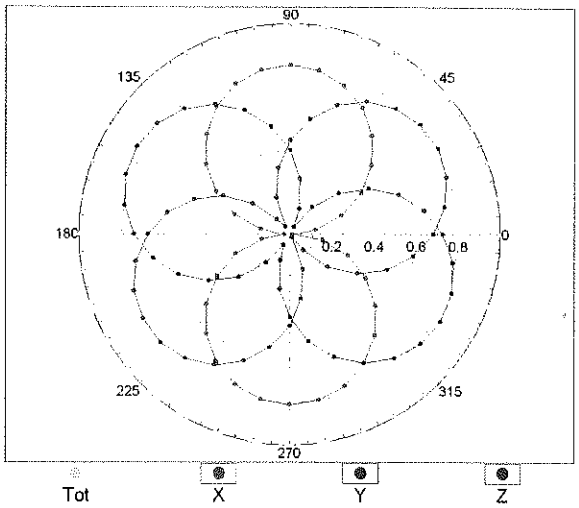
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



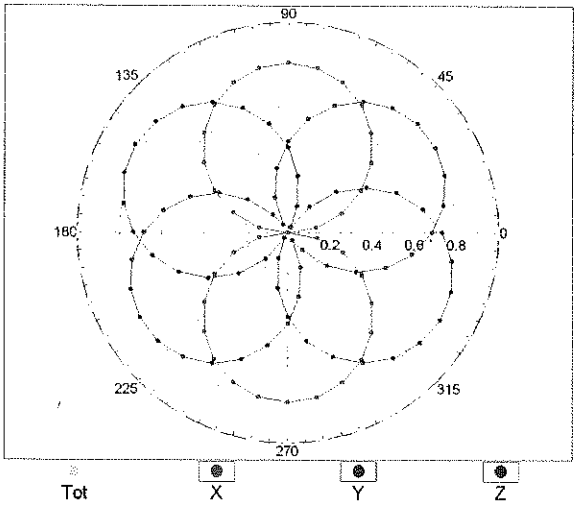
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

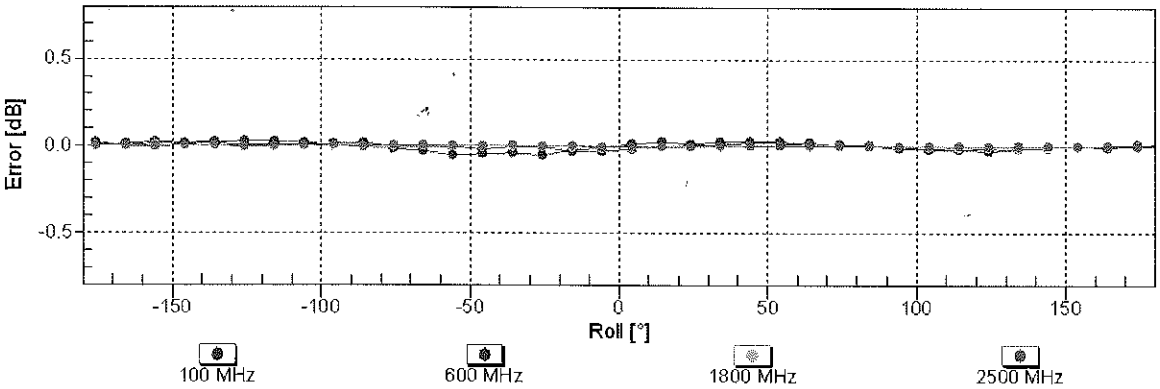
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



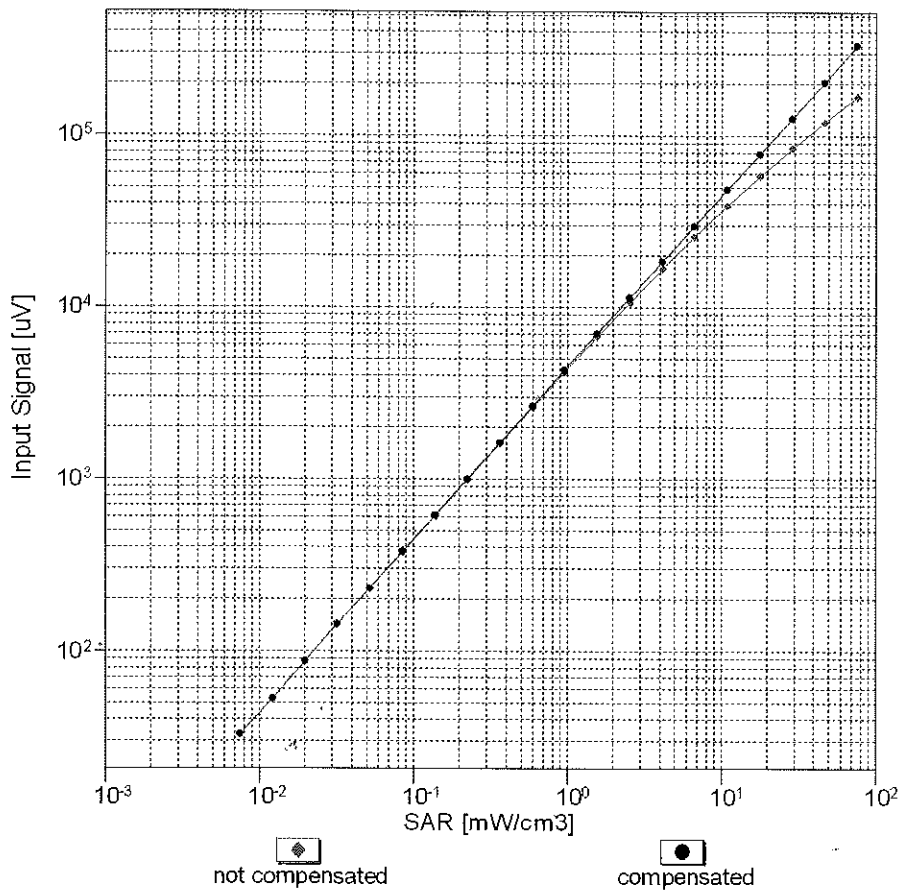
f=1800 MHz,R22

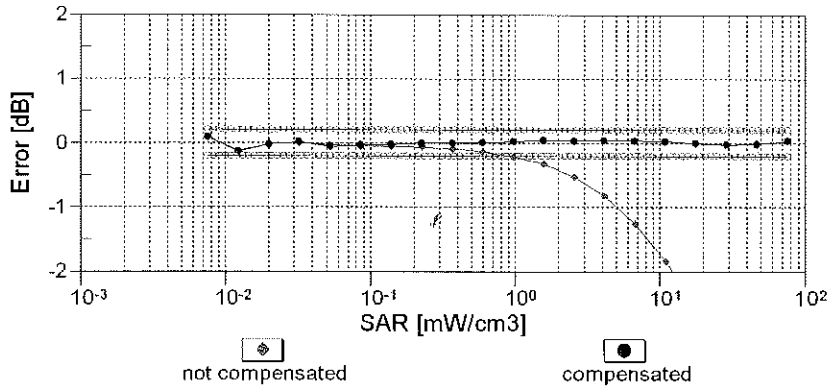




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

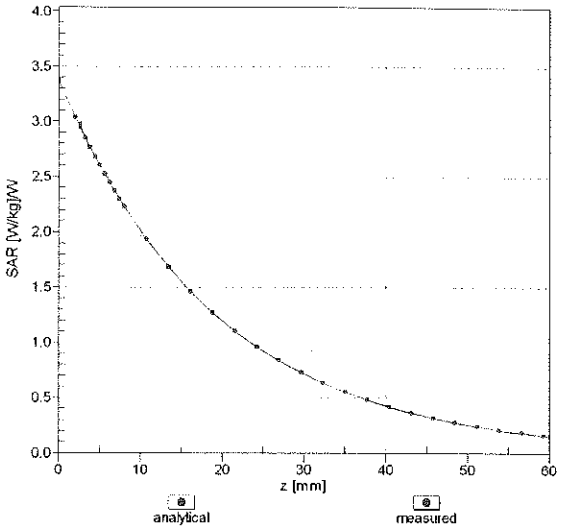




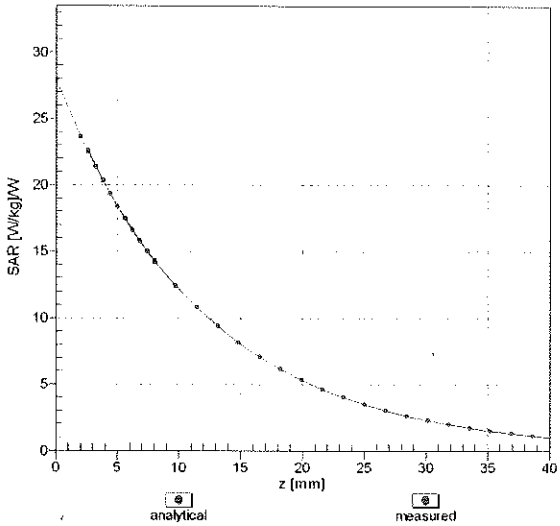
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

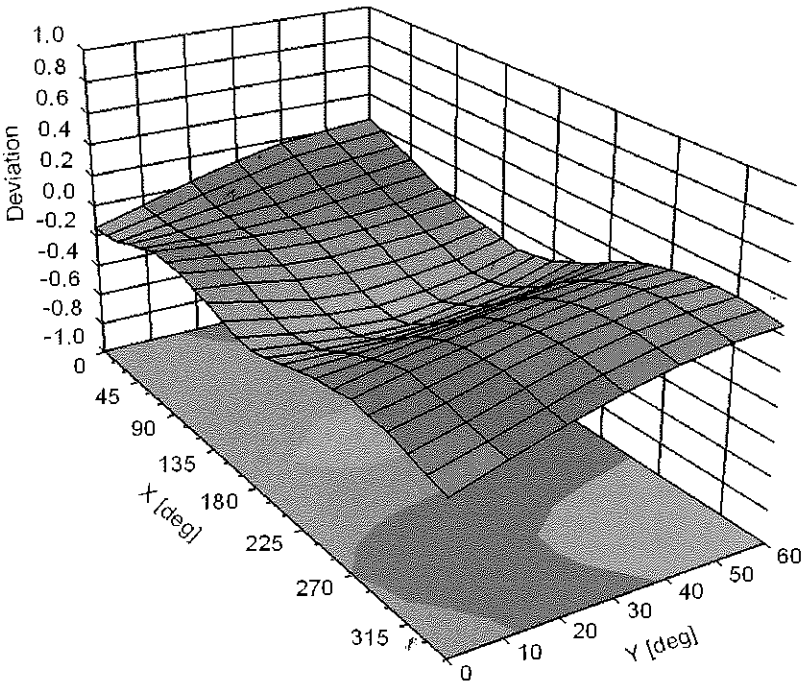


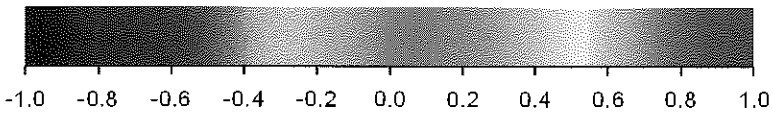
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-15.9
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
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S Swiss Calibration Service

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

Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1900V2-5d141_May13

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d141
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 02, 2013

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: 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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 2, 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	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	39.3 ± 6 %	1.37 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**40.8 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.3 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.0 ± 6 %	1.51 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	**41.5 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.51 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.1 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6 Ω + 4.9 jΩ
Return Loss	- 25.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.3 Ω + 5.9 jΩ
Return Loss	- 24.1 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: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

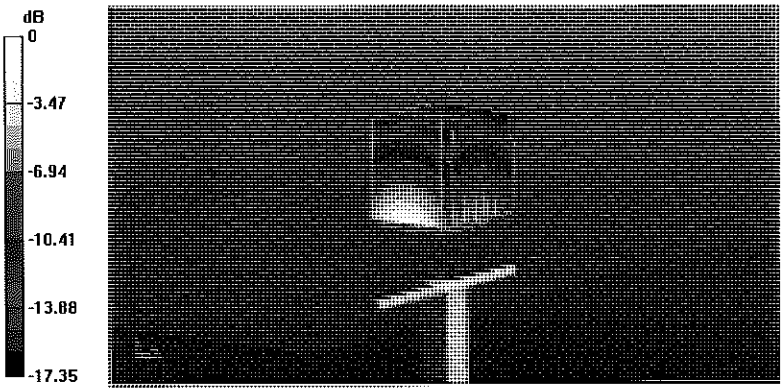
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.37 S/m; ε_r = 39.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.6(1115); SEMCAD X 14.6.9(7117)

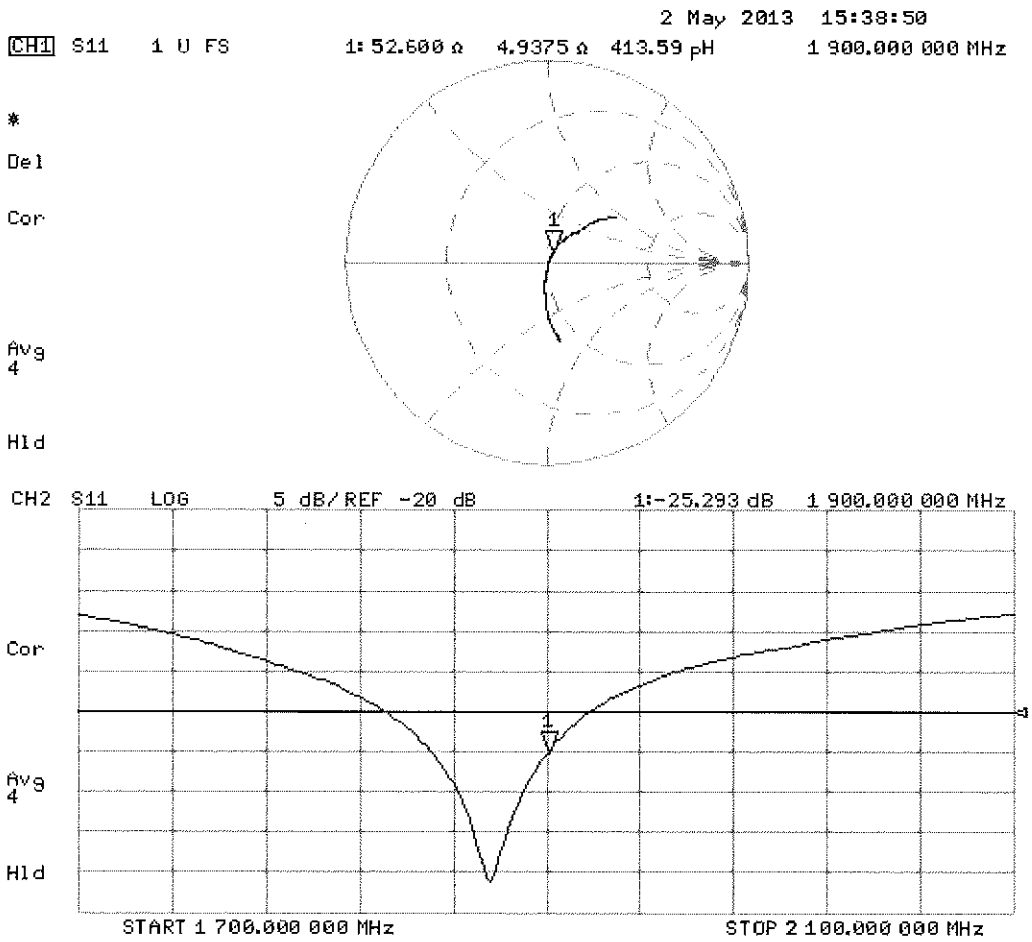
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.124 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 18.2 W/kg
SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.3 W/kg
Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.05.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

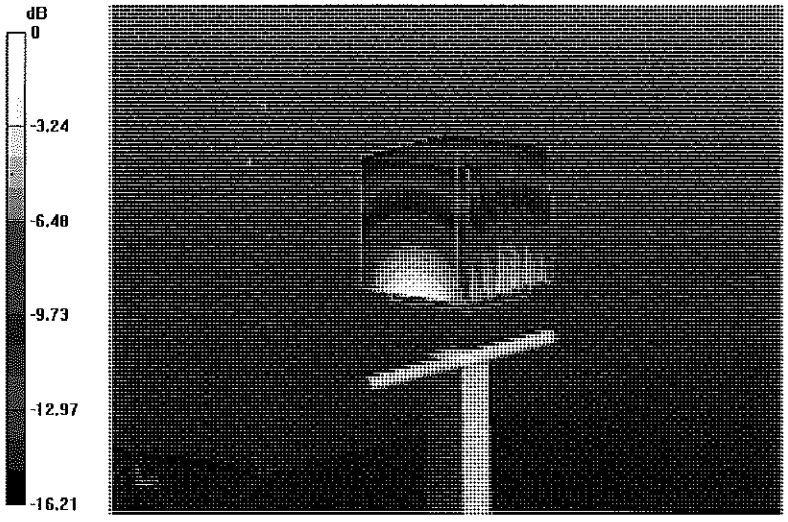
Communication System: UID 0 - CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.51 S/m; ε_r = 54; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); 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 52.8.6(1115); SEMCAD X 14.6.9(7117)

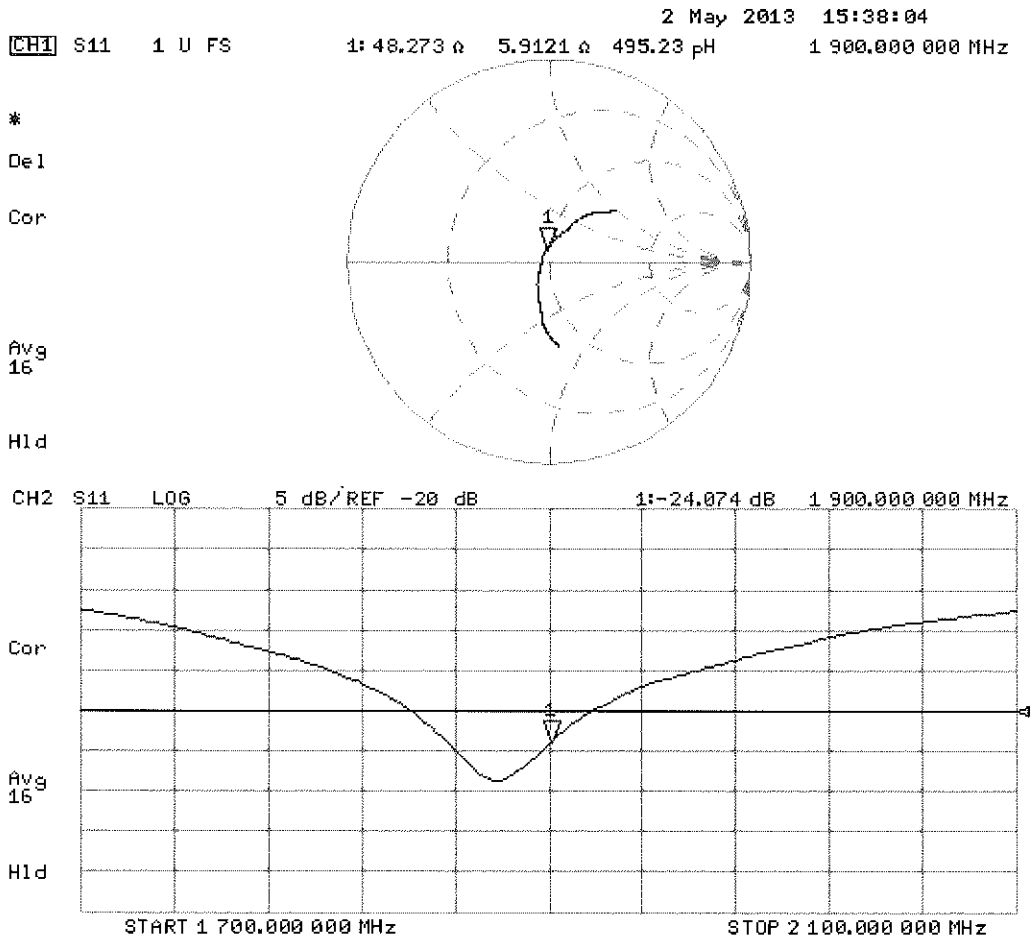
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.124 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 17.6 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.51 W/kg
Maximum value of SAR (measured) = 13.0 W/kg



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

Impedance Measurement Plot for 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: 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

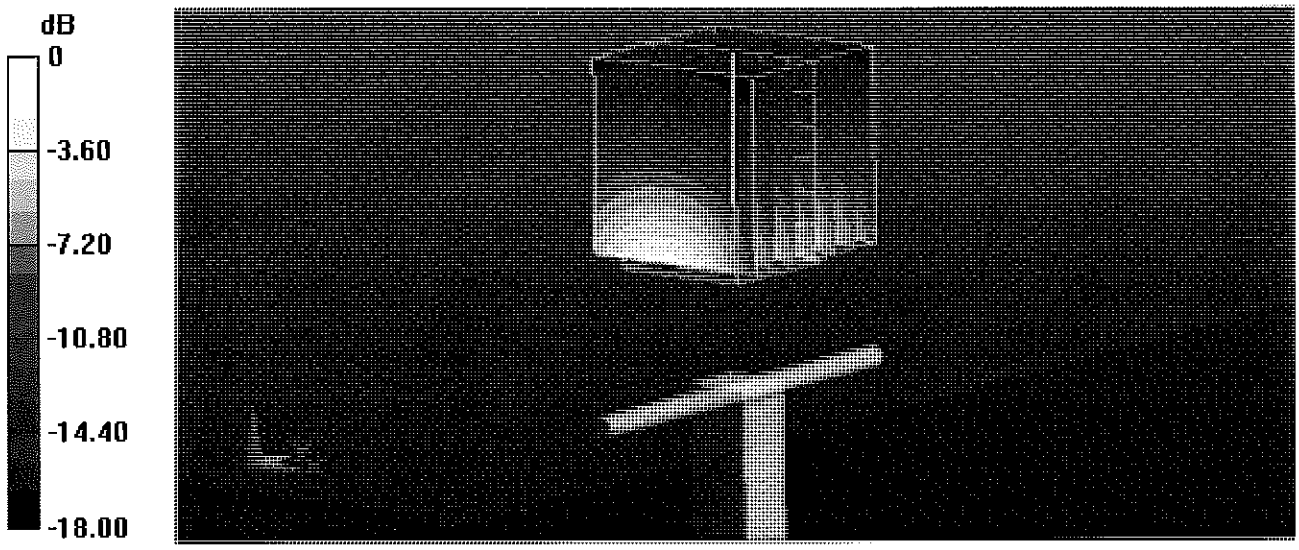
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 S/m; ε_r = 39.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

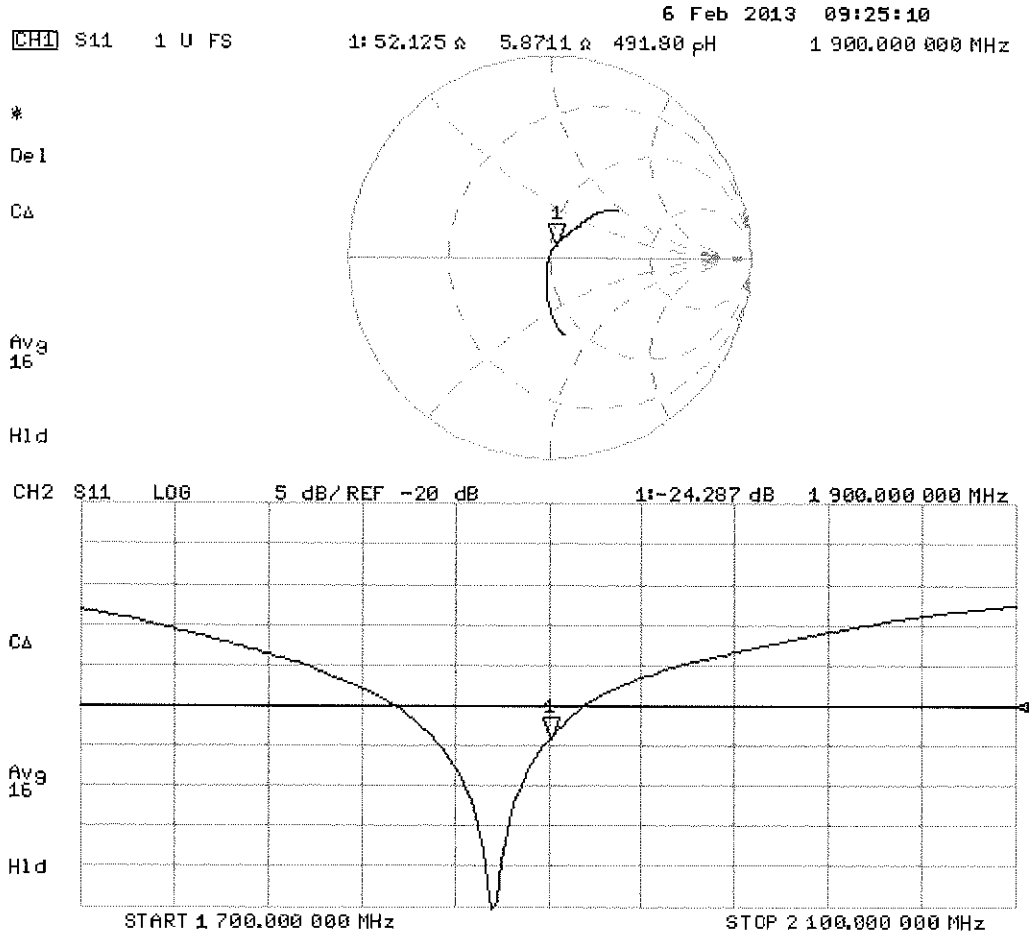
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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

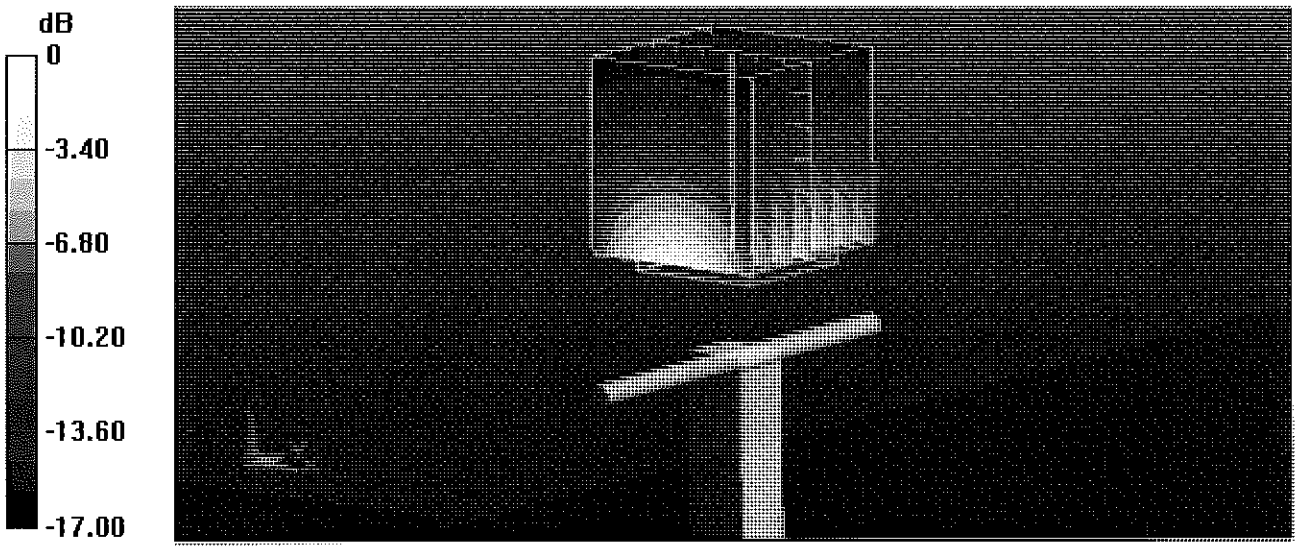
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.53 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

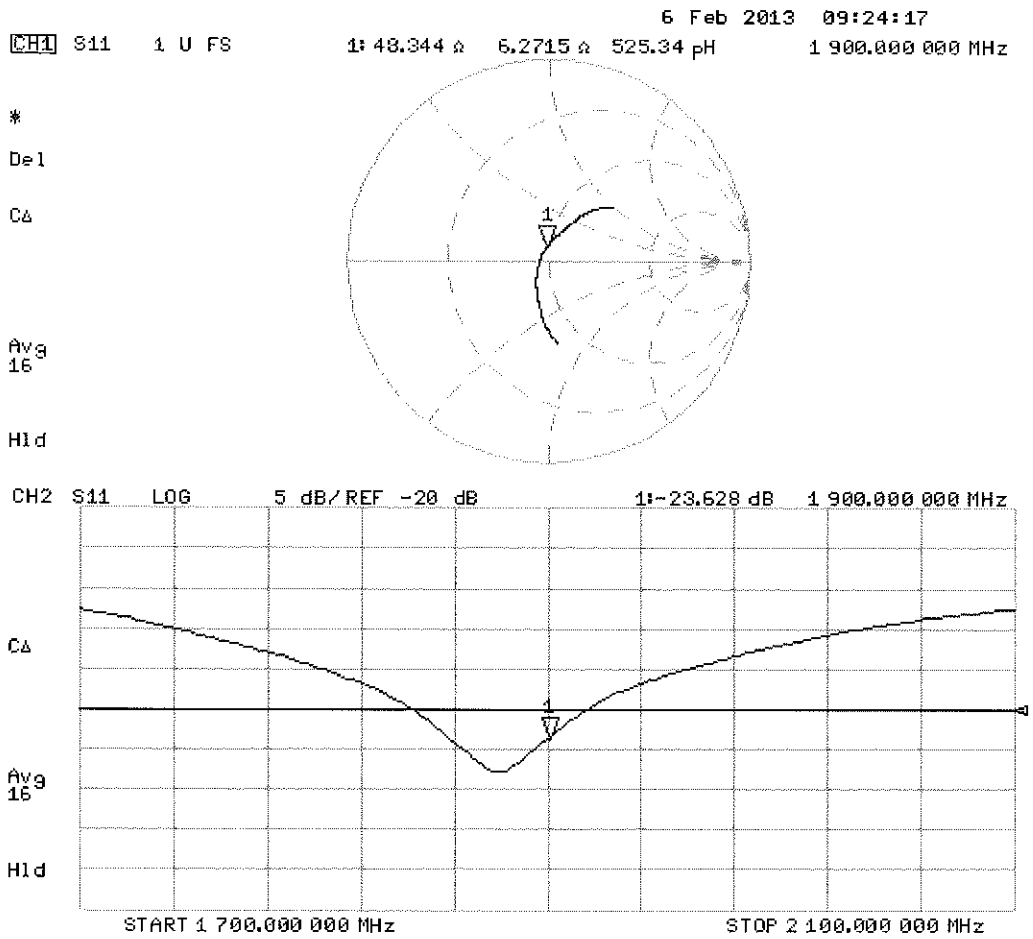
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D1900V2-5d080_Jul12

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d080
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	July 20, 2012

✓ KOK 8/13/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
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-11)	In house check: Oct-12

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

Issued: July 20, 2012

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Accreditation No.: **SCS 108**

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Glossary:

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

Calibration is Performed According to the Following Standards:

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	V52.8.1
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	39.9 ± 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	9.78 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.4 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.8 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.6 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**40.3 mW / g ± 17.0 % (k=2)**

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.9 Ω + 5.7 jΩ
Return Loss	- 24.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.9 Ω + 6.0 jΩ
Return Loss	- 23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.191 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 28, 2006

DASY5 Validation Report for Head TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

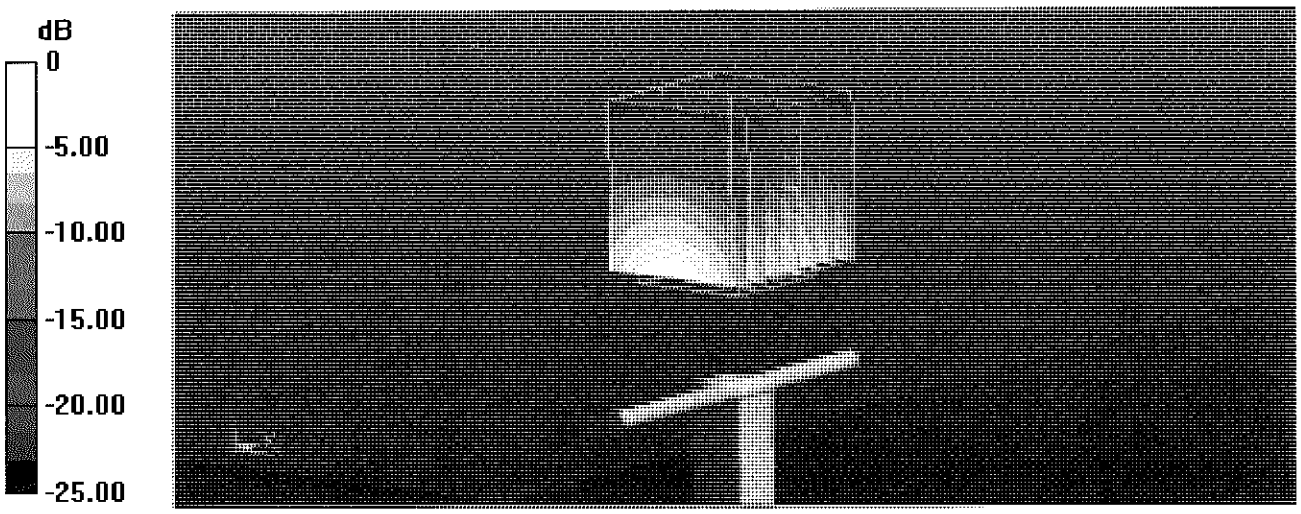
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.38 mho/m; ε_r = 39.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

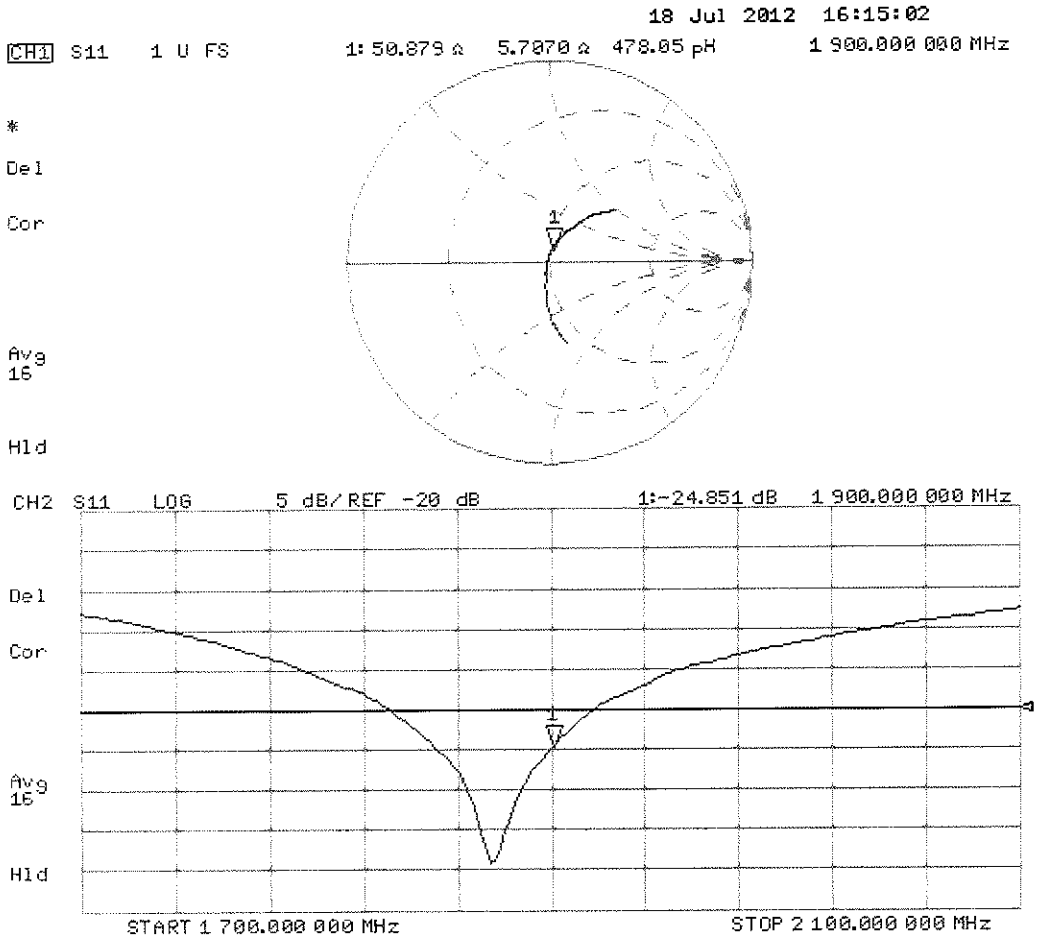
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.586 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 17.454 mW/g
SAR(1 g) = 9.78 mW/g; SAR(10 g) = 5.17 mW/g
Maximum value of SAR (measured) = 12.2 mW/g



0 dB = 12.2 mW/g = 21.73 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 20.07.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d080

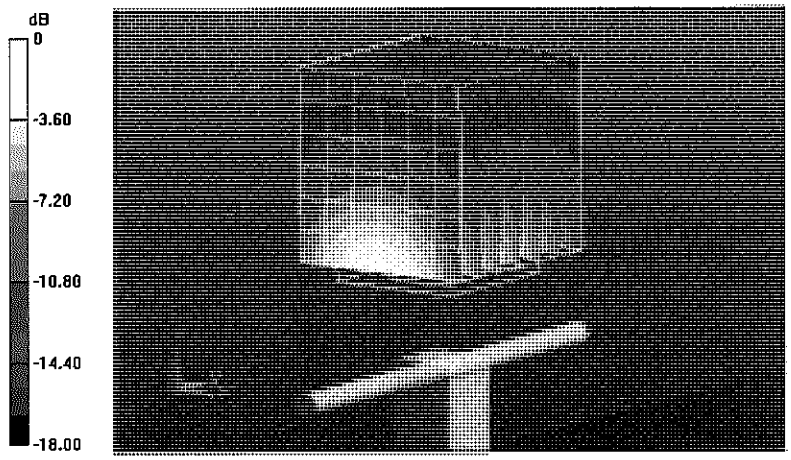
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

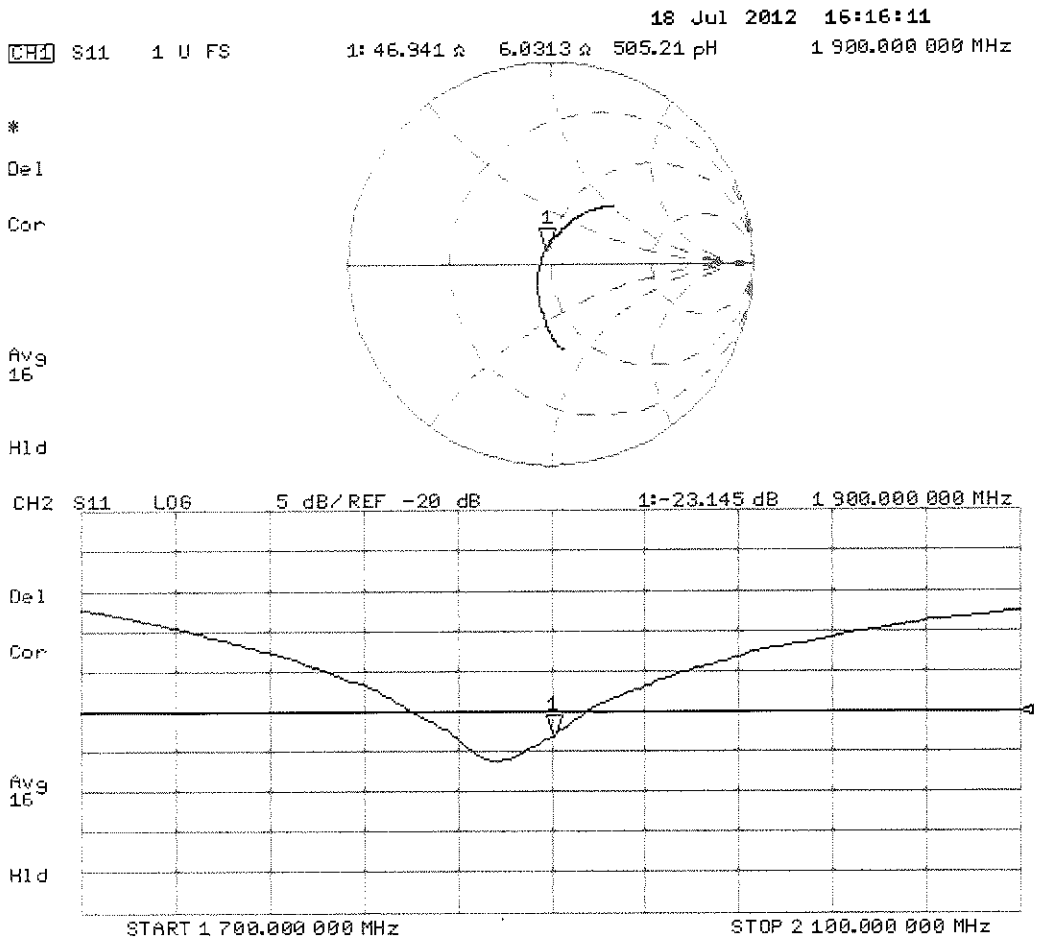
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.688 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 17.552 mW/g
SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.35 mW/g
Maximum value of SAR (measured) = 12.8 mW/g



0 dB = 12.8 mW/g = 22.14 dB mW/g

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D2450V2-882_Feb13

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 882
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 11, 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:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 11, 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	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	37.9 ± 6 %	1.85 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**51.7 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.07 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.0 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	50.9 ± 6 %	2.02 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	12.8 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**49.9 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.91 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.3 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.6 Ω - 0.4 jΩ
Return Loss	- 29.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5 Ω + 1.2 jΩ
Return Loss	- 37.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.157 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	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 882

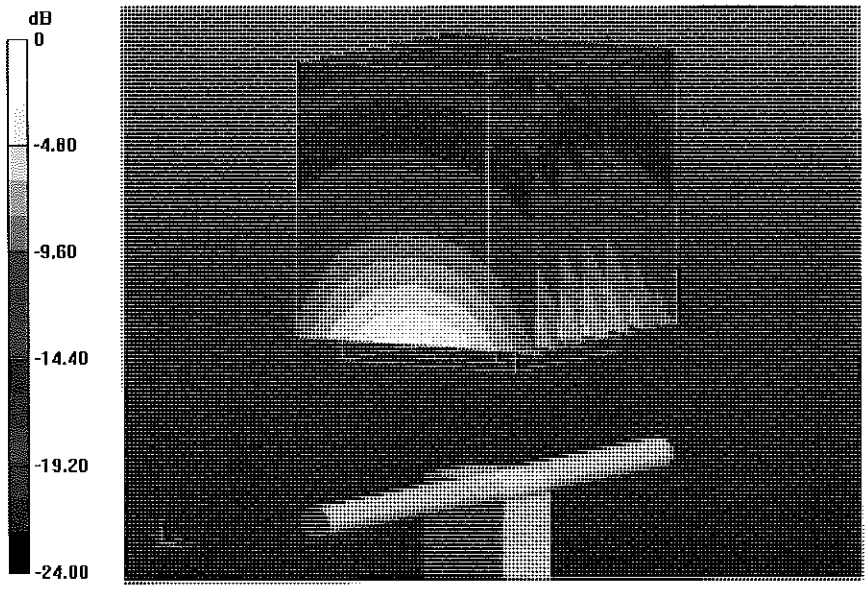
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.85 S/m; ε_r = 37.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); 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)

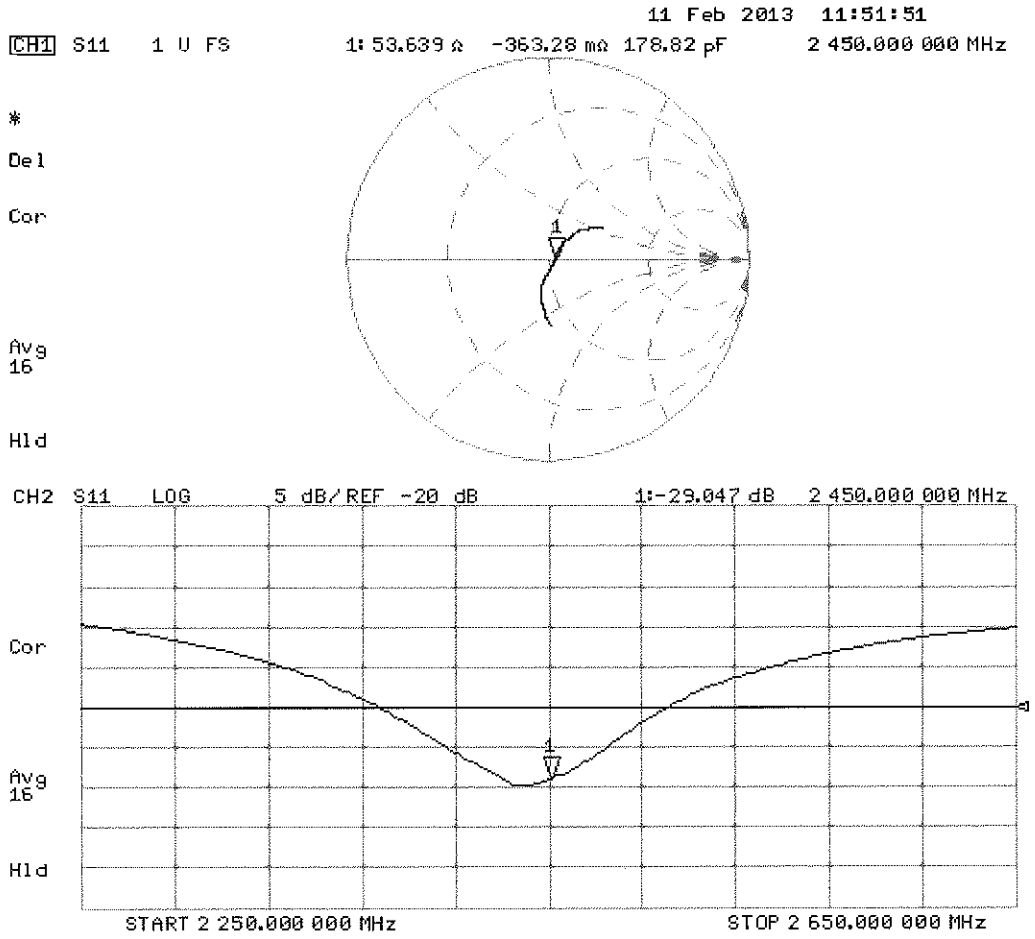
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 97.806 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.6 W/kg
SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.07 W/kg
Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 11.02.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 882

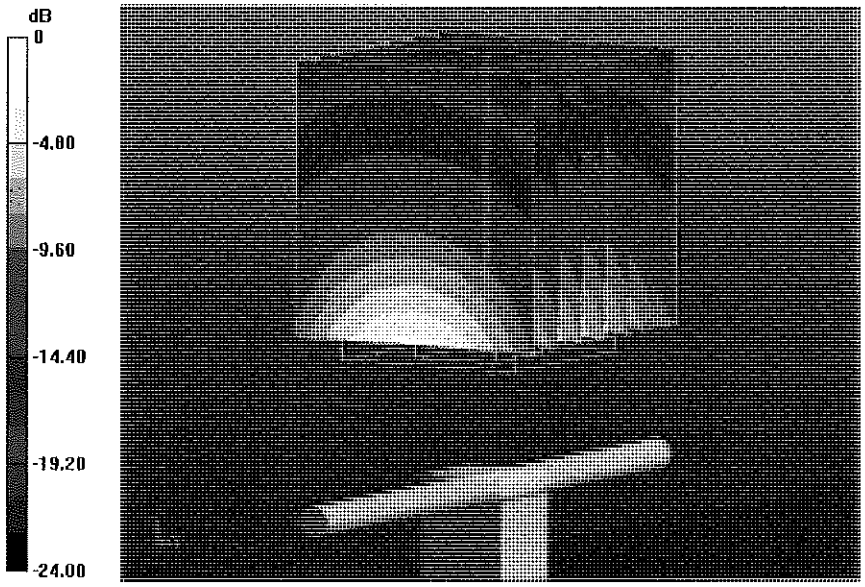
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); 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)

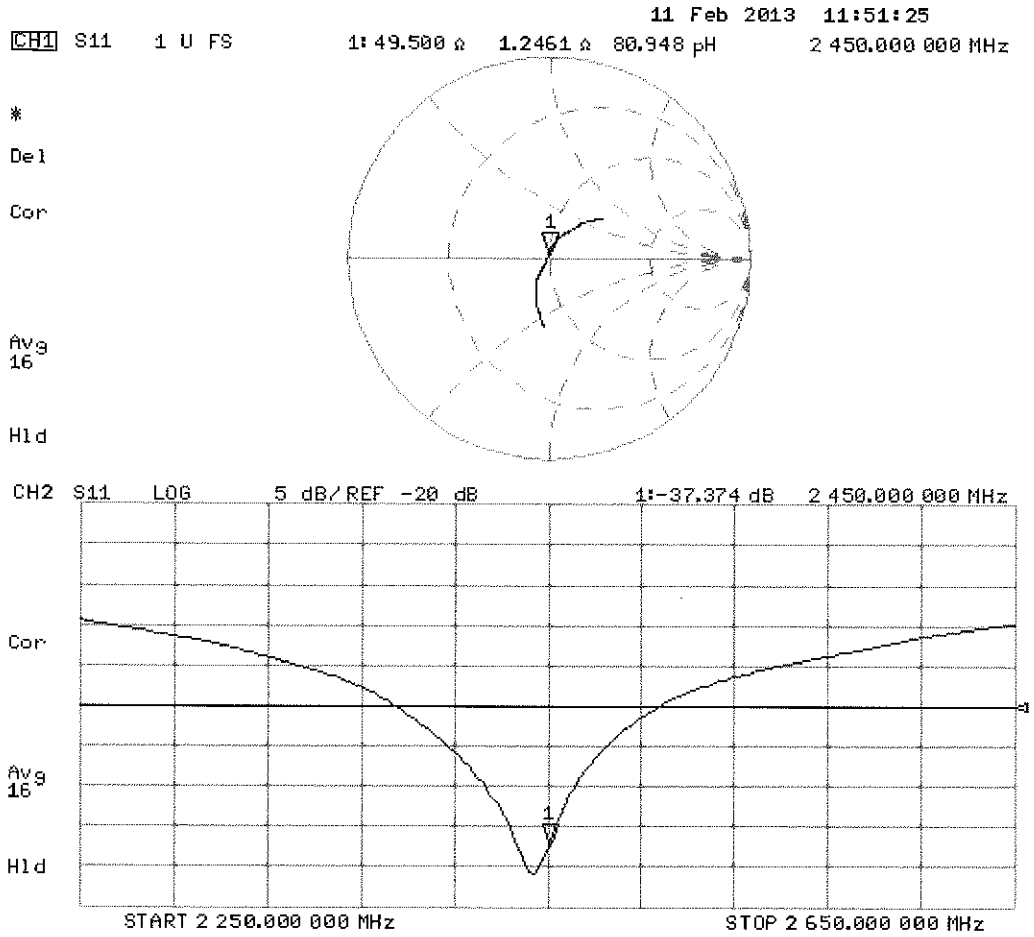
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.474 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 27.1 W/kg
SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.91 W/kg
Maximum value of SAR (measured) = 16.9 W/kg



0 dB = 16.9 W/kg = 12.28 dBW/kg

Impedance Measurement Plot for Body TSL



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Accreditation No.: SCS 108

Client **PC Test**

Certificate No: D5GHzV2-1057_Jan13

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1057
Calibration procedure(s)	QA CAL-22.v2 Calibration procedure for dipole validation kits between 3-6 GHz
Calibration date:	January 11, 2013

✓ KOK 1/29/13

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 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: January 11, 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	34.6 ± 6 %	4.50 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	7.66 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**75.9 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 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 %	4.60 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	7.76 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.9 W / kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.9 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 %	4.79 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	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 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 %	4.88 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	8.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**80.4 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.30 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.7 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	33.8 ± 6 %	5.09 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	7.69 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**76.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**21.4 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.42 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	7.61 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	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 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	46.8 ± 6 %	5.55 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	7.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.1 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	46.5 ± 6 %	5.81 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	8.14 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.8 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.4 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	46.3 ± 6 %	5.94 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.25 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	46.0 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.7 W/kg ± 19.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.5 Ω - 9.8 jΩ
Return Loss	- 20.3 dB

Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	48.5 Ω - 4.5 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	50.6 Ω - 5.8 jΩ
Return Loss	- 24.8 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 3.8 jΩ
Return Loss	- 25.6 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	52.5 Ω - 4.4 jΩ
Return Loss	- 26.1 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	49.3 Ω - 7.9 jΩ
Return Loss	- 22.0 dB

Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	48.7 Ω - 3.2 jΩ
Return Loss	- 29.2 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.2 Ω - 4.8 jΩ
Return Loss	- 26.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.6 Ω - 2.1 jΩ
Return Loss	- 27.9 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	53.3 Ω - 2.9 jΩ
Return Loss	- 27.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 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	November 27, 2006

DASY5 Validation Report for Head TSL

Date: 11.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1057

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 = 4.5 S/m; ε_r = 34.6; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 4.6 S/m; ε_r = 34.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 4.79 S/m; ε_r = 34.2; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 4.88 S/m; ε_r = 34.1; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 5.09 S/m; ε_r = 33.8; 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)

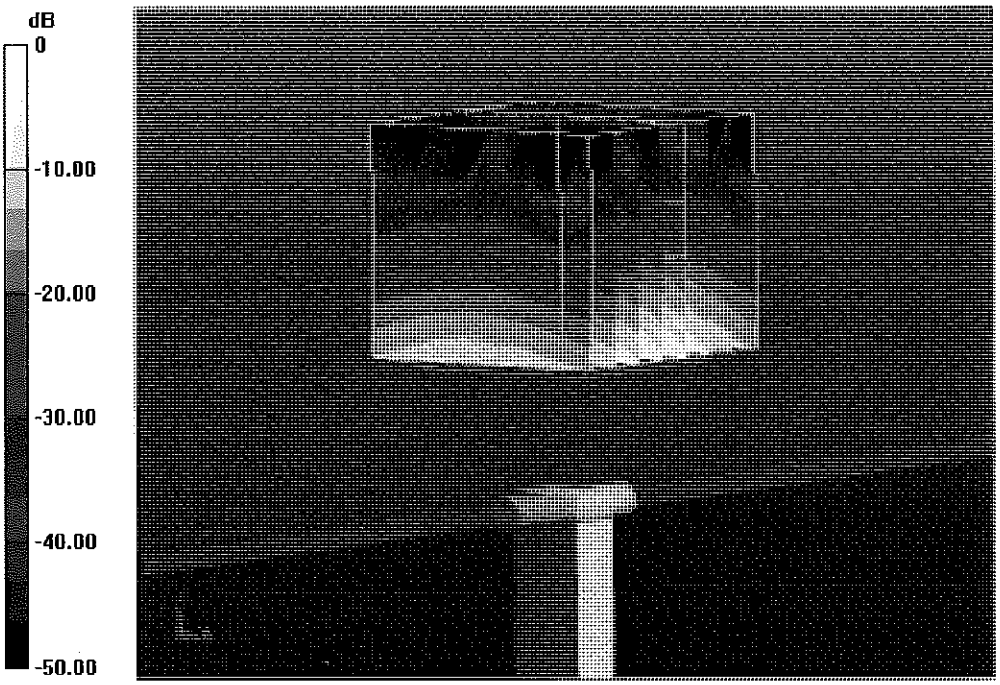
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.671 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 29.4 W/kg
SAR(1 g) = 7.66 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 18.5 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.473 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 30.3 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 18.8 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.735 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 33.2 W/kg
SAR(1 g) = 8.09 W/kg; SAR(10 g) = 2.28 W/kg
Maximum value of SAR (measured) = 20.1 W/kg

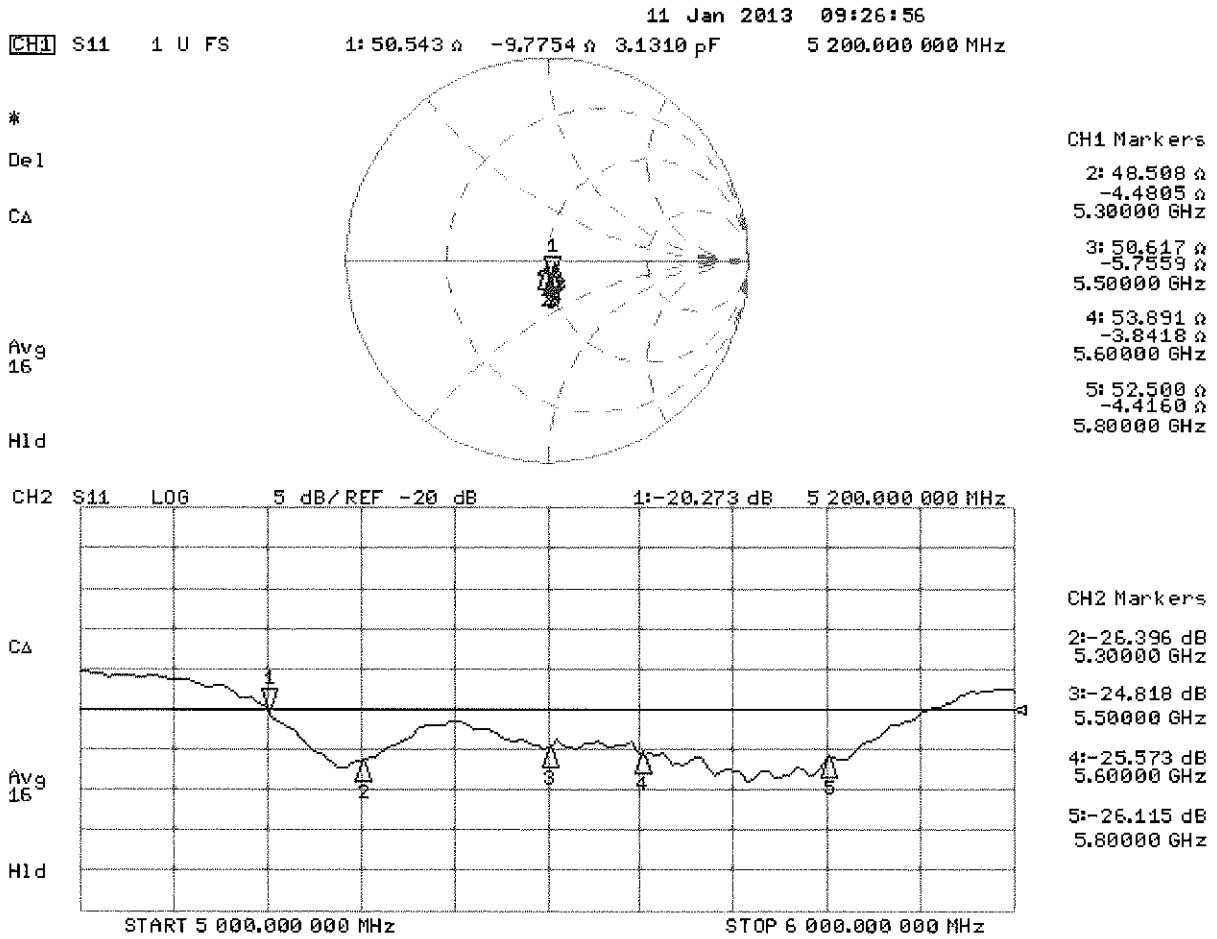
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.848 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 8.12 W/kg; SAR(10 g) = 2.3 W/kg
Maximum value of SAR (measured) = 20.2 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 = 60.467 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 33.3 W/kg
SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.17 W/kg
Maximum value of SAR (measured) = 19.4 W/kg



0 dB = 19.4 W/kg = 12.88 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1057

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 = 5.42 S/m; ε_r = 47; ρ = 1000 kg/m^3 , Medium parameters used: f = 5300 MHz; σ = 5.55 S/m; ε_r = 46.8; ρ = 1000 kg/m^3 , Medium parameters used: f = 5500 MHz; σ = 5.81 S/m; ε_r = 46.5; ρ = 1000 kg/m^3 , Medium parameters used: f = 5600 MHz; σ = 5.94 S/m; ε_r = 46.3; ρ = 1000 kg/m^3 , Medium parameters used: f = 5800 MHz; σ = 6.21 S/m; ε_r = 46; 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)

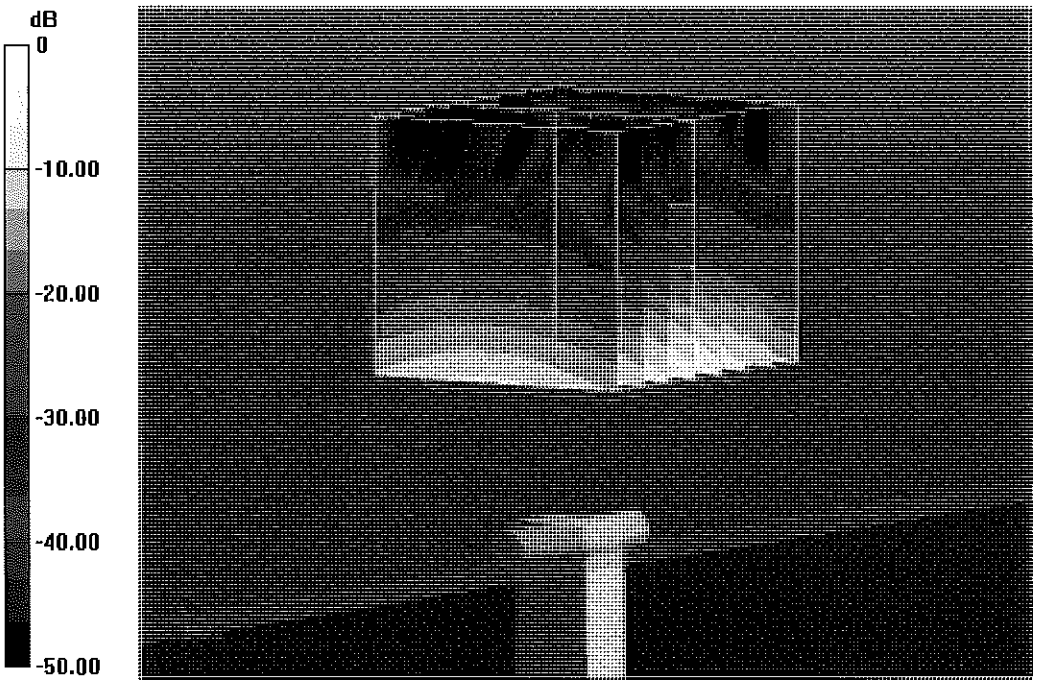
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.074 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 30.4 W/kg
SAR(1 g) = 7.61 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.924 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 30.9 W/kg
SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.13 W/kg
Maximum value of SAR (measured) = 17.9 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 = 59.561 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 35.3 W/kg
SAR(1 g) = 8.14 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 19.7 W/kg

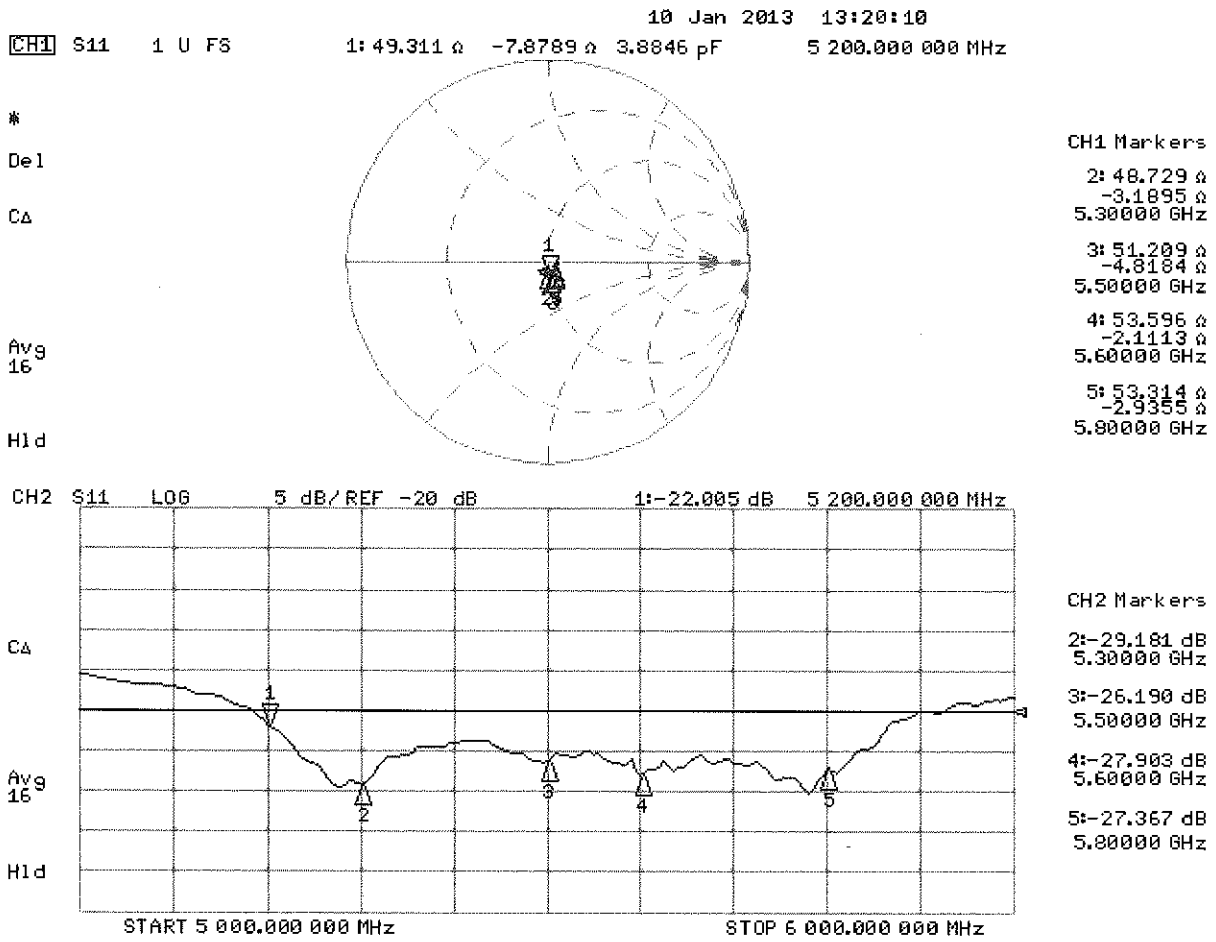
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.884 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 36.3 W/kg
SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.25 W/kg
Maximum value of SAR (measured) = 20.0 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 55.753 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 35.6 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.09 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg = 12.76 dBW/kg

Impedance Measurement Plot for Body TSL



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

S Schweizerischer Kalibrierdienst
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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: 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

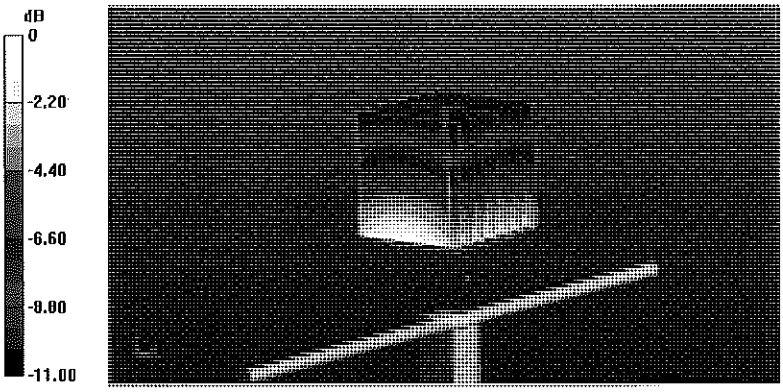
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.94 S/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

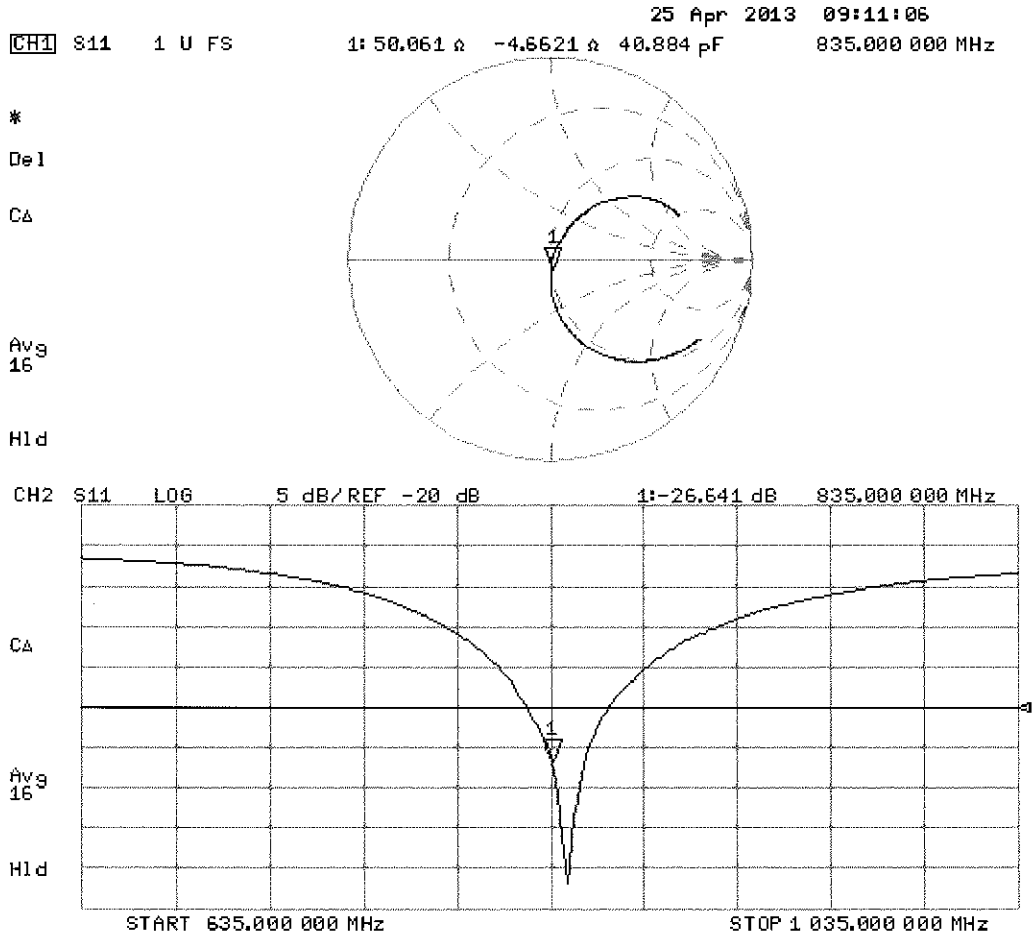
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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

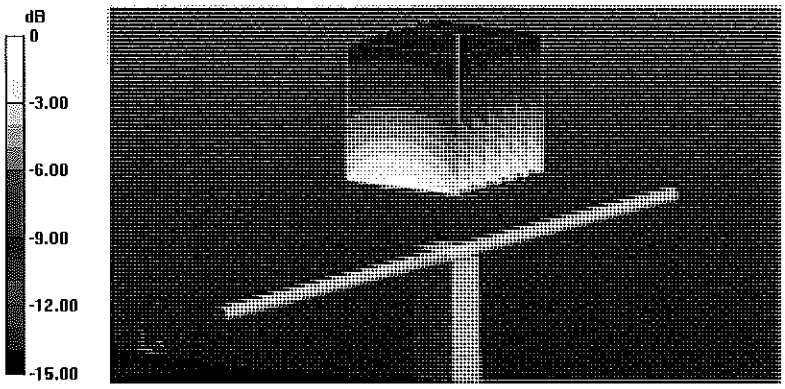
Communication System: UID 0 - CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1.01 S/m; ε_r = 54; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

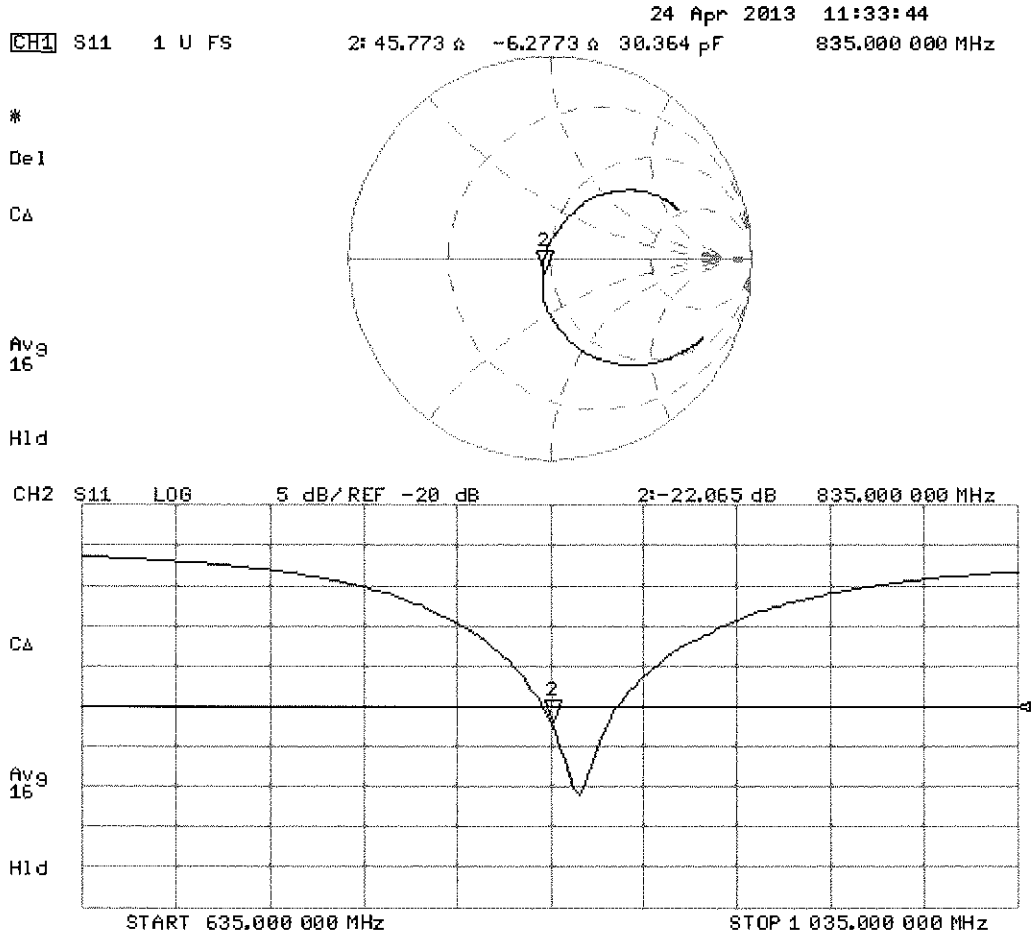
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

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
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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: D835V2-4d132_Jan13

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d132
Calibration procedure(s)	QA CAL-05.v9 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 07, 2013

✓ KOK 1/28/13

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: January 8, 2013

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Glossary:

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

Calibration is Performed According to the Following Standards:

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	V52.8.4
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	42.0 ± 6 %	0.92 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	2.45 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.66 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.29 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	54.7 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.38 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.36 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.20 W/kg ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.2 Ω + 1.3 jΩ
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.8 Ω - 1.3 jΩ
Return Loss	- 34.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.391 ns

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	July 22, 2011

DASY5 Validation Report for Head TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

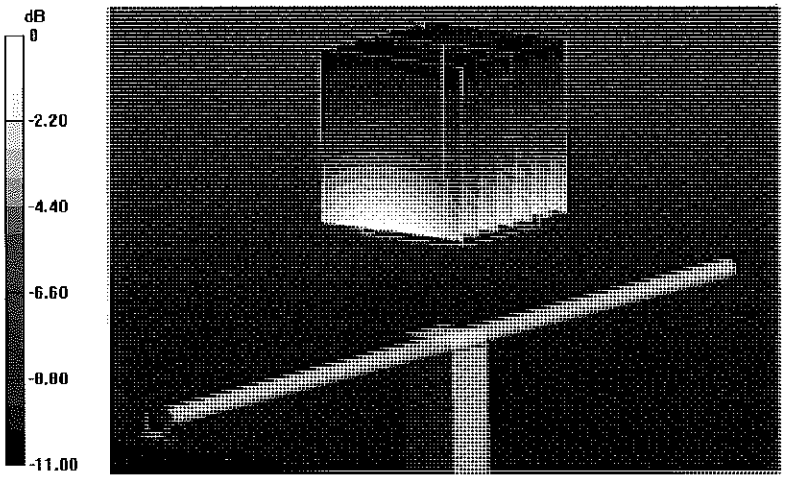
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.92 S/m; ε_r = 42; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

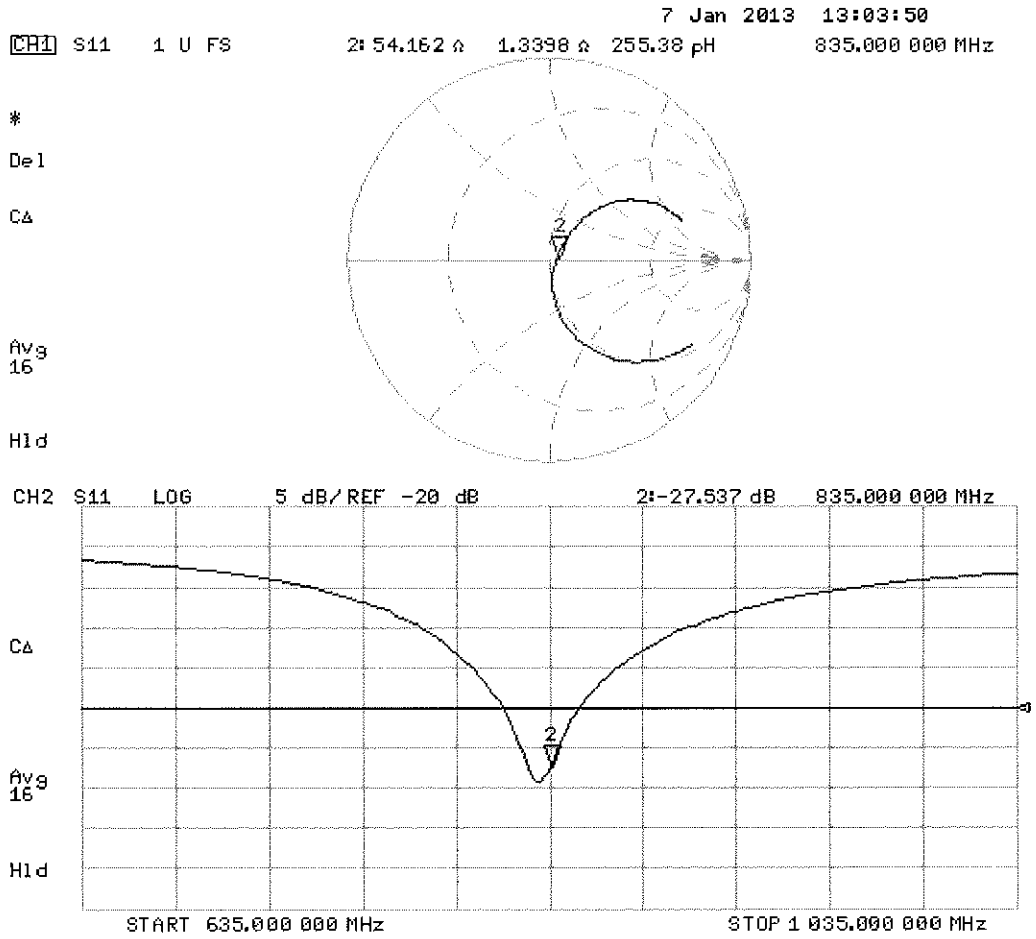
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.542 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.71 W/kg
SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.59 W/kg
Maximum value of SAR (measured) = 2.88 W/kg



0 dB = 2.88 W/kg = 4.59 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 07.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

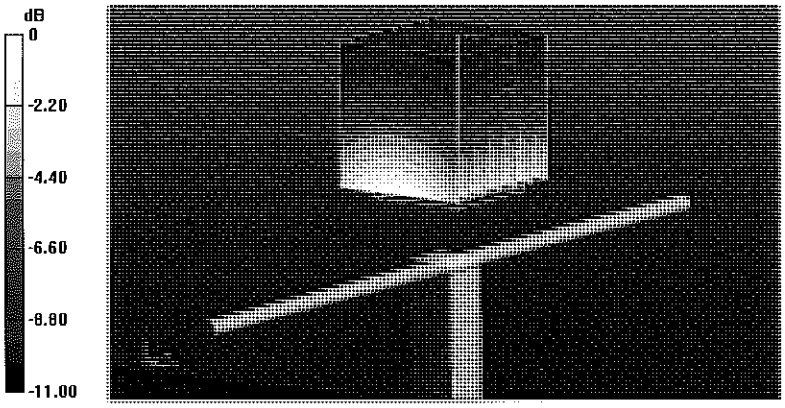
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ε_r = 54.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

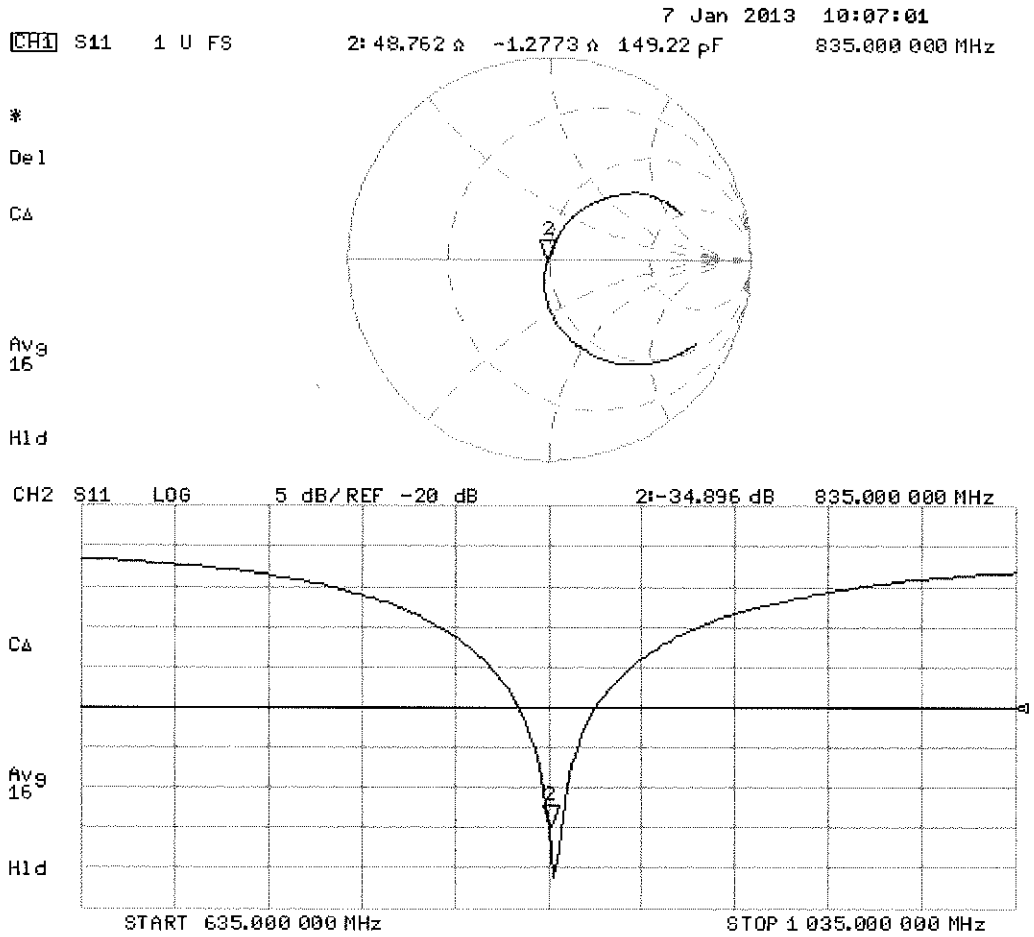
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.512 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 3.47 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.57 W/kg
Maximum value of SAR (measured) = 2.77 W/kg



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

Impedance Measurement Plot for Body TSL



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

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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: D835V2-4d026_Aug12

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d026
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	August 23, 2012

KOK 9/17/12

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
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-11)	In house check: Oct-12

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

Issued: August 23, 2012

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	V52.8.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.3 ± 6 %	0.90 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	2.35 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**9.39 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.53 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**6.12 mW /g ± 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	53.2 ± 6 %	1.00 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.47 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**9.58 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.62 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**6.33 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7 Ω - 3.4 jΩ
Return Loss	- 26.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω - 4.8 jΩ
Return Loss	- 26.4 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.389 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	December 17, 2004

DASY5 Validation Report for Head TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

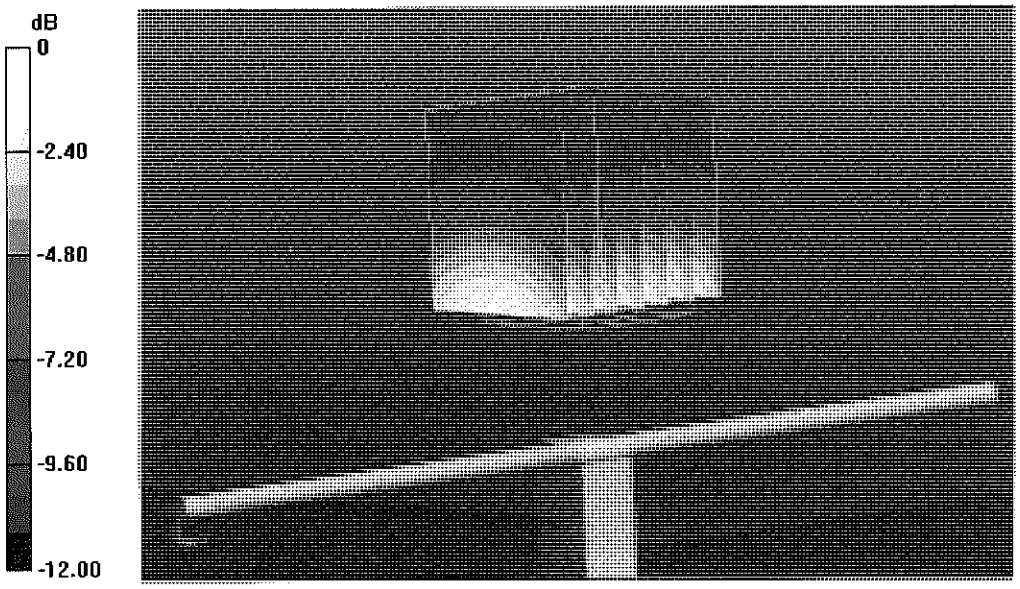
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.9 mho/m; ε_r = 41.3; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

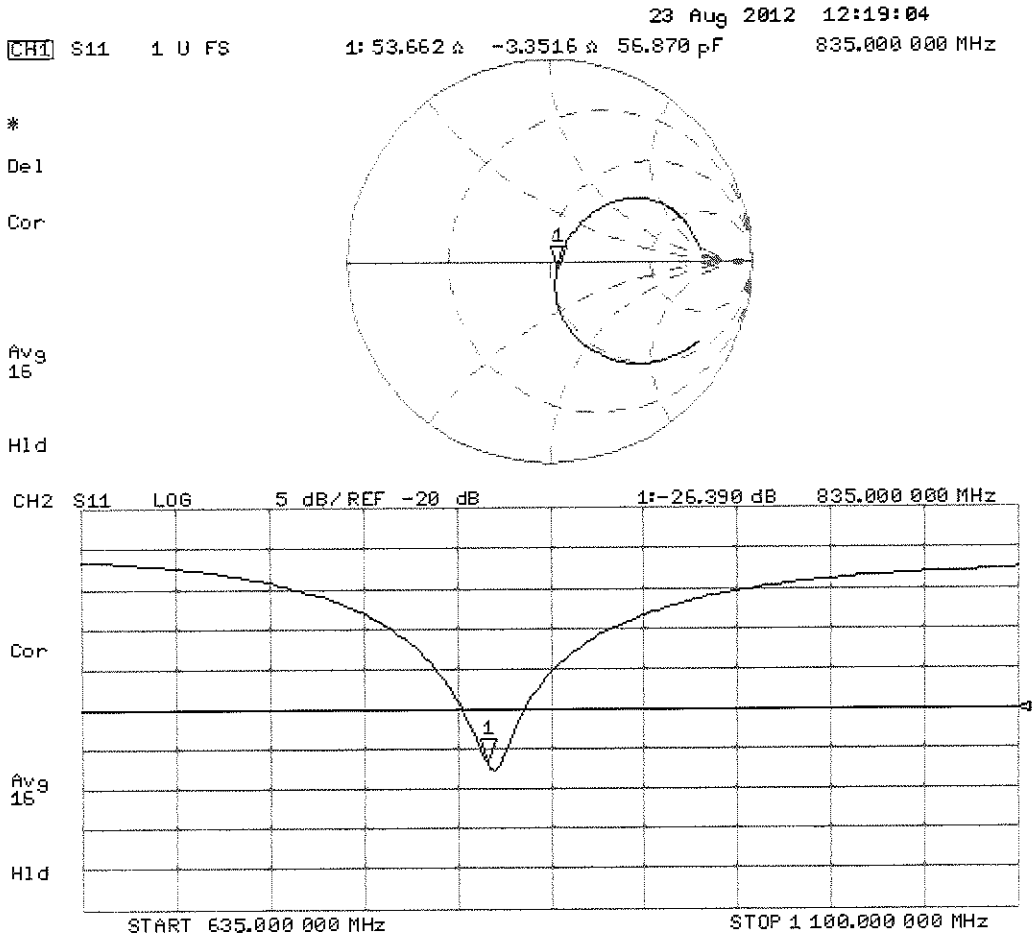
Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm 2/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.824 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 3.482 mW/g
SAR(1 g) = 2.35 mW/g; SAR(10 g) = 1.53 mW/g
Maximum value of SAR (measured) = 2.72 W/kg



0 dB = 2.72 W/kg = 8.69 dB W/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.08.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d026

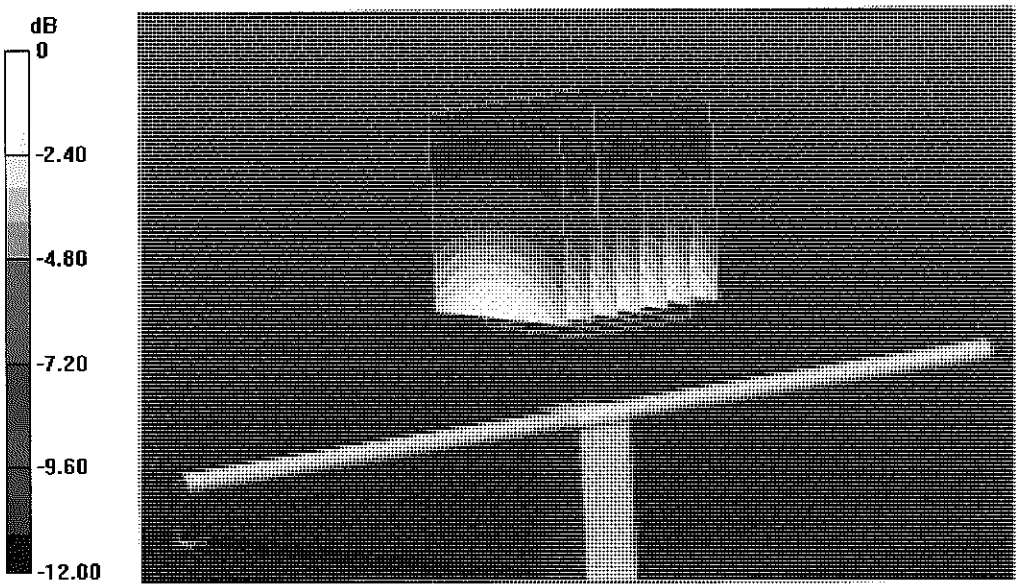
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 1 mho/m; ε_r = 53.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.2(969); SEMCAD X 14.6.6(6824)

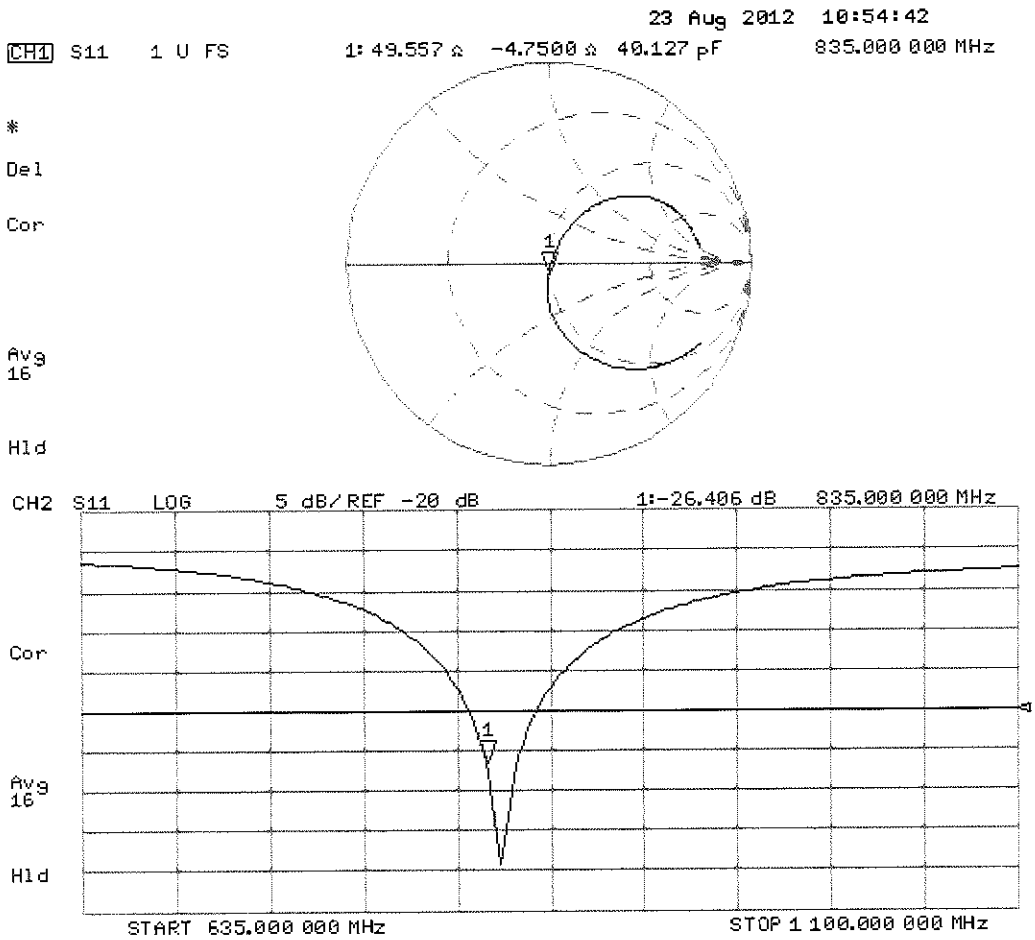
Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.339 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 3.592 mW/g
SAR(1 g) = 2.47 mW/g; SAR(10 g) = 1.62 mW/g
Maximum value of SAR (measured) = 2.87 W/kg



0 dB = 2.87 W/kg = 9.16 dB W/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_Aug12

CALIBRATION CERTIFICATE

Object	ES3DV2 - SN:3022
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	August 28, 2012

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 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	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

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

Issued: August 28, 2012

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	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, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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 28, 2012

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]	98.3	99.5	101.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	133.3	±2.7 %
			Y	0.00	0.00	1.00	140.3	
			Z	0.00	0.00	1.00	178.9	

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 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	6.30	6.30	6.30	0.30	1.72	± 12.0 %
835	41.5	0.90	6.03	6.03	6.03	0.35	1.63	± 12.0 %
1750	40.1	1.37	5.07	5.07	5.07	0.32	1.89	± 12.0 %
1900	40.0	1.40	4.86	4.86	4.86	0.40	1.57	± 12.0 %
2450	39.2	1.80	4.23	4.23	4.23	0.59	1.44	± 12.0 %
2600	39.0	1.96	4.10	4.10	4.10	0.67	1.37	± 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

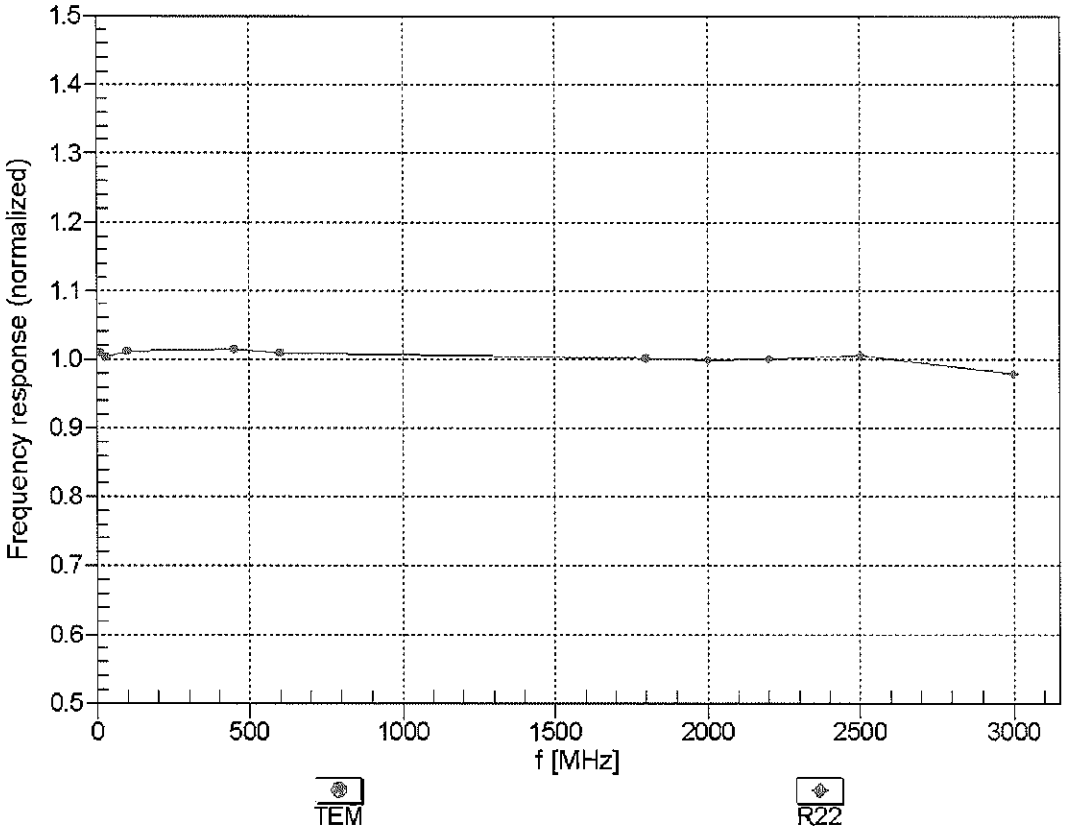
Calibration Parameter Determined in Body Tissue Simulating Media

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	6.07	6.07	6.07	0.23	2.09	± 12.0 %
835	55.2	0.97	6.02	6.02	6.02	0.47	1.44	± 12.0 %
1750	53.4	1.49	4.70	4.70	4.70	0.46	1.55	± 12.0 %
1900	53.3	1.52	4.43	4.43	4.43	0.36	1.87	± 12.0 %
2450	52.7	1.95	3.97	3.97	3.97	0.65	1.06	± 12.0 %
2600	52.5	2.16	3.80	3.80	3.80	0.54	0.75	± 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

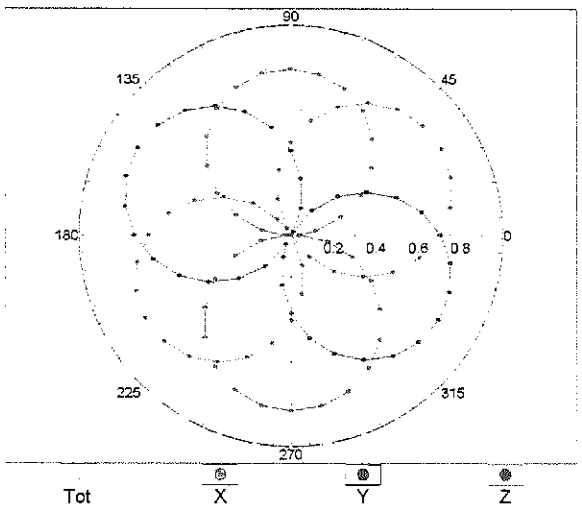
(TEM-Cell:ifi110 EXX, Waveguide: R22)



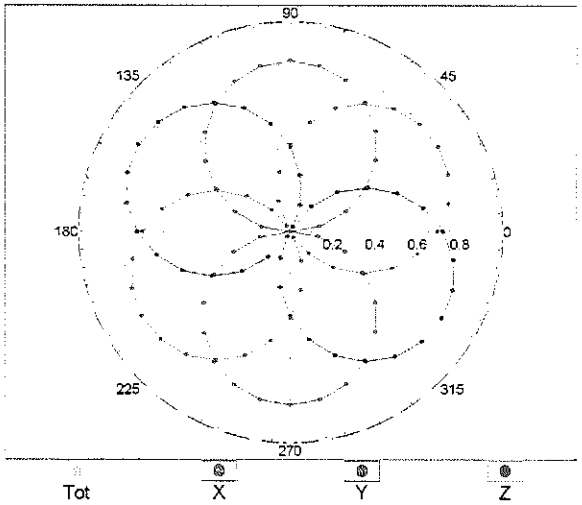
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

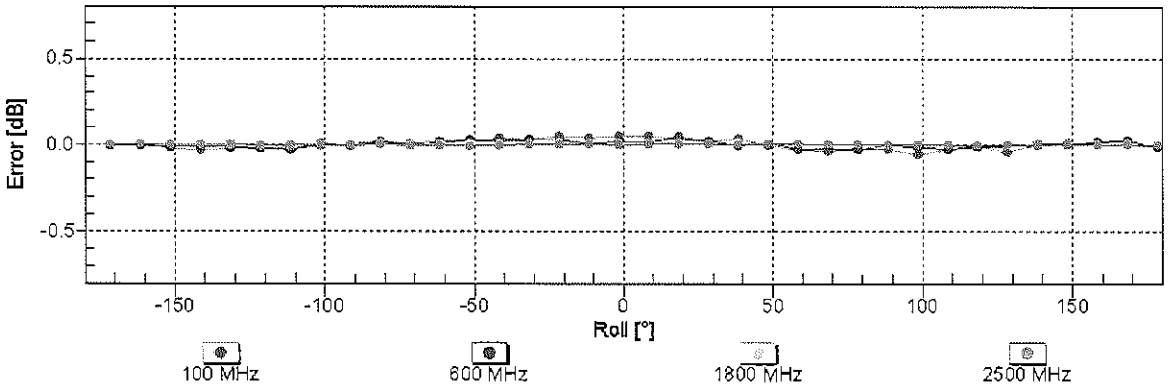
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



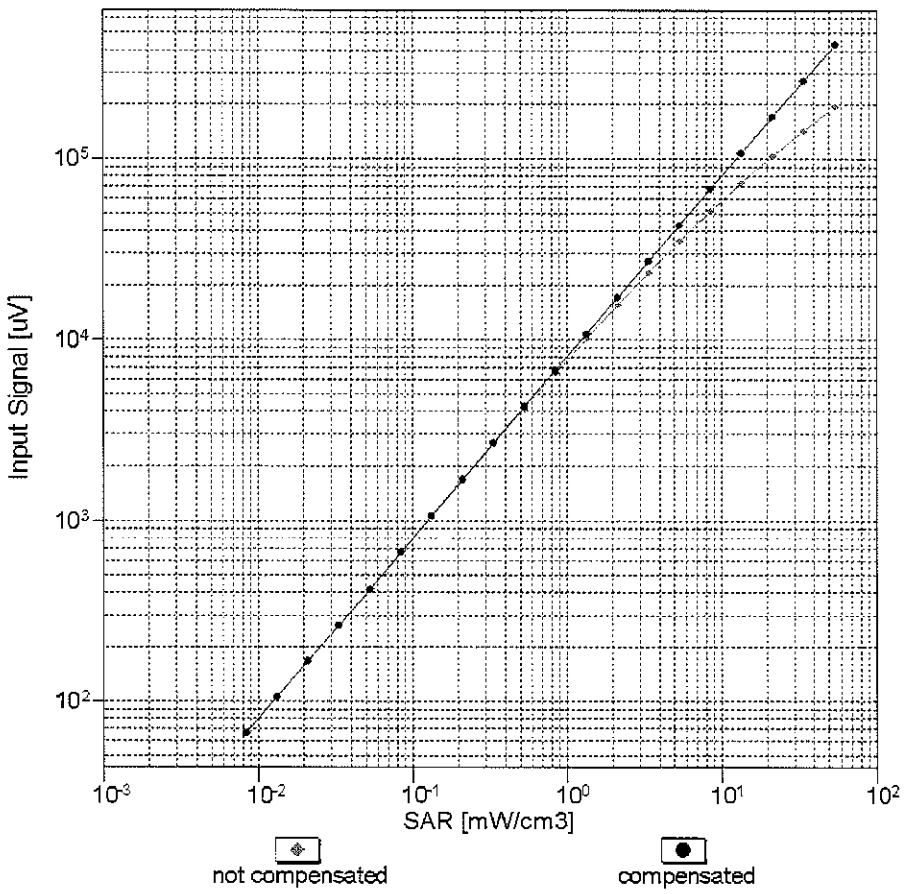
f=1800 MHz,R22

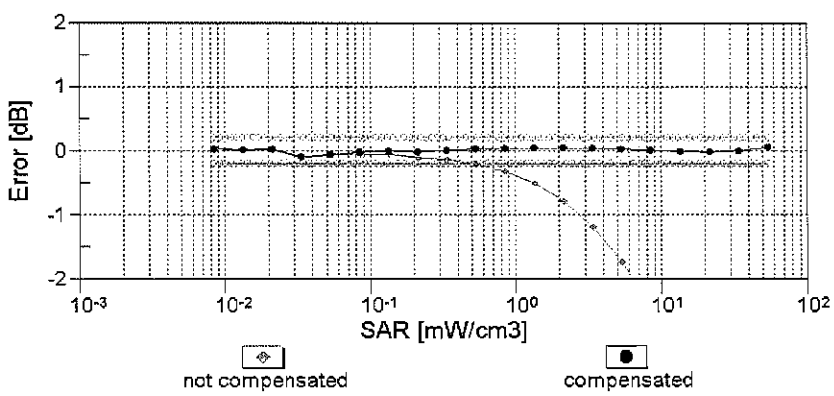




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

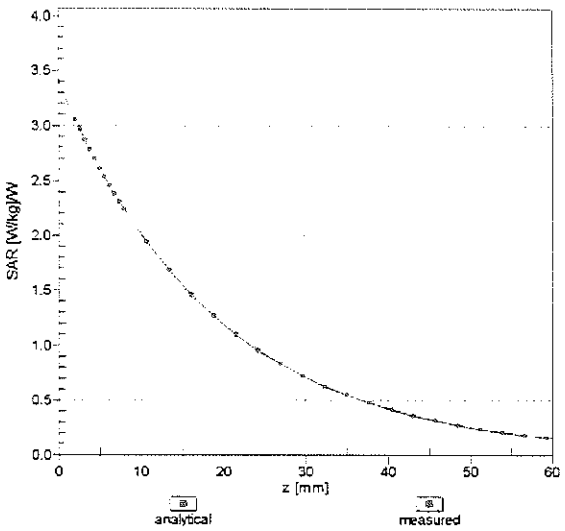




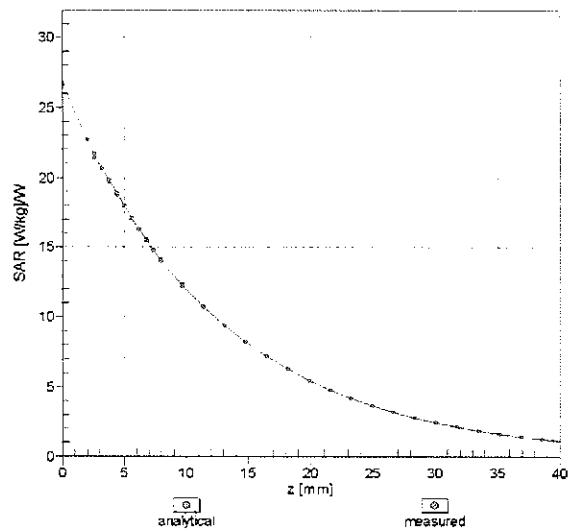
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

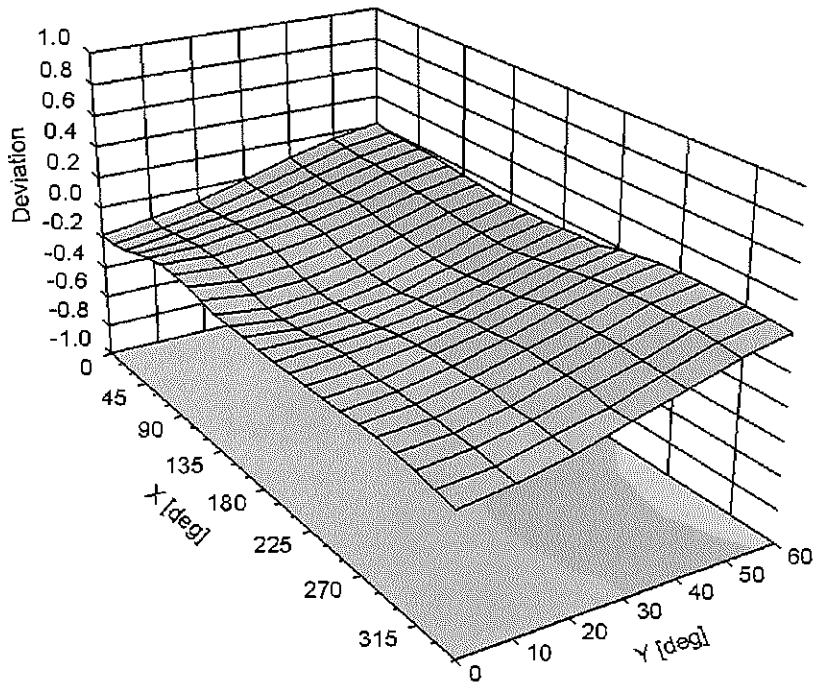


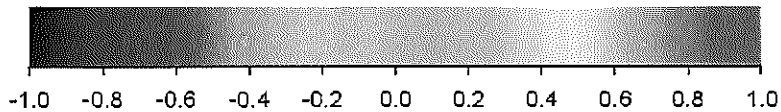
f = 1750 MHz,WGLS R22 (H_convF)



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 (°)	98.5
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
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 108

Client PC Test

Certificate No: ES3-3318_Apr13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3318
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	April 29, 2013

VCC 6/24/13

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

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

Calibration Equipment used (M&TE critical for calibration)

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

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

Issued: April 29, 2013

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 ES3DV3

SN:3318

Manufactured: January 10, 2012
Calibrated: April 29, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.15	0.92	1.29	± 10.1 %
DCP (mV)[B]	102.6	105.4	100.8	

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	153.6	±3.5 %
		Y	0.0	0.0	1.0		133.8	
		Z	0.0	0.0	1.0		154.8	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

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	6.59	6.59	6.59	0.25	2.12	± 12.0 %
850	41.5	0.92	6.33	6.33	6.33	0.57	1.25	± 12.0 %
1900	40.0	1.40	5.22	5.22	5.22	0.79	1.25	± 12.0 %
2450	39.2	1.80	4.59	4.59	4.59	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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3318

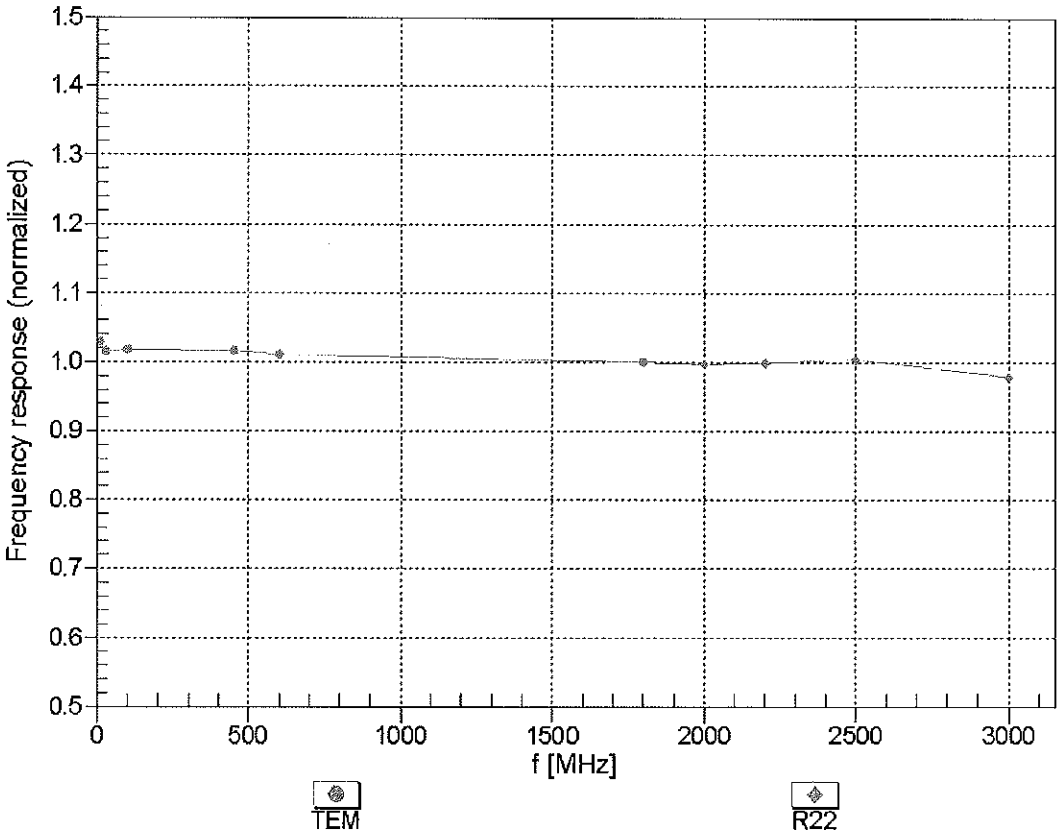
Calibration Parameter Determined in Body Tissue Simulating Media

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	6.35	6.35	6.35	0.53	1.42	± 12.0 %
850	55.2	0.99	6.21	6.21	6.21	0.57	1.38	± 12.0 %
1900	53.3	1.52	4.79	4.79	4.79	0.46	1.77	± 12.0 %
2450	52.7	1.95	4.31	4.31	4.31	0.80	1.09	± 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

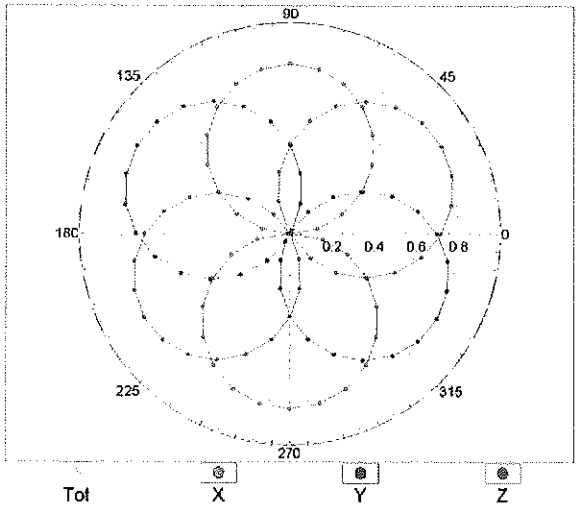
(TEM-Cell:ifi110 EXX, Waveguide: R22)



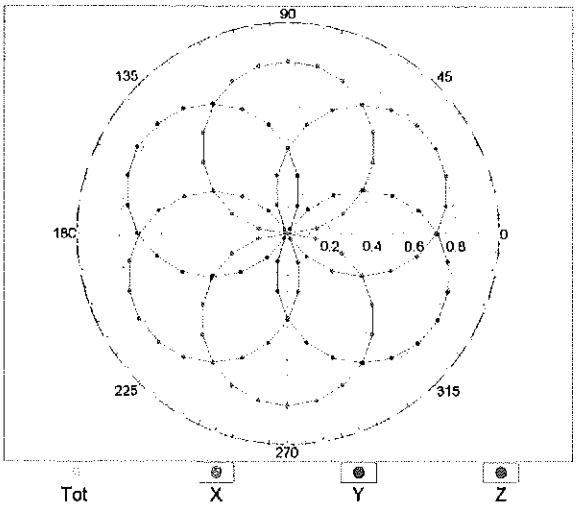
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

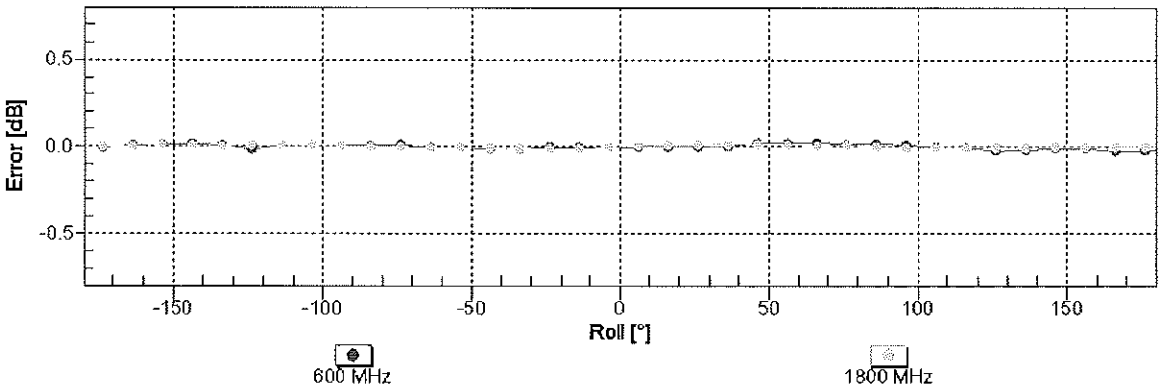
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



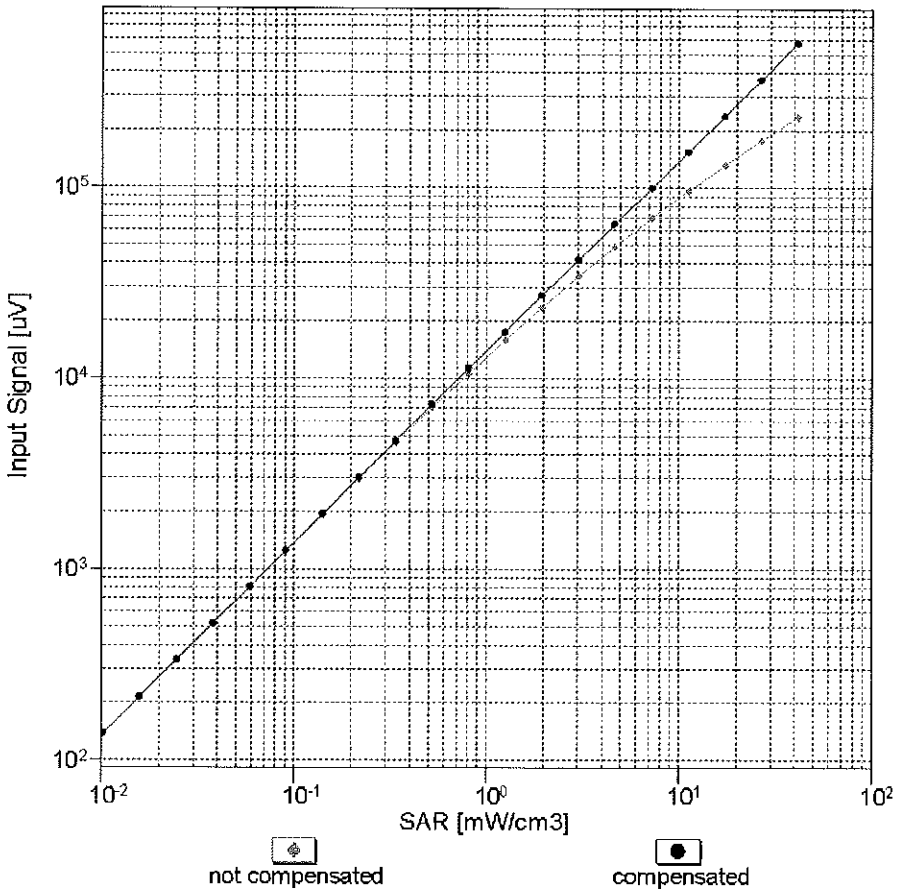
f=1800 MHz,R22

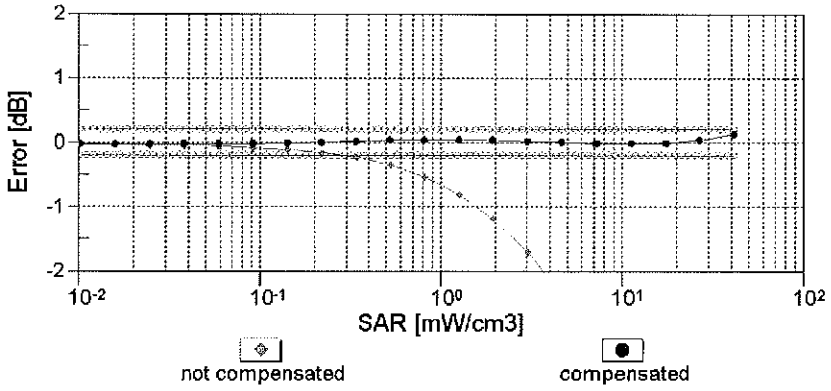




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

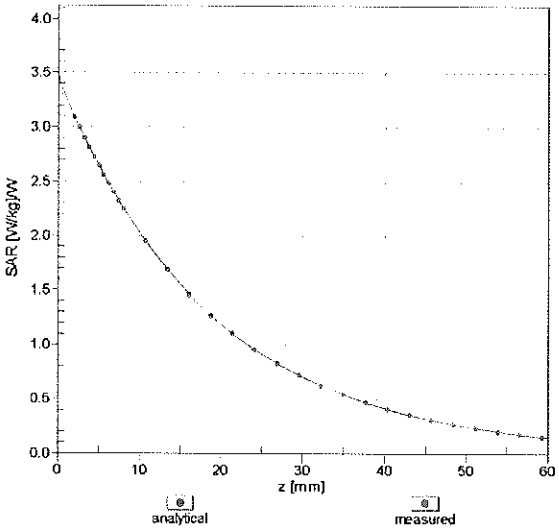




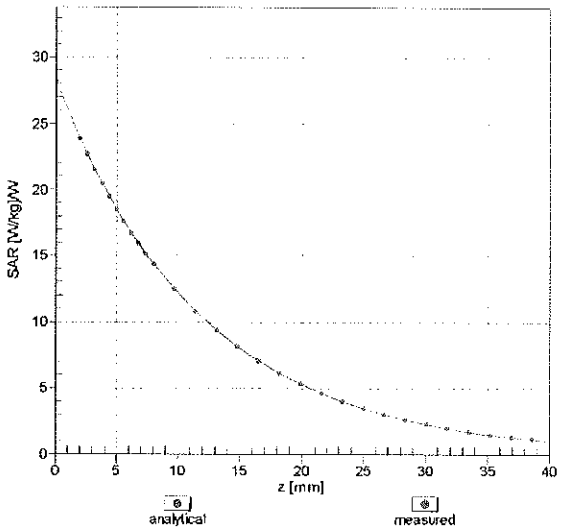
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

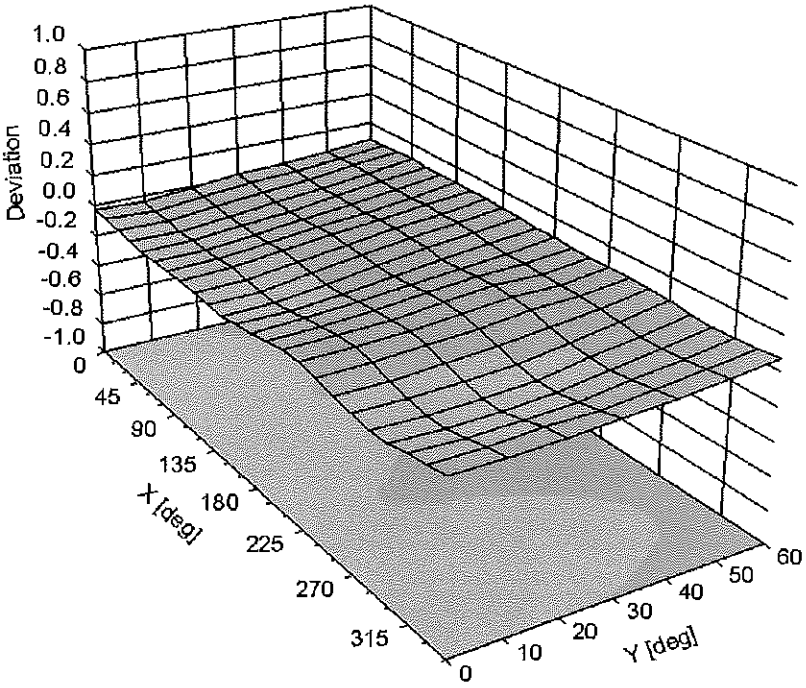


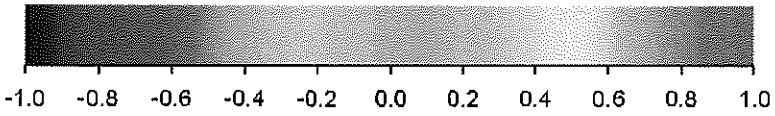
f = 1900 MHz,WGLS R22 (H_convF)



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:3318

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-103.8
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

Schmid & Partner Engineering AG

s p e a g

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Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors

for Dosimetric E-Field Probe

Type:	**ES3DV3**
Serial Number:	**3318**
Place of Assessment:	**Zurich**
Date of Assessment:	**June 19, 2013**
Probe Calibration Date:	**April 29, 2013**

J Kot 6/25/13

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

Assessed by:

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV3 SN:3318

Conversion factor (± standard deviation)

1750 ± 50 MHz	*ConvF*	**5.59 ± 7%**	**ε_r = 40.1 ± 5%** **σ = 1.37 ± 5% mho/m** (head tissue)
1750 ± 50 MHz	*ConvF*	**5.22 ± 7%**	**ε_r = 53.4 ± 5%** **σ = 1.49 ± 5% mho/m** (body tissue)

Important Note:

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

Please see also DASY Manual.

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: ES3-3209_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.

80244

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

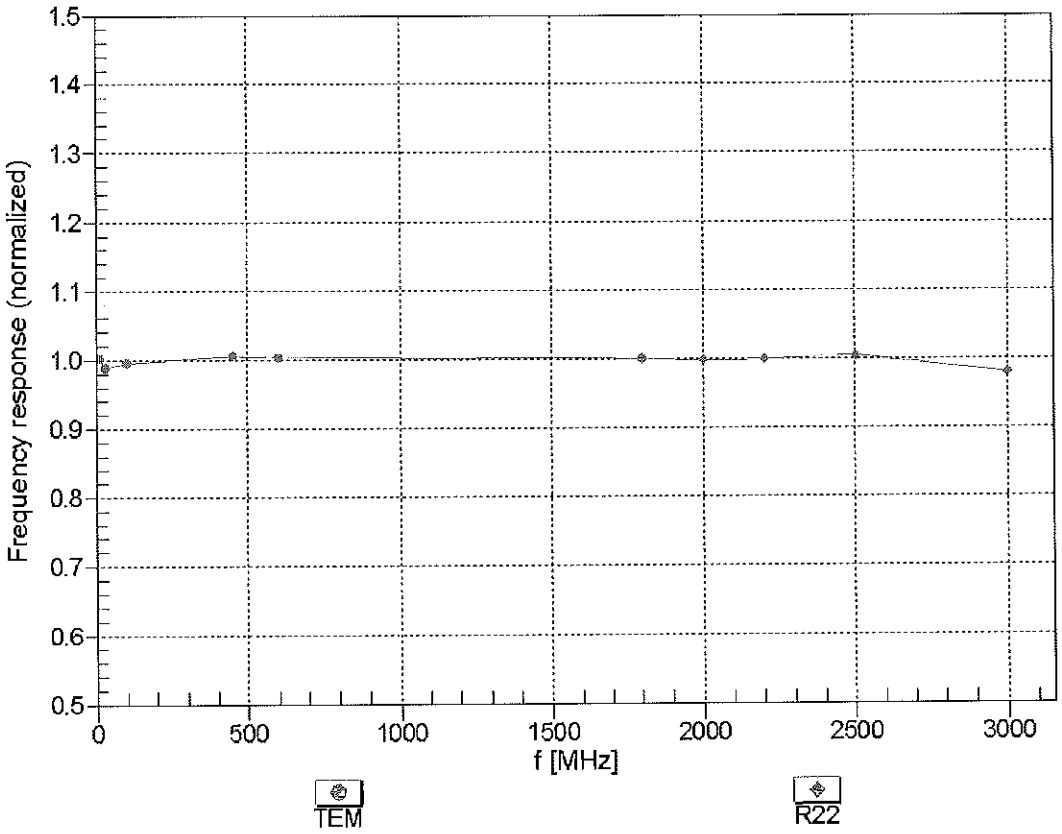
Calibration Parameter Determined in Body Tissue Simulating Media

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

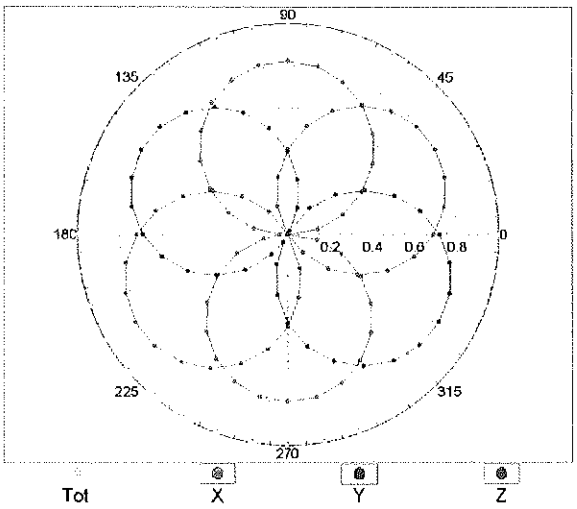
(TEM-Cell:ifi110 EXX, Waveguide: R22)



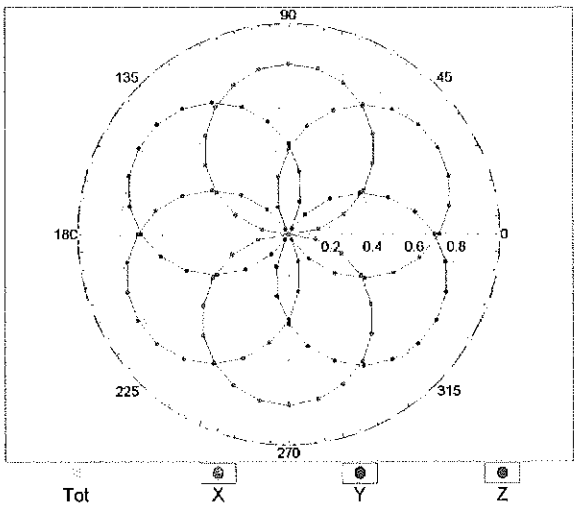
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

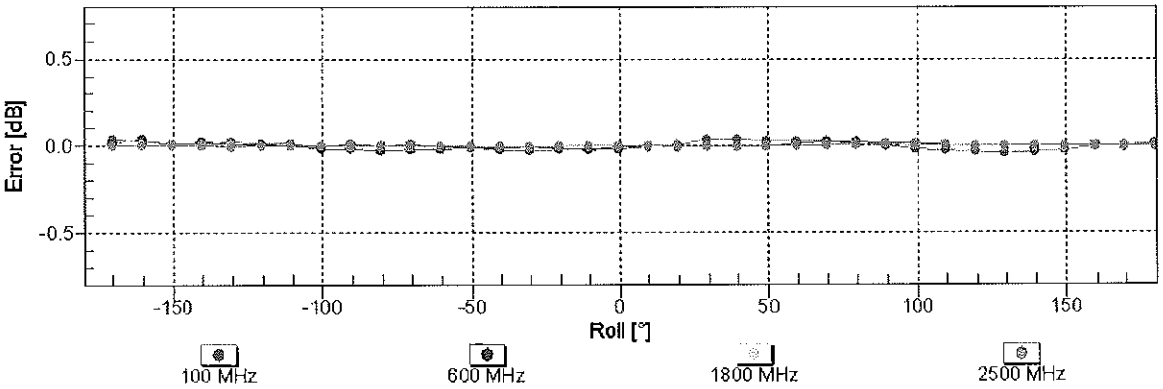
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



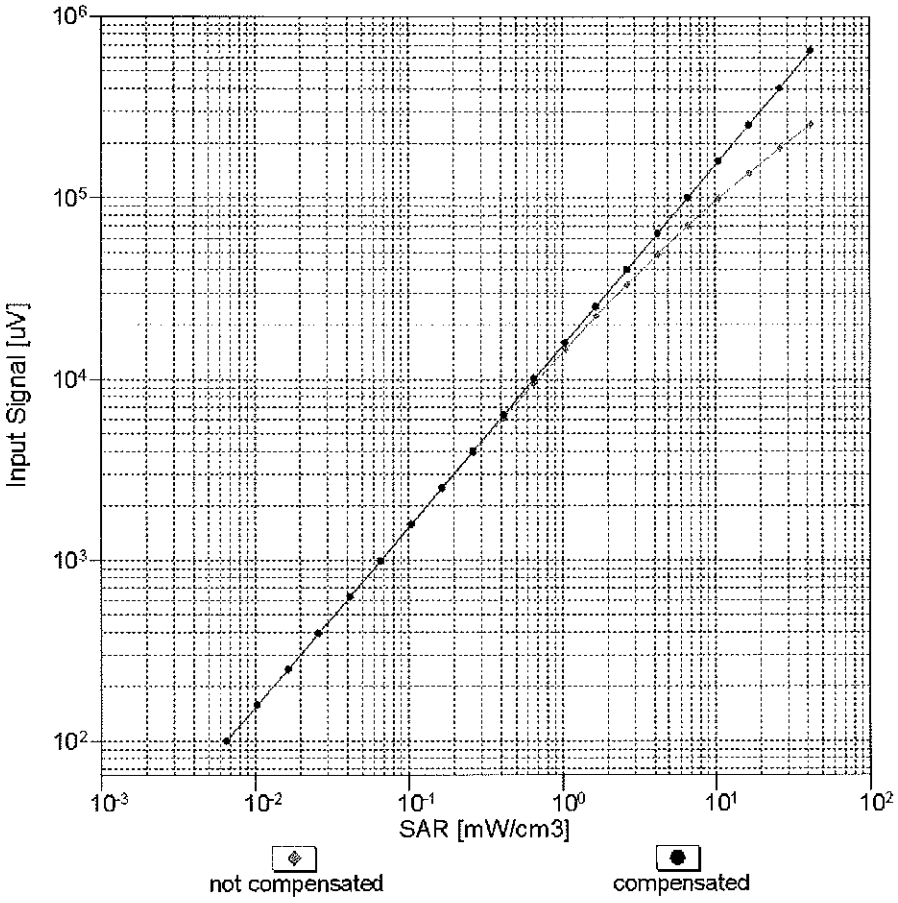
f=1800 MHz,R22

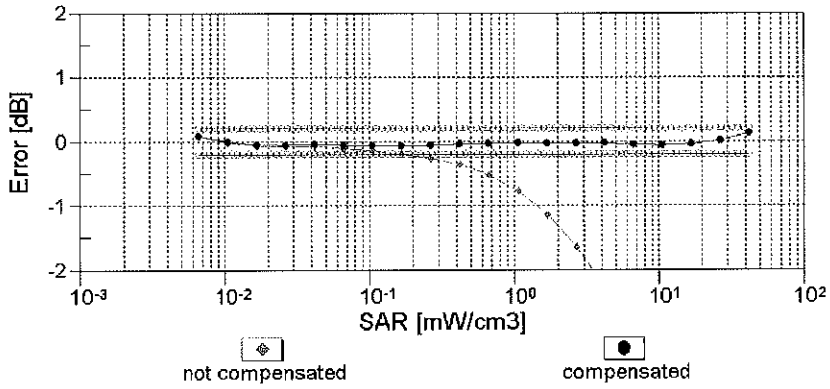




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

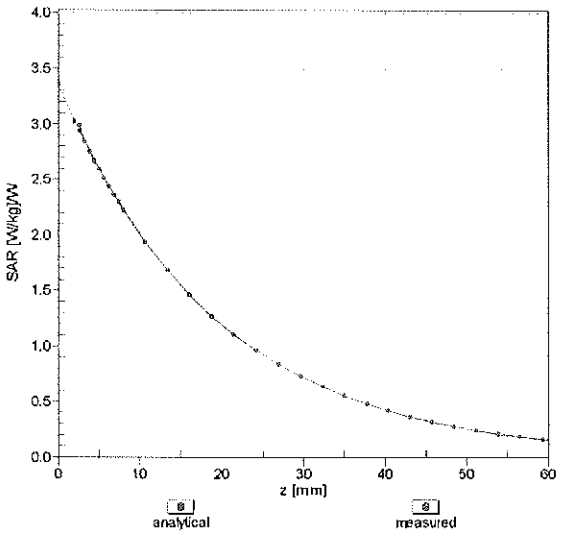




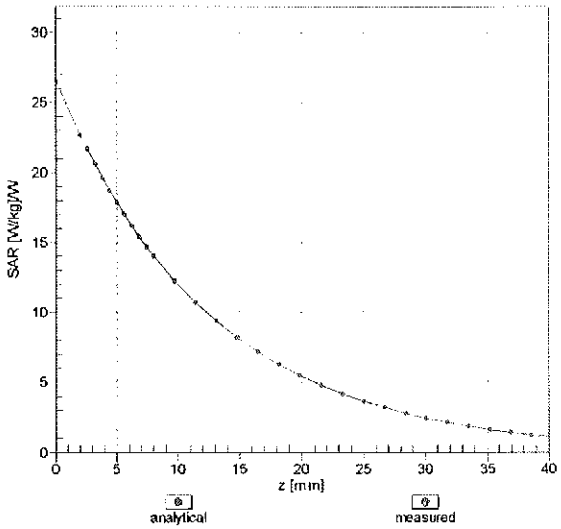
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

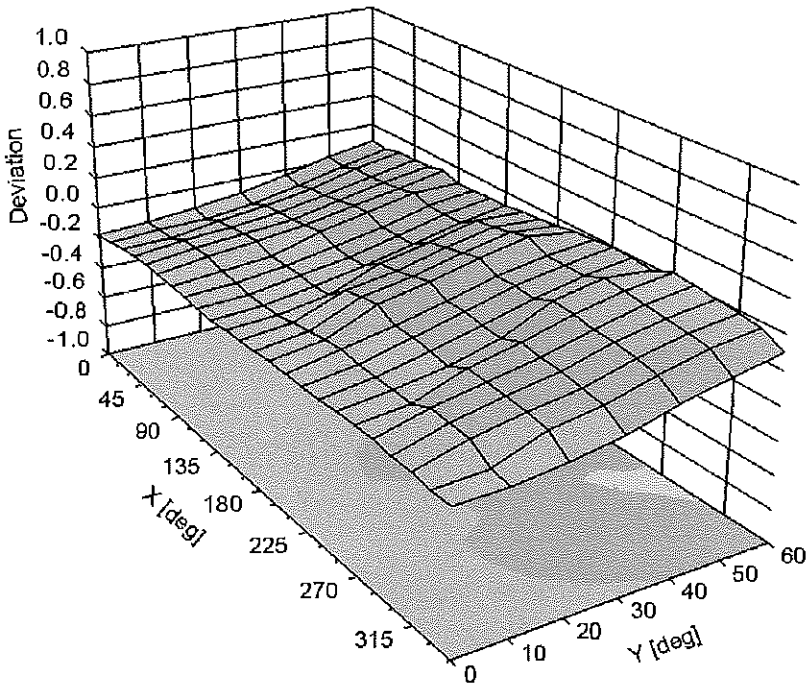


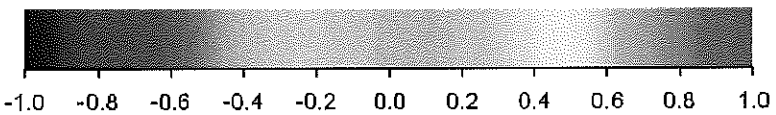
f = 1750 MHz,WGLS R22 (H_convF)



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
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: ES3-3263_May13

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3263
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	May 16, 2013

✓ KOK 5/23/13

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:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 17, 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 ES3DV3

SN:3263

Manufactured: January 25, 2010
Calibrated: May 16, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.21	1.25	1.12	± 10.1 %
DCP (mV)[B]	101.2	100.2	103.7	

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	156.5	±2.5 %
		Y	0.0	0.0	1.0		153.2	
		Z	0.0	0.0	1.0		147.2	

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:3263

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	6.51	6.51	6.51	0.21	2.29	± 12.0 %
835	41.5	0.90	6.29	6.29	6.29	0.50	1.38	± 12.0 %
1750	40.1	1.37	5.30	5.30	5.30	0.45	1.54	± 12.0 %
1900	40.0	1.40	5.11	5.11	5.11	0.57	1.38	± 12.0 %
2450	39.2	1.80	4.47	4.47	4.47	0.59	1.49	± 12.0 %
2600	39.0	1.96	4.31	4.31	4.31	0.80	1.28	± 12.0 %

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

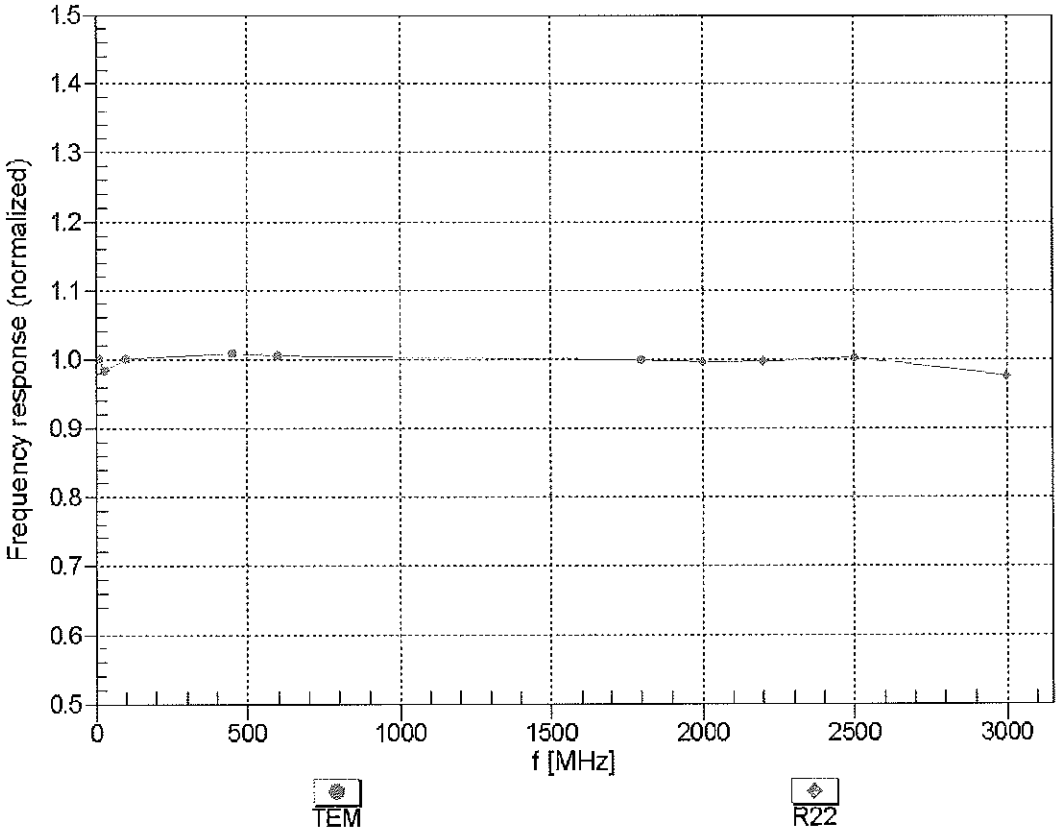
Calibration Parameter Determined in Body Tissue Simulating Media

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	6.37	6.37	6.37	0.34	1.82	± 12.0 %
835	55.2	0.97	6.29	6.29	6.29	0.54	1.39	± 12.0 %
1750	53.4	1.49	5.01	5.01	5.01	0.72	1.27	± 12.0 %
1900	53.3	1.52	4.78	4.78	4.78	0.53	1.56	± 12.0 %
2450	52.7	1.95	4.33	4.33	4.33	0.80	1.14	± 12.0 %
2600	52.5	2.16	4.14	4.14	4.14	0.80	1.02	± 12.0 %

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

Frequency Response of E-Field

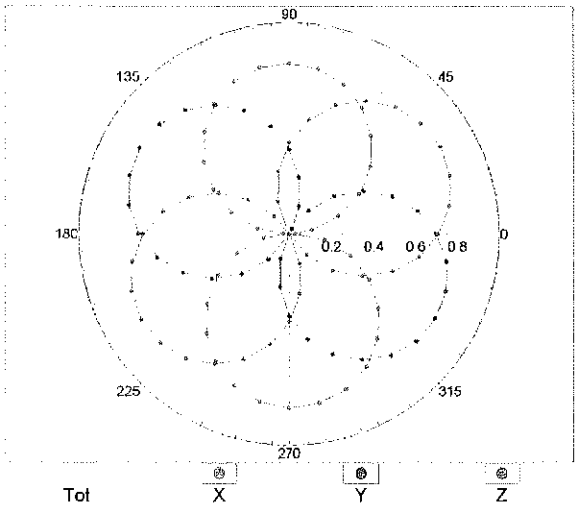
(TEM-Cell:ifi110 EXX, Waveguide: R22)



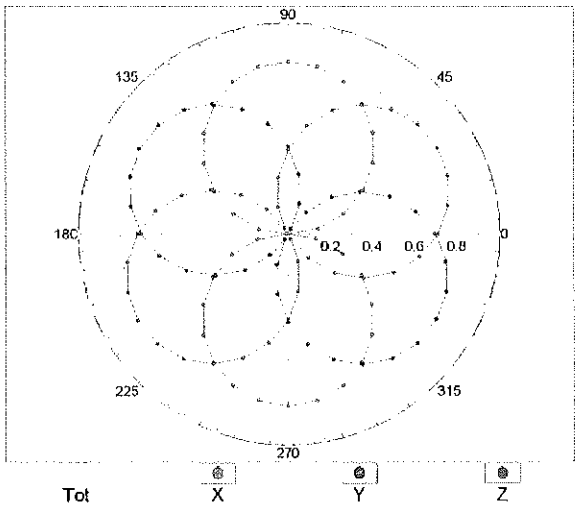
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

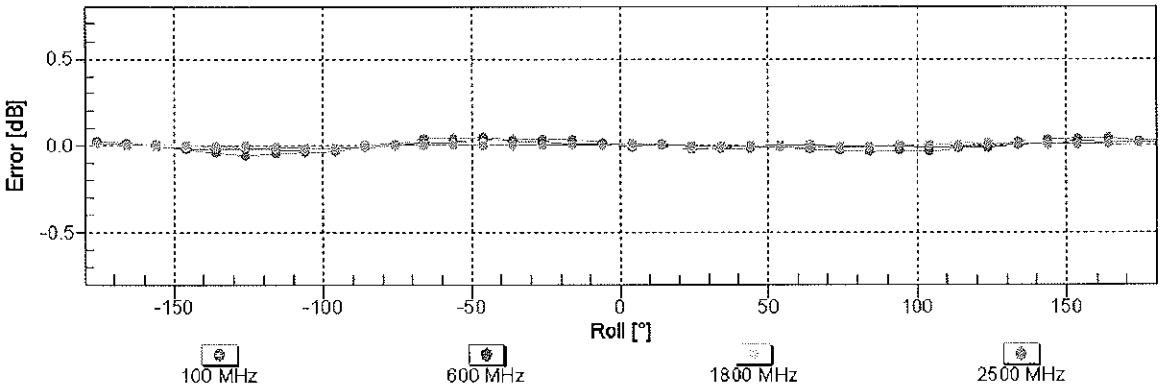
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



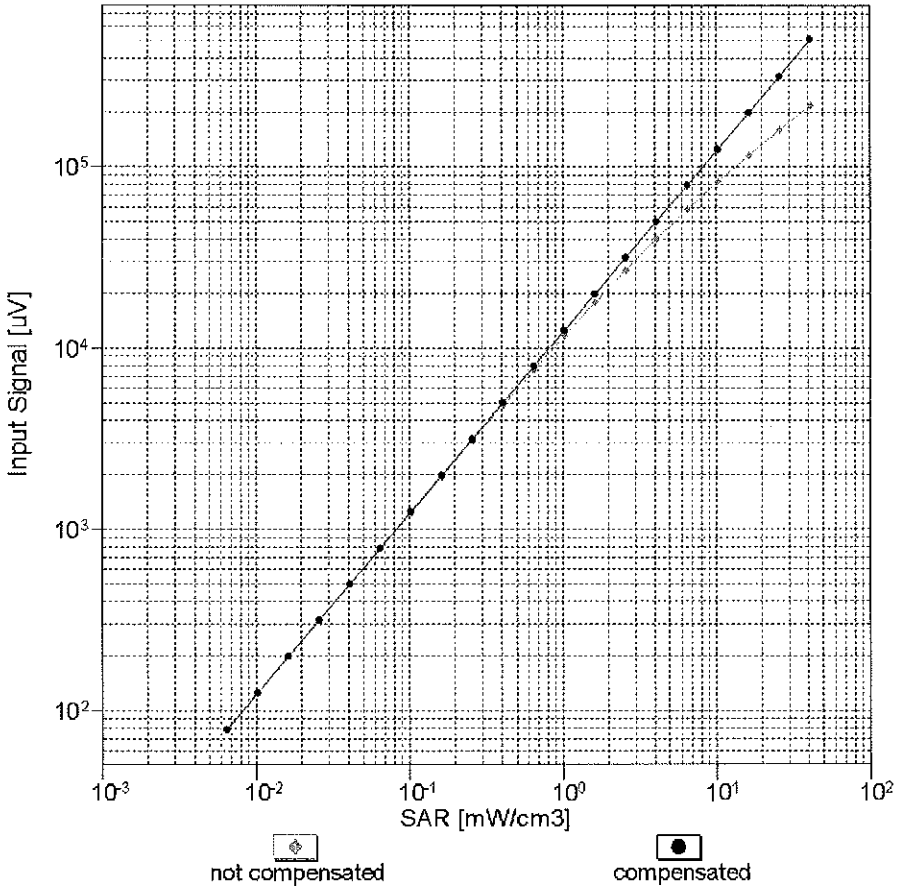
f=1800 MHz,R22

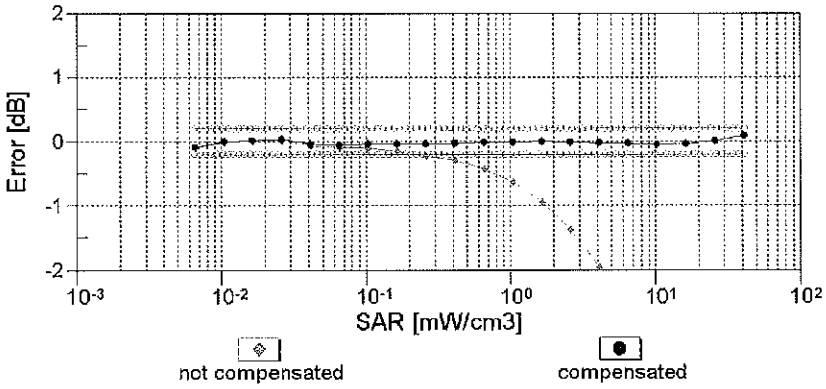




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

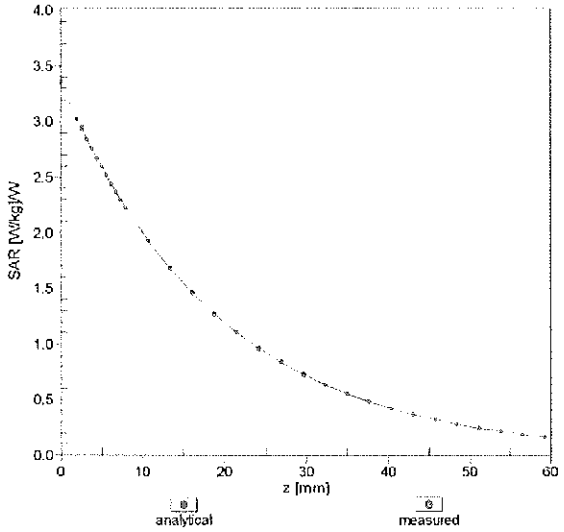




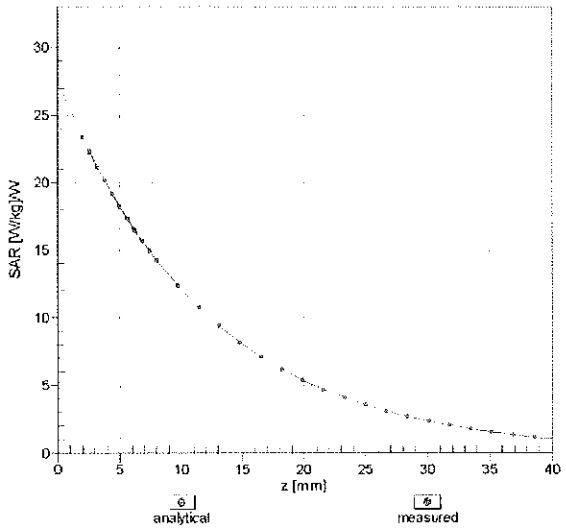
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

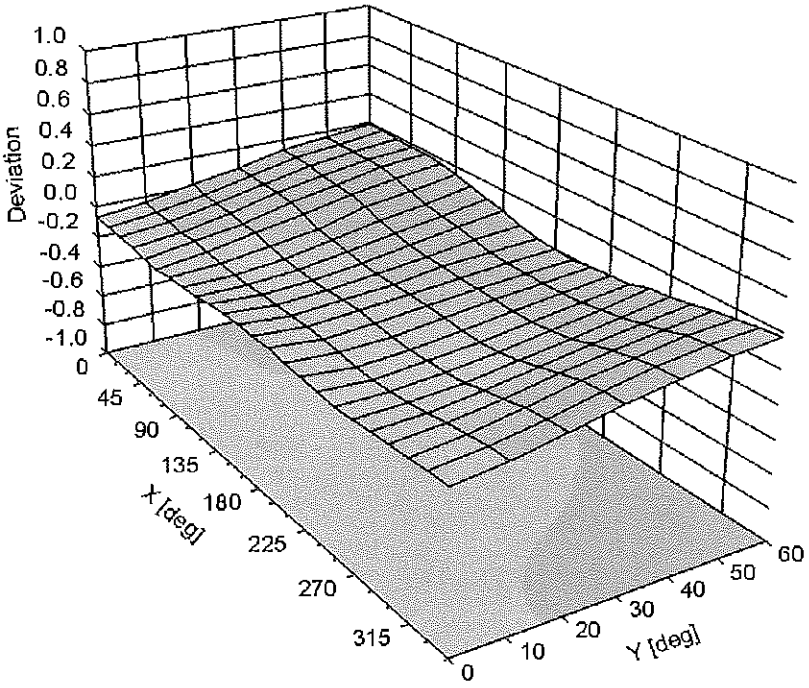


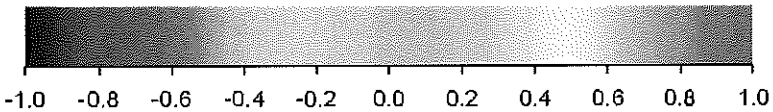
f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3263

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-116
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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S Swiss Calibration Service

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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: EX3-3920_Feb13/2

CALIBRATION CERTIFICATE (Replacement of No: EX3-3920_Feb13)

Object	EX3DV4 - SN:3920
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	February 27, 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%.

✓ KOK 3/22/13

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:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: March 5, 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 EX3DV4

SN:3920

Manufactured: December 18, 2012
Calibrated: February 27, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.34	0.50	0.50	± 10.1 %
DCP (mV)[B]	101.2	101.0	99.1	

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	134.3	±3.3 %
		Y	0.0	0.0	1.0		164.7	
		Z	0.0	0.0	1.0		161.4	

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: EX3DV4 - SN:3920

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	9.86	9.86	9.86	0.19	1.39	± 12.0 %
835	41.5	0.90	9.58	9.58	9.58	0.77	0.54	± 12.0 %
1750	40.1	1.37	7.97	7.97	7.97	0.57	0.69	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.54	0.73	± 12.0 %
2450	39.2	1.80	7.04	7.04	7.04	0.40	0.82	± 12.0 %
2600	39.0	1.96	6.80	6.80	6.80	0.49	0.76	± 12.0 %
5200	36.0	4.66	4.87	4.87	4.87	0.35	1.80	± 13.1 %
5300	35.9	4.76	4.73	4.73	4.73	0.37	1.80	± 13.1 %
5500	35.6	4.96	4.52	4.52	4.52	0.39	1.80	± 13.1 %
5600	35.5	5.07	4.17	4.17	4.17	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.02	4.02	4.02	0.45	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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3920

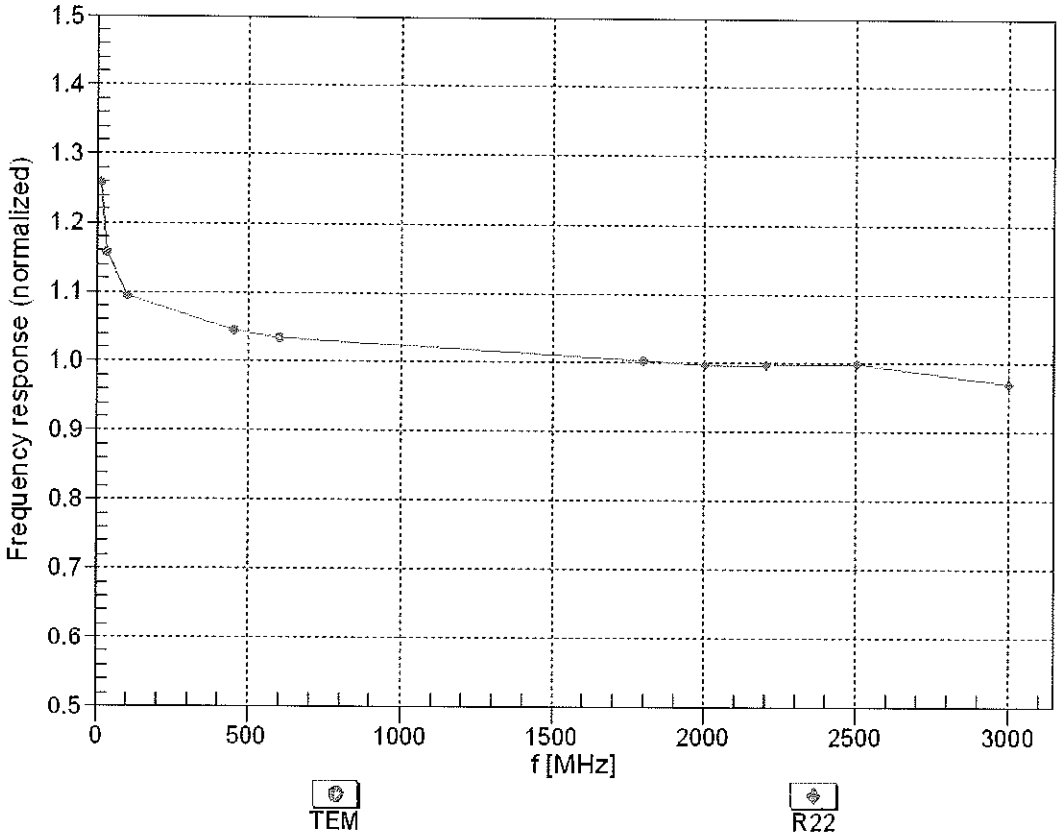
Calibration Parameter Determined in Body Tissue Simulating Media

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	9.57	9.57	9.57	0.43	0.83	± 12.0 %
835	55.2	0.97	9.42	9.42	9.42	0.36	0.98	± 12.0 %
1750	53.4	1.49	7.59	7.59	7.59	0.43	0.78	± 12.0 %
1900	53.3	1.52	7.38	7.38	7.38	0.33	0.91	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.55	± 12.0 %
2600	52.5	2.16	6.73	6.73	6.73	0.80	0.56	± 12.0 %
5200	49.0	5.30	4.23	4.23	4.23	0.51	1.90	± 13.1 %
5300	48.9	5.42	4.13	4.13	4.13	0.49	1.90	± 13.1 %
5500	48.6	5.65	3.63	3.63	3.63	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.62	3.62	3.62	0.49	1.90	± 13.1 %
5800	48.2	6.00	3.91	3.91	3.91	0.54	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.

Frequency Response of E-Field

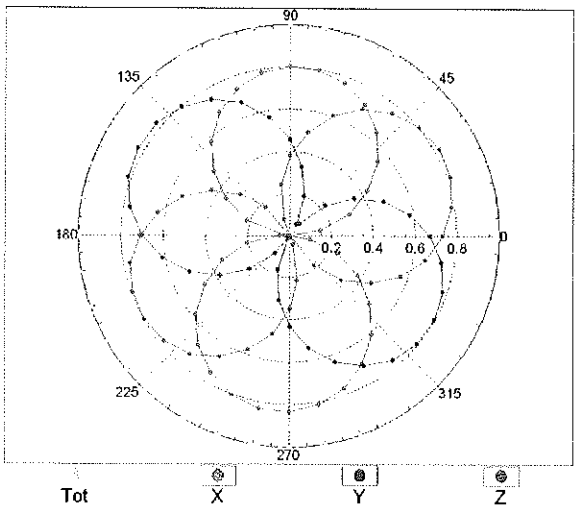
(TEM-Cell:ifi110 EXX, Waveguide: R22)



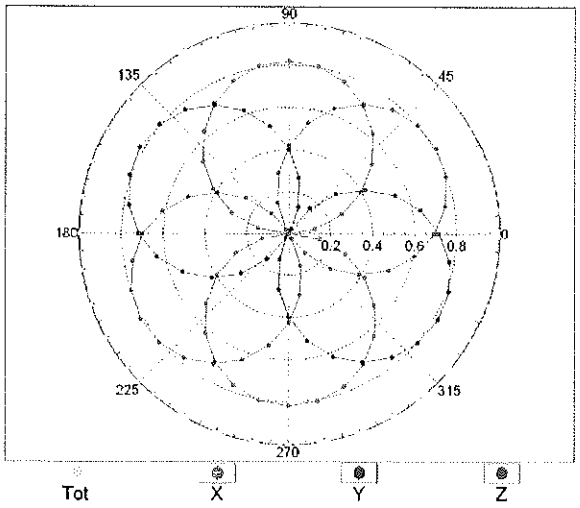
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

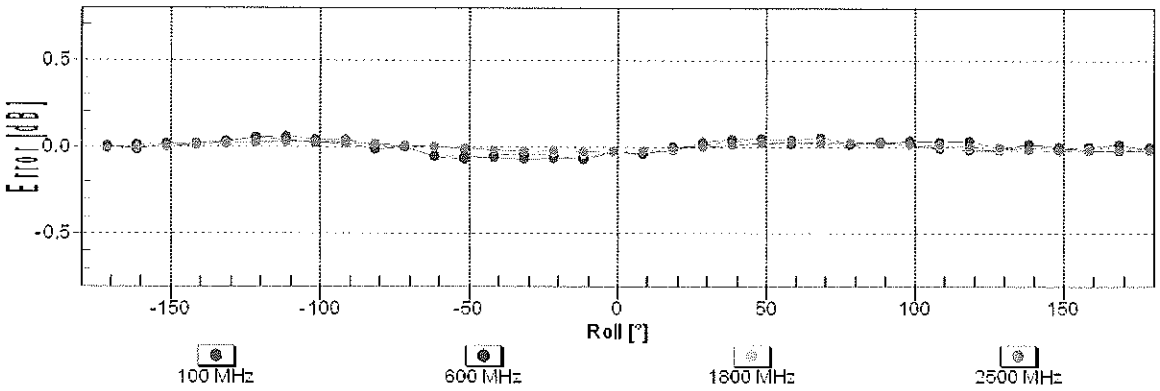
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



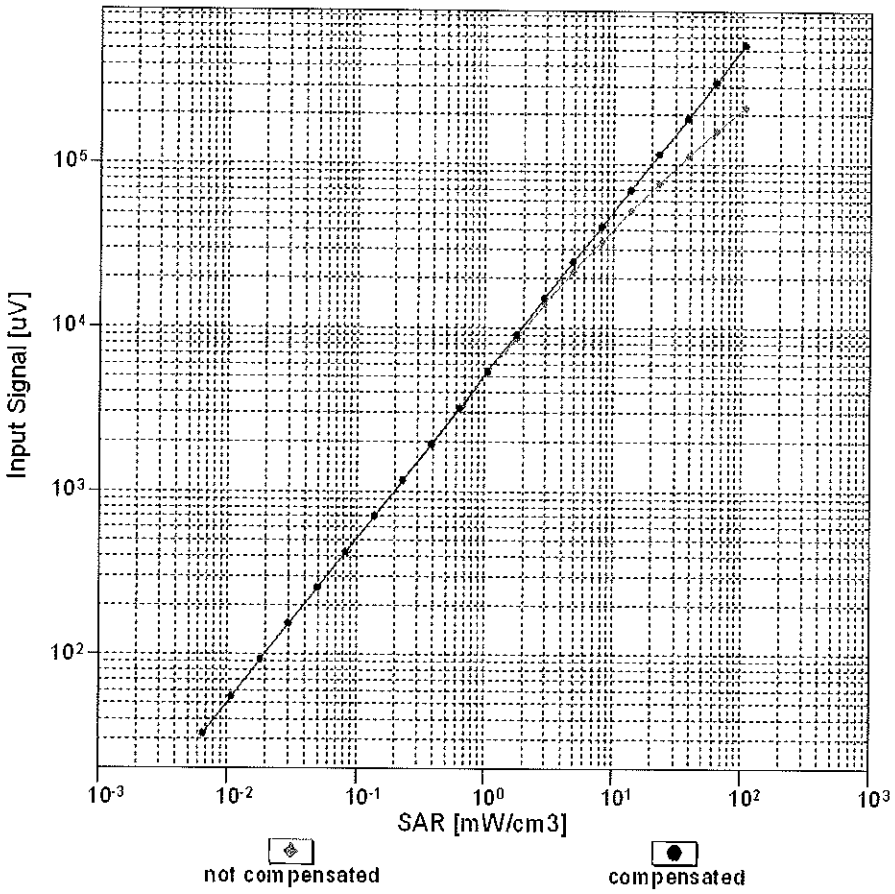
f=1800 MHz,R22

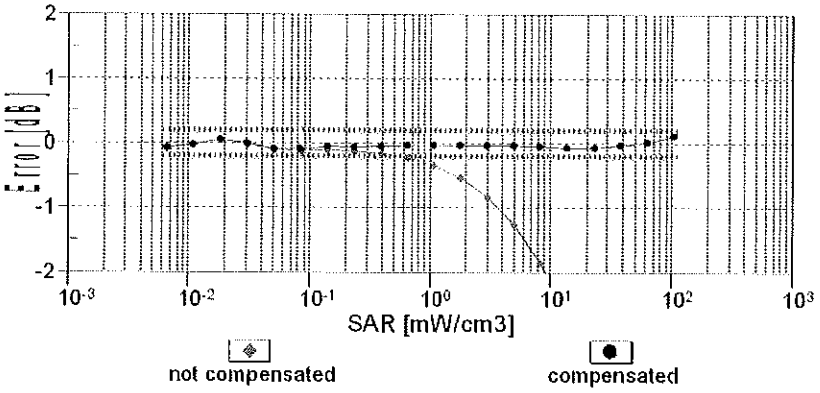




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

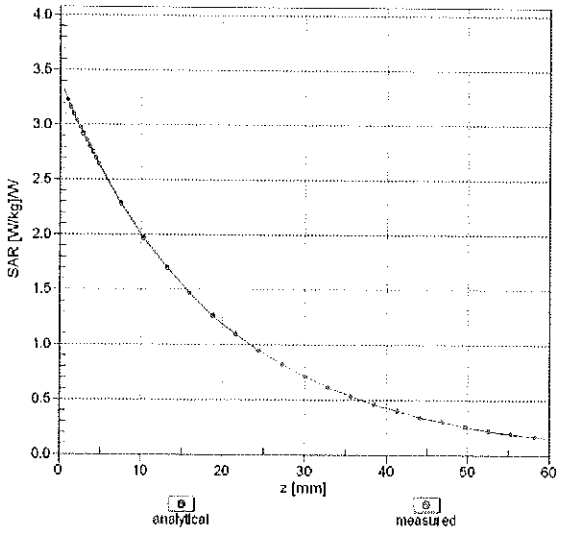




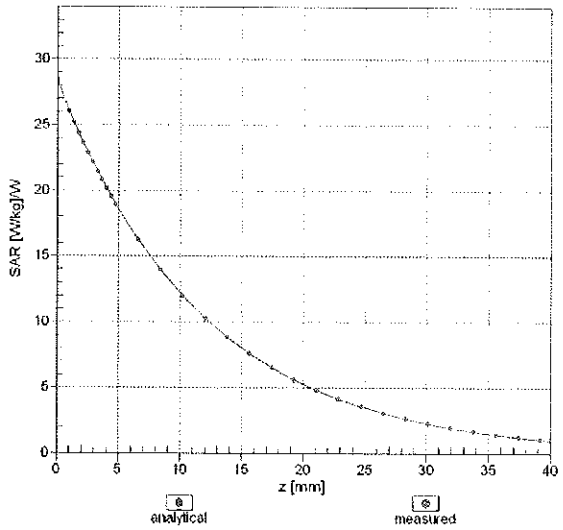
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

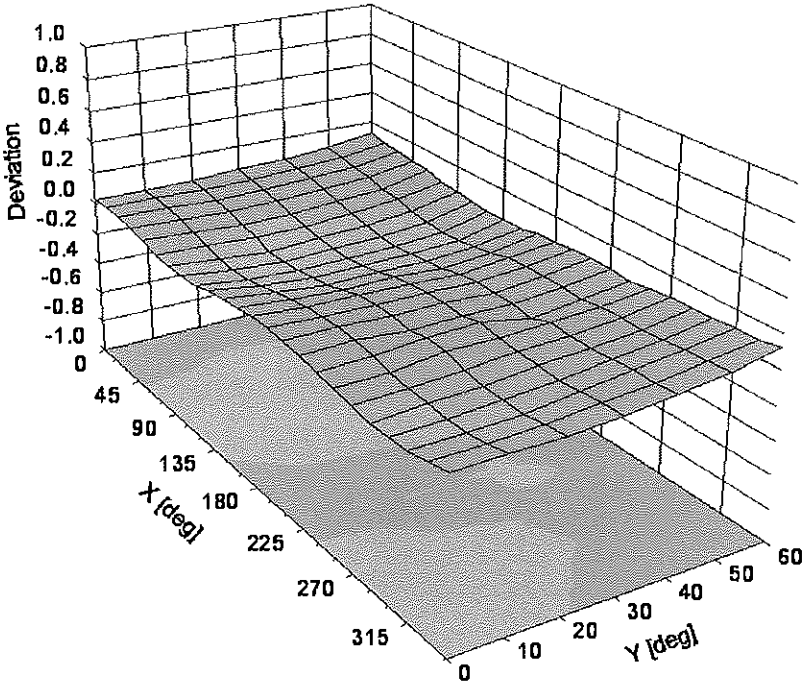


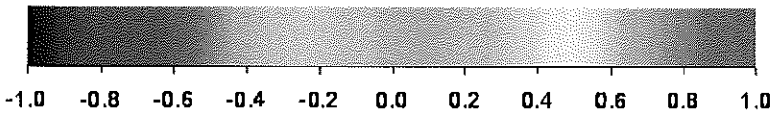
f = 1900 MHz,WGLS R22 (H_convF)



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:3920

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-21.6
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

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: EX3-3589_Jan13

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3589
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 17, 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	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 17, 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 EX3DV4

SN:3589

Manufactured: March 30, 2006
Calibrated: January 17, 2013

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.46	0.40	0.40	± 10.1 %
DCP (mV)[B]	100.5	103.8	99.6	

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	165.8	±3.3 %
		Y	0.0	0.0	1.0		134.3	
		Z	0.0	0.0	1.0		140.5	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

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	8.70	8.70	8.70	0.39	0.96	± 12.0 %
835	41.5	0.90	8.40	8.40	8.40	0.52	0.74	± 12.0 %
1750	40.1	1.37	7.34	7.34	7.34	0.45	0.93	± 12.0 %
1900	40.0	1.40	7.09	7.09	7.09	0.80	0.65	± 12.0 %
2450	39.2	1.80	6.37	6.37	6.37	0.39	0.97	± 12.0 %
2600	39.0	1.96	6.19	6.19	6.19	0.30	1.12	± 12.0 %
5200	36.0	4.66	4.48	4.48	4.48	0.45	1.80	± 13.1 %
5300	35.9	4.76	4.27	4.27	4.27	0.45	1.80	± 13.1 %
5500	35.6	4.96	4.14	4.14	4.14	0.50	1.80	± 13.1 %
5600	35.5	5.07	3.81	3.81	3.81	0.55	1.80	± 13.1 %
5800	35.3	5.27	3.85	3.85	3.85	0.55	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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3589

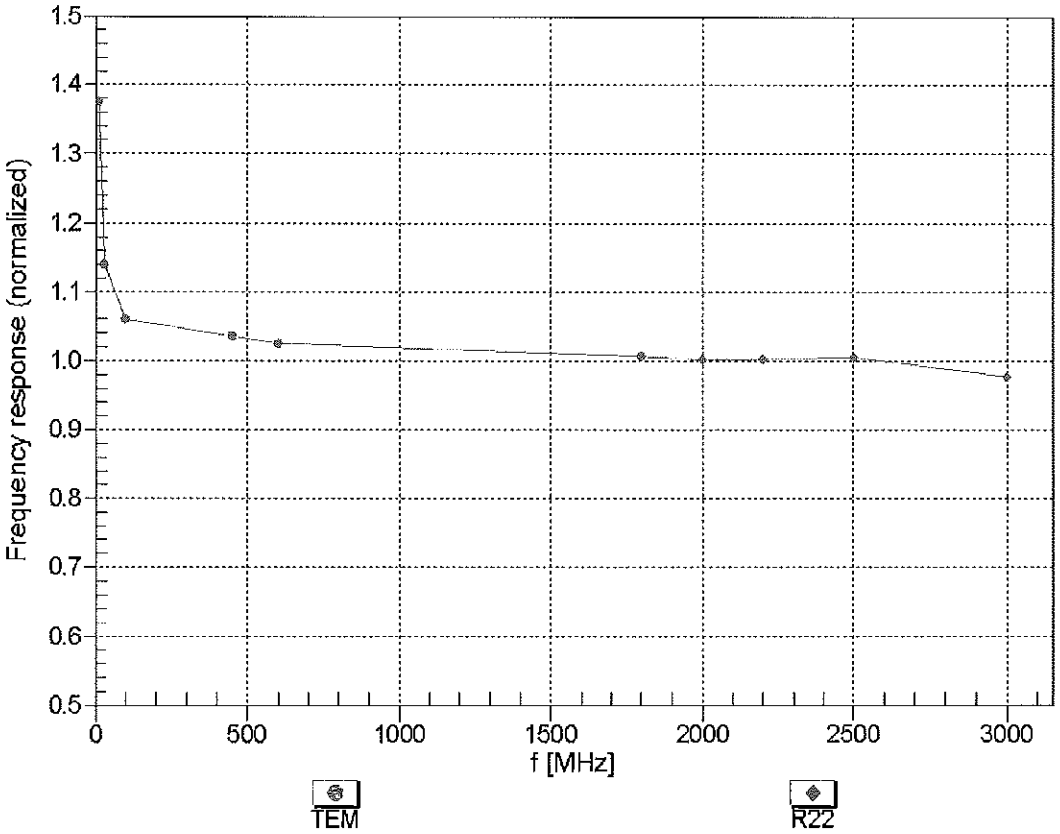
Calibration Parameter Determined in Body Tissue Simulating Media

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	8.59	8.59	8.59	0.49	0.86	± 12.0 %
835	55.2	0.97	8.43	8.43	8.43	0.38	1.05	± 12.0 %
1750	53.4	1.49	7.87	7.87	7.87	0.44	0.89	± 12.0 %
1900	53.3	1.52	7.46	7.46	7.46	0.58	0.75	± 12.0 %
2450	52.7	1.95	7.07	7.07	7.07	0.80	0.50	± 12.0 %
2600	52.5	2.16	6.68	6.68	6.68	0.80	0.50	± 12.0 %
5200	49.0	5.30	3.99	3.99	3.99	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.81	3.81	3.81	0.50	1.90	± 13.1 %
5500	48.6	5.65	3.52	3.52	3.52	0.55	1.90	± 13.1 %
5600	48.5	5.77	3.32	3.32	3.32	0.60	1.90	± 13.1 %
5800	48.2	6.00	3.66	3.66	3.66	0.60	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.

Frequency Response of E-Field

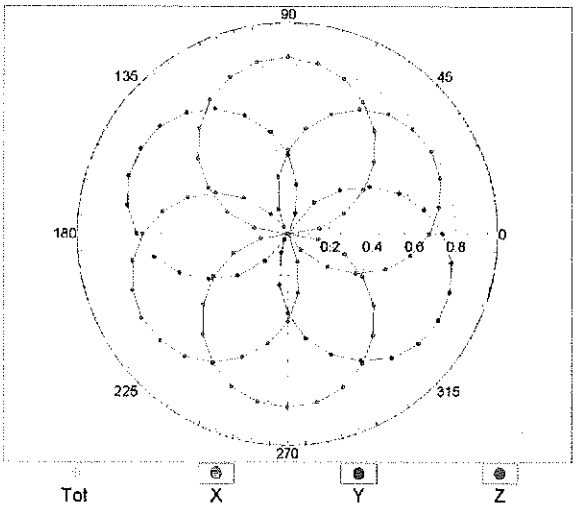
(TEM-Cell:ifi110 EXX, Waveguide: R22)



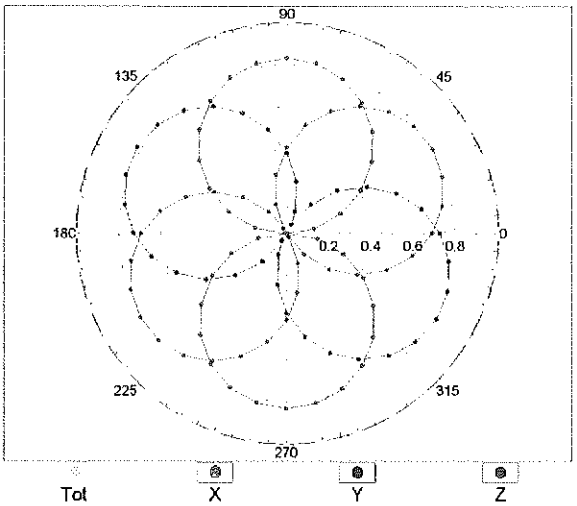
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

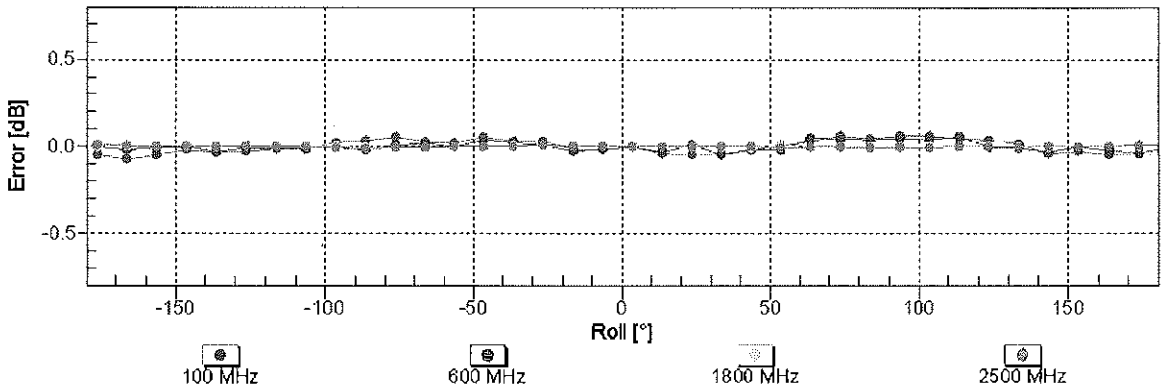
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



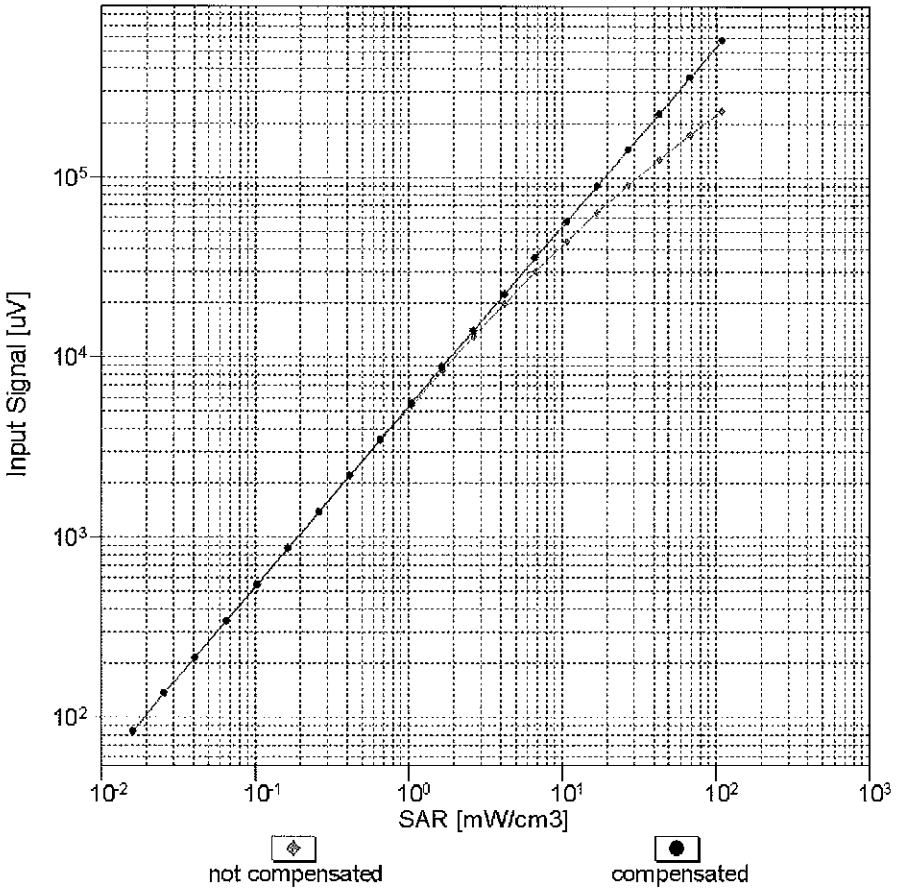
f=1800 MHz,R22

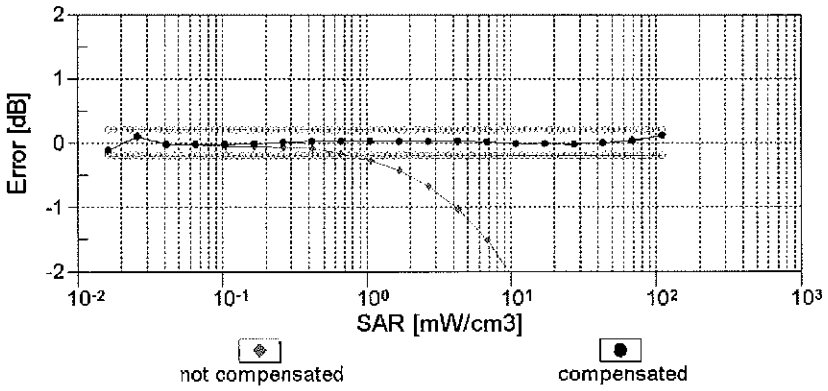




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

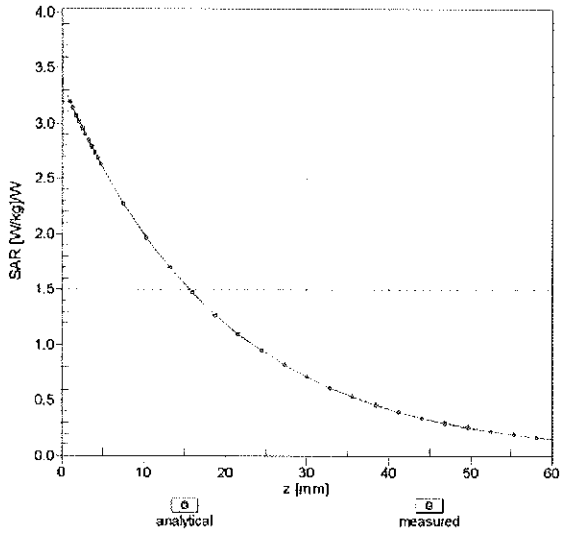




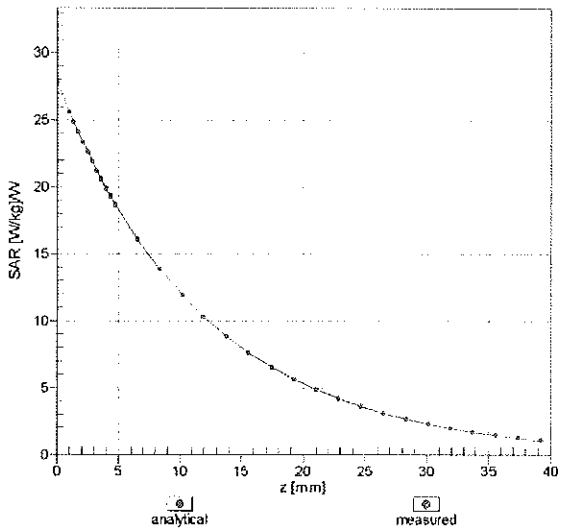
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

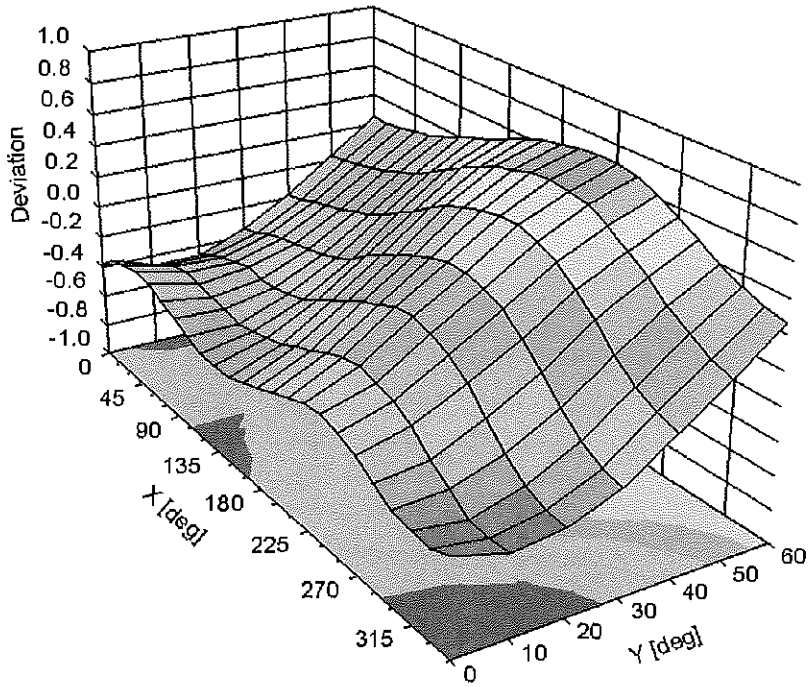


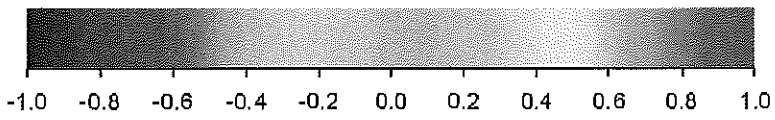
f = 1900 MHz,WGLS R22 (H_convF)



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:3589

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-26.4
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 ε' 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	835	1900	1900	2450	2450	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)								
Bactericide	0.1	0.1			See Page 2		See Page 3	
DGBE			44.92	29.44		26.7		
HEC	1	1						
NaCl	1.45	0.94	0.18	0.39		0.1		
Sucrose	57	44.9						
Polysorbate (Tween) 80								20
Water	40.45	53.06	54.9	70.17		73.2		80

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

H2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25 – 48% (CAS-No. 112-34-5, EC-No. 203-961-6, EC-index-No. 603-096-00-8) Relevant for safety; Refer to the respective Safety Data Sheet*.
NaCl	Sodium Chloride, <1.0%

Figure D-1
Composition of 2.4 GHz Head Tissue Equivalent Matter

Note: 2.4 GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HSL 2450)**
Product No.	SL AAH 245 BA (Charge: 120112-4)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

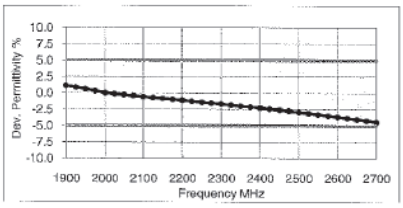
Ambient Condition	22°C ; 30% humidity
TSL Temperature	23°C
Test Date	18-Jan-12

Additional Information

TSL Density	0.988 g/cm³
TSL Heat-capacity	3.680 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	HP-e'	HP-e''	sigma	eps	sigma	Δ-eps	Δ-sigma
1900	40.5	11.99	1.27	40.0	1.40	1.1	-9.5
1925	40.3	12.08	1.29	40.0	1.40	0.9	-7.6
1950	40.2	12.17	1.32	40.0	1.40	0.6	-5.7
1975	40.1	12.26	1.35	40.0	1.40	0.3	-3.8
2000	40.0	12.35	1.37	40.0	1.40	0.0	-1.9
2025	39.9	12.44	1.40	40.0	1.42	-0.1	-1.5
2050	39.8	12.53	1.43	39.9	1.44	-0.3	-1.1
2075	39.7	12.60	1.46	39.9	1.47	-0.4	-0.8
2100	39.6	12.68	1.48	39.8	1.49	-0.6	-0.5
2125	39.5	12.76	1.51	39.8	1.51	-0.7	-0.2
2150	39.4	12.84	1.54	39.7	1.53	-0.8	0.2
2175	39.3	12.93	1.56	39.7	1.56	-1.0	0.6
2200	39.2	13.02	1.59	39.6	1.58	-1.1	1.0
2225	39.1	13.09	1.62	39.6	1.60	-1.3	1.3
2250	38.0	13.17	1.65	39.6	1.62	-1.4	1.6
2275	38.9	13.25	1.68	39.5	1.64	-1.5	2.0
2300	38.8	13.33	1.71	39.5	1.67	-1.7	2.3
2325	38.7	13.40	1.73	39.4	1.69	-1.8	2.7
2350	38.6	13.48	1.76	39.4	1.71	-2.0	3.0
2375	38.5	13.56	1.79	39.3	1.73	-2.1	3.3
2400	38.4	13.63	1.82	39.3	1.76	-2.3	3.7
2425	38.3	13.71	1.85	39.2	1.78	-2.4	4.0
2450	38.2	13.78	1.88	39.2	1.80	-2.6	4.4
2475	38.1	13.85	1.91	39.2	1.83	-2.7	4.4
2500	38.0	13.93	1.94	39.1	1.85	-2.9	4.4
2525	37.9	13.99	1.97	39.1	1.88	-3.1	4.4
2550	37.8	14.06	1.99	39.1	1.91	-3.3	4.4
2575	37.7	14.13	2.02	39.0	1.94	-3.5	4.5
2600	37.6	14.20	2.05	39.0	1.96	-3.7	4.6
2625	37.5	14.26	2.08	39.0	1.99	-3.8	4.6
2650	37.4	14.32	2.11	38.9	2.02	-4.0	4.6
2675	37.3	14.39	2.14	38.9	2.05	-4.3	4.7
2700	37.1	14.46	2.17	38.9	2.07	-4.5	4.8



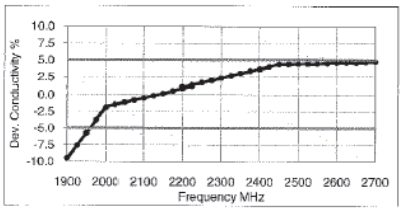


Figure D-2
2.4 GHz Head Tissue Equivalent Matter

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2 Composition / Information on ingredients

The Item is composed of the following ingredients:

Water	50 – 65%
Mineral oil	10 – 30%
Emulsifiers	8 – 25%
Sodium salt	0 – 1.5%

Figure D-3
Composition of 5 GHz Head Tissue Equivalent Matter

Note: 5GHz head liquid recipes are proprietary SPEAG. Since the composition is approximate to the actual liquids utilized, the manufacturer tissue-equivalent liquid data sheets are provided below.

Measurement Certificate / Material Test

Item Name	**Head Tissue Simulating Liquid (HBBL3500-5800V5)**
Product No.	SL AAH 502 AB (Charge: 120402-2)
Manufacturer	SPEAG

Measurement Method

TSL dielectric parameters measured using calibrated OCP probe (type DAK).

Target Parameters

Target parameters as defined in the IEEE 1528 and IEC 62209 compliance standards.

Test Condition

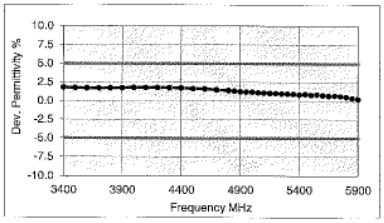
Ambient Condition	22°C ; 30% humidity
TSL Temperature	22°C
Test Date	4-Apr-12

Additional Information

TSL Density	0.985 g/cm^3
TSL Heat-capacity	3.383 kJ/(kg*K)

Results

	Measured			Target		Diff.to Target [%]	
f [MHz]	**HP-e'**	**HP-e''**	**sigma**	eps	sigma	**Δ-eps**	**Δ-sigma**
3400	38.7	14.96	2.83	38.0	2.81	1.8	0.7
3500	38.6	14.91	2.90	37.9	2.91	1.7	-0.3
3600	38.5	14.92	2.99	37.8	3.02	1.7	-0.9
3700	38.3	14.92	3.07	37.7	3.12	1.7	-1.5
3800	38.2	14.94	3.16	37.6	3.22	1.7	-1.9
3900	38.1	14.95	3.24	37.5	3.32	1.7	-2.4
4000	38.0	15.00	3.34	37.4	3.43	1.8	-2.5
4100	37.9	15.04	3.43	37.2	3.53	1.8	-2.8
4200	37.8	15.08	3.52	37.1	3.63	1.8	-2.9
4300	37.7	15.14	3.62	37.0	3.73	1.8	-3.0
4400	37.5	15.18	3.71	36.9	3.84	1.7	-3.1
4500	37.4	15.20	3.81	36.8	3.94	1.6	-3.3
4600	37.3	15.29	3.91	36.7	4.04	1.6	-3.2
4700	37.1	15.34	4.01	36.6	4.14	1.5	-3.2
4800	37.0	15.39	4.11	36.4	4.25	1.4	-3.2
4850	36.9	15.43	4.16	36.4	4.30	1.3	-3.1
4900	36.8	15.45	4.21	36.3	4.35	1.3	-3.1
4950	36.7	15.47	4.26	36.3	4.40	1.2	-3.1
5000	36.7	15.50	4.31	36.2	4.45	1.2	-3.1
5050	36.6	15.55	4.37	36.2	4.50	1.1	-3.0
5100	36.5	15.60	4.43	36.1	4.55	1.1	-2.8
5150	36.4	15.62	4.48	36.0	4.60	1.0	-2.8
5200	36.4	15.65	4.53	36.0	4.66	1.0	-2.8
5250	36.3	15.67	4.58	35.9	4.71	1.0	-2.8
5300	36.2	15.70	4.63	35.9	4.76	1.0	-2.7
5350	36.1	15.70	4.67	35.8	4.81	0.9	-2.9
5400	36.1	15.74	4.73	35.8	4.86	0.8	-2.7
5450	36.0	15.75	4.77	35.7	4.91	0.9	-2.8
5500	35.9	15.75	4.82	35.6	4.96	0.8	-2.9
5550	35.9	15.80	4.88	35.6	5.01	0.8	-2.7
5600	35.8	15.82	4.93	35.5	5.07	0.7	-2.7
5650	35.7	15.86	4.98	35.5	5.12	0.7	-2.6
5700	35.7	15.88	5.03	35.4	5.17	0.7	-2.6
5750	35.6	15.90	5.08	35.4	5.22	0.6	-2.6
5800	35.5	15.94	5.14	35.3	5.27	0.5	-2.4
5850	35.4	15.98	5.20	35.3	5.34	0.4	-2.5
5900	35.4	16.02	5.26	35.3	5.40	0.2	-2.6



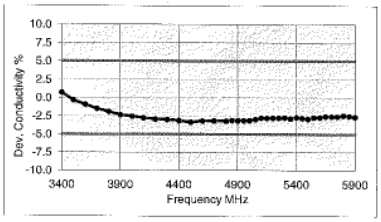


Figure D-4
5GHz Head Tissue Equivalent Matter

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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 IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

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

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ε_r)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
C	835	8/12/2013	3263	ES3DV3	835	Head	0.902	40.72	PASS	PASS	PASS	GMSK	PASS	N/A
H	835	6/20/2013	3318	ES3DV3	835	Head	0.910	41.10	PASS	PASS	PASS	GMSK	PASS	PASS
C	1900	10/17/2012	3022	ES3DV2	1900	Head	1.441	39.38	PASS	PASS	PASS	GMSK	PASS	N/A
H	1900	6/18/2013	3318	ES3DV3	1900	Head	1.453	38.95	PASS	PASS	PASS	GMSK	PASS	N/A
C	2450	8/12/2013	3263	ES3DV3	2450	Head	1.863	38.51	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	1/24/2013	3589	EX3DV4	5200	Head	4.659	35.55	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/24/2013	3589	EX3DV4	5300	Head	4.800	35.40	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/24/2013	3589	EX3DV4	5500	Head	5.004	34.83	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/24/2013	3589	EX3DV4	5600	Head	5.112	34.61	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/24/2013	3589	EX3DV4	5800	Head	5.392	34.17	PASS	PASS	PASS	OFDM	N/A	PASS
G	835	3/26/2013	3209	ES3DV3	835	Body	1.006	54.42	PASS	PASS	PASS	GMSK	PASS	N/A
E	1900	3/5/2013	3920	EX3DV4	1900	Body	1.574	52.42	PASS	PASS	PASS	GMSK	PASS	N/A
B	1900	1/29/2013	3287	ES3DV3	1900	Body	1.570	51.00	PASS	PASS	PASS	GMSK	PASS	N/A
E	2450	3/18/2013	3920	EX3DV4	2450	Body	2.011	51.68	PASS	PASS	PASS	OFDM	N/A	PASS
A	5200	1/23/2013	3589	EX3DV4	5200	Body	5.292	47.85	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	1/23/2013	3589	EX3DV4	5300	Body	5.477	47.47	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	1/23/2013	3589	EX3DV4	5500	Body	5.729	47.03	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	1/23/2013	3589	EX3DV4	5600	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS
A	5800	1/23/2013	3589	EX3DV4	5800	Body	6.233	46.20	PASS	PASS	PASS	OFDM	N/A	PASS

Table E-II
SAR System Validation Summary - Extremity

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
A	5200	3/11/2013	3589	EX3DV4	5200	Body	5.268	48.58	PASS	PASS	PASS	OFDM	N/A	PASS
A	5300	3/11/2013	3589	EX3DV4	5300	Body	5.405	48.31	PASS	PASS	PASS	OFDM	N/A	PASS
A	5500	3/11/2013	3589	EX3DV4	5500	Body	5.703	47.90	PASS	PASS	PASS	OFDM	N/A	PASS
A	5600	3/11/2013	3589	EX3DV4	5600	Body	5.875	47.66	PASS	PASS	PASS	OFDM	N/A	PASS

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

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