



MOTOROLA

Portable Cellular Phone SAR Test Report v2

Tests Requested By: Motorola Mobile Devices Business
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This laboratory is accredited to ISO/IEC 17025-2005 to perform the following tests:

Accreditation:



TESTING CERT #2518-03

Tests:

Electromagnetic Specific Absorption Rate

Procedures:

IEC 62209-1

RSS-102

IEEE 1528 - 2003

FCC OET Bulletin 65 (*including Supplement C*)

Australian Communications Authority Radio

Communications (Electromagnetic Radiation – Human
Exposure) Standard 2003

CENELEC EN 50360

ARIB Std. T-56 (2002)

Statement of Compliance:

On the following products or types of products:

On the following products or types of products: Wireless Communications Devices (Examples): Two Way Radios; Portable Phones (including Cellular, Licensed Non-Broadcast and PCS); Low Frequency Readers; and Pagers

Motorola declares under its sole responsibility that the portable cellular telephone model to which this declaration relates, is in conformity with the appropriate General Population/Uncontrolled RF exposure standards, recommendations and guidelines (FCC 47 CFR §2.1093) as well as with CENELEC en50360:2001 and ANSI / IEEE C95.1. It also declares that the product was tested in accordance with IEEE 1528 / CENELEC EN62209-1 (2006), as well as other appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

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1. Introduction

The Motorola Mobile Devices Business Product Safety Laboratory has performed measurements of the maximum potential exposure to the user of the portable cellular phone covered by this test report. The Specific Absorption Rate (SAR) of this product was measured. The portable cellular phone was tested in accordance with [1], [4] and [5]. The SAR values measured for the portable cellular phone are below the maximum recommended levels of 1.6 W/kg in a 1g average set in [3] and 2.0W/kg in a 10g average set in [2].

For ANSI / IEEE C95.1 (1g), the final SAR reading for this phone is 1.27 W/kg for head adjacent use and 0.92 W/kg for body worn use. These measurements were performed using a Dasy4™ v4.7 system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich Switzerland.

2. Description of the Device Under Test

2.1 Antenna description

Type	Internal Antenna	
Location	Bottom of the Transceiver	
Dimensions	Length	6.66 mm
	Width	56.22 mm
Configuration	FICA	

2.2 Device description

Serial number	356899020002312								
Mode(s) of Operation	GSM 850	GSM 900	GSM 1800	GSM 1900	WCDMA 850	WCDMA 1900	WCDMA 2100	Bluetooth	WLAN 802.11b/g
Modulation Mode(s)	GMSK	GMSK	GMSK	GMSK	QPSK	QPSK	QPSK	GFSK	BPSK
Maximum Output Power Setting	33.0 dBm	33.0 dBm	30.0 dBm	30.0 dBm	24.0 dBm	24.0 dBm	24.0 dBm	10.0 dBm	23.0 dBm
Duty Cycle	1:8	1:8	1:8	1:8	1:1	1:1	1:1	1:1	1:1
Transmitting Frequency Rang(s)	824.2-848.8MHz	880.2-914.8MHz	1710.2-1784.8MHz	1850.2-1909.8MHz	826.4-846.6MHz	1852.4-1907.6MHz	1922.4-1977.6MHz	2402.0-2483.5MHz	2412.0-2462.5MHz
Production Unit or Identical Prototype (47 CFR §2.908)	Identical Prototype								
Device Category	Portable								
RF Exposure Limits	General Population / Uncontrolled								

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Mode(s) of Operation	GPRS 850				GPRS 900				GPRS 1800				GPRS 1900			
Modulation Mode(s)	GMSK				GMSK				GMSK				GMSK			
Maximum Output Power Setting	33.0 dBm	31.0 dBm	29.0 dBm	27.0 dBm	33.0 dBm	31.0 dBm	29.0 dBm	27.0 dBm	30.0 dBm	28.0 dBm	26.0 dBm	24.0 dBm	30.0 dBm	28.0 dBm	26.0 dBm	24.0 dBm
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Transmitting Frequency Rang(s)	824.2-848.8MHz				880.2-914.8MHz				1710.2-1784.8MHz				1850.2-1909.8MHz			

Mode(s) of Operation	EDGE 850				EDGE 900				EDGE 1800				EDGE 1900			
Modulation Mode(s)	8PSK				8PSK				8PSK				8PSK			
Maximum Output Power Setting	27.5 dBm	25.5 dBm	23.5 dBm	21.5 dBm	27.5 dBm	25.5 dBm	23.5 dBm	21.5 dBm	26.5 dBm	24.5 dBm	22.5 dBm	20.5 dBm	26.5 dBm	24.5 dBm	22.5 dBm	20.5 dBm
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Transmitting Frequency Rang(s)	824.2-848.8MHz				880.2-914.8MHz				1710.2-1784.8MHz				1850.2-1909.8MHz			

Note: Bolded entries indicate data mode configurations of highest time-average power output per band and data mode type.

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Mobile Devices Business Product Safety & Compliance Laboratory utilizes a Dosimetric Assessment System (Dasy4™ v4.7) manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. All the SAR measurements are taken within a shielded enclosure. The overall 10g RSS uncertainty of the measurement system is $\pm 10.8\%$ (K=1) with an expanded uncertainty of $\pm 21.6\%$ (K=2). The overall 1g RSS uncertainty of the measurement system is $\pm 11.1\%$ (K=1) with an expanded uncertainty of $\pm 22.2\%$ (K=2). The measurement uncertainty budget is given in Appendix 5. Per IEEE 1528, this uncertainty budget is applicable to the SAR range of 0.4W/kg to 10W/kg.

The list of calibrated equipment used for the measurements is shown in the following table.

Description	Serial Number	Cal Due Date
DASY4™ DAE V1	398	11-06-2009
E-Field Probe ETDV6	3180	7-21-2010
S.A.M. Phantom used for 800/900MHz	TP-1155	
S.A.M. Phantom used for 1800/1900/2450MHz	TP-1086	
Dipole Validation Kit, DV900V2	77	4-1-2010
Dipole Validation Kit, DV1800V2	280tr	4-1-2010
Dipole Validation Kit, DV2450V2	767	4-1-2010

3.2 Additional Equipment

Description	Serial Number	Cal Due Date
Signal Generator HP8648C	3847A04630	Jan-21-2010
Power Meter E4419B	US39250623	Jan-21-2010
Power Sensor #1 - 8481A	US37296472	Jan-21-2010
Power Sensor #2 - 8481A	US39250623	Jan-21-2010
Network Analyzer HP8753ES	US39172714	Jan-22-2010
Dielectric Probe Kit HP85070C	US99936027	

4. Electrical parameters of the tissue simulating liquid

Prior to conducting SAR measurements, the relative permittivity, ϵ_r , and the conductivity, σ , of the tissue simulating liquids were measured with a HP85070 Dielectric Probe Kit. These values, along with the temperature of the simulated tissue are shown in the table below. The recommended limits for permittivity and conductivity are also shown. A mass density of $\rho=1\text{g/cm}^3$ was entered into the system in all the cases. It can be seen that the measured parameters are within tolerance of the recommended limits specified in [1] and [5].

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			ϵ_r	σ (S/m)	Temp (°C)
835	Head	Measured, 05-Oct-2009	41.1	0.90	20.7
		Measured, 06-Oct-2009	41.1	0.90	21.1
		Recommended Limits	41.5 $\pm$ 5%	0.90 $\pm$ 5%	18-25
	Body	Measured, 05-Oct-2009	54.6	1.01	21.4
		Measured, 06-Oct-2009	54.6	1.01	21.6
		Recommended Limits	55.2 $\pm$ 5%	0.97 $\pm$ 5%	18-25
1880	Head	Measured, 06-Oct-2009	39.1	1.45	21.3
		Recommended Limits	40.0 $\pm$ 5%	1.40 $\pm$ 5%	18-25
	Body	Measured, 06-Oct-2009	51.8	1.56	21.3
		Recommended Limits	53.3 $\pm$ 5%	1.52 $\pm$ 5%	18-25
2450	Head	Measured, 07-Oct-2009	37.2	1.89	22.6
		Recommended Limits	39.2 $\pm$ 10%	1.80 $\pm$ 5%	18-25
	Body	Measured, 07-Oct-2009	50.2	2.04	21.9
		Recommended Limits	52.7 $\pm$ 10%	1.95 $\pm$ 5%	18-25

The list of ingredients and the percent composition used for the tissue simulates are indicated in the table below.

Ingredient	835MHz / 900 MHz Head	835MHz / 900 MHz Body	1800MHz / 1900 MHz Head	1800 MHz / 1900 MHz Body	2450MHz Head	2450 MHz Body
Sugar	57	44.9	--	--	--	--
DGBE	--	--	47	30.8	--	30
Diacetin	--	--	--	--	51	--
Water	40.45	53.06	52.62	68.8	48.75	70
Salt	1.45	0.94	0.38	0.4	0.15	--
HEC	1	1	--	--	--	--
Bact.	0.1	0.1	--	--	0.1	--

5. System Accuracy Verification

A system accuracy verification of the DASY4™ was performed using the measurement equipment listed in Section 3.1. The daily system accuracy verification occurs within the flat section of the SAM phantom.

A SAR measurement was performed to verify the measured SAR was within $\pm 10\%$ from the target SAR indicated in Appendix 6. These frequencies are within $\pm 10\%$ of the compliance test mid-band frequency as required in [1] and [5]. The test was conducted on the same days as the measurement of the DUT. Recommended limits for permittivity and conductivity, specified in [5], are shown in the table below. The obtained results from the system accuracy verification are also displayed in the table below. SAR values are normalized to 1W forward power delivered to the dipole. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values. The distributions of SAR compare well with those of the reference measurements (see Appendix 1). The tissue stimulant depth was verified to be 15.0cm ± 0.5 cm. Z-axis scans showing the SAR penetration are also included in Appendix 1.

f (MHz)	Description	SAR (W/kg), 1gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
			ϵ_r	σ (S/m)		
900	Measured , 05-Oct-2009	11.08	40.4	0.96	21.5	21.5
	Measured , 06-Oct-2009	11.15	40.4	0.96	20.6	21.5
	Recommended Limits	11.19	41.5 $\pm 5\%$	0.97 $\pm 5\%$	18-25	18-25
1800	Measured , 06-Oct-2009	37.93	39.4	1.37	20.2	21.6
	Recommended Limits	37.91	40.0 $\pm 5\%$	1.40 $\pm 5\%$	18-25	18-25
2450	Measured , 07-Oct-2009	54.50	37.2	1.89	21.8	22.8
	Recommended Limits	56.68	39.2 $\pm 10\%$	1.80 $\pm 5\%$	18-25	18-25

The following probe conversion factors were used on the E-Field probe(s) used for the system accuracy verification measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3180	900	5.91	8 of 9
		1810	5.15	8 of 9
		2450	4.47	8 of 9

6. Test Results

The test sample was operated using an actual transmission through a base station simulator. The base station simulator was setup to the proper channel, transmitter power level and transmit mode of operation. The phone was tested in the configurations stipulated in [1], [4] and [5]. The phone was positioned into these configurations using the device holder supplied with the DASY4™ SAR measurement system. The measured dielectric constant of the material used for the device holder is less than 2.9 and the loss tangent is less than 0.02 ($\pm 30\%$) at 850MHz. The default settings for the “coarse” and “cube” scans were chosen and used for measurements. The grid spacing of the course scan was set to 15 mm as shown in the SAR plots included in Appendix 2 and 3. Please refer to the DASY4™ manual for additional information on SAR scanning procedures and algorithms used.

The Cellular Phone model covered by this report has the following battery options:
SNN5843A - 1390 mAH Battery

This battery was used to do of the SAR testing. The phone was placed in the SAR measurement system with a fully charged battery.

Per the “SAR Measurement Procedures for 3G Devices” released in October, 2007, 12.2kbps RMC, 12.2kbps AMR, HS-DPCCH Sub-test 1-4, and E-DCH Sub-test 1-5 modes were considered. The conducted power measurements (per section 5.2 of 3GPP TS 34.121) for each mode are shown in the table below.

Band	Channel	Conducted power (dBm) for WCDMA modes		Conducted Power (dBm) for WCDMA – HSDPA (Rel 5) Modes				Conducted Power (dBm) for WCDMA – HSPA (HSUPA/HSDPA-Rel 6) Modes				
		RMC	AMR	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 5
WCDMA 850	4132	24.1	24.13	24.1	24.17	24.19	24.2	24.09	24.18	24.19	24.22	24.22
	4180	24.04	24.06	24.11	24.13	24.16	24.15	24.11	24.15	24.16	24.16	24.17
	4233	23.8	23.8	23.95	23.95	23.96	23.95	23.94	23.95	23.96	23.96	23.96
WCDMA 1900	9262	24.03	24.02	24.1	24.08	24.08	24.08	24.18	24.15	24.13	24.12	24.11
	9400	23.91	23.9	24.04	24.03	24.04	24.04	24.15	24.1	24.07	24.06	24.07
	9538	23.87	23.85	23.96	23.95	23.95	23.95	24.07	24.04	23.99	23.98	23.98

This product utilizes the following mechanism for Maximum Power Reduction (MPR)

The device supports MPR to solve linearity issues (ACLR or SEM) due to the higher peak-to-average ratios (PAR) of the HSUPA signal. This prevents saturating the full range of the TX DAC inside of the device and provides a reduced power output to the RF transceiver chip according to the Cubic Metric (a function of the combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH).

When E-DPDCH channels are present, the beta gains on those channels are reduced first to try to get the power under the allowed limit. If the beta gains are lowered as far as possible, then a hard limiting is applied at the maximum allowed level.

The SW currently recalculates the cubic metric every time the beta gains on the E-DPDCH are reduced. The cubic metric will likely get lower each time this is done. However, there is no reported reduction of maximum output power in the HSUPA mode since the device also provides a mechanism to compensate for the power back-off by increasing the gain of TX_AGC in the transceiver (PA) device.

The end effect is that the DUT output power is identical to the case where there is no MPR in the device.

6.1 Head Adjacent Test Results

The SAR results shown in tables 1 through 4 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to the [6]. Also shown are the measured conducted output power levels, the temperature of the simulated tissue after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is $\text{New SAR} = \text{Old SAR} * 10^{(-\text{drift}/10)}$. The SAR reported at the end of the measurement process by the DASY4™ measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process. This is the most conservative SAR because it corresponds to the average output power at the beginning of the SAR test. This extrapolation has been done because when the DUT is operating properly it may exhibit a slump in radiated power and SAR over time. This is verified by measuring the SAR drift after the test. Note that 800MHz digital mode SAR measurements were performed in accordance with [4].

The left head and right head SAR contour distributions are similar. Because of this similarity, the cheek/touch and 15° tilt test conditions with the highest SAR values in each band are indicated as bold numbers in the following tables and are included in Appendix 2. All other test conditions measured lower SAR values than those included in Appendix 2.

The SAR measurements were performed using the SAM phantoms listed in section 3.1. Since the same phantoms and simulated tissue were used for the system accuracy verification and the device SAR measurements, the Z-axis scans included in Appendix 1 are applicable for verification of simulated tissue depth to be 15.0cm ±0.5cm.

The following probe conversion factors were used on the E-Field probe(s) used for the head adjacent measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3180	900	5.91	8 of 9
		1810	5.15	8 of 9
		2450	4.47	8 of 9

Left Head Cheek Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	<i>10g SAR value</i>		<i>1g SAR value</i>	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	20.7	-0.0224	0.183	0.18	0.241	0.24
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.4	0.0521	0.13	0.13	0.204	0.20
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21	0.022	0.164	0.16	0.218	0.22
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	21.5	-0.0218	0.24	0.24	0.372	0.37
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	22.8	-0.027	0.293	0.30	0.586	0.59
	Channel 11	22.41						
<i>GSM850 + WLAN</i>						<i>0.48</i>		<i>0.83</i>
<i>GSM1900 + WLAN</i>						<i>0.43</i>		<i>0.79</i>
<i>WCDMA 850 + WLAN</i>						<i>0.46</i>		<i>0.81</i>
<i>WCDMA1900 + WLAN</i>						<i>0.54</i>		<i>0.96</i>

Table 1: SAR measurement results at the highest possible output power, measured in a head cheek position against the ICNIRP and ANSI SAR Limit.

Right Head Cheek Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	<i>10g SAR value</i>		<i>1g SAR value</i>	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	20.5	-0.0194	0.177	0.18	0.232	0.23
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.3	-0.077	0.168	0.17	0.283	0.29
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21.1	-0.00916	0.169	0.17	0.233	0.23
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	21.2	-0.0406	0.306	0.31	0.504	0.51
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	22.6	0.0646	0.357	0.36	0.758	0.76
	Channel 11	22.41						
<i>GSM850 + WLAN</i>						0.54		0.99
<i>GSM1900 + WLAN</i>						0.53		1.05
<i>WCDMA 850 + WLAN</i>						0.53		0.99
<i>WCDMA1900 + WLAN</i>						0.67		1.27

Table 2: SAR measurement results at the highest possible output power, measured in a head cheek position against the ICNIRP and ANSI SAR Limit.

Left Head 15° Tilt Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	20.7	0.0646	0.141	0.14	0.188	0.19
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.4	0.0315	0.103	0.10	0.173	0.17
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21.1	-0.0196	0.14	0.14	0.185	0.19
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	21.3	0.0037	0.189	0.19	0.313	0.31
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	22.7	-0.0818	0.314	0.32	0.665	0.68
	Channel 11	22.41						
GSM850 + WLAN						0.46		0.87
GSM1900 + WLAN						0.42		0.85
WCDMA 850 + WLAN						0.46		0.87
WCDMA1900 + WLAN						0.51		0.99

Table 3: SAR measurement results at the highest possible output power, measured in a head 15° Tilt position against the ICNIRP and ANSI SAR Limit.

Right Head 15° Tilt Position								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	20.5	0.146	0.145	0.15	0.191	0.19
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.3	0.0304	0.0837	0.08	0.13	0.13
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21.1	0.108	0.145	0.15	0.192	0.19
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	21.1	0.00782	0.146	0.15	0.229	0.23
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	22.5	-0.00824	0.273	0.27	0.541	0.54
	Channel 11	22.41						
GSM850 + WLAN						0.42		0.73
GSM1900 + WLAN						0.35		0.67
WCDMA 850 + WLAN						0.42		0.73
WCDMA1900 + WLAN						0.42		0.77

Table 4: SAR measurement results at the highest possible output power, measured in a head 15° Tilt position against the ICNIRP and ANSI SAR Limit.

6.2 Body Worn Test Results

The SAR results shown in tables 5 through 7 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to the [6]. Also shown are the measured conducted output power levels, the temperature of the test facility during the test, the temperature of the tissue simulate after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is $\text{New SAR} = \text{Old SAR} * 10^{(-\text{drift}/10)}$. The SAR reported at the end of the measurement process by the DASY4™ measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process. This is the most conservative SAR because it corresponds to the average output power at the beginning of the SAR test. This extrapolation has been done because when the DUT is operating properly it may exhibit a slump in radiated power and SAR over time. This is verified by measuring the SAR drift after the test. Note that 800MHz digital mode SAR measurements were performed in accordance with [4].

The test conditions that produced the highest SAR values in each band are indicated as bold numbers in the following tables and are included in Appendix 3. All other test conditions measured lower SAR values than those included in Appendix 3.

A “flat” phantom was for the body-worn tests. This “flat” phantom is made out of 1” thick natural High Density Polyethylene with a thickness at the bottom equal to 2.0mm. It measures 52.7cm(long) x 26.7cm(wide) x 21.2cm(tall). The measured dielectric constant of the material used is less than 2.3 and the loss tangent is less than 0.0046 all the way up to 2.184GHz.

The tissue stimulant depth was verified to be 15.0cm ±0.5cm. The same device holder described in section 6 was used for positioning the phone. The functional accessories were divided into two categories, the ones with metal components and the ones with non-metal components. For non-metallic component accessories, testing was performed on the accessory that displayed the closest proximity to the flat phantom. Each metallic component accessory, if any, was checked for uniqueness of metal component so that each is tested with the device. If multiple accessories shared an identical metal component, only the accessory that dictates the closest spacing to the body was tested. The cellular phone was tested with a headset connected to the device for all body-worn SAR measurements.

There are no Body-Worn Accessories available for this phone at the time of testing hence the device was tested per the supplement C testing guidelines for devices that do not have body worn accessories. A separation distance of 15mm between the device and the flat phantom was used for testing body-worn SAR. The device was tested with the front and back of the device facing the phantom.

In addition to accessory testing, the cellular phone was tested in data mode operations with the front and back of the phone facing the phantom. For these tests, a separation distance of 25mm between the device and the flat phantom was used. The device was tested with the front and back of the device facing the phantom.

The following probe conversion factors were used on the E-Field probe(s) used for the body worn measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	SN3180	900	5.93	8 of 9
		1810	4.76	8 of 9
		2450	4.15	8 of 9

BODY WORN Front of phone 15mm away from Phantom								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	10g SAR value		1g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	21.5	0.0175	0.135	0.14	0.18	0.18
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.3	0.0479	0.0988	0.10	0.155	0.16
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21.6	0.0426	0.129	0.13	0.173	0.17
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	20.9	-0.107	0.172	0.18	0.269	0.28
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	21.9	-0.161	0.1	0.10	0.179	0.19
	Channel 11	22.41						
Bluetooth	Channel 0	9.22						
	Channel 39	9.10	21.3	-0.0265	0.0031	0.00	0.00642	0.01
	Channel 78	9.35						
GSM850 + WLAN + Bluetooth						0.24		0.38
GSM1900 + WLAN + Bluetooth						0.20		0.36
WCDMA 850 + WLAN + Bluetooth						0.23		0.37
WCDMA1900 + WLAN + Bluetooth						0.28		0.48

Table 5: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

BODY WORN Back of phone 15mm away from Phantom								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	<i>10g SAR value</i>		<i>1g SAR value</i>	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	33.13						
	Channel 190	33.10	21.4	-0.00595	0.261	0.26	0.351	0.35
	Channel 251	33.15						
GSM 1900	Channel 512	29.91						
	Channel 661	30.03	21.3	0.00373	0.211	0.21	0.364	0.36
	Channel 810	30.02						
WCDMA 850	Channel 4132	24.10						
	Channel 4180	24.04	21.6	0.0416	0.223	0.22	0.3	0.30
	Channel 4233	23.80						
WCDMA 1900	Channel 9262	24.03						
	Channel 9400	23.91	20.8	0.0121	0.419	0.42	0.74	0.74
	Channel 9538	23.87						
WLAN	Channel 1	21.95						
	Channel 6	22.06	21.7	0.00166	0.0988	0.10	0.174	0.17
	Channel 11	22.41						
Bluetooth	Channel 0	9.22						
	Channel 39	9.10	21.1	0.327	0.00211	0.00	0.00465	0.01
	Channel 78	9.35						
<i>GSM850 + WLAN + Bluetooth</i>						0.36		0.53
<i>GSM1900 + WLAN + Bluetooth</i>						0.31		0.54
<i>WCDMA 850 + WLAN + Bluetooth</i>						0.32		0.48
<i>WCDMA1900 + WLAN + Bluetooth</i>						0.52		0.92

Table 6: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

BODY WORN <i>Noted facing position of phone 25mm away from Phantom</i>								
<i>f</i> (MHz)	Description	Conducte d Output Power (dBm)	Temp (°C)	Drift (dB)	<i>10g SAR value</i>		<i>1g SAR value</i>	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GPRS 850 Class10 <i>Back</i>	Channel 128	31.05						
	Channel 190	31.04	21.2	0.00556	0.152	0.15	0.204	0.20
	Channel 251	31.09						
GPRS 1900 Class10 <i>Back</i>	Channel 512	27.91						
	Channel 661	27.98	21.2	0.00418	0.0944	0.09	0.15	0.15
	Channel 810	27.95						
EDGE 850 Class10 <i>Back</i>	Channel 128	25.83						
	Channel 190	25.62	21.1	-0.00893	0.0432	0.04	0.0583	0.06
	Channel 251	25.68						
EDGE 1900 Class10 <i>Back</i>	Channel 512	24.69						
	Channel 661	24.70	21.1	0.00437	0.0424	0.04	0.0676	0.07
	Channel 810	24.70						
WLAN <i>Front</i>	Channel 1	21.95						
	Channel 6	22.06	21.5	0.0319	0.0324	0.03	0.0567	0.06
	Channel 11	22.41						
WLAN <i>Back</i>	Channel 1	21.95						
	Channel 6	22.06	21.7	0.148	0.0321	0.03	0.0556	0.06
	Channel 11	22.41						
<i>GPRS850 +</i> <i>WLAN</i>						0.18		0.26
<i>GPRS1900 +</i> <i>WLAN</i>						0.12		0.21
<i>EDGE850 +</i> <i>WLAN</i>						0.07		0.12
<i>EDGE1900 +</i> <i>WLAN</i>						0.07		0.13

Table 7: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

References

- [1] CENELEC, en62209-1:2006 “Human Exposure to Radio Frequency Fields From Hand - Held and Body - Mounted Wireless Communication Devices – Human Models, Instrumentation, and Procedures”
- [2] CENELEC, en50360:2001 “Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300MHz – 3GHz)”.
- [3] ANSI / IEEE, C95.1 1999 Edition “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz”
- [4] FCC OET Bulletin 65 Supplement C 01-01
- [5] IEEE 1528 2003 Edition “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”
- [6] ICNIRP Guidelines “Guidelines for Limiting Exposure to Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)”

Appendix 1

SAR distribution comparison for the system accuracy verification

Date/Time: 10/05/2009 AM 10:18:50

Test Laboratory: Motorola 20091005_900MHz_-1.0%

Procedure Notes: 900 MHz System Performance Check / Dipole Sn# 077 PM1 Power = 200 mW

Sim.Temp@meas = 21.4 °C Sim.Temp@SPC = 21.5 °C Room Temp @ SPC = 21.5 °C

Communication System: CW - Dipole; Frequency: 900 MHz; Channel Number: 4; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.96 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.21 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 50.9 V/m; Power Drift = 0.008 dB

Peak SAR (extrapolated) = 3.25 W/kg

SAR(1 g) = 2.21 mW/g; SAR(10 g) = 1.43 mW/g

Maximum value of SAR (measured) = 2.39 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 50.9 V/m; Power Drift = 0.008 dB

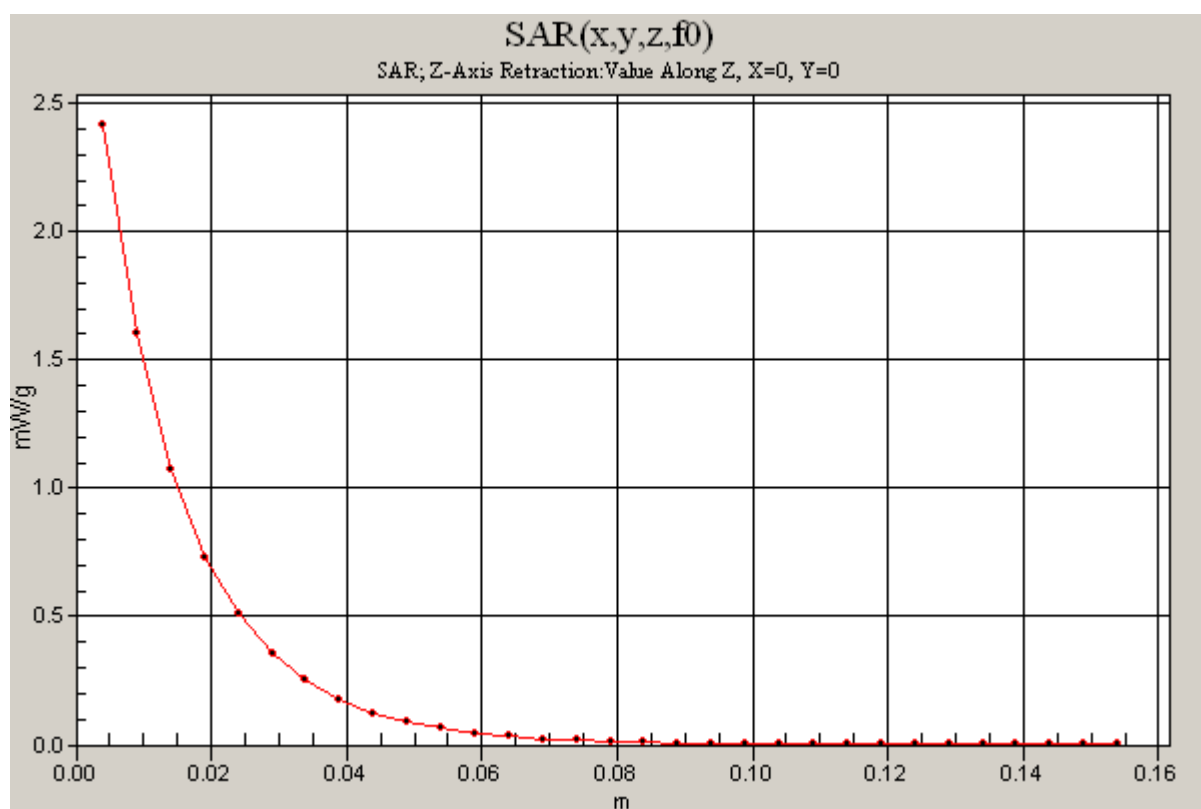
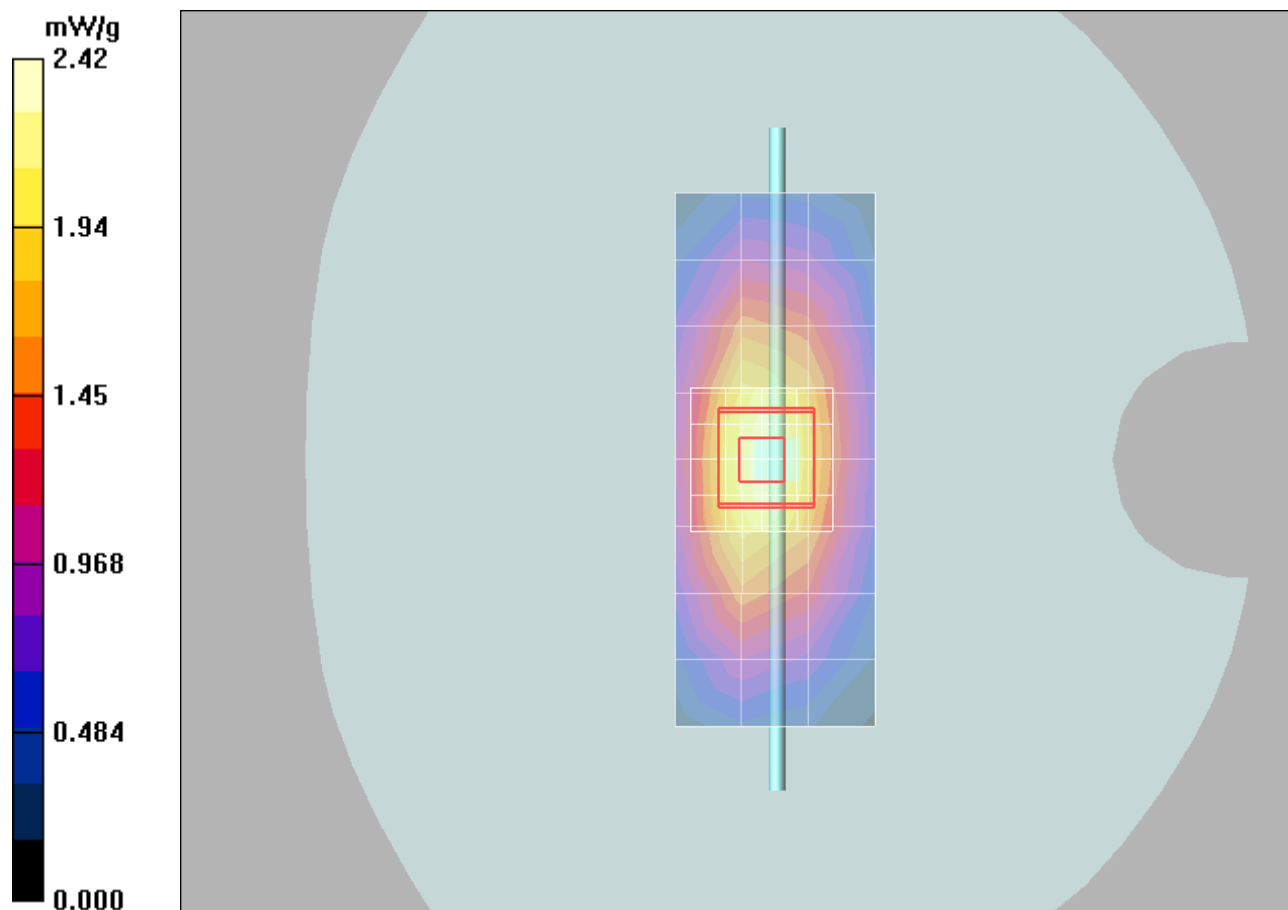
Peak SAR (extrapolated) = 3.28 W/kg

SAR(1 g) = 2.22 mW/g; SAR(10 g) = 1.43 mW/g

Maximum value of SAR (measured) = 2.41 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 2.42 mW/g



Date/Time: 10/06/2009 AM 10:06:37

Test Laboratory: Motorola**20091006_900MHz_-0.4%**

Procedure Notes: 900 MHz System Performance Check / Dipole Sn# 077 PM1 Power = 200 mW

Sim.Temp@meas = 21.5 °C Sim.Temp@SPC = 21.5 °C Room Temp @ SPC = 20.6 °C

Communication System: CW - Dipole; Frequency: 900 MHz; Channel Number: 4; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 900 \text{ MHz}$; $\sigma = 0.96 \text{ mho/m}$; $\epsilon_r = 40.4$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.24 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 51.2 V/m; Power Drift = -0.036 dB

Peak SAR (extrapolated) = 3.29 W/kg

SAR(1 g) = 2.23 mW/g; SAR(10 g) = 1.44 mW/g

Maximum value of SAR (measured) = 2.42 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 51.2 V/m; Power Drift = -0.036 dB

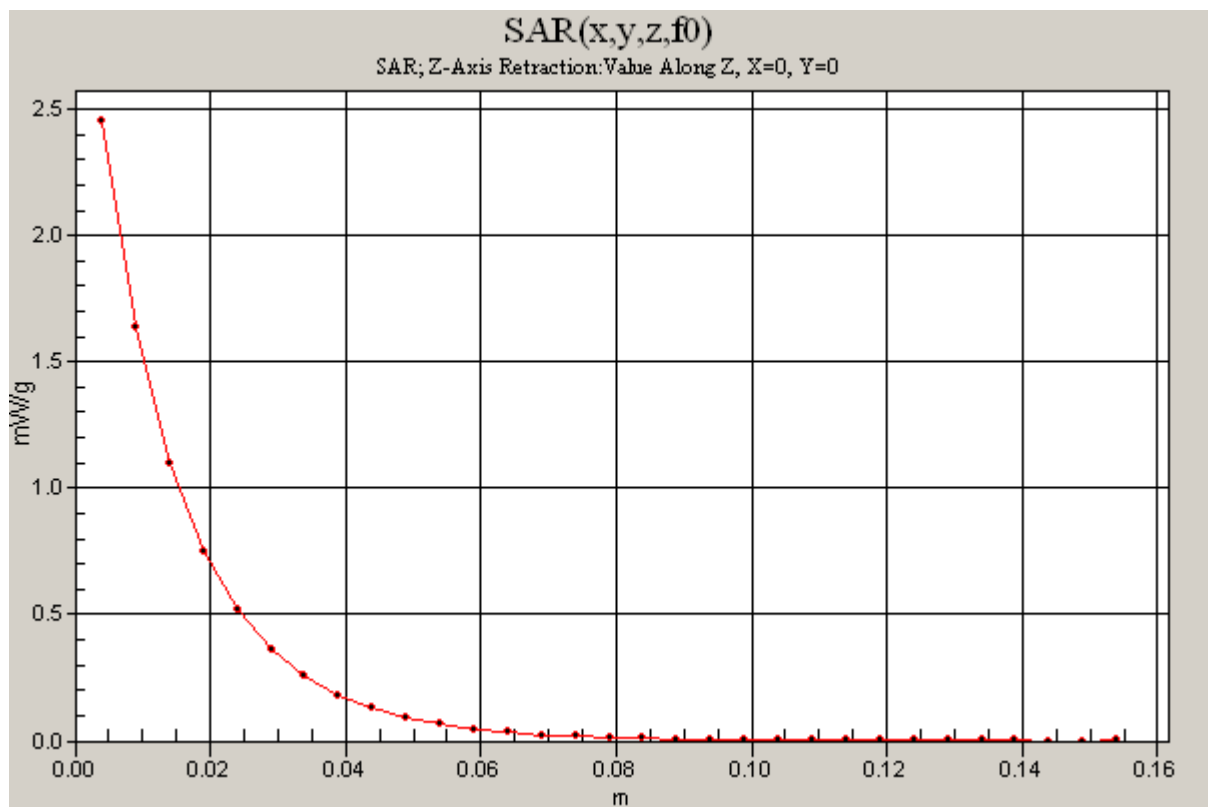
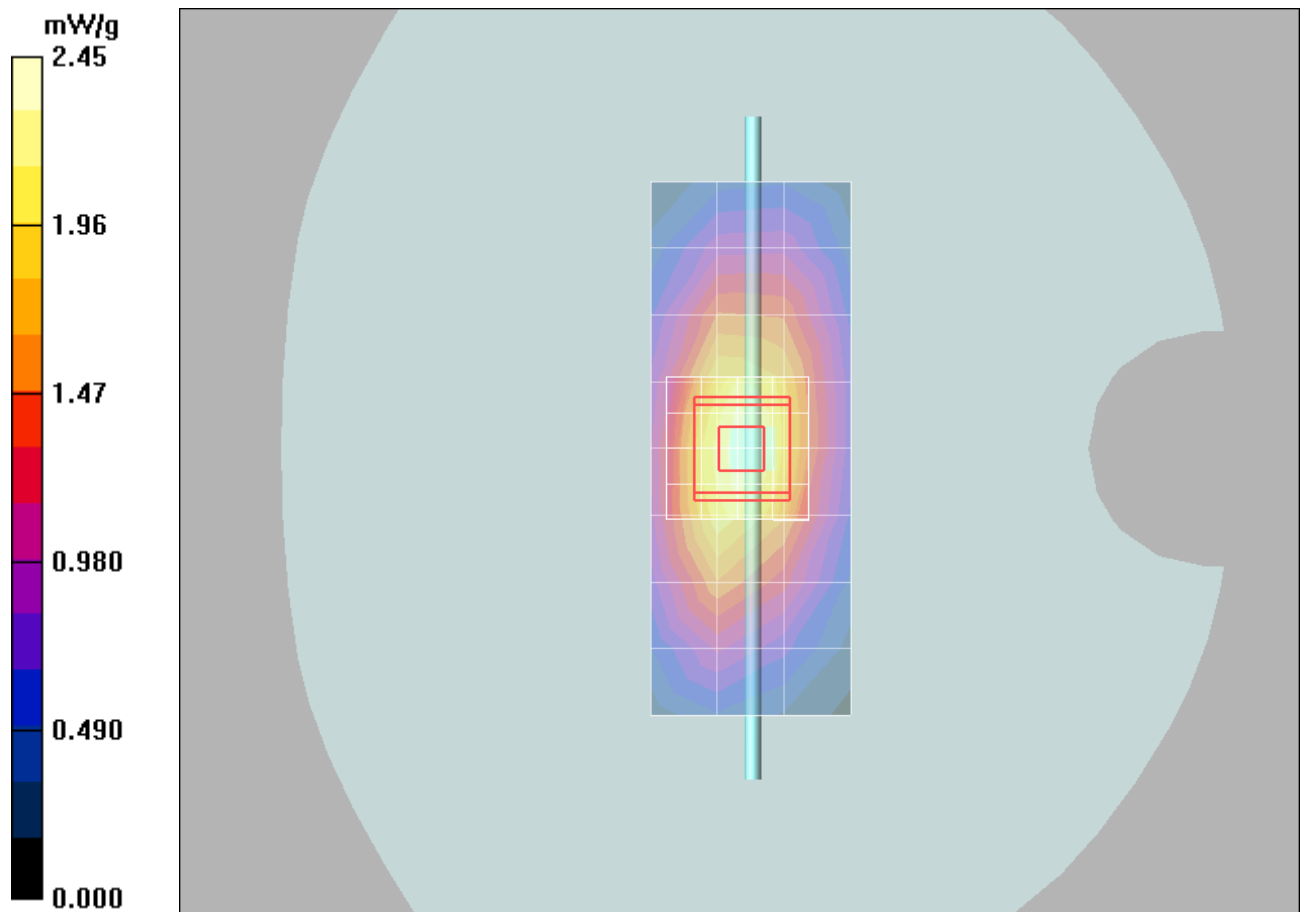
Peak SAR (extrapolated) = 3.27 W/kg

SAR(1 g) = 2.23 mW/g; SAR(10 g) = 1.44 mW/g

Maximum value of SAR (measured) = 2.41 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 2.45 mW/g



Date/Time: 10/06/2009 AM 10:34:36

Test Laboratory: Motorola 20091006_1800MHz_+0.0%

Procedure Notes: 1800 MHz System Performance Check / Dipole Sn# 280tr PM1 Power = 200 mW

Sim.Temp@meas = 21.7 °C Sim.Temp@SPC = 21.6 °C Room Temp @ SPC = 20.2 °C

Communication System: CW - Dipole; Frequency: 1800 MHz; Channel Number: 8; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 1800 \text{ MHz}$; $\sigma = 1.37 \text{ mho/m}$; $\epsilon_r = 39.4$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3180; ConvF(5, 5, 5); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 6.81 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 76.9 V/m; Power Drift = 0.040 dB

Peak SAR (extrapolated) = 13.9 W/kg

SAR(1 g) = 7.56 mW/g; SAR(10 g) = 3.96 mW/g

Maximum value of SAR (measured) = 8.39 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 76.9 V/m; Power Drift = 0.040 dB

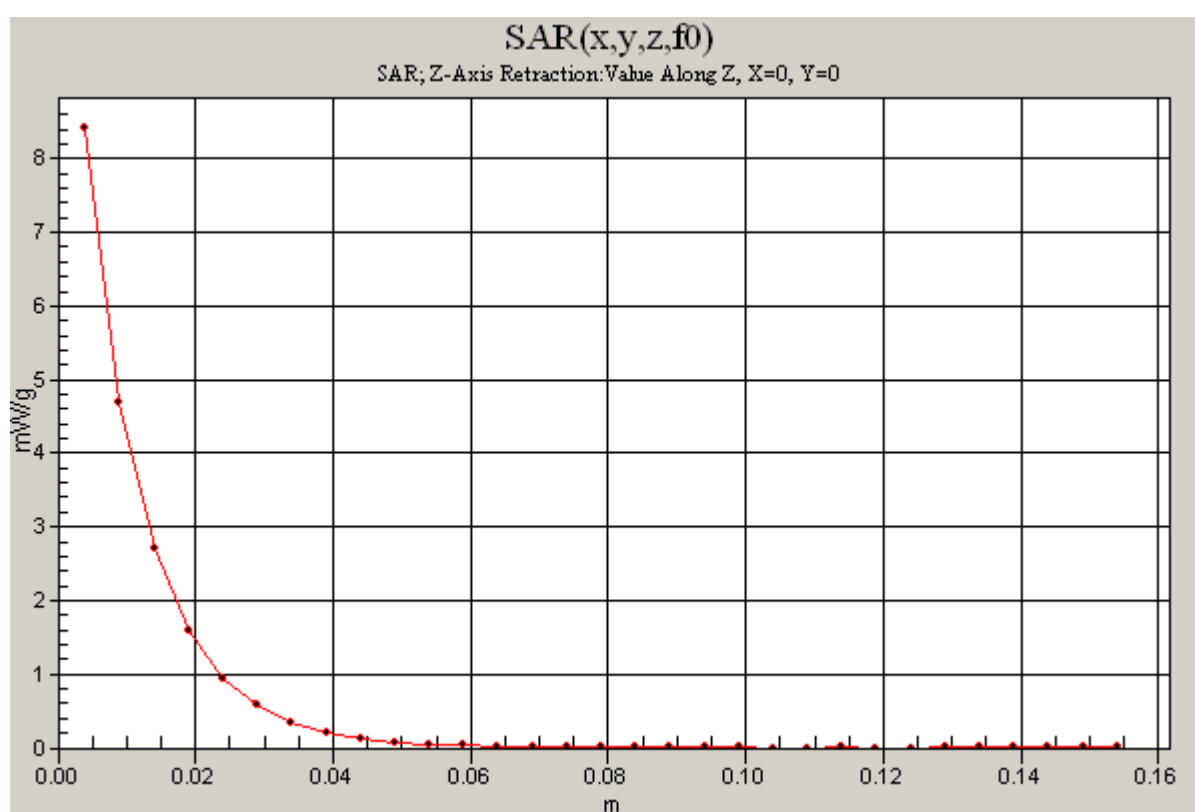
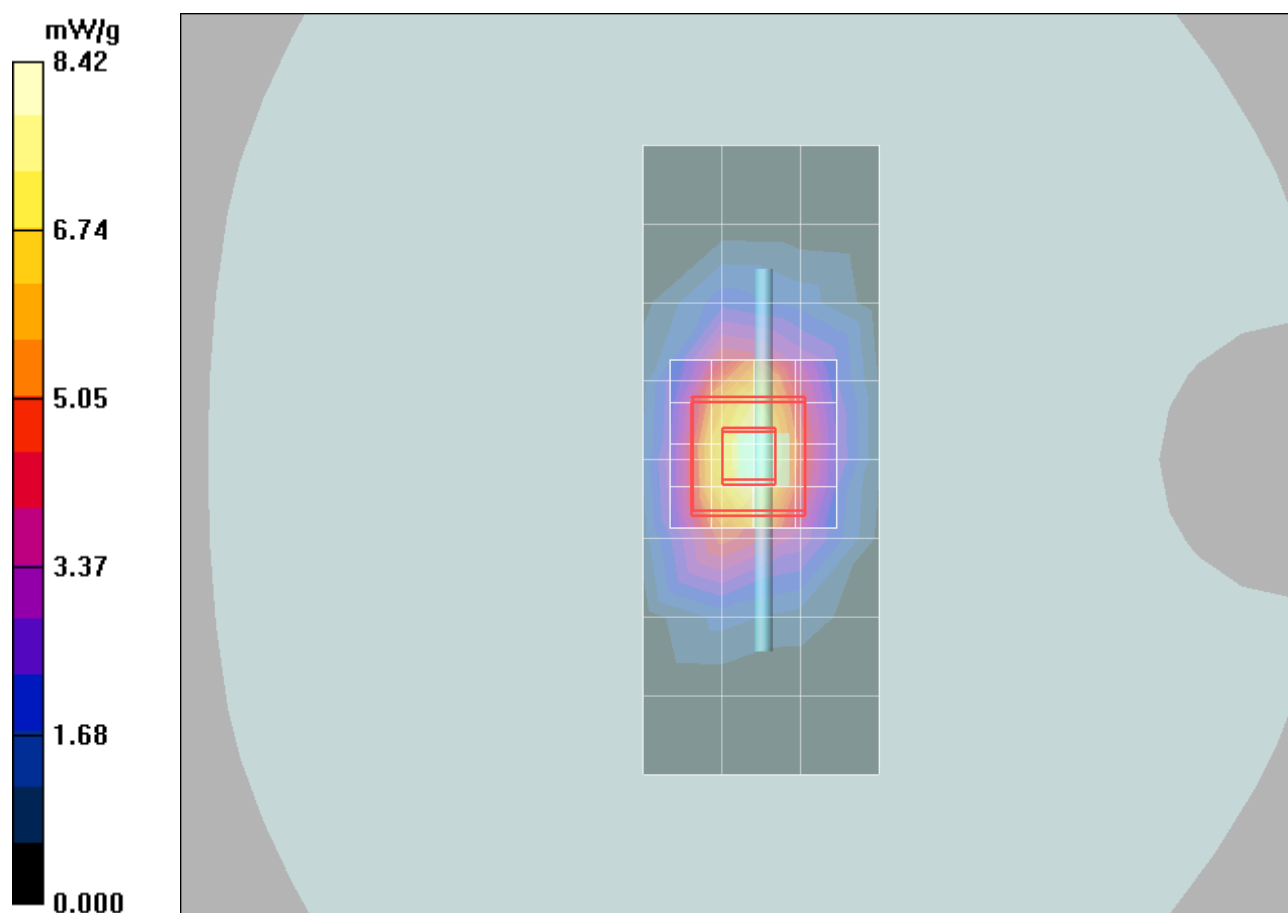
Peak SAR (extrapolated) = 14.0 W/kg

SAR(1 g) = 7.61 mW/g; SAR(10 g) = 4 mW/g

Maximum value of SAR (measured) = 8.41 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 8.42 mW/g



Test Laboratory: Motorola **20091007_2450MHz_-3.8%**

Procedure Notes: 2450 MHz System Performance Check / Dipole Sn# 767 PM1 Power = 200 mW

Sim.Temp@meas = 23.4 °C Sim.Temp@SPC = 22.8 °C Room Temp @ SPC = 21.8 °C

Communication System: CW - Dipole; Frequency: 2450 MHz; Channel Number: 11; Duty Cycle: 1:1

Medium: VALIDATION Only; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.89 \text{ mho/m}$; $\epsilon_r = 37.2$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3180; ConvF(4.44, 4.44, 4.44); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (4x9x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 8.20 mW/g

Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 81.0 V/m; Power Drift = 0.002 dB

Peak SAR (extrapolated) = 23.9 W/kg

SAR(1 g) = 10.8 mW/g; SAR(10 g) = 4.85 mW/g

Maximum value of SAR (measured) = 12.1 mW/g

Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 81.0 V/m; Power Drift = 0.002 dB

Peak SAR (extrapolated) = 24.6 W/kg

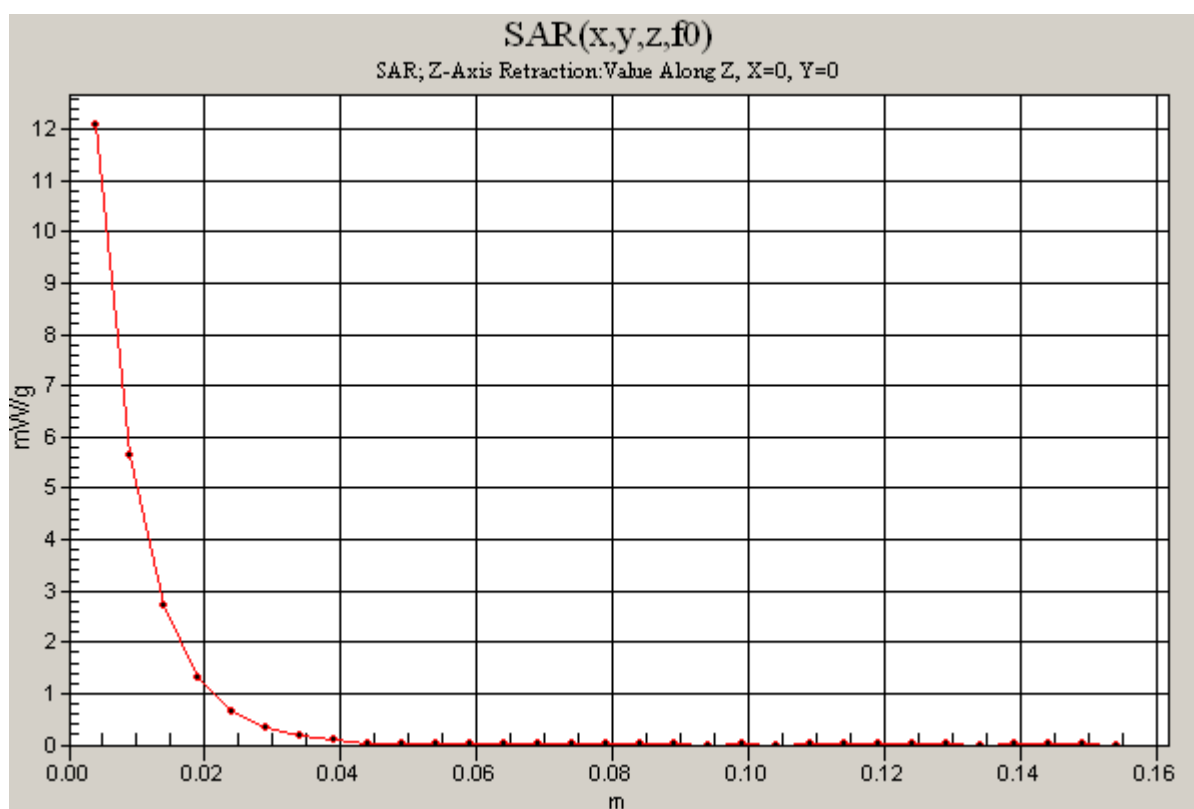
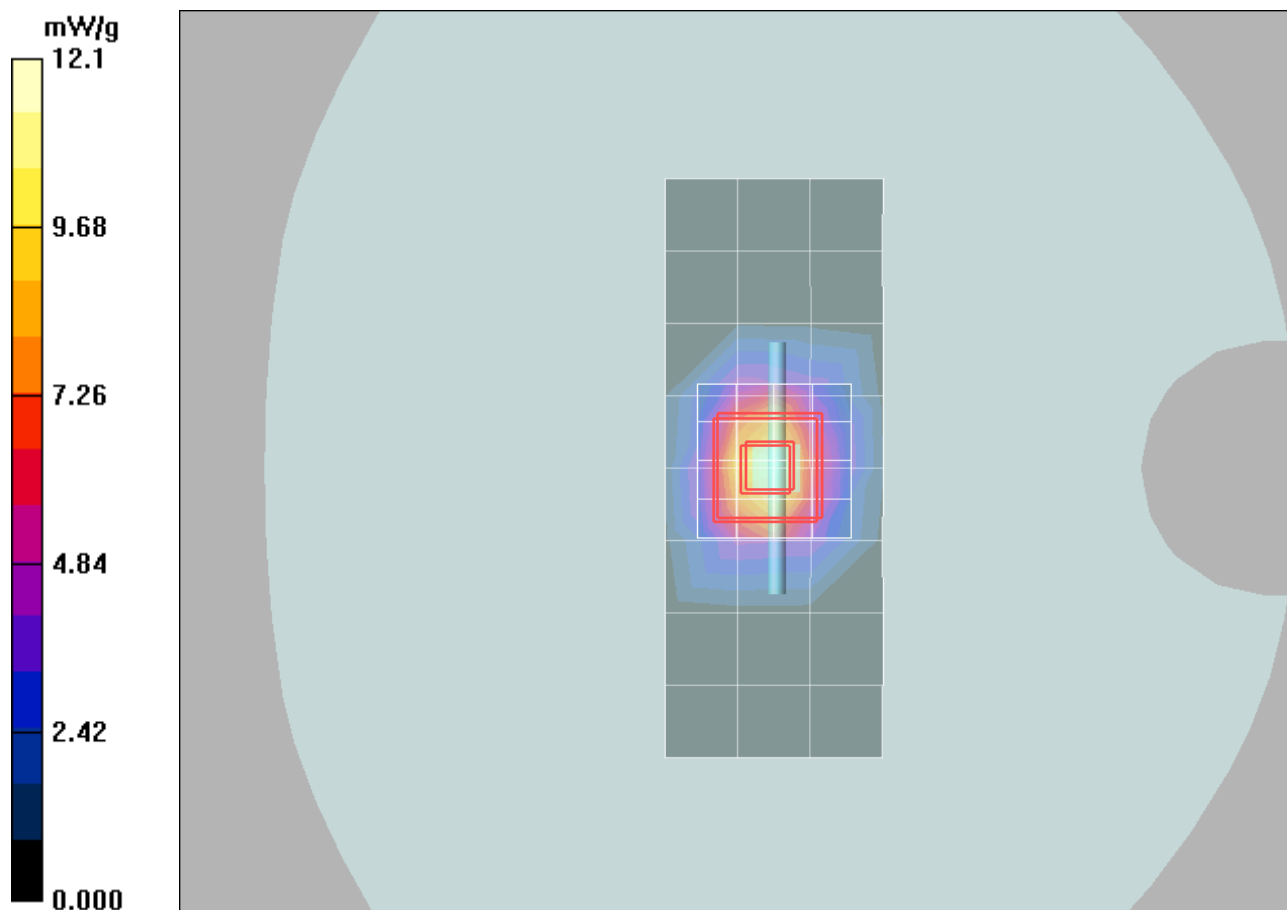
SAR(1 g) = 11 mW/g; SAR(10 g) = 4.91 mW/g

Maximum value of SAR (measured) = 12.0 mW/g

Daily SPC Check/Z-Axis Retraction (1x1x31):

Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 12.1 mW/g



Appendix 2

SAR distribution plots for Phantom Head Adjacent Use

Date/Time: 10/05/2009 PM 12:49:36

Test Laboratory: Motorola GSM850 Cheek**56899020002312;**

Procedure Notes: Pwr Step: 05(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: GSM 850; Frequency: 836.6 MHz; Channel Number: 190; Duty Cycle: 1:8

Medium: Low Freq Head; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ mho/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 0.259 mW/g

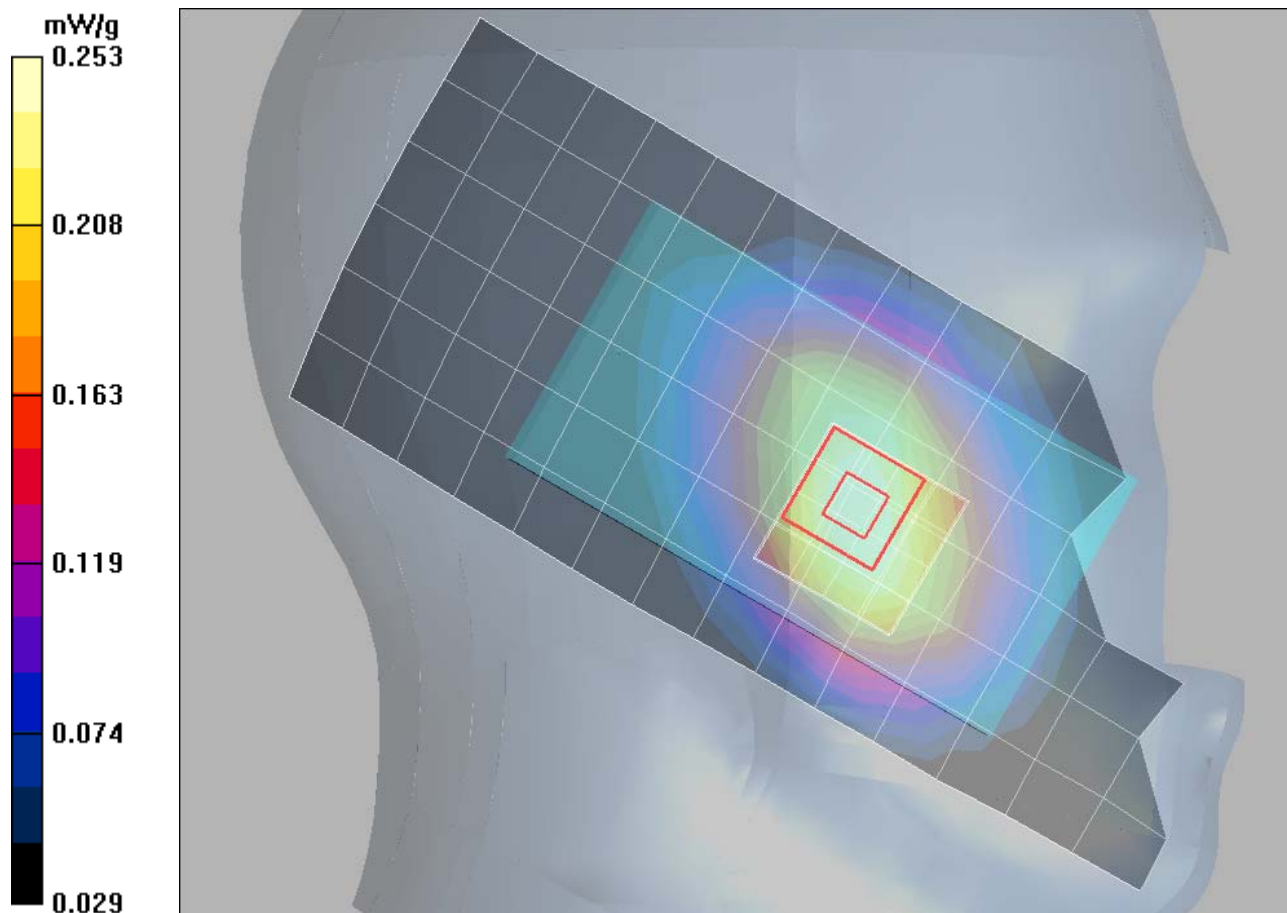
Left Head Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 17.0 V/m; Power Drift = -0.022 dB

Peak SAR (extrapolated) = 0.293 W/kg

SAR(1 g) = 0.241 mW/g; SAR(10 g) = 0.183 mW/g

Maximum value of SAR (measured) = 0.253 mW/g



Date/Time: 10/06/2009 PM 12:32:15

Test Laboratory: Motorola GSM1900 Cheek**356899020002312;**

Procedure Notes: Pwr Step: 00(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: GSM 1900; Frequency: 1880 MHz; Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³**DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5, 5, 5); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.300 mW/g**Right Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:**

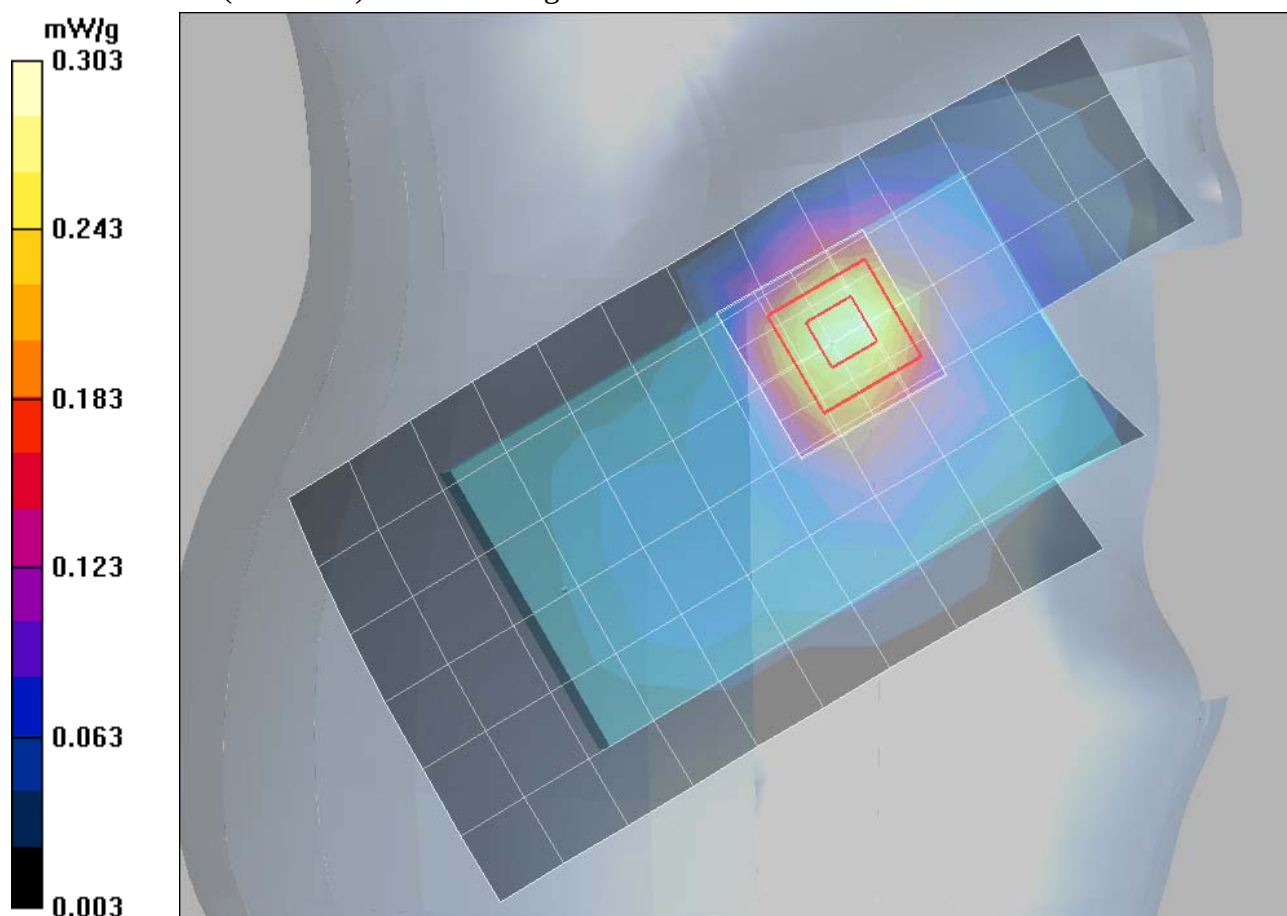
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.4 V/m; Power Drift = -0.077 dB

Peak SAR (extrapolated) = 0.444 W/kg

SAR(1 g) = 0.283 mW/g; SAR(10 g) = 0.168 mW/g

Maximum value of SAR (measured) = 0.303 mW/g



Date/Time: 10/06/2009 AM 08:09:07

Test Laboratory: Motorola**WCDMA850 Cheek****356899020002312;**

Procedure Notes: Pwr Step: All Up(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: 3G-WCDMA 850; Frequency: 836 MHz; Channel Number: 4180; Duty Cycle: 1:1

Medium: Low Freq Head; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ mho/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (10mm) (10x25x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 0.243 mW/g

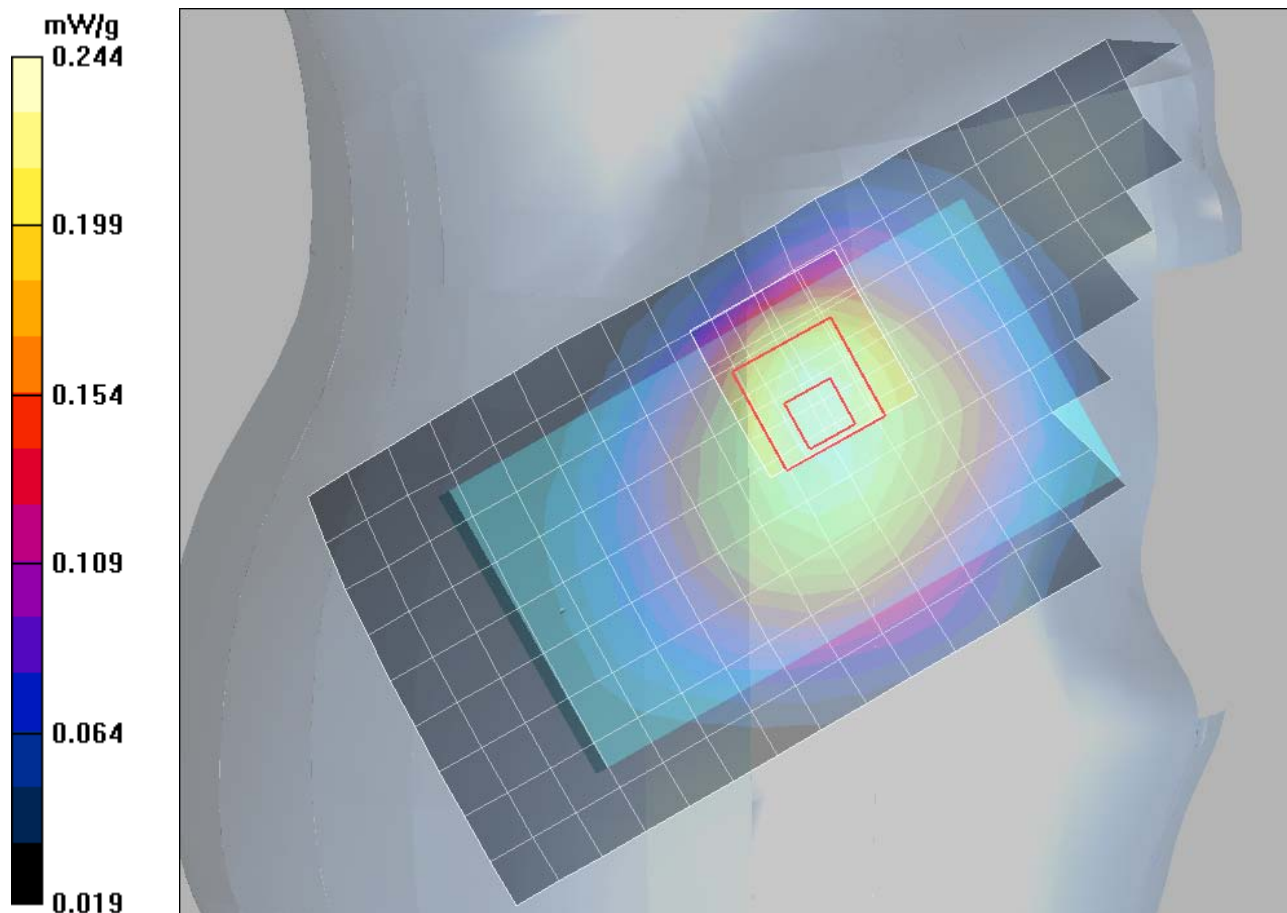
Right Head Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 16.2 V/m; Power Drift = -0.009 dB

Peak SAR (extrapolated) = 0.294 W/kg

SAR(1 g) = 0.233 mW/g; SAR(10 g) = 0.169 mW/g

Maximum value of SAR (measured) = 0.244 mW/g



Date/Time: 10/06/2009 PM 07:12:09

Test Laboratory: Motorola WCDMA1900 Cheek**356899020002312;**

Procedure Notes: Pwr Step: All Up(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: 3G/WCDMA 1900; Frequency: 1880 MHz; Channel Number: 9400; Duty Cycle: 1:1

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³**DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5, 5, 5); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.521 mW/g**Right Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:**

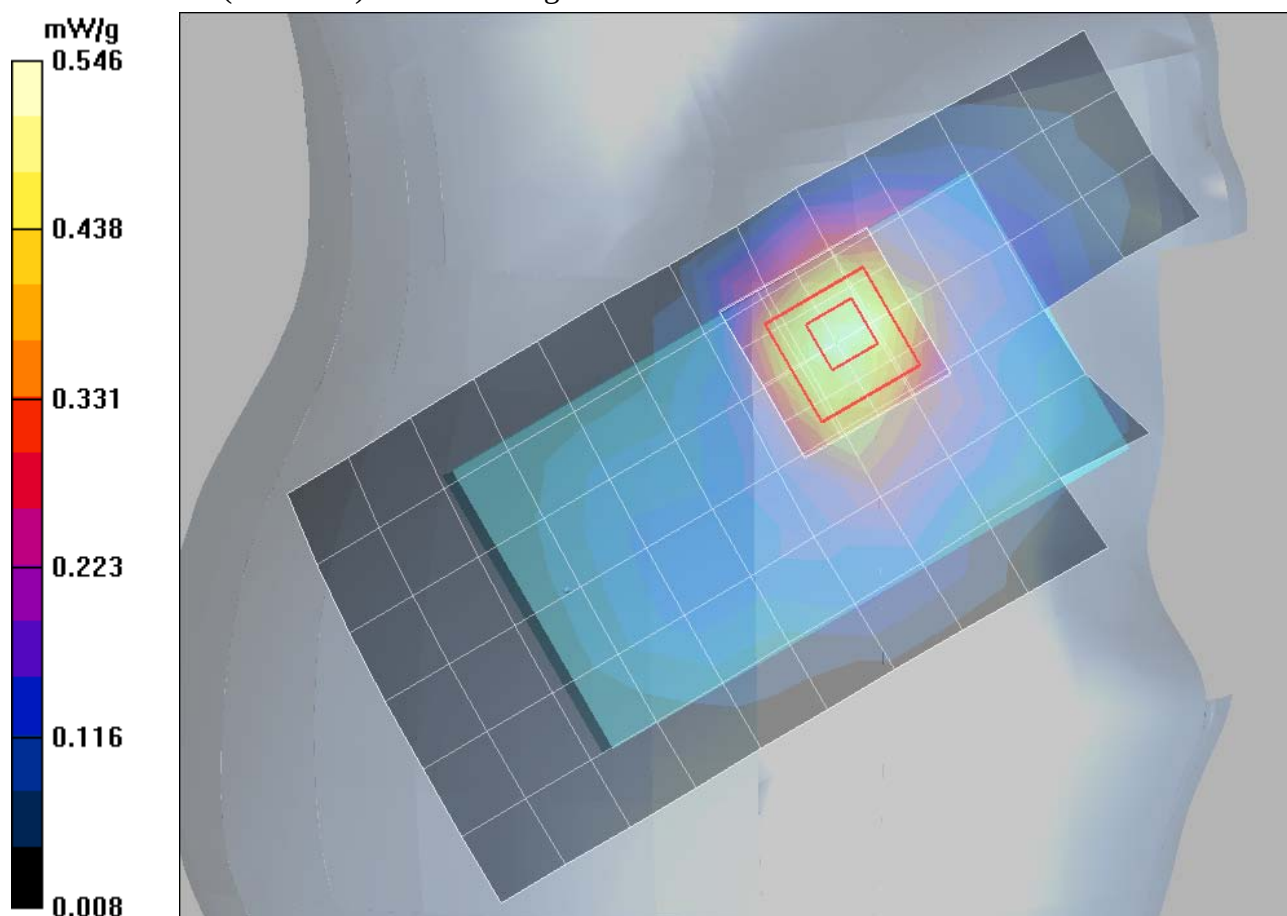
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 19.3 V/m; Power Drift = -0.041 dB

Peak SAR (extrapolated) = 0.773 W/kg

SAR(1 g) = 0.504 mW/g; SAR(10 g) = 0.306 mW/g

Maximum value of SAR (measured) = 0.546 mW/g



Date/Time: 10/07/2009 PM 04:44:19

Test Laboratory: Motorola WiFi 2450 Cheek**356899020002312;**

Procedure Notes: Pwr Step: N/A Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Cheek

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Channel Number: 6; Duty Cycle: 1:1

Medium: 2450 Glycol Head; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.89 \text{ mho/m}$; $\epsilon_r = 37.2$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(4.44, 4.44, 4.44); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.739 mW/g

Right Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

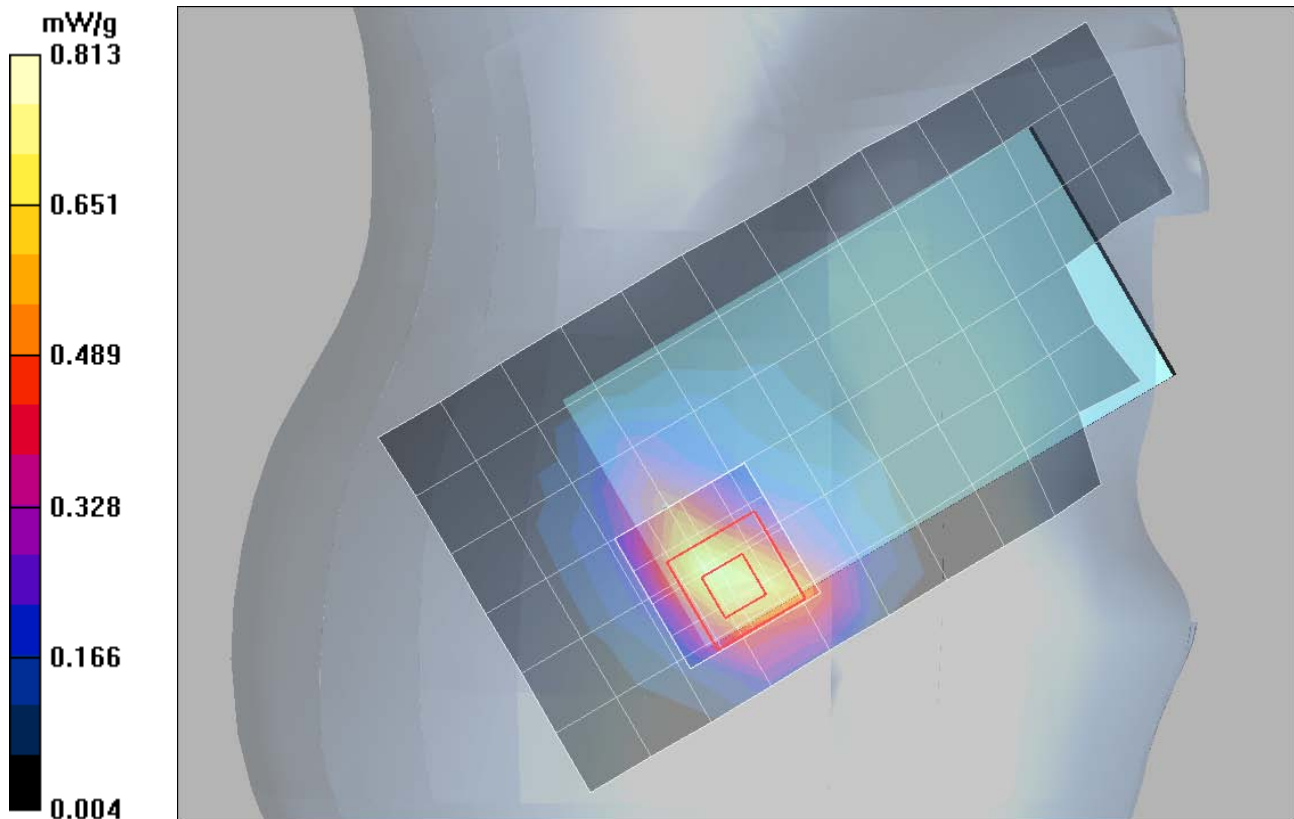
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.4 V/m; Power Drift = 0.065 dB

Peak SAR (extrapolated) = 1.64 W/kg

SAR(1 g) = 0.758 mW/g; SAR(10 g) = 0.357 mW/g

Maximum value of SAR (measured) = 0.813 mW/g



Date/Time: 10/05/2009 PM 02:02:52

Test Laboratory: Motorola GSM850 Tilt**356899020002312;**

Procedure Notes: Pwr Step: 05(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Rotated

Communication System: GSM 850; Frequency: 836.6 MHz; Channel Number: 190; Duty Cycle: 1:8

Medium: Low Freq Head; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ mho/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.198 mW/g

Right Head Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:

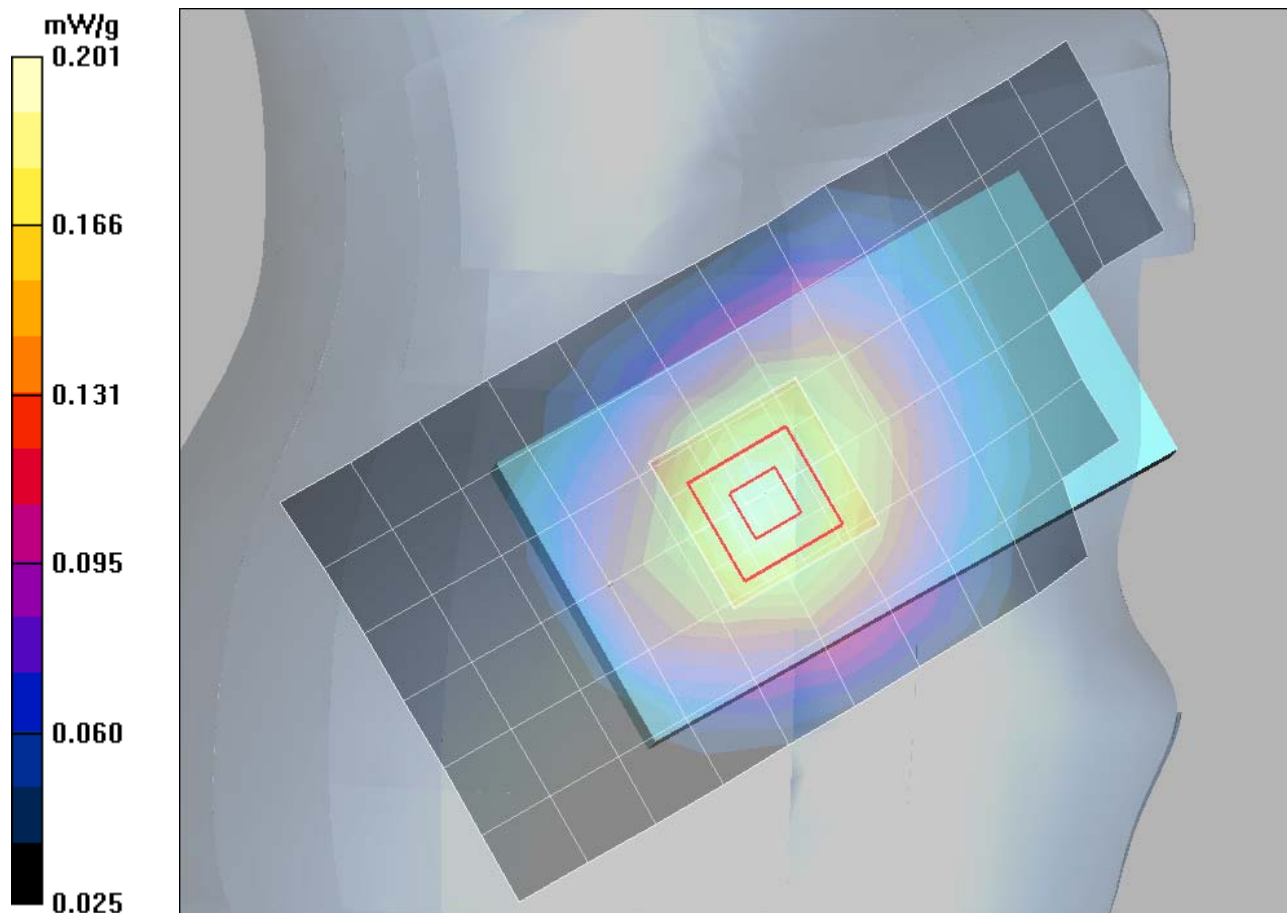
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.9 V/m; Power Drift = 0.146 dB

Peak SAR (extrapolated) = 0.232 W/kg

SAR(1 g) = 0.191 mW/g; SAR(10 g) = 0.145 mW/g

Maximum value of SAR (measured) = 0.201 mW/g



Date/Time: 10/06/2009 AM 11:54:48

Test Laboratory: Motorola GSM1900 Tilt**356899020002312;**

Procedure Notes: Pwr Step: 00(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Rotated

Communication System: GSM 1900; Frequency: 1880 MHz; Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³**DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5, 5, 5); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.186 mW/g

Left Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

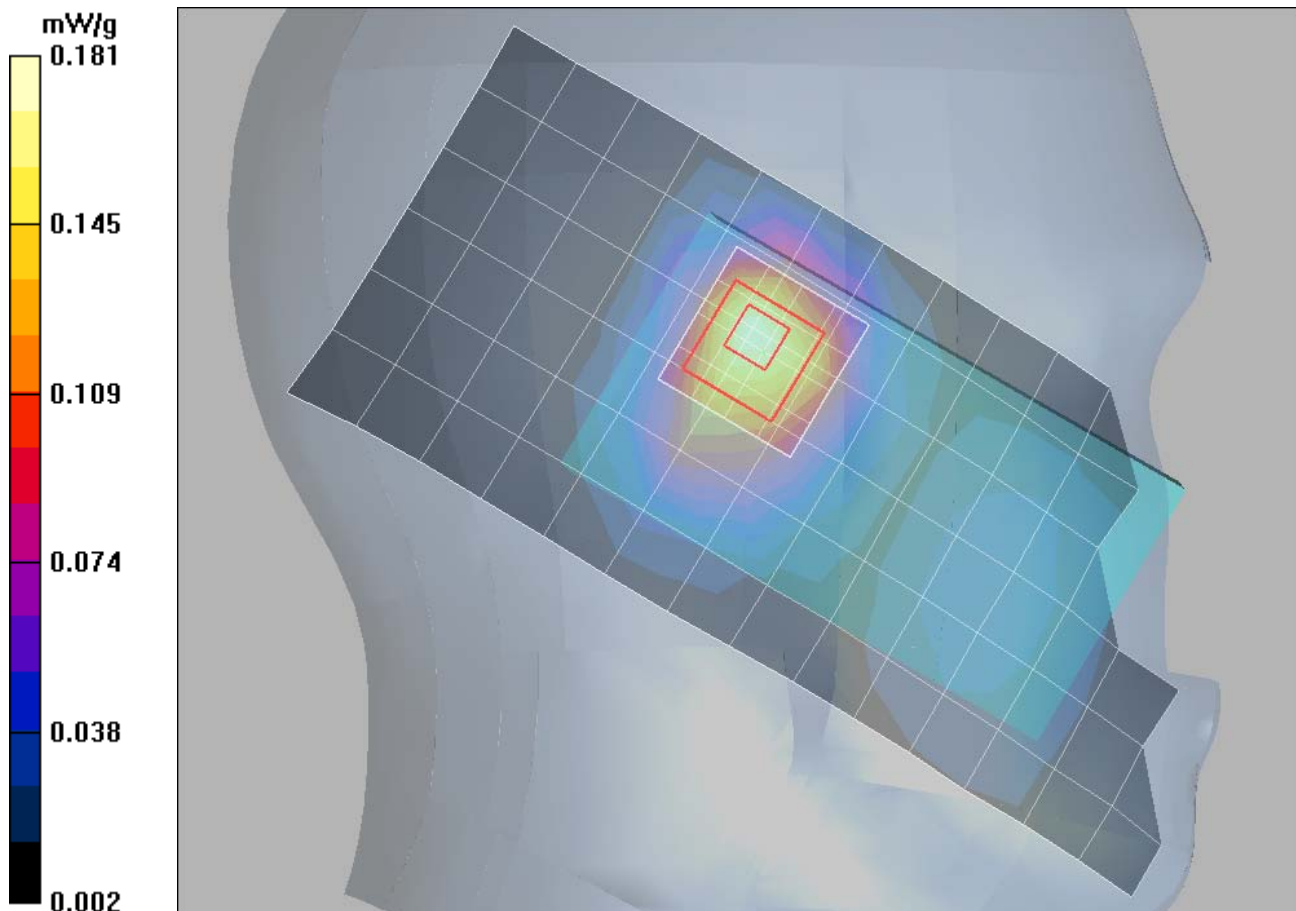
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.5 V/m; Power Drift = 0.032 dB

Peak SAR (extrapolated) = 0.274 W/kg

SAR(1 g) = 0.173 mW/g; SAR(10 g) = 0.103 mW/g

Maximum value of SAR (measured) = 0.181 mW/g



Date/Time: 10/06/2009 AM 08:43:42

Test Laboratory: Motorola WCDMA850 Tilt**356899020002312;**

Procedure Notes: Pwr Step: All Up(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Rotated

Communication System: 3G-WCDMA 850; Frequency: 836 MHz; Channel Number: 4180; Duty Cycle: 1:1

Medium: Low Freq Head; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.9 \text{ mho/m}$; $\epsilon_r = 41.1$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.88, 5.88, 5.88); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1155;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Right Head Template/Area Scan - Normal (10mm) (10x25x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 0.202 mW/g

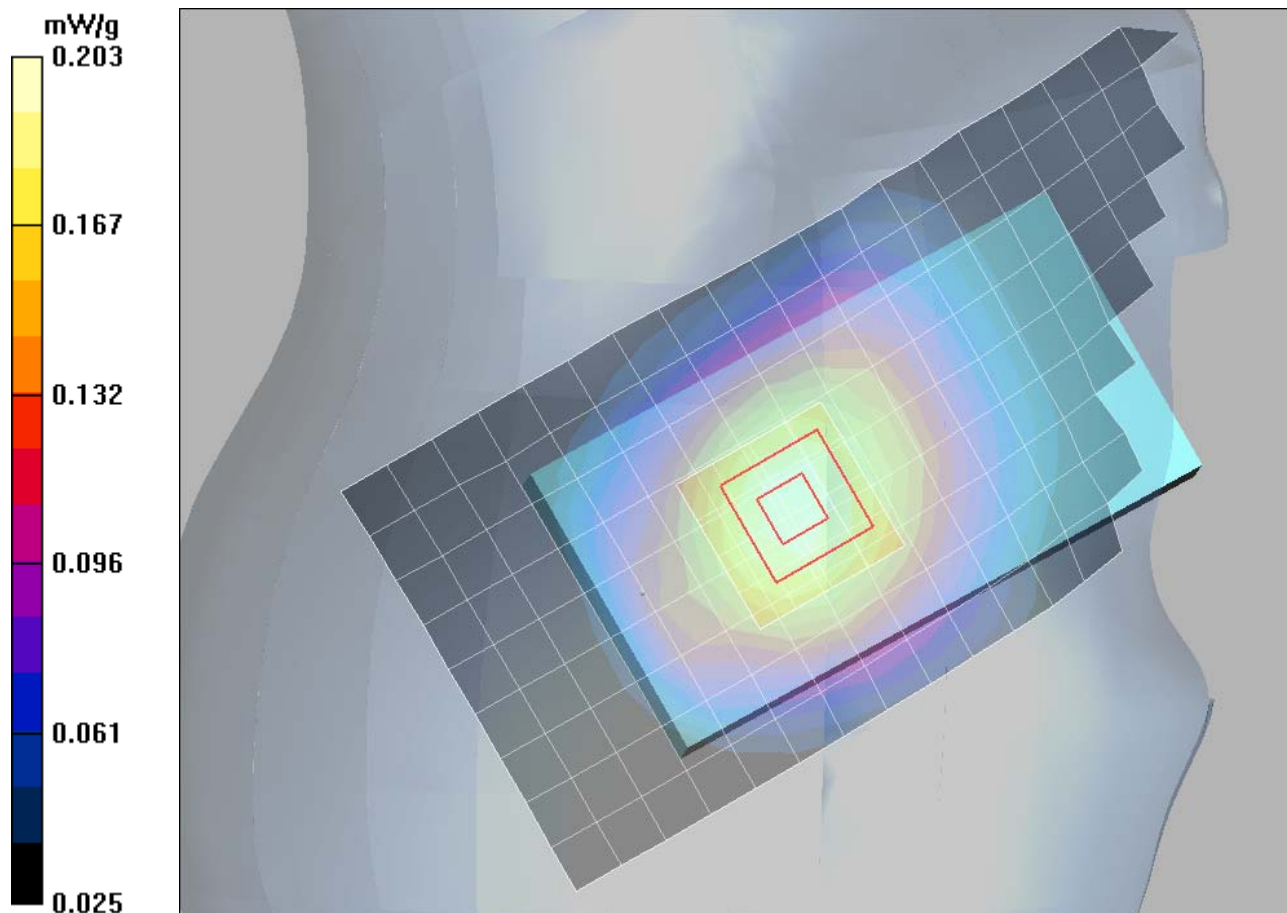
Right Head Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 14.8 V/m; Power Drift = 0.108 dB

Peak SAR (extrapolated) = 0.236 W/kg

SAR(1 g) = 0.192 mW/g; SAR(10 g) = 0.145 mW/g

Maximum value of SAR (measured) = 0.203 mW/g



Date/Time: 10/06/2009 PM 06:12:58

Test Laboratory: Motorola WCDMA1900 Tilt

356899020002312;

Procedure Notes: Pwr Step: All Up(OTA) Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Rotated

Communication System: 3G/WCDMA 1900; Frequency: 1880 MHz; Channel Number: 9400; Duty Cycle: 1:1

Medium: Regular Glycol Head 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ mho/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3180; ConvF(5, 5, 5); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.337 mW/g

Left Head Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

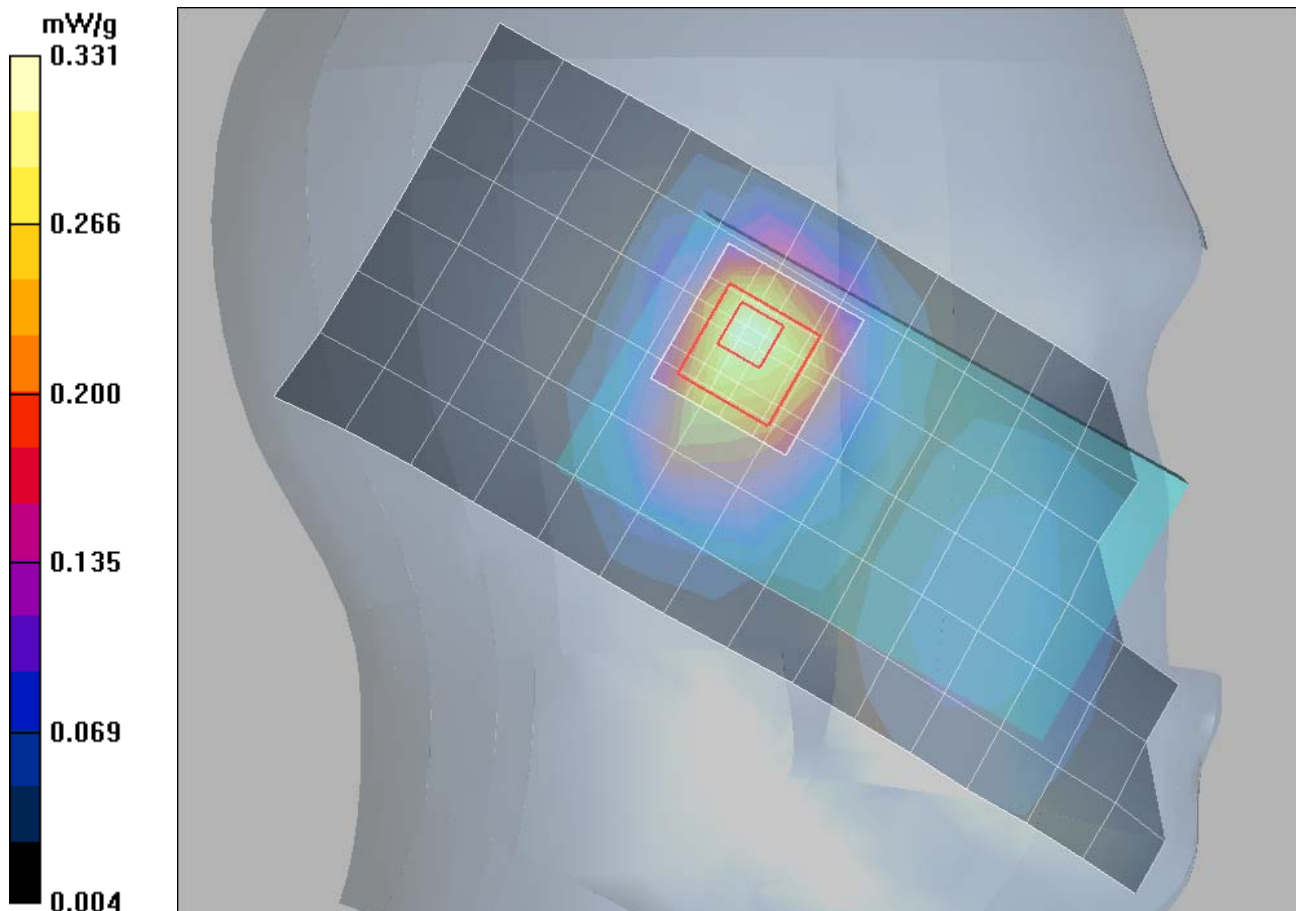
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.3 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 0.488 W/kg

SAR(1 g) = 0.313 mW/g; SAR(10 g) = 0.189 mW/g

Maximum value of SAR (measured) = 0.331 mW/g



Date/Time: 10/07/2009 PM 04:24:15

Test Laboratory: Motorola WiFi 2450 Tilt**356899020002312;**

Procedure Notes: Pwr Step: N/A Antenna Position: Internal

Battery Model #: SNN5843A DEVICE POSITION (cheek or rotated): Rotated

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Channel Number: 6; Duty Cycle: 1:1

Medium: 2450 Glycol Head; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.89 \text{ mho/m}$; $\epsilon_r = 37.2$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(4.44, 4.44, 4.44); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1086;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Left Head Template/Area Scan - Normal (15mm) (7x17x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 0.619 mW/g

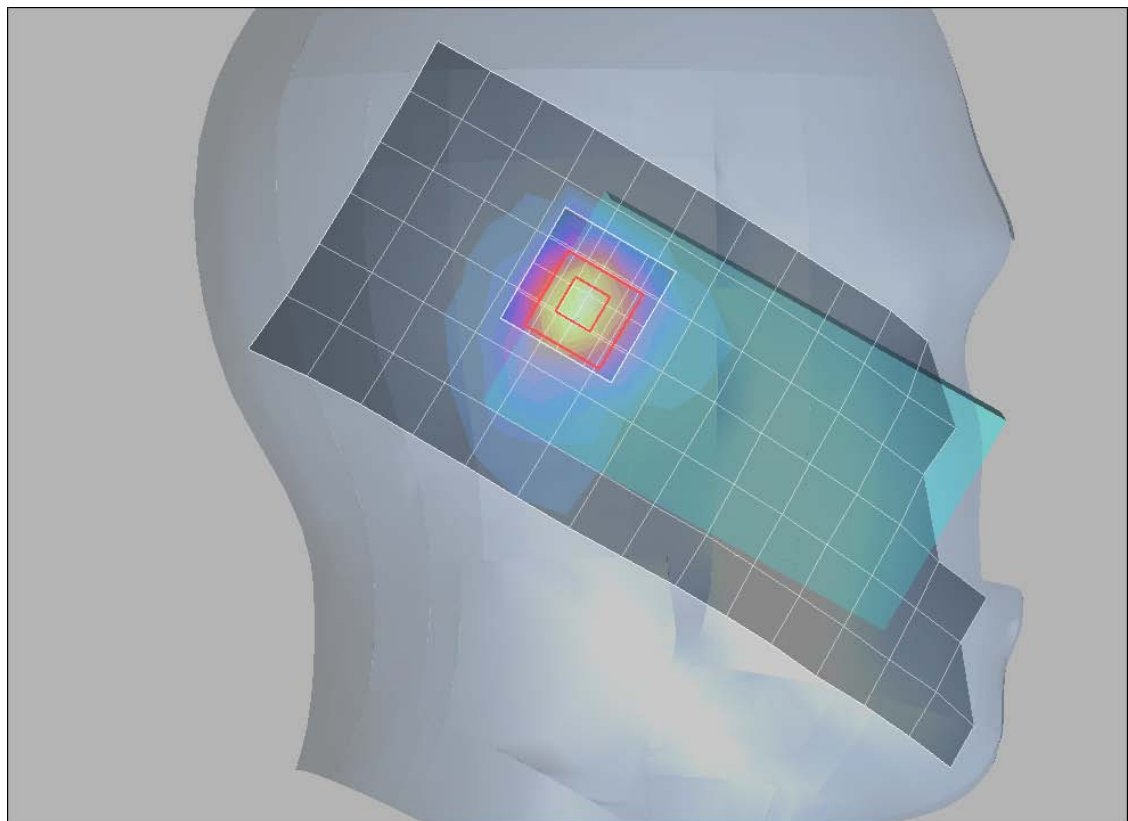
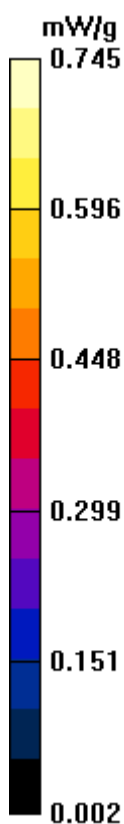
Left Head Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.6 V/m; Power Drift = -0.082 dB

Peak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.665 mW/g; SAR(10 g) = 0.314 mW/g

Maximum value of SAR (measured) = 0.745 mW/g



Appendix 3

SAR distribution plots for Body Worn Configuration

Date/Time: 10/05/2009 PM 02:44:22

Test Laboratory: Motorola GSM850 BodyWorn**356899020002312;**

Procedure Notes: Pwr Step: 05(OTA) Antenna Position: Internal

Battery Model #: SNN5843A Device Position: Back of phone 15mm away from phantom

Communication System: GSM 850; Frequency: 836.6 MHz; Channel Number: 190; Duty Cycle: 1:8

Medium: Low Freq Body; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ mho/m}$; $\epsilon_r = 54.6$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.84, 5.84, 5.84); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 1, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 0.367 mW/g

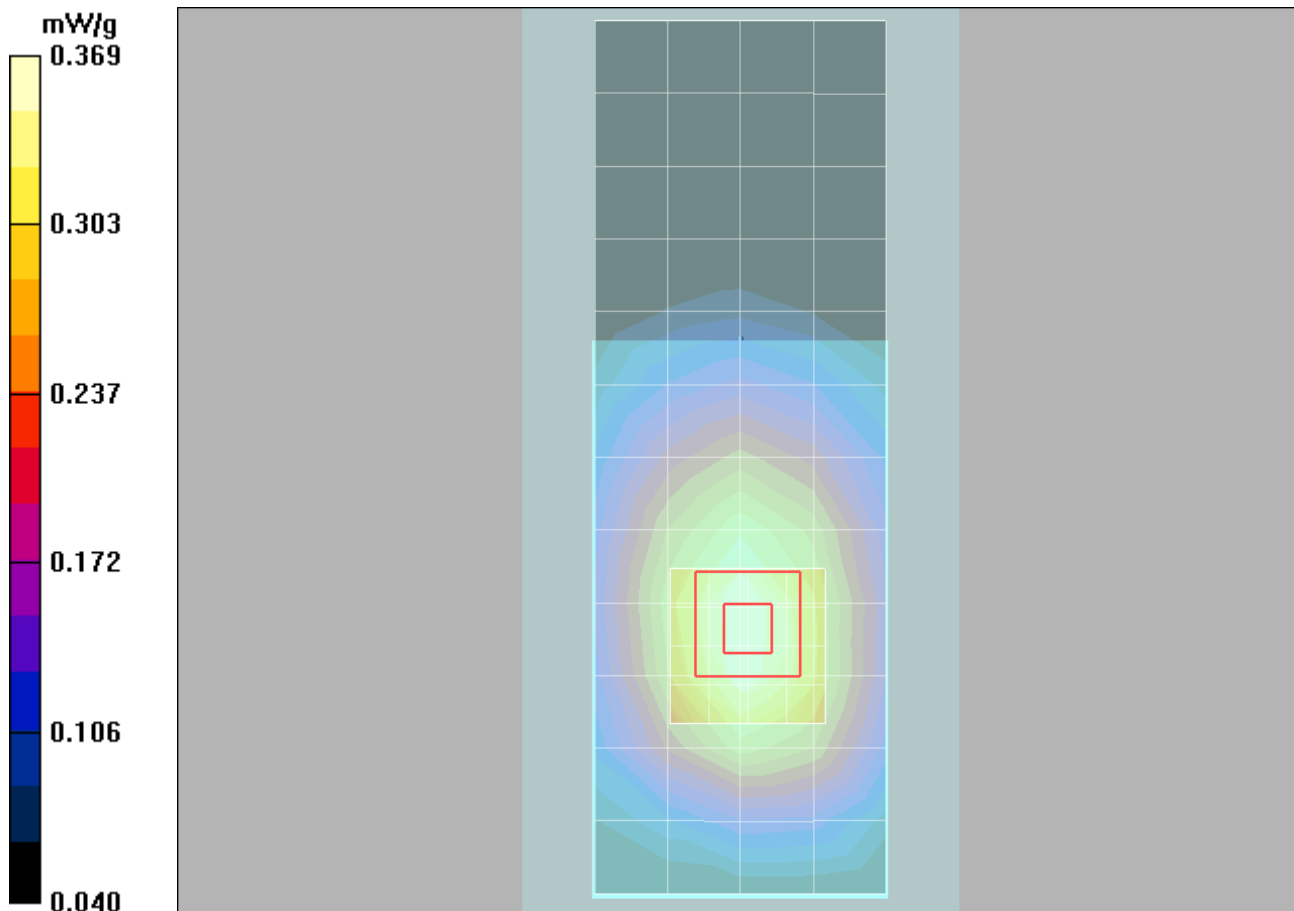
Amy Twin Phone Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.1 V/m; Power Drift = -0.006 dB

Peak SAR (extrapolated) = 0.445 W/kg

SAR(1 g) = 0.351 mW/g; SAR(10 g) = 0.261 mW/g

Maximum value of SAR (measured) = 0.369 mW/g



Date/Time: 10/06/2009 PM 02:02:56

Test Laboratory: Motorola GSM1900 BodyWorn**356899020002312;**

Procedure Notes: Pwr Step: 00(OTA) Antenna Position: Internal

Battery Model #: SNN5843A Device Position: Back of phone 15mm away from phantom

Communication System: GSM 1900; Frequency: 1880 MHz; Channel Number: 661; Duty Cycle: 1:8

Medium: Regular Glycol Body 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 51.8$; $\rho = 1000$ kg/m³**DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(4.64, 4.64, 4.64); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.320 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

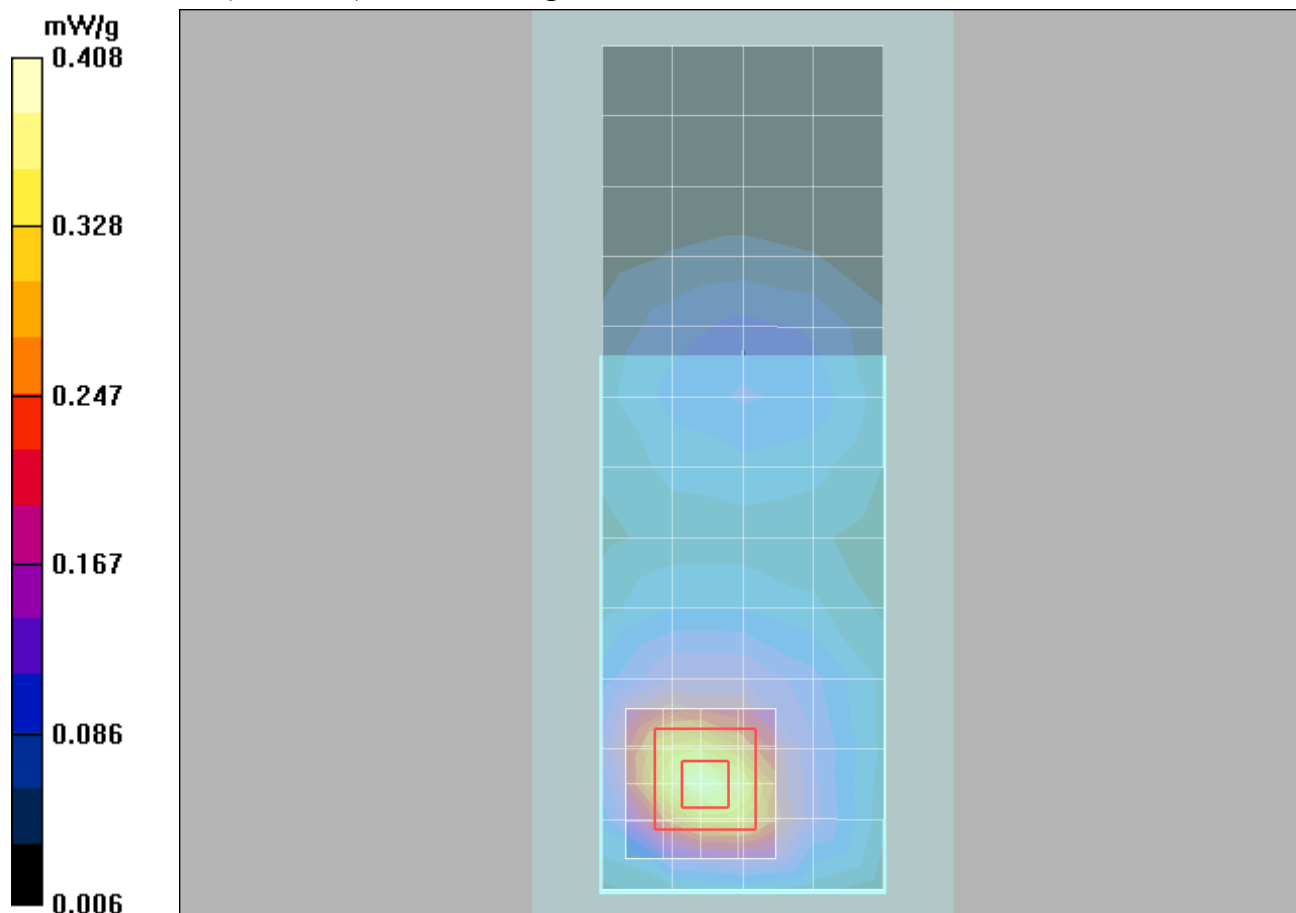
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.5 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 0.567 W/kg

SAR(1 g) = 0.364 mW/g; SAR(10 g) = 0.211 mW/g

Maximum value of SAR (measured) = 0.408 mW/g



Test Laboratory: Motorola**WCDMA850 BodyWorn****356899020002312;**

Procedure Notes: Pwr Step: AllUp(OTA) Antenna Position: Internal

Battery Model #:SNN5843A Device Position: Back of phone 15mm away from Phantom

Communication System: 3G-WCDMA 850; Frequency: 836 MHz; Channel Number: 4180; Duty Cycle: 1:1

Medium: Low Freq Body; Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 1.01 \text{ mho/m}$; $\epsilon_r = 54.6$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(5.84, 5.84, 5.84); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 1, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.313 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:

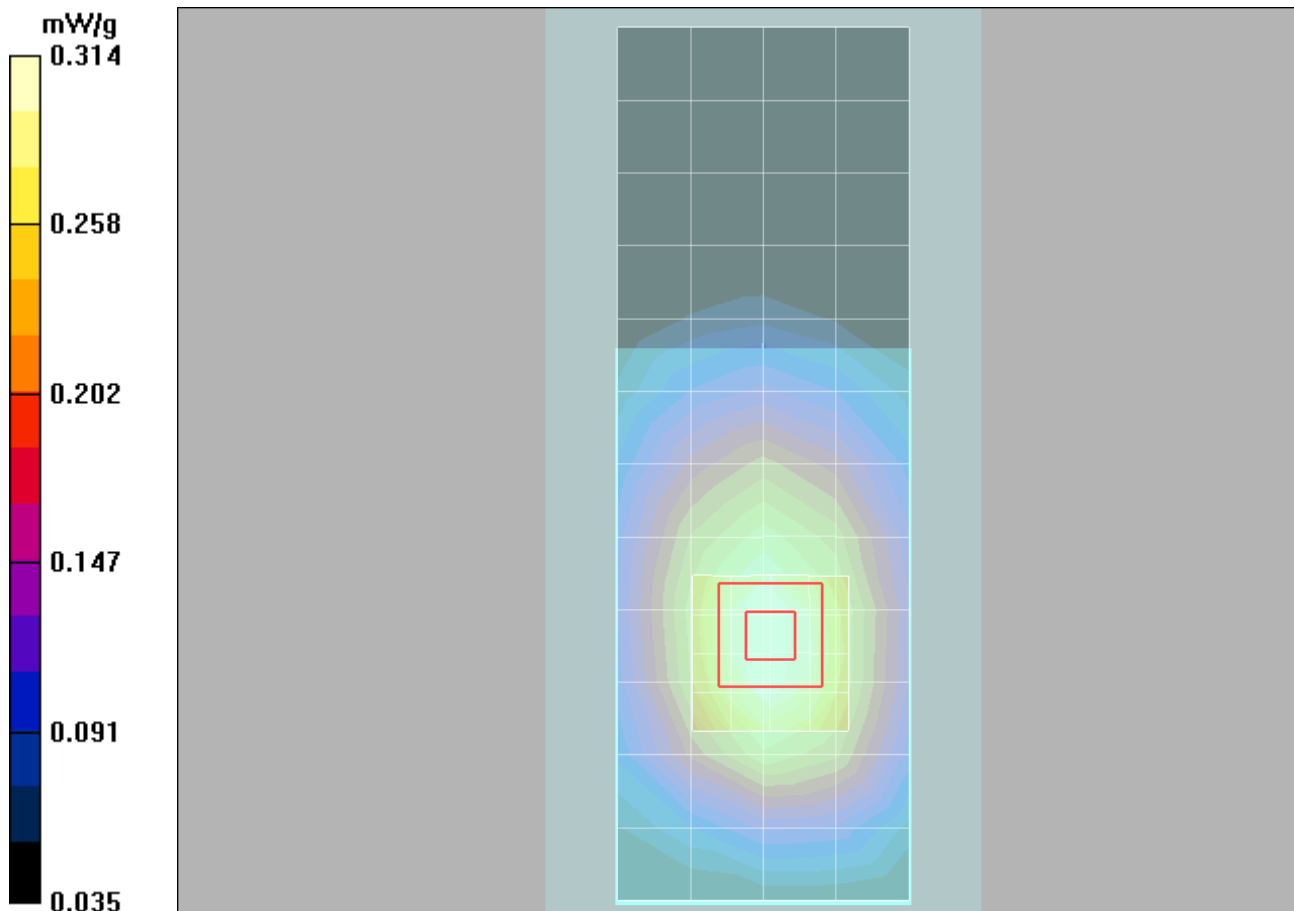
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 17.5 V/m; Power Drift = 0.042 dB

Peak SAR (extrapolated) = 0.381 W/kg

SAR(1 g) = 0.300 mW/g; SAR(10 g) = 0.223 mW/g

Maximum value of SAR (measured) = 0.314 mW/g



Date/Time: 10/06/2009 PM 04:36:52

Test Laboratory: Motorola**WCDMA1900 BodyWorn****356899020002312;**

Procedure Notes: Pwr Step: All Up(OTA) Antenna Position: Internal

Battery Model #: SNN5843A Device Position: Back of phone 15mm away from phantom

Communication System: 3G/WCDMA 1900; Frequency: 1880 MHz; Channel Number: 9400; Duty Cycle: 1:1

Medium: Regular Glycol Body 1750/1880; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.56$ mho/m; $\epsilon_r = 51.8$; $\rho = 1000$ kg/m³**DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(4.64, 4.64, 4.64); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.647 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

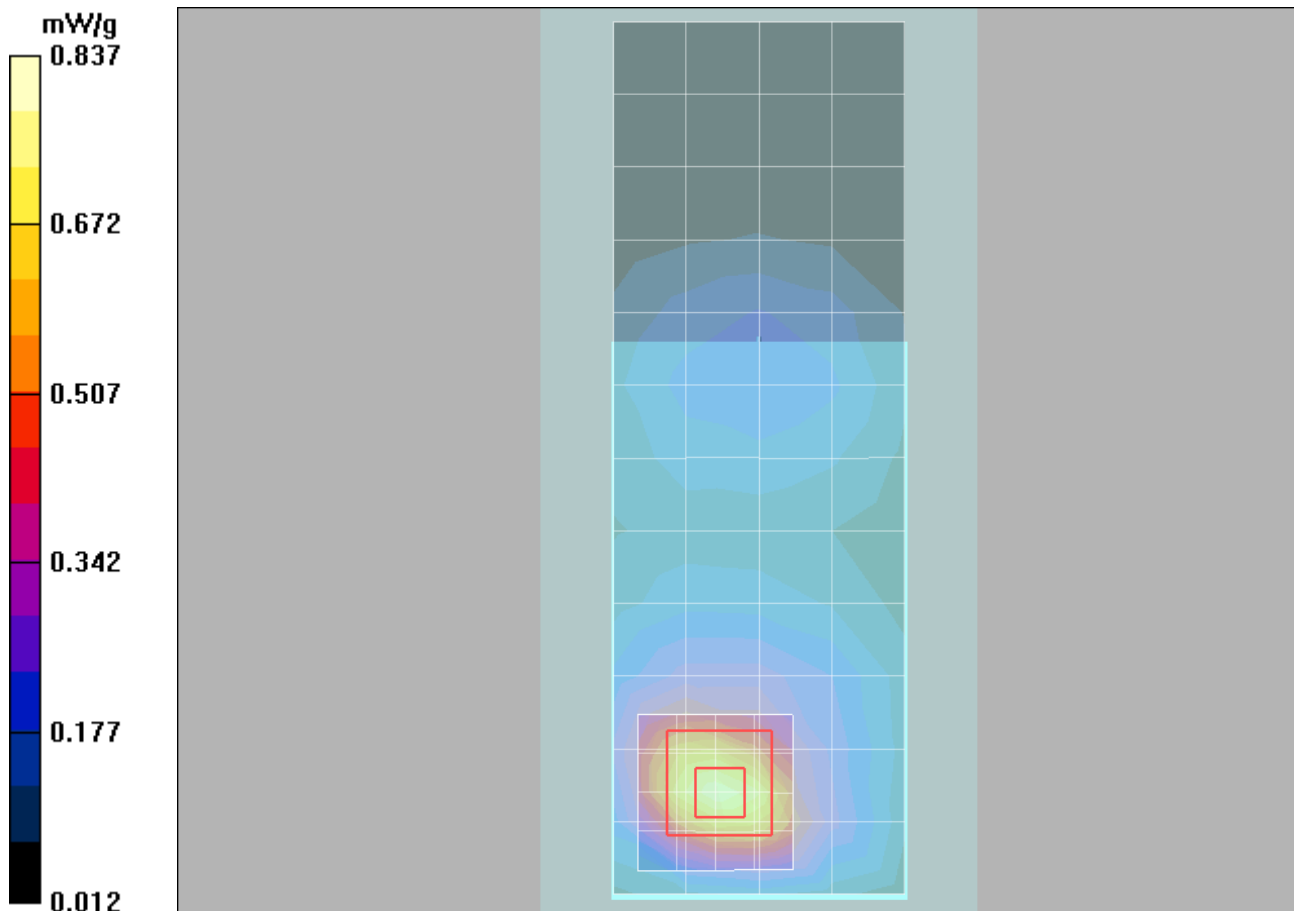
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.9 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 1.18 W/kg

SAR(1 g) = 0.740 mW/g; SAR(10 g) = 0.419 mW/g

Maximum value of SAR (measured) = 0.837 mW/g



Date/Time: 10/07/2009 PM 05:40:01

Test Laboratory: Motorola**WiFi 2450 BodyWorn****356899020002312;**

Procedure Notes: Pwr Step: N/A Antenna Position: Internal

Battery Model #: SNN5843A Device Position: Front of phone 15mm away from phantom

Communication System: Wi-Fi 2450; Frequency: 2437 MHz; Channel Number: 6; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 2.04 \text{ mho/m}$; $\epsilon_r = 50.2$; $\rho = 1000 \text{ kg/m}^3$ **DASY4 Configuration:**

- Probe: ES3DV3 - SN3180; ConvF(4.19, 4.19, 4.19); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 0.166 mW/g

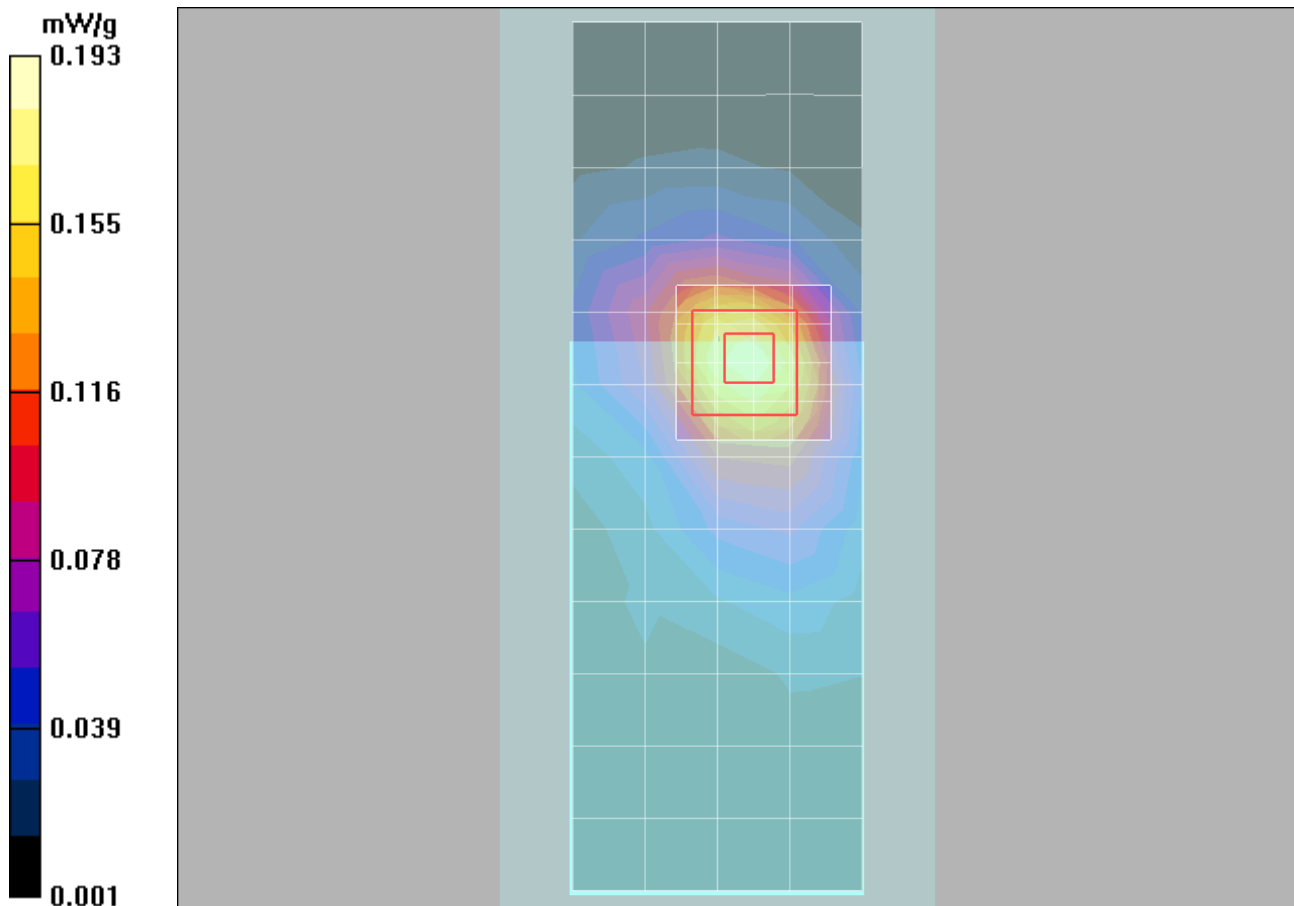
Amy Twin Phone Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.99 V/m; Power Drift = -0.161 dB

Peak SAR (extrapolated) = 0.325 W/kg

SAR(1 g) = 0.179 mW/g; SAR(10 g) = 0.100 mW/g

Maximum value of SAR (measured) = 0.193 mW/g



Date/Time: 10/07/2009 PM 07:18:47

Test Laboratory: Motorola Bluetooth 2450 BodyWorn

356899020002312;

Procedure Notes: Pwr Step:N/A Antenna Position: Internal

Battery Model #: SNN5843A Device Position: Front of phone 15mm away from phantom

Communication System: Bluetooth; Frequency: 2441 MHz; Channel Number: 39; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 2.04 \text{ mho/m}$; $\epsilon_r = 50.2$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3180; ConvF(4.19, 4.19, 4.19); Calibrated: 07/21/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn398; Calibrated: 11/06/2008
- Phantom: PCS-10_ Section 2, Amy Twin, Rev2 (23-June-04); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Amy Twin Phone Template/Area Scan - Normal Body (15mm) (13x7x1):

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.006 mW/g

Amy Twin Phone Template/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0:

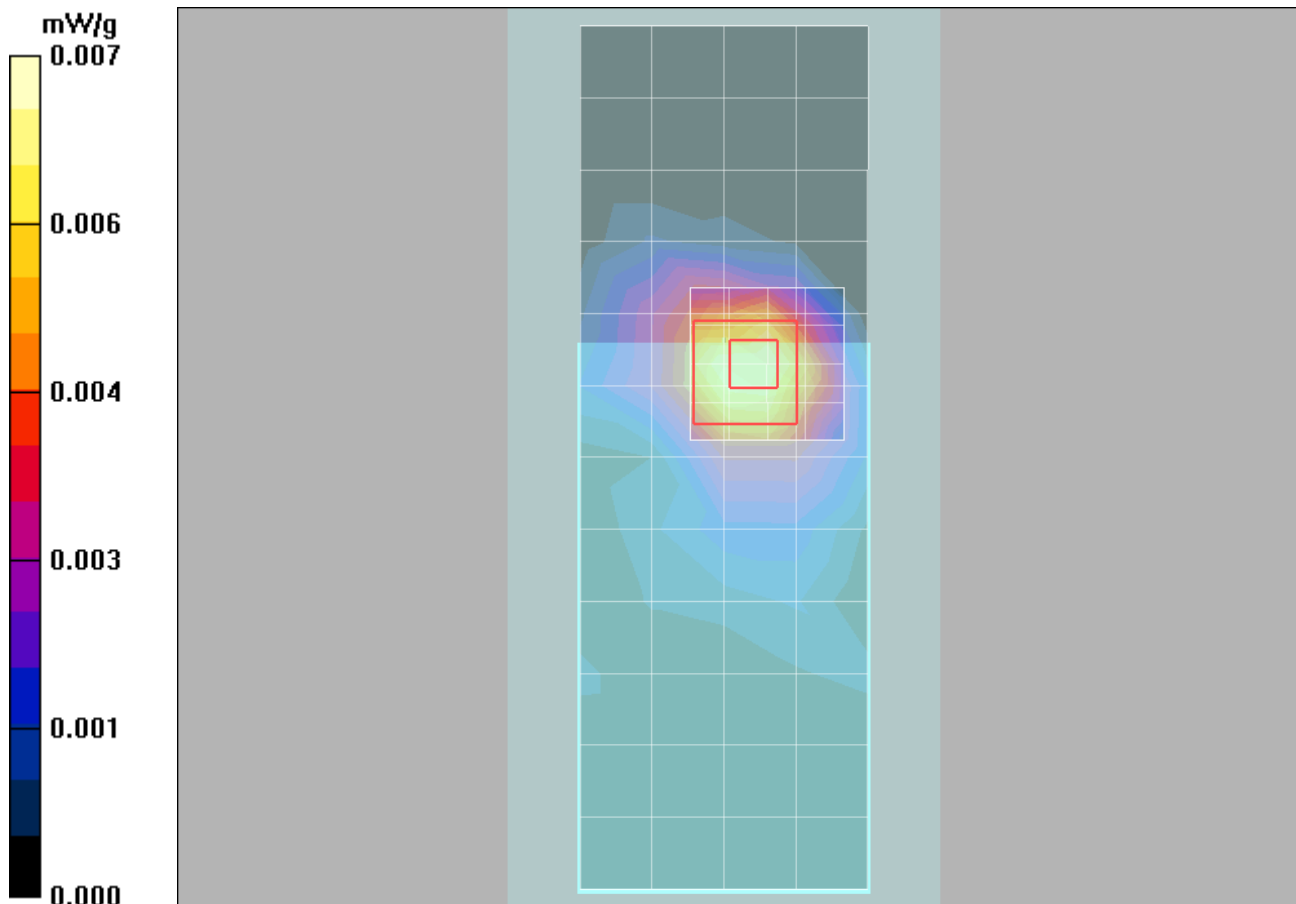
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.51 V/m; Power Drift = -0.026 dB

Peak SAR (extrapolated) = 0.011 W/kg

SAR(1 g) = 0.00642 mW/g; SAR(10 g) = 0.0031 mW/g

Maximum value of SAR (measured) = 0.007 mW/g



Appendix 4
Probe Calibration Certificate



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA

Multilateral Agreement for the recognition of calibration certificates

Client **Motorola Korea**

Certificate No: **ES3-3180_Jul09**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3180**

Calibration procedure(s) **QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
 Calibration procedure for dosimetric E-field probes**

Calibration date: **July 21, 2009**

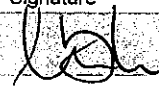
Condition of the calibrated item **In Tolerance**

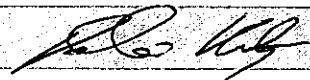
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
 The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

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

Issued: July 21, 2009

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
Polarization ϕ	ϕ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * *frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * *ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3180

Manufactured:	March 25, 2008
Last calibrated:	July 14, 2008
Recalibrated:	July 21, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ES3DV3 SN:3180

Sensitivity in Free Space^A

Diode Compression^B

NormX	1.22 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	93 mV
NormY	1.06 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	97 mV
NormZ	1.03 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	96 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	9.9	5.9
SAR _{be} [%]	With Correction Algorithm	0.8	0.3

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SAR _{be} [%]	Without Correction Algorithm	9.9	6.4
SAR _{be} [%]	With Correction Algorithm	0.9	0.5

Sensor Offset

Probe Tip to Sensor Center **2.0 mm**

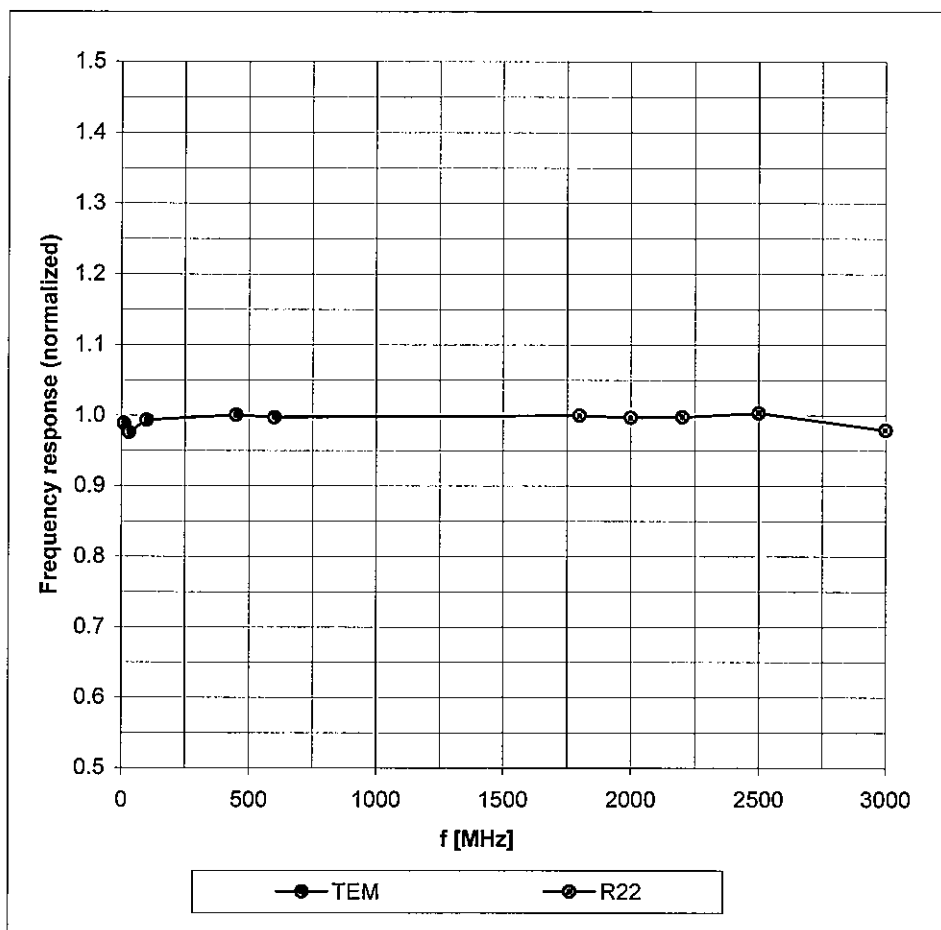
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

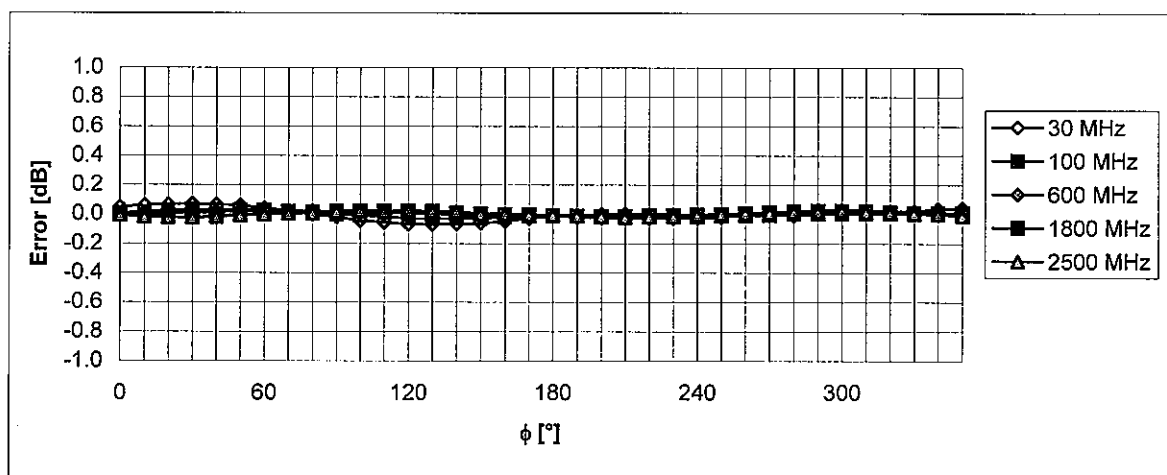
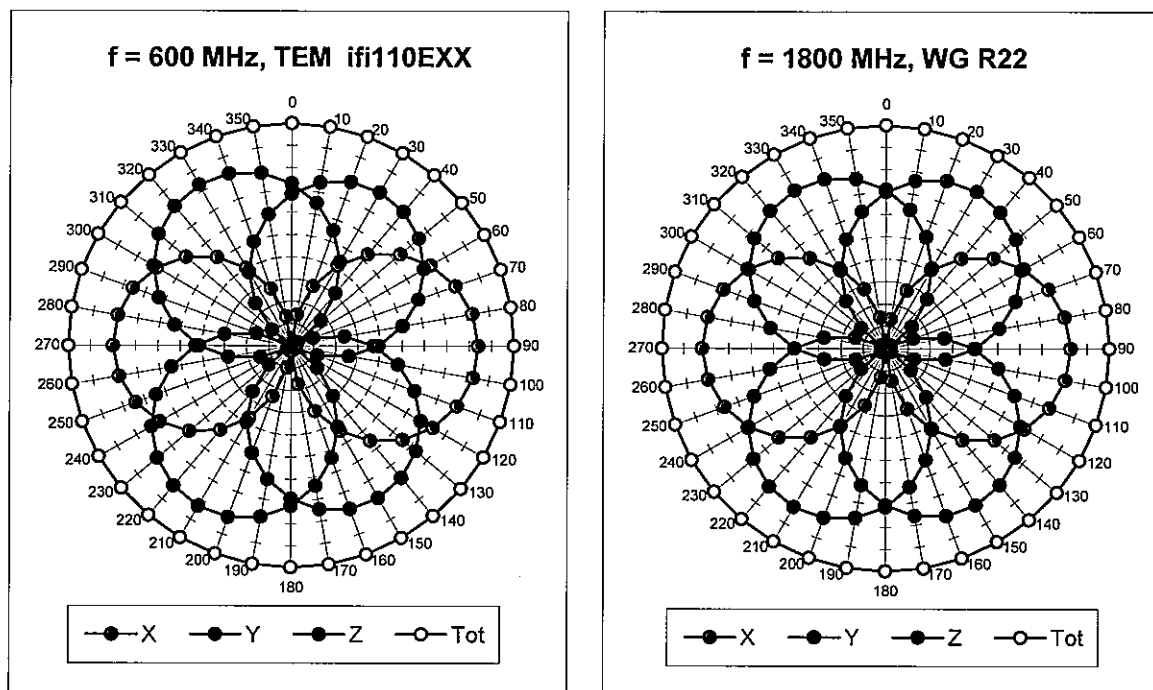
^B Numerical linearization parameter: uncertainty not required.

Frequency Response of E-Field

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

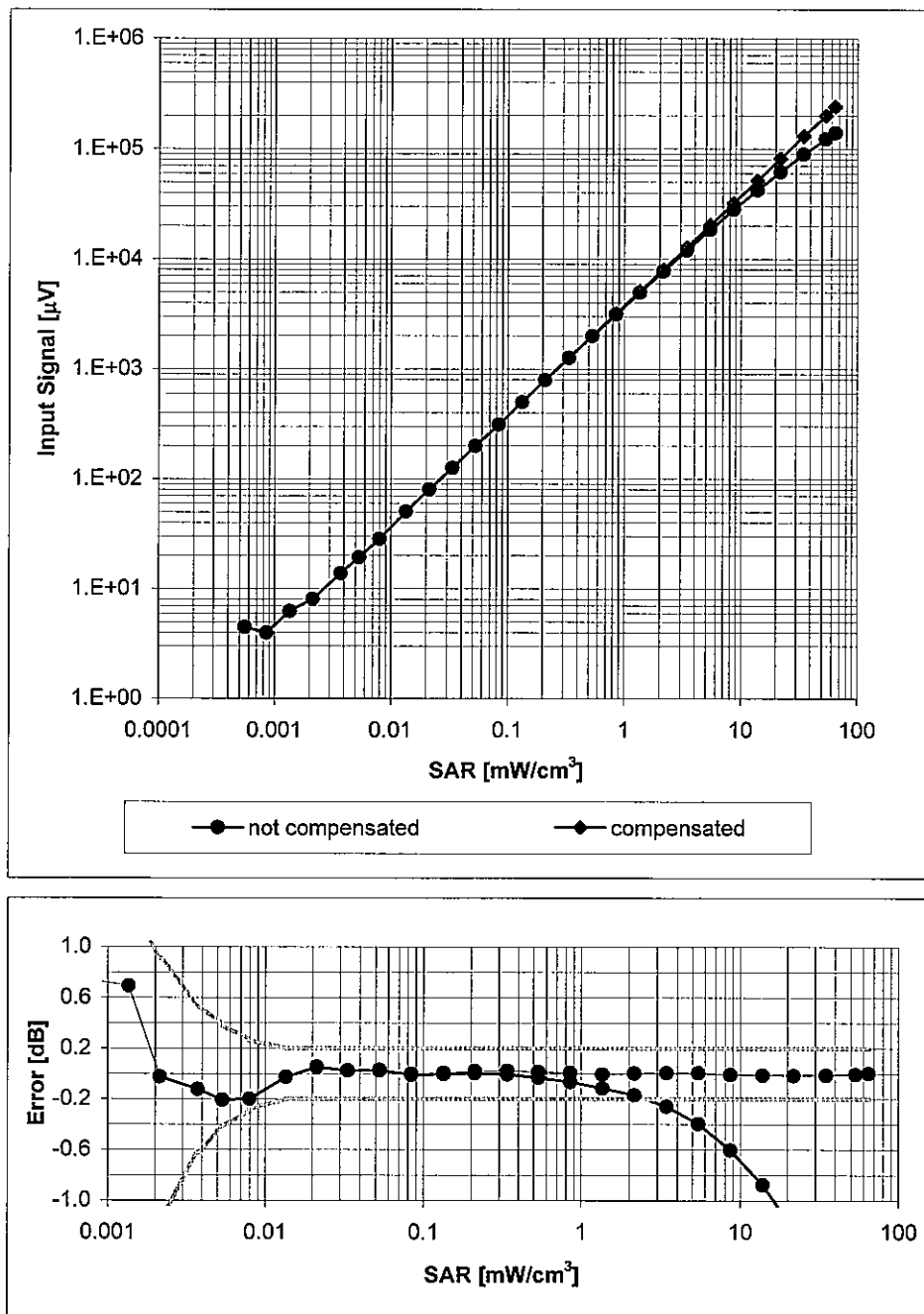


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$ Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

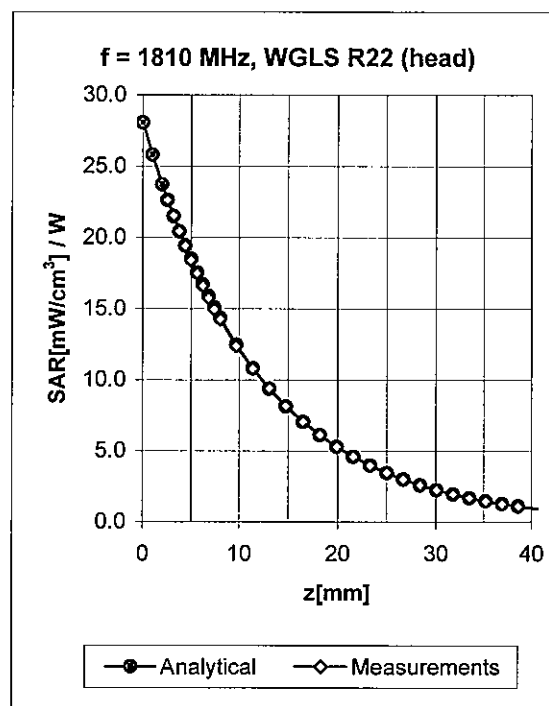
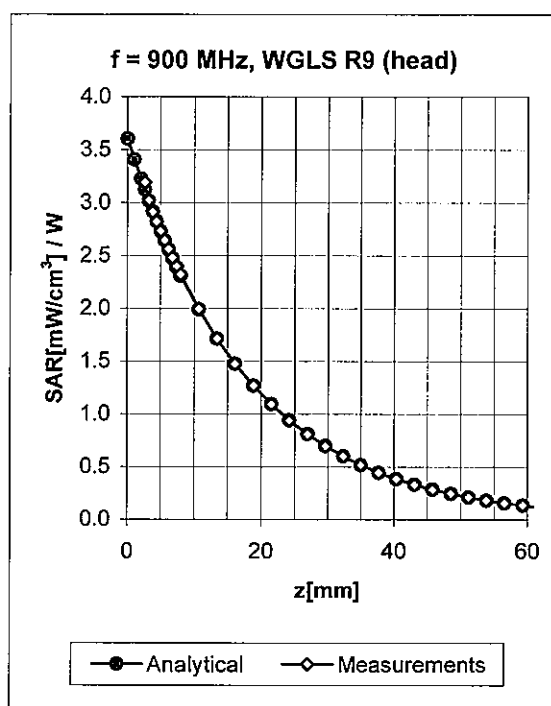
Dynamic Range $f(\text{SAR}_{\text{head}})$

(Waveguide R22, $f = 1800$ MHz)



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

Conversion Factor Assessment

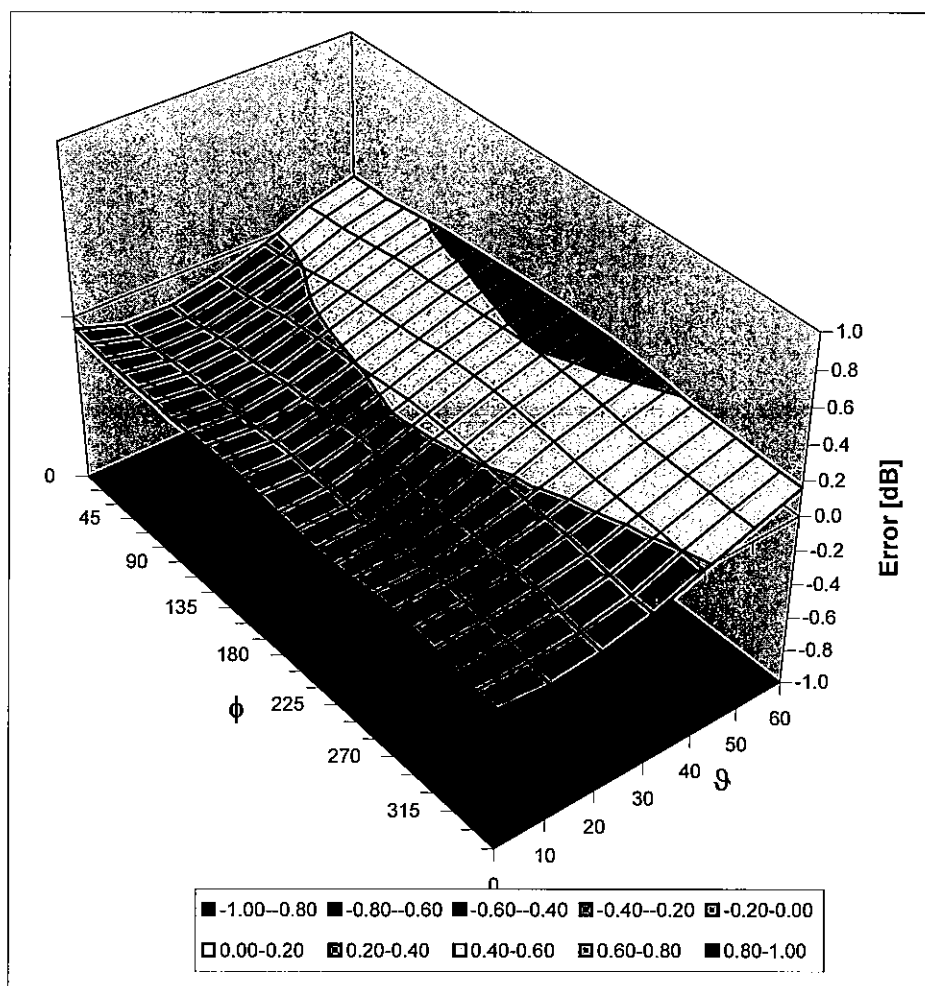


f [MHz]	Validity [MHz] ^c	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.22	2.30	5.88 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.42	1.62	5.00 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.37	1.76	4.83 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.49	1.61	4.44 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.52	1.38	5.84 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.27	2.74	4.64 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.30	2.70	4.63 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.99	1.03	4.19 ± 11.0% (k=2)

^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Deviation from Isotropy in HSL

Error (ϕ , ϑ), $f = 900$ MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

Appendix 5
Measurement Uncertainty Budget

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	IEEE 1528 section	Tol. (± %)	Prob Dist	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (±%)	10 g <i>u_i</i> (±%)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	5.9	N	1.00	1	1	5.9	5.9	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	0.0	R	1.73	1	1	0.0	0.0	∞
Probe Positioner Mech. Tolerance	E.6.2	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.2	N	1.00	1	1	3.2	3.2	29
Device Holder Uncertainty	E.4.1	4.0	N	1.00	1	1	4.0	4.0	8
SAR drift	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3	3.3	N	1.00	0.64	0.43	2.1	1.4	∞
Liquid Permittivity (target)	E.3.2	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Liquid Permittivity (measurement)	E.3.3	1.9	N	1.00	0.6	0.49	1.1	0.9	∞
Combined Standard Uncertainty			RSS				11.1	10.8	411
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				22.2	21.6	

Appendix 6

Dipole Characterization Certificate

Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

	900 MHz	
Reference Target:	10.9	(W/kg)
Measurement Uncertainty (k=1):	9.0%	
Measurement Period:	15April08 - 26March09	
# of tests performed:	1,099	
Grand Average:	11.19	(W/kg)
% Delta (Average - Reference Target)	2.7%	
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	
	Applies to Dipole SN's: 55, 69, 77, 78, 79, 80, 91, 92, 93, 94, 95, 96, 97, 1d034, 1d035	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
900 MHz	11.19	41.5 +/- 5%	0.97 +/- 5%

-Approvals-

Submitted by: Marge Kaunas Date: 1-Apr-09

Signed: Marge Kaunas

Comments: Data file available upon request.

Approved by: Steve Hauswirth Date: 1-Apr-09

Signed: Steven Hauswirth

Comments:

Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

1800 MHz		
Reference Target:	38.4	(W/kg)
Measurement Uncertainty (k=1):	9.0%	
Measurement Period:	15April08 - 26March09	
# of tests performed:	929	
Grand Average:	37.91	(W/kg)
% Delta (Average - Reference Target)	-1.3%	
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	
Applies to Dipole SN's: 246tr, 250tr, 251tr, 259tr, 263tr, 271tr, 272tr, 276tr, 277tr, 279tr, 280tr, 281tr, 283tr, 284tr, 2d128, 2d129		

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
1800 MHz	37.91	40.0 +/- 5%	1.40 +/- 5%

-Approvals-

Submitted by:

Marge Kaunas

Date:

1-Apr-09

Signed:

Marge Kaunas

Comments:

Data file available upon request.

Approved by:

Steve Hauswirth

Date:

1-Apr-09

Signed:

Steve Hauswirth

Comments:

Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

	2450 MHz	
Reference Target:	52.4	(W/kg)
Measurement Uncertainty (k=1):	9.0%	
Measurement Period:	15April08 - 26March09	
# of tests performed:	150	
Grand Average:	56.68	(W/kg)
% Delta (Average - Reference Target)	8.2%	
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	
	Applies to Dipole SN's:	
	740, 766, 767, 788, 789	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
2450 MHz	56.68	39.2 +/- 10%	1.80 +/- 5%

-Approvals-

Submitted by: Marge Kaunas Date: 1-Apr-09

Signed: Marge Kaunas

Comments: Data file available upon request.

Approved by: Steve Hauswirth Date: 1-Apr-09

Signed: Steve Hauswirth

Comments:

END OF REPORT