

**MOTOROLA**

Portable Hand-Held Device SAR Test Report

Tests Requested By: Motorola Mobility, Inc.
600 N. US Highway 45
Libertyville, IL 60048

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Date of Report: Oct 10, 2011
Date of Test: Sep-21-2011 to Oct-4-2011
FCC ID #: IHDP56MF3
Generic Name: M0BC1

Test Laboratory: Motorola Mobility, Inc. - ADR Test Services Laboratory
600 N. US Highway 45
Libertyville, IL 60048

Report Author: Steven Hauswirth
Distinguished Member of the Technical Staff

This laboratory is accredited to ISO/IEC 17025-2005 to perform the following tests:

Accreditation:



2404

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)

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

Statement of Compliance:

Motorola declares under its sole responsibility that the portable hand-held device 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:

Motorola's ISO 17025 accreditation scope does not currently include SAR testing in the 5 GHz band. Therefore, SAR testing performed in this band was performed outside of our ISO 17025 accreditation. The general procedures and guidelines provided within; FCC KDB 248227 D01, FCC KDB 648474 D01, FCC KDB 865664 D01 and IEC 62209-2 were utilized for testing.

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Revision History

Revision Version	Date	Notes
Rev. 0	Oct-10-2011	Initial report release.
Rev. A	Oct -11-2011	Various typo corrections.

1. Introduction

The Motorola Mobility ADR Test Services Laboratory has performed measurements of the maximum potential exposure to the user of the portable Hand-Held Device covered by this test report. The Specific Absorption Rate (SAR) of this product was measured. The portable Hand-Held Device was tested in accordance with [1], [4] and [5]. The SAR values measured for the portable Hand-Held Device are below the maximum recommended levels of 1.6 W/kg in a 1 g average set in [3] and 2.0 W/kg in a 10 g average set in [2].

For ANSI / IEEE C95.1 (1 g), the final stand-alone SAR readings for this device are given in the table below. These measurements were performed using a Dasy4™ v4.7 system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich Switzerland.

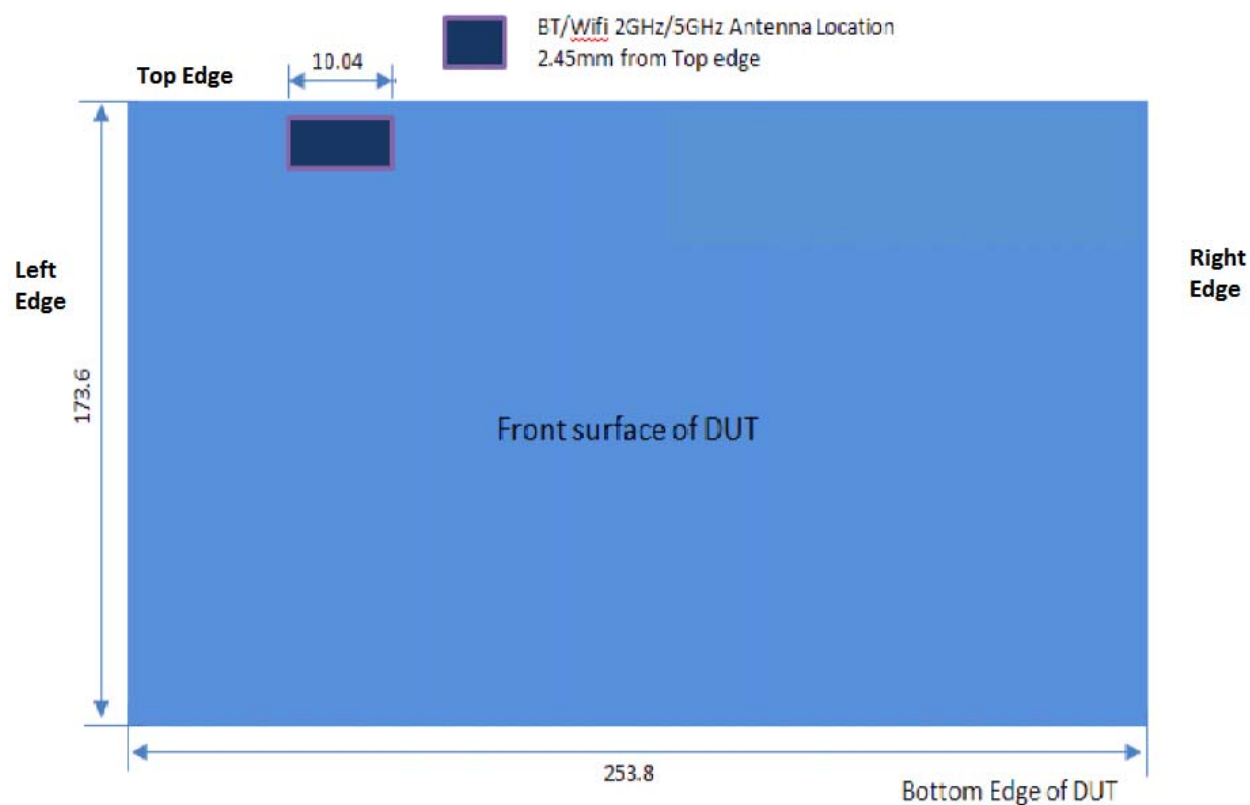
Summary of Stand-Alone SAR Results	
Transmit Band	Body SAR (1g ^W /kg)
Wi-Fi 2.45 GHz	1.42
Wi-Fi 5.2 GHz	1.19
Wi-Fi 5.8 GHz	1.25

2. Description of the Device Under Test

2.1 Antenna description

Bluetooth/Wi-Fi 2.45 / 5 GHz Antenna

Type	Internal	
Location	Top of Transceiver	
Dimensions	Width	3.67 mm
	Length	10.04 mm



2.2 Device Signaling¹

Serial Number(s) (Functional Use)	KPE00G0052 (Wi-Fi SAR testing)
Production Unit or Identical Prototype (47 CFR §2.908)	Identical Prototype
Device Category	Portable / Mobile Station
RF Exposure Limits	General Population / Uncontrolled

Mode(s) of Operation	Modulation Mode(s)	Maximum Output Power Setting	Duty Cycle	Transmitting Frequency Range(s)
2.45 GHz Wi-Fi 802.11b/g/n	BPSK	14.5 dBm	1:1	2412.0 - 2462.5 MHz
Wi-Fi 802.11a/n	BPSK	12.7 dBm	1:1	5180.0 - 5240.0 MHz, 5745.0 - 5805.0 MHz
Bluetooth	GFSK	7.83 dBm	1:1	2402.0 - 2483.5 MHz

¹ **Bolded** entries indicate data mode configurations of highest time-average power output per band and data mode type, and thus were utilized for SAR testing in this report.

2.3 Device Conducted Power Measurements

2.3.1 Wi-Fi 802.11 modes

Per “SAR Measurement Procedures for 802.11 a/b/g Transmitters” (FCC KDB 248227), power measurements were performed for 802.11 operational modes. The conducted power measurements for each mode are shown in the tables below. SAR testing for 802.11 was performed within each transmit band (2.5 GHz, 5.2 GHz, 5.8 GHz) with the transmitter set to the lowest data rate on the default test channels **highlighted in bold** in the tables below. The body positions that resulted in the highest SAR values were further tested on the additional channels within that sub-transmit band. Also the body positions that resulted in the highest SAR values were further tested with the higher data rates **highlighted in blue** in the tables below because of the conducted power difference. Due to the relatively large number of data rates with measured conducted power exceeding the lowest data rate conducted power by more than 0.25 dB, there will be a large number of tests performed on the configuration that results in the highest measured SAR for the lowest data rate.

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11b Mode Data Rates			
		1 Mbps	2 Mbps	5.5 Mbps	11 Mbps
Wi-Fi 2450 MHz	1	13.18	13.24	14.26	14.42
	6	13.17	13.33	14.34	14.23
	11	13.07	13.15	14.03	14.12

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11g Mode Data Rates							
		6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
Wi-Fi 2450 MHz	1	13.43	13.46	13.47	13.53	14.01	13.95	13.11	13.32
	6	13.71	13.55	13.58	13.59	14.16	14.04	13.19	13.25
	11	13.48	13.35	13.31	13.33	13.76	13.82	12.94	12.88

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11n Mode Data Rates (20 MHz Channel, 400 ns Guard Interval)							
		7.2 Mbps	14.4 Mbps	21.6 Mbps	28.8 Mbps	43.3 Mbps	57.7 Mbps	65 Mbps	72.2 Mbps
Wi-Fi 2450 MHz	1	13.33	13.37	13.42	13.83	13.88	13.04	12.89	12.15
	6	13.43	13.41	13.54	13.99	14.06	13.03	12.96	12.11
	11	13.25	13.14	13.31	13.79	13.82	12.73	12.83	11.98

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11n Mode Data Rates (20 MHz Channel, 800 ns Guard Interval)							
		6.5 Mbps	13 Mbps	19.5 Mbps	26 Mbps	39 Mbps	52 Mbps	58.5 Mbps	65 Mbps
Wi-Fi 2450 MHz	1	13.33	13.46	13.53	14.13	13.91	13.01	12.94	11.98
	6	13.43	13.41	13.54	14.15	14.06	13.1	13.08	12.32
	11	13.25	13.26	13.39	13.98	13.8	12.94	12.92	11.93

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11a Mode Data Rates							
		6 Mbps	9 Mbps	12 Mbps	18 Mbps	24 Mbps	36 Mbps	48 Mbps	54 Mbps
Wi-Fi 5210 MHz	36	11.01	10.95	8.85	8.89	9.46	9.35	9.44	9.45
	40	12.65	12.64	10.55	10.67	10.95	10.94	11.03	11.01
	44	11.75	11.74	9.66	9.74	10.18	10.23	10.32	10.24
	48	12.31	12.29	10.23	10.2	10.69	10.64	10.75	10.77
Wi-Fi 5775 MHz	149	8.78	8.77	6.66	6.7	7.12	7.12	7.19	7.19
	153	9.58	9.49	7.57	7.62	7.84	7.93	7.91	7.95
	157	9.7	9.58	7.54	7.78	8.01	7.97	8.02	8.04
	161	9.71	9.52	7.58	7.82	8.05	8.02	8.22	8.16
	165	12.51	12.48	10.56	10.63	10.91	10.88	10.97	10.95

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11n Mode Data Rates (20 MHz Channel, 400 ns Guard Interval)							
		7.2 Mbps	14.4 Mbps	21.6 Mbps	28.8 Mbps	43.3 Mbps	57.7 Mbps	65 Mbps	72.2 Mbps
Wi-Fi 5210 MHz	36	10.72	8.92	8.83	9.43	9.44	9.44	9.45	9.45
	40	12.4	10.51	10.42	10.94	10.94	10.84	10.84	10.97
	44	11.51	9.65	9.55	10.2	10.11	10.22	10.15	10.22
	48	11.97	10.24	10.11	10.59	10.66	10.66	10.69	10.79
Wi-Fi 5775 MHz	149	8.54	6.53	6.65	7.1	7.08	7.03	7.01	7.18
	153	9.35	7.44	7.46	7.83	7.8	7.78	7.81	7.89
	157	9.49	7.6	7.5	7.86	7.87	7.87	7.93	8.04
	161	9.49	7.66	7.54	8.02	8	8.12	8.04	8.14
	165	12.26	10.29	10.3	10.76	10.77	10.81	10.76	10.84

Band	Channel	Conducted Power (Max AVG in dBm) for 802.11n Mode Data Rates (20 MHz Channel, 800 ns Guard Interval)							
		6.5 Mbps	13 Mbps	19.5 Mbps	26 Mbps	39 Mbps	52 Mbps	58.5 Mbps	65 Mbps
Wi-Fi 5210 MHz	36	10.75	8.94	8.96	9.46	9.49	9.5	9.5	9.54
	40	12.41	10.51	10.54	10.98	11	11.01	11	11.06
	44	11.52	9.65	9.66	10.25	10.2	10.27	10.26	10.32
	48	12.07	10.21	10.12	10.79	10.67	10.71	10.64	10.8
Wi-Fi 5775 MHz	149	8.57	6.64	6.65	7.08	7.09	7.71	7.12	7.2
	153	9.42	7.37	7.4	7.79	7.8	7.82	7.82	7.92
	157	9.51	7.56	7.52	7.97	7.96	7.93	7.97	8.1
	161	9.57	7.65	7.58	8.08	8.06	8.17	8.09	8.15
	165	12.39	10.43	10.45	10.93	10.88	10.91	10.86	10.9

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Mobility ADR Test Services 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 10 g RSS uncertainty of the measurement system is $\pm 10.8\%$ (K=1) with an expanded uncertainty of $\pm 21.6\%$ (K=2). The overall 1 g 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 0.4 W/kg to 10 W/kg.

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

Description	Serial Number	Cal Date	Cal Due Date
DASY4™ DAE V1	702	Apr-14-2011	Apr-14-2012
E-Field Probe ES3DV3	3184	Mar-11-2011	Mar-11-2012
DASY4™ DAE V1	440	Nov-11-2010	Nov-11-2011
E-Field Probe EX3DV4	3728	May 20, 2011	May 20, 2012
S.A.M. Phantom used for 782/800/1900/2450 MHz	TP-1136		
S.A.M. Phantom used for 5210/5875 MHz	TP-1106		
Dipole Validation Kit, DV2450V2	766	Jul-15-2011	Jul-15-2013
Dipole Validation Kit, DV2450V2	740	Mar-17-2011	Mar-17-2013
Dipole Validation Kit, D5GHzV2	1088	May 20, 2011	May 20, 2013

3.2 Additional Equipment

Description	Serial Number	Cal Date	Cal Due Date
Signal Generator HP8648C	3847A04982	Nov-18-2009	Nov-18-2011
Power Meter E4419B	GB39510900	Mar-28-2011	Mar-28-2013
Power Sensor #1 - E9301A	US39211007	Aug-16-2011	Aug-16-2012
Power Sensor #2 - E9301A	US39211008	Aug-16-2011	Aug-16-2012
Signal Generator HP8648C	3847A04632	Aug-13-2011	Aug-13-2013
Power Meter E4419B	GB39511087	Dec-22-2009	Dec-22-2011
Power Sensor #1 - E9301A	US39211006	Oct-25-2010	Oct-25-2011
Power Sensor #2 - E9301A	US39210934	Oct-25-2010	Oct-25-2011
Signal Generator HP8648C	3847A04843	Mar-28-2011	Mar-28-2013
Power Meter E4419B	GB39511084	Mar-28-2011	Mar-28-2013
Power Sensor #1 - E9301A	US39210929	Mar-31-2011	Mar-31-2012
Power Sensor #2 - E9301A	US39210930	Mar-31-2011	Mar-31-2012
Network Analyzer HP8753ES	US39171846	May-19-2011	May-19-2012
Dielectric Probe Kit HP85070C	US99360070		

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)
2450	Body	Measured, Sep-21-2011	51.6	1.92	19.7
		Measured, Sep-24-2011	52.0	1.92	19.9
		Recommended Limits	52.7 $\pm$ 5%	1.95 $\pm$ 5%	18-25
5210	Body	Measured, Oct-1-2011	48.1	5.92	19.7
		Recommended Limits	49.0 $\pm$ 10%	5.31 $\pm$ 5%	18-25
5785	Body	Measured, Oct-01-2011	46.8	6.77	20.5
		Measured, Oct-04-2011	47.3	6.74	20.1
		Recommended Limits	48.2 $\pm$ 10%	5.98 $\pm$ 5%	18-25

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

Ingredient	835 MHz / 900 MHz Head	835 MHz / 900 MHz Body	1800 MHz / 1900 MHz Head	1800 MHz / 1900 MHz Body	2450 MHz 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	--

All 5.2 GHz and 5.8 GHz SAR testing was performed using HSL 3500/5800 and MSL 3500/5800 tissue simulating liquids from Schmid & Partner Engineering AG. Prior to conducting SAR measurements, the relative permittivity, ϵ_r , and the conductivity, σ , of the liquids was measured. The conductivity of the purchased liquids was determined to be at the high compared to the target parameter. SPEAG is investigating why the values consistently measure high. Since they measured on the conservative side of the target window, all subsequent 5.2 GHz and 5.8 GHz SAR tests were also on the conservative side of their uncertainty window.

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 1 W 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). For frequencies below 3 GHz, the simulated tissue depth was verified to be $15.0 \text{ cm} \pm 0.5 \text{ cm}$. For frequencies above 3 GHz, the simulated tissue depth was verified to be $10 \text{ cm} \pm 0.5 \text{ cm}$. Z-axis scans showing the SAR penetration are also included in Appendix 1.

f (MHz)	Description	SAR (W/kg), 1 gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
			ϵ_r	σ (S/m)		
2450	Measured, Sep-21-2011	49.35	51.6	1.92	21.2	20.5
	Recommended Limits	50.40	52.7 $\pm 5\%$	1.95 $\pm 5\%$	18-25	18-25
	Measured, Sep-24-2011	51.0	52.0	1.92	21.3	20.2
	Recommended Limits	51.3	52.7 $\pm 10\%$	1.95 $\pm 5\%$	18-25	18-25
5200	Measured, Oct-1-2011	81.9	48.1	5.91	21.3	20.2
	Recommended Limit	75.5	49.0 $\pm 10\%$	5.30 $\pm 5\%$	18-25	18-25
5800	Measured, Oct-1-2011	77.4	46.8	6.79	21.2	20.1
	Measured, Oct-4-2011	77.5	46.8	6.79	21.3	20.0
	Recommended Limits	75.4	48.2 $\pm 10\%$	6.00 $\pm 5\%$	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	3184	2450	4.33	6 of 11
E-Field Probe EX3DV4	3728	5200	4.16	6 of 11
		5800	3.76	6 of 11

6. Test Results

Wi-Fi testing was conducted using manufacturer test mode software, per guidance given in FCC KDB 248227. The test software was set up for the proper channels, transmitter power levels and transmit modes of operation.

The portable hand-held device was tested in the configurations stipulated in [1], [4] and [5]. The device was positioned into these configurations using the device holder supplied with the DASY4™ SAR measurement system. The default settings for the “coarse” and “cube” scans were chosen and used for measurements. The grid spacing of the coarse scan was set to 15 mm or less as shown in the SAR plots included in Appendices 2. Please refer to the DASY4™ manual for additional information on SAR scanning procedures and algorithms used.

The portable hand-held device model covered by this report has an internal battery that is not replaceable by the end user. This battery was used to do all of the SAR testing. The battery was charged prior to each test.

6.1 Body Test Results

The SAR results shown in tables 1 through 3 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 [6]. Also shown are the temperature of the simulated tissue after the test, the measured drift, the measured conducted output power levels, power reduction amount (when applicable), the measured SAR corrected for probe calibration (when applicable), and the extrapolated SAR. The exact method of extrapolation is:

$$\text{Extrapolated SAR} = (\text{Measured or Corrected SAR}) * 10^{(-\text{drift}/10)}$$

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.

The requisite test positions for the DUT were chosen per the guidance provided in FCC KDB 447498 D01. The DUT was tested with the back surface of the device facing the phantom with no separation for all transmitters requiring test. The DUT was also tested along the edges of the device in which an antenna is located within 5 cm of that edge. Pictorial representation of the antenna locations and separation distances are given in section 1 above. Additionally, the software within the DUT was set to invert the orientation results from the DUT's sensor. E.g., the DUT "top edge" facing up (away from the body) was operating instead at the "top edge" facing down (toward the body) performance levels. This inversion of the orientation ensures proper exposure conditions were measured for SAR testing of an edge using the standard DASY4 measurement setup.

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 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. The simulated tissue depth was verified to be 15.0 cm ± 0.5 cm for frequencies less than 3 GHz, or 10.0 cm ± 0.5 cm for frequencies greater than 3 GHz. The same device holder described in section 6 was used for positioning the DUT.

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3184	2450	4.33	6 of 11
E-Field Probe EX3DV4	3728	5200	4.16	6 of 11
		5800	3.76	6 of 11

Body, Top Edge of DUT 0 mm from Phantom																
f (MHz)	Mode	Battery/ Accessory	Channel	Temp (°C)	Drift (dB)	DUT Power		10 g SAR value			1 g SAR value			Test Plot		
						Measured (dBm)	Power Reduction (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page	
2450	802.11b, 1 Mbps	Internal	1	20.0	-0.0589	13.18		0.157		0.16	0.365		0.37	5x5x7	26	
			6													
			11													
5210	802.11a, 6 Mbps		36	19.4	0.0331	11.01		0.326		0.33	1.14		1.14			
			40	19.8	0.168	12.65		0.348		0.35	1.19		1.19	7x7x12	27	
			44	19.2	0.0351	11.75		0.332		0.33	1.14		1.14			
			48	19.5	-0.0926	12.31		0.329		0.34	1.12		1.14			
5785	802.11a, 6 Mbps		149													
			153	19.8	-0.076	9.58		0.199		0.20	0.735		0.75			
			157	19.5	-0.114	9.7		0.234		0.24	0.854		0.88			
			161													
			165	19.5	-0.079	12.51		0.266		0.27	0.955		0.97	7x7x12	28	

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

Body, Back Surface of DUT 0 mm from Phantom															
f (MHz)	Mode	Battery/ Accessory	Channel	Temp (°C)	Drift (dB)	DUT Power		10 g SAR value			1 g SAR value			Test Plot	
						Measured (dBm)	Power Reduction (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page
5210	802.11a, 6 Mbps	Internal	36												
			40	19.6	0.0364	12.65		0.244		0.24	0.867		0.87	7x7x12	29
			44												
			48	19.5	0.17	12.31		0.218		0.22	0.78		0.78		
5785	802.11a, 6 Mbps		149	19.3	-0.171	8.78		0.294		0.31	1.11		1.11		
			153	19.8	0.157	9.58		0.331		0.33	1.25		1.25	7x7x12	30
			157	19.2	-0.0655	9.7		0.305		0.31	1.23		1.25		
			161	19.6	-0.0344	9.71		0.298		0.30	1.19		1.20		
			165	19.5	0.001	12.51		0.284		0.28	1.13		1.13		

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

Body, Back Surface of DUT 0 mm from Phantom

Body, Back Surface of DUT 0 mm from Phantom																	
f (MHz)	Mode	Battery/ Accessory	Channel	Temp (°C)	Drift (dB)	DUT Power		10 g SAR value			1 g SAR value			Test Plot			
						Measured (dBm)	Power Reduction (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page		
2450	802.11b, 1 Mbps	Internal	1	20.2	-0.111	13.18			0.513			0.53	1.19				
			6	20.0	0.0459	13.17			0.532			0.53	1.25				
			11	20.0	0.0138	13.07			0.542			0.54	1.29				
	802.11b, 5.5 Mbps		1	20.0	0.0732	14.26			0.594			0.59	1.39				
			6	20.0	0.124	14.34			0.541			0.54	1.28				
			11	20.0	-0.148	14.03			0.527			0.55	1.24				
	802.11b, 11 Mbps		1	20.0	-0.104	14.42			0.559			0.57	1.29				
			6	20.0	-0.0501	14.23			0.535			0.54	1.25				
			11	20.0	0.0862	14.12			0.532			0.53	1.28				
	802.11g, 6 Mbps		6	20.0	-0.208	13.71			0.533			0.58	1.24				
			11	20.0	-0.0731	13.48			0.52			0.53	1.23				
	802.11g, 9 Mbps		1	19.2	0.0261	13.46			0.575			0.58	1.36				
			6	19.3	-0.295	13.55			0.519			0.56	1.24				
			11	19.3	0.0172	13.35			0.552			0.55	1.31				
	802.11g, 12 Mbps		1	19.3	0.0904	13.47			0.557			0.57	1.31				
			6	19.3	-0.139	13.58			0.551			0.57	1.30				
	802.11g, 18 Mbps		1	19.3	0.0345	13.53			0.577			0.58	1.36				
			6	19.3	-0.0105	13.59			0.52			0.52	1.23				
			11	19.3	-0.0143	13.33			0.498			0.50	1.21				
	802.11g, 24 Mbps		1	19.3	-0.084	14.01			0.549			0.56	1.28				
			6	19.3	0.0708	14.16			0.512			0.51	1.21				
			11	19.3	-0.291	13.76			0.49			0.52	1.17				
	802.11g, 36 Mbps		1	19.3	0.184	13.95			0.554			0.55	1.31				
			6	19.3	0.241	14.04			0.517			0.52	1.23				
	802.11n, 7.2 Mbps		11	19.6	-0.0794	13.82			0.475			0.48	1.12				
	802.11n, 21.7 Mbps		6	19.6	-0.129	13.43			0.507			0.52	1.19				
			6	20.5	0.0626	13.54			0.513			0.51	1.20				
	802.11n, 28.9 Mbps		1	20.5	0.0768	13.83			0.60			0.60	1.42			5x5x7	31
			6	20.5	0.115	13.99			0.535			0.54	1.25				
			11	20.5	0.0835	13.79			0.459			0.46	1.09				
	802.11n, 43.3 Mbps		1	19.6	-0.0025	13.88			0.50			0.50	1.24				
			6	19.6	-0.104	14.06			0.487			0.50	1.17				
			11	19.6	-0.0702	13.82			0.465			0.47	1.17				
	802.11n, 6.5 Mbps		6	20.5	0.0324	13.43			0.519			0.52	1.21				
	802.11n, 13 Mbps		1	20.0	0.0687	13.46			0.574			0.57	1.37				
			1	20.0	-0.0432	13.53			0.574			0.58	1.35				
	802.11n, 19.5 Mbps		6	20.0	0.0578	13.54			0.518			0.52	1.21				
			11	20.0	0.0529	13.39			0.503			0.50	1.18				
			1	20.0	0.185	14.13			0.562			0.56	1.31				
	802.11n, 26 Mbps		6	20.0	0.163	14.15			0.519			0.52	1.20				
			11	19.6	-0.065	13.98			0.484			0.49	1.21				
			1	19.6	0.0725	13.91			0.545			0.55	1.33				
	802.11n, 39 Mbps		6	19.6	-0.0506	14.06			0.473			0.48	1.16				
			11	19.6	-0.073	13.80			0.482			0.49	1.20				

Table 3: SAR measurement results at the highest possible output power, measured in a body adjacent 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 (300 MHz – 3 GHz)”.
- [3] ANSI / IEEE, C95.1 1992 Edition “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”
- [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

Test Laboratory: Motorola 2450 MHz System Performance Check

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:766

Procedure Notes: PM1 Power = 200 mW Refl.Pwr PM3 = -22.55B [Sim.Temp@SPC](#) = 20.5 Room Temp @ SPC = 21.2

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

Medium: Validation *BODY Tissue* ; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.92 \text{ mho/m}$; $\epsilon_r = 51.6$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.33, 4.33, 4.33); Calibrated: 3/11/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn702; Calibrated: 4/14/2011
- Phantom: R#2 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1136;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (5x15x1): Measurement grid: $dx=10\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 9.68 mW/g

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

Reference Value = 67.8 V/m; Power Drift = 0.103 dB

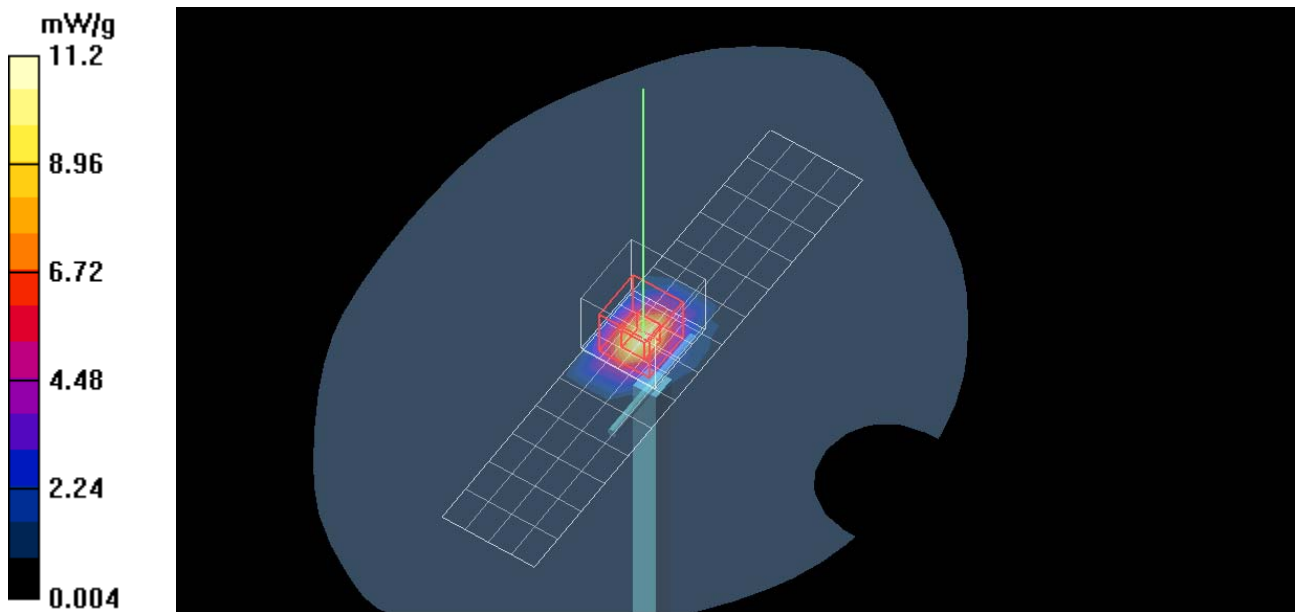
Peak SAR (extrapolated) = 19.7 W/kg

SAR(1 g) = 9.87 mW/g; SAR(10 g) = 4.65 mW/g

Maximum value of SAR (measured) = 11.3 mW/g

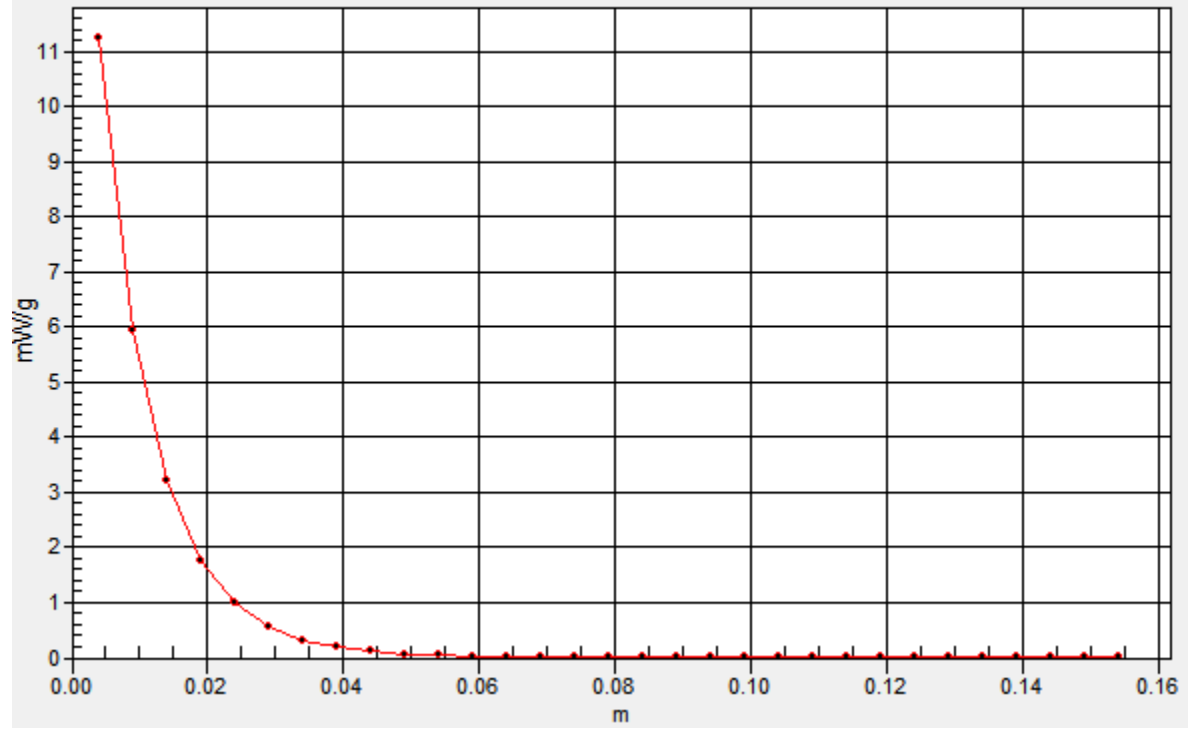
Daily SPC Check/Z-Axis Retraction (1x1x31): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=5\text{mm}$

Maximum value of SAR (measured) = 11.2 mW/g



SAR(x,y,z,f0)

SAR; Z-Axis Retraction: Value Along Z, X=0, Y=0



Test Laboratory: Motorola 2450 MHz System Performance Check

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:740

Procedure Notes: PM1 Power = 200 mW Refl.Pwr PM3 = -24.2dB [Sim.Temp@SPC](#) = 20.2°C Room Temp @ SPC = 21.3°C

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

Medium: Validation *BODY Tissue* ; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.92 \text{ mho/m}$; $\epsilon_r = 52$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.33, 4.33, 4.33); Calibrated: 3/11/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn702; Calibrated: 4/14/2011
- Phantom: R#2 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1136;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (5x15x1): Measurement grid: dx=10mm, dy=15mm

Maximum value of SAR (measured) = 11.5 mW/g

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

Reference Value = 78.8 V/m; Power Drift = -0.019 dB

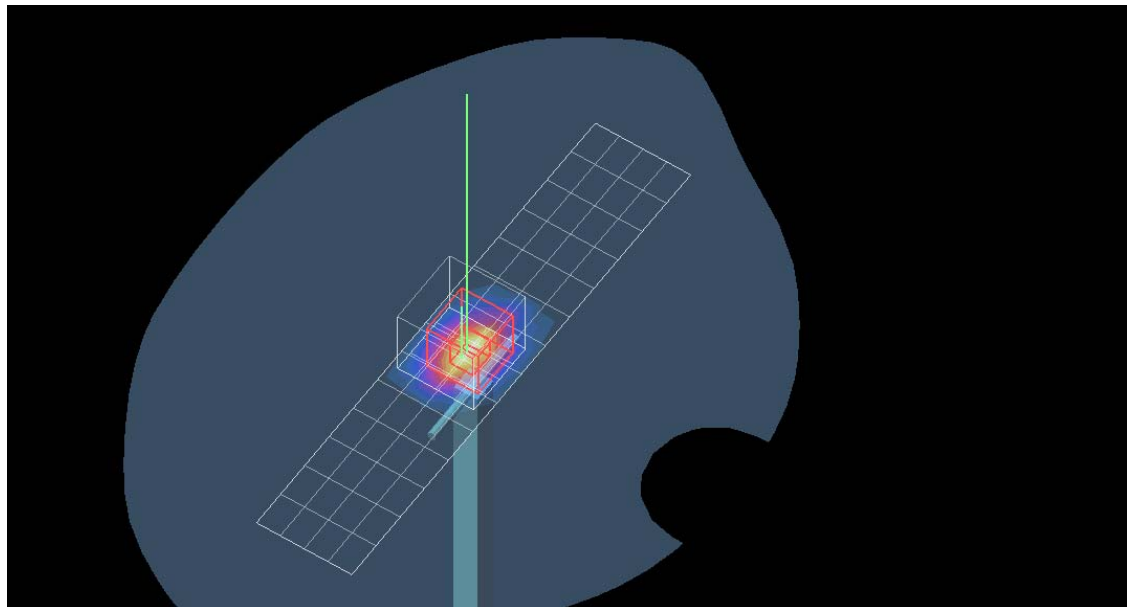
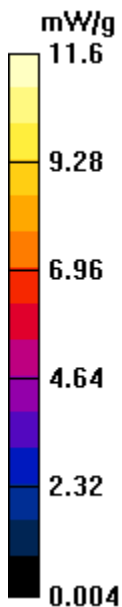
Peak SAR (extrapolated) = 20.3 W/kg

SAR(1 g) = 10.2 mW/g; SAR(10 g) = 4.81 mW/g

Maximum value of SAR (measured) = 11.2 mW/g

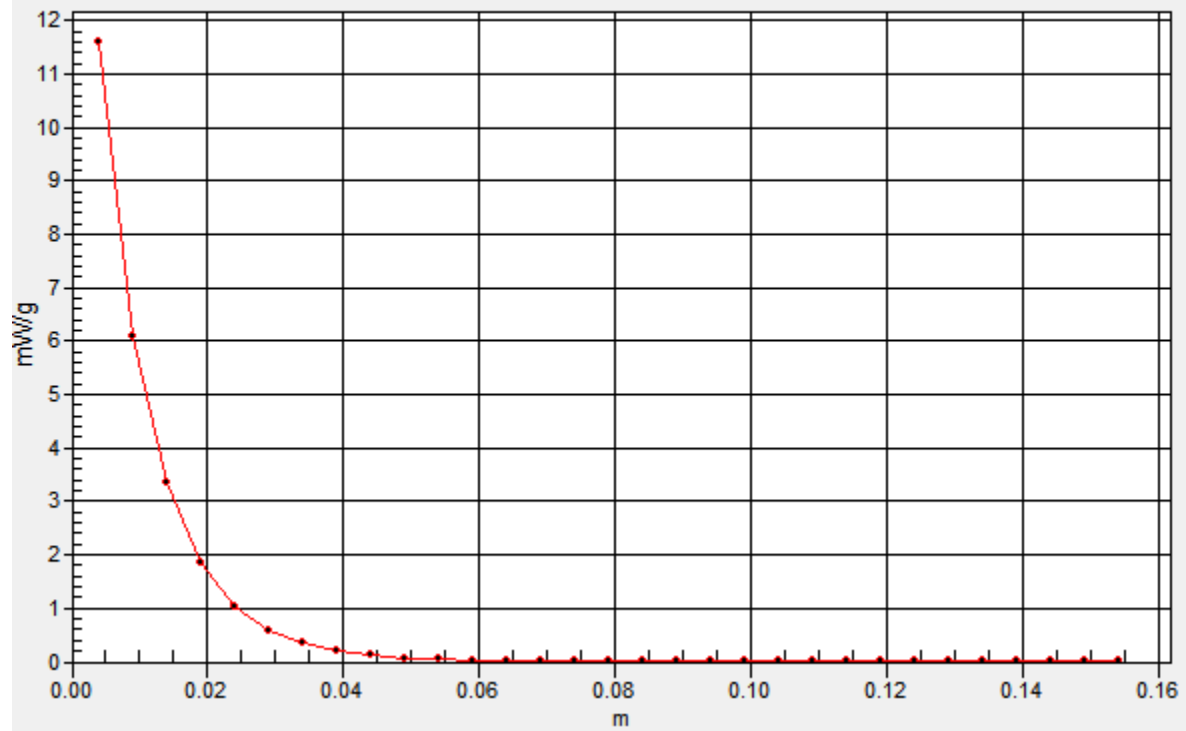
Daily SPC Check/Z-Axis Retraction (1x1x31): Measurement grid: dx=20mm, dy=20mm, dz=5mm

Maximum value of SAR (measured) = 11.6 mW/g



SAR(x,y,z,f0)

SAR; Z-Axis Retraction: Value Along Z, X=0, Y=0



Test Laboratory: Motorola 5200 MHz System Performance Check

DUT: Dipole 5-6GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1098

Procedure Notes: PM1 Power = 100 mW Refl.Pwr PM3 = -18.97 dB [Sim.Temp@SPC](#) = 20.2C Room Temp @ SPC = 21.3C

Communication System: CW - Dipole; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: Validation *BODY Tissue* ; Medium parameters used: $f = 5200$ MHz; $\sigma = 5.91$ mho/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(4.16, 4.16, 4.16); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (5x22x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 11.2 mW/g

Daily SPC Check/0-Degree, 7x7x12 Cube (7x7x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 52.9 V/m; Power Drift = 0.140 dB

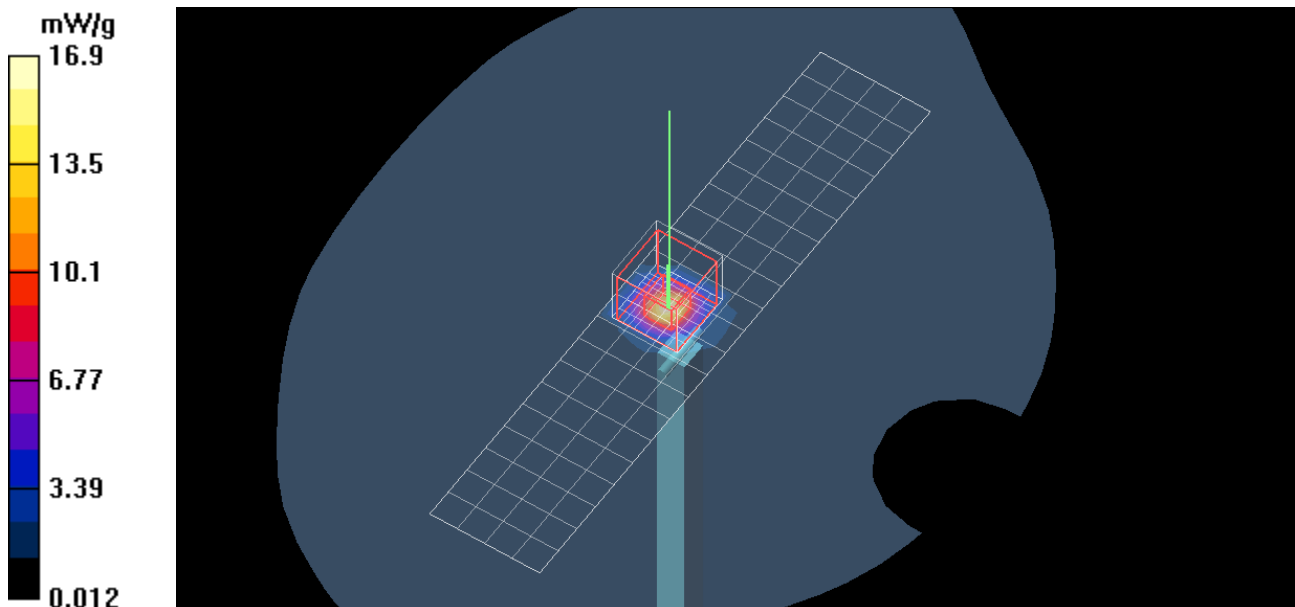
Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 8.19 mW/g; SAR(10 g) = 2.31 mW/g

Maximum value of SAR (measured) = 17.2 mW/g

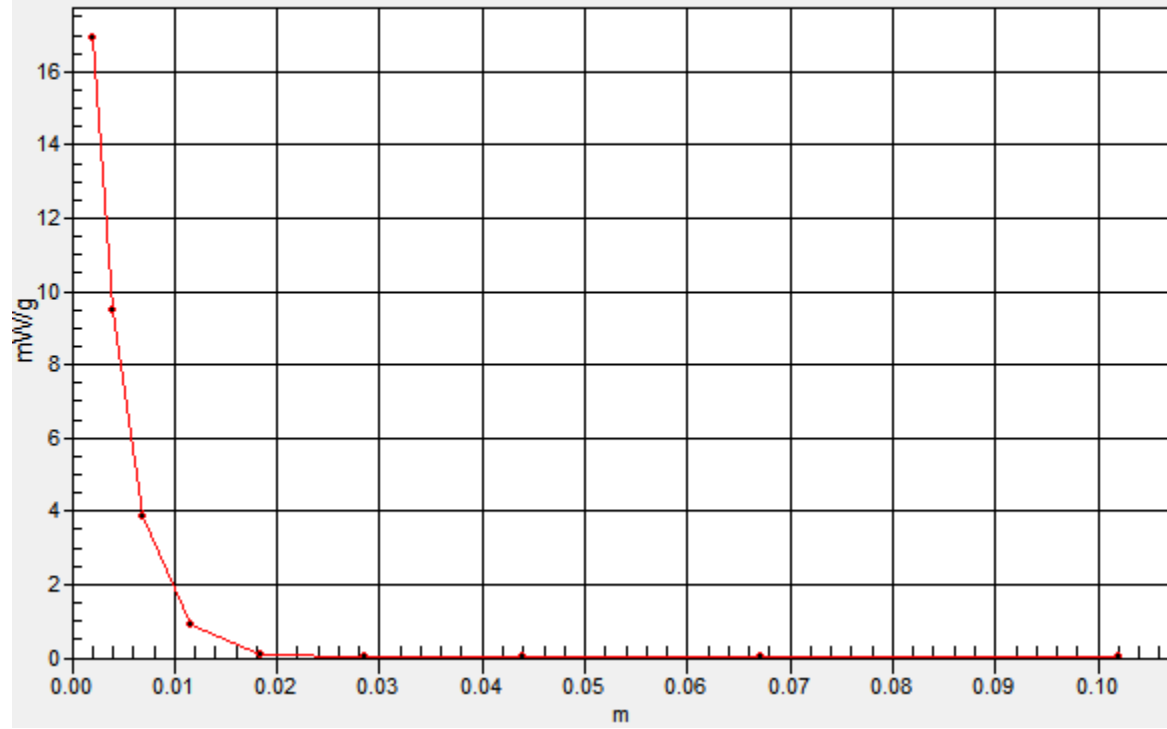
Daily SPC Check/Z-Axis Retraction, Graded 1.5 (1x1x9): Measurement grid: dx=20mm, dy=20mm, dz=2mm

Maximum value of SAR (measured) = 16.9 mW/g



SAR(x,y,z,f0)

SAR; Z-Axis Retraction, Graded 1.5: Value Along Z, X=0, Y=0



Test Laboratory: Motorola 5800 MHz System Performance Check

DUT: Dipole 5-6GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1098

Procedure Notes: PM1 Power = 100 mW Refl.Pwr PM3 = -22.35 dB [Sim.Temp@SPC](#) = 20.1C Room Temp @ SPC = 21.2C

Communication System: CW - Dipole; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: Validation *BODY Tissue* ; Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.79 \text{ mho/m}$; $\epsilon_r = 46.8$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(3.76, 3.76, 3.76); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (5x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 10.7 mW/g

Daily SPC Check/0-Degree, 7x7x12 Cube (7x7x6)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$

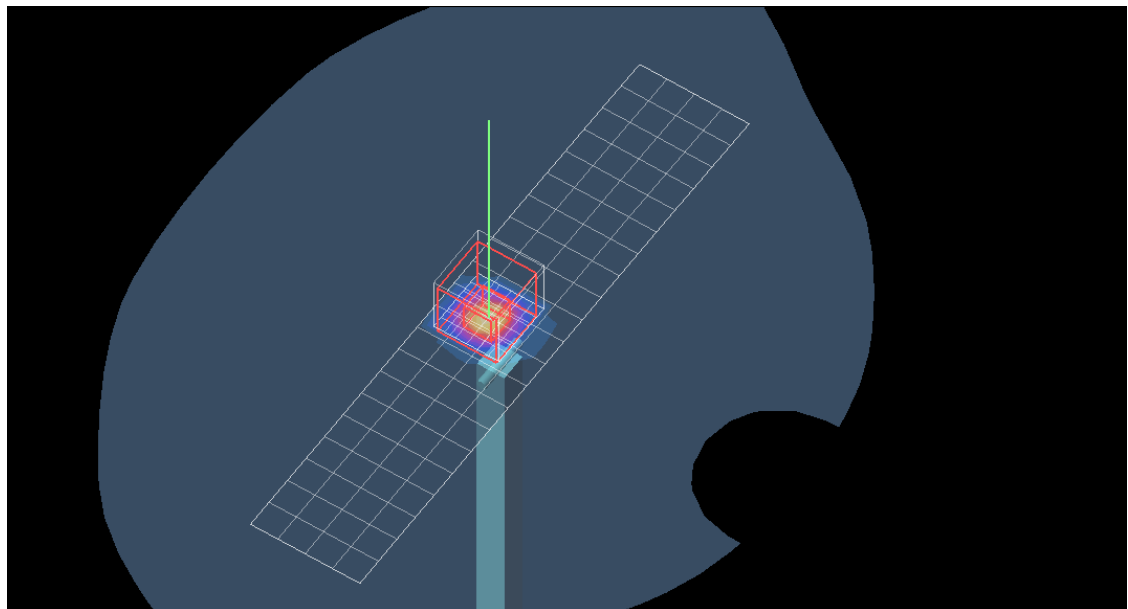
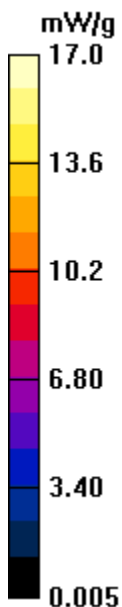
Reference Value = 49.3 V/m; Power Drift = 0.157 dB

Peak SAR (extrapolated) = 33.0 W/kg

SAR(1 g) = 7.74 mW/g; SAR(10 g) = 2.16 mW/g

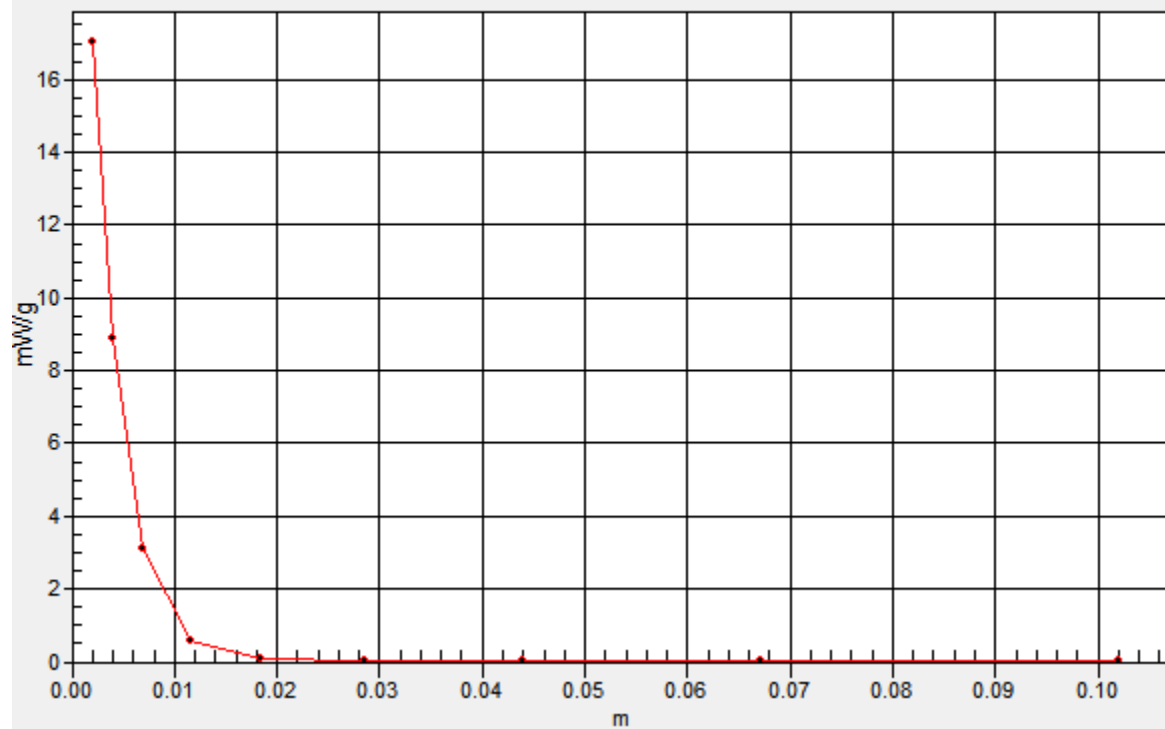
Maximum value of SAR (measured) = 17.0 mW/g

Daily SPC Check/Z-Axis Retraction, Graded 1.5 (1x1x9): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=2\text{mm}$



SAR(x,y,z,f0)

SAR; Z-Axis Retraction, Graded 1.5: Value Along Z, X=0, Y=0



Test Laboratory: Motorola 5800 MHz System Performance Check

DUT: Dipole 5-6GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN:1098

Procedure Notes: PM1 Power = 100 mW Refl.Pwr PM3 = -22.11 dB [Sim.Temp@SPC](#) = 20.0C Room Temp @ SPC = 21.3C

Communication System: CW - Dipole; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: Validation *BODY Tissue* ; Medium parameters used: $f = 5800 \text{ MHz}$; $\sigma = 6.79 \text{ mho/m}$; $\epsilon_r = 46.8$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(3.76, 3.76, 3.76); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Daily SPC Check/Dipole Area Scan (5x22x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 11.8 mW/g

Daily SPC Check/0-Degree, 7x7x12 Cube (7x7x6)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$

Reference Value = 52.6 V/m; Power Drift = -0.050 dB

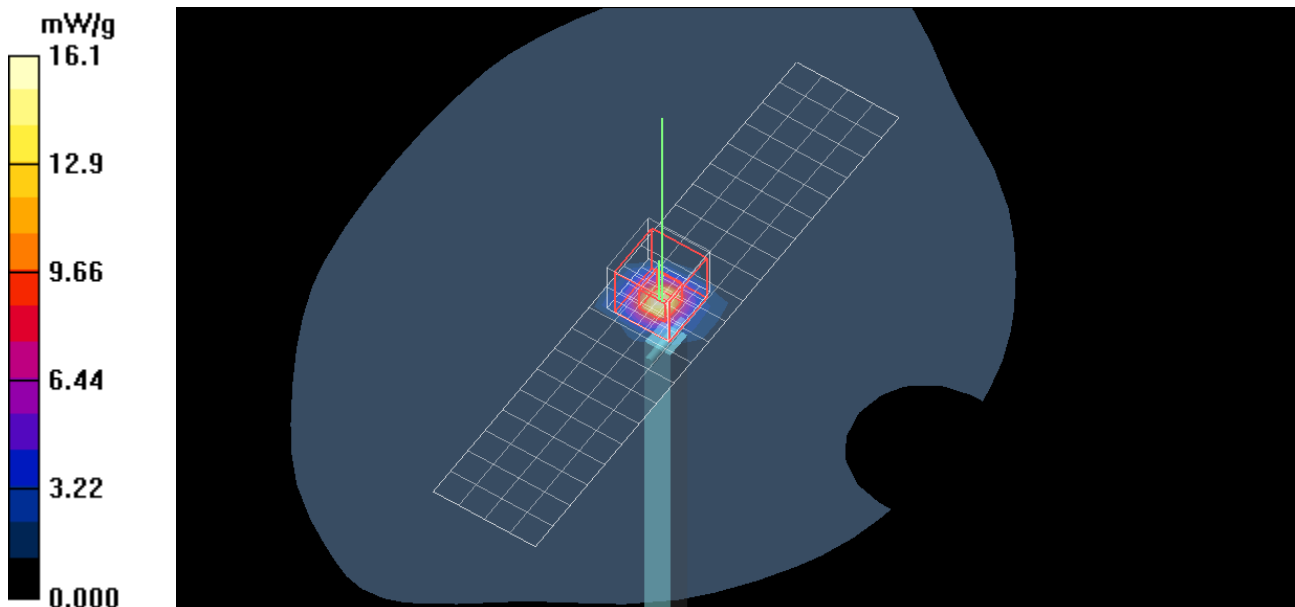
Peak SAR (extrapolated) = 33.8 W/kg

SAR(1 g) = 7.75 mW/g; SAR(10 g) = 2.15 mW/g

Maximum value of SAR (measured) = 16.9 mW/g

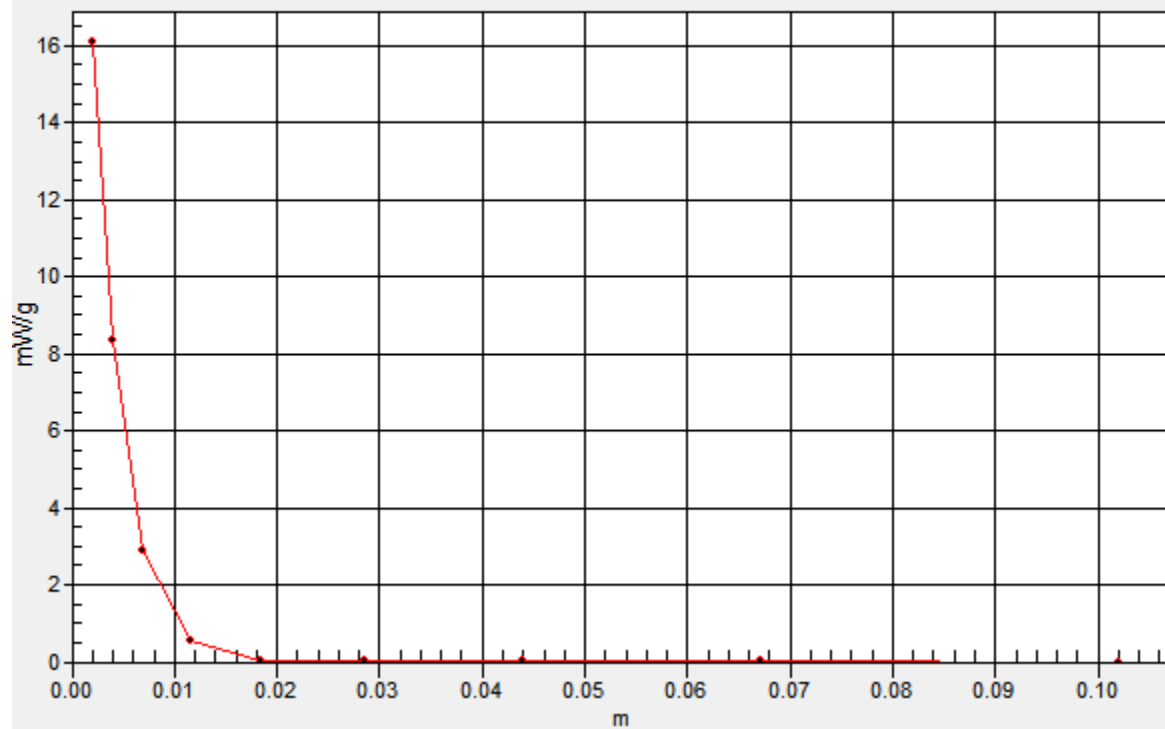
Daily SPC Check/Z-Axis Retraction, Graded 1.5 (1x1x9): Measurement grid: $dx=20\text{mm}$, $dy=20\text{mm}$, $dz=2\text{mm}$

Maximum value of SAR (measured) = 16.1 mW/g



SAR(x,y,z,f0)

SAR; Z-Axis Retraction, Graded 1.5: Value Along Z, X=0, Y=0



Appendix 2

SAR distribution plots for Body Configuration

Test Laboratory: Motorola 2450 MHz WiFi - Top Edge

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11b 1 Mbps Chn 1 Battery Model #: Internal Tester Test Configuration = Top Edge of DUT 0mm from Flat Phantom

Communication System: Wi-Fi 2450; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450$ MHz; $\sigma = 1.92$ mho/m; $\epsilon_r = 51.6$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.33, 4.33, 4.33); Calibrated: 3/11/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn702; Calibrated: 4/14/2011
- Phantom: R#2 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1136;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Long Edge Area Scan - Body (15mm) (21x6x1):

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

Maximum value of SAR (measured) = 0.385 mW/g

SAM Phone Against Flat Section/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0: Measurement grid:

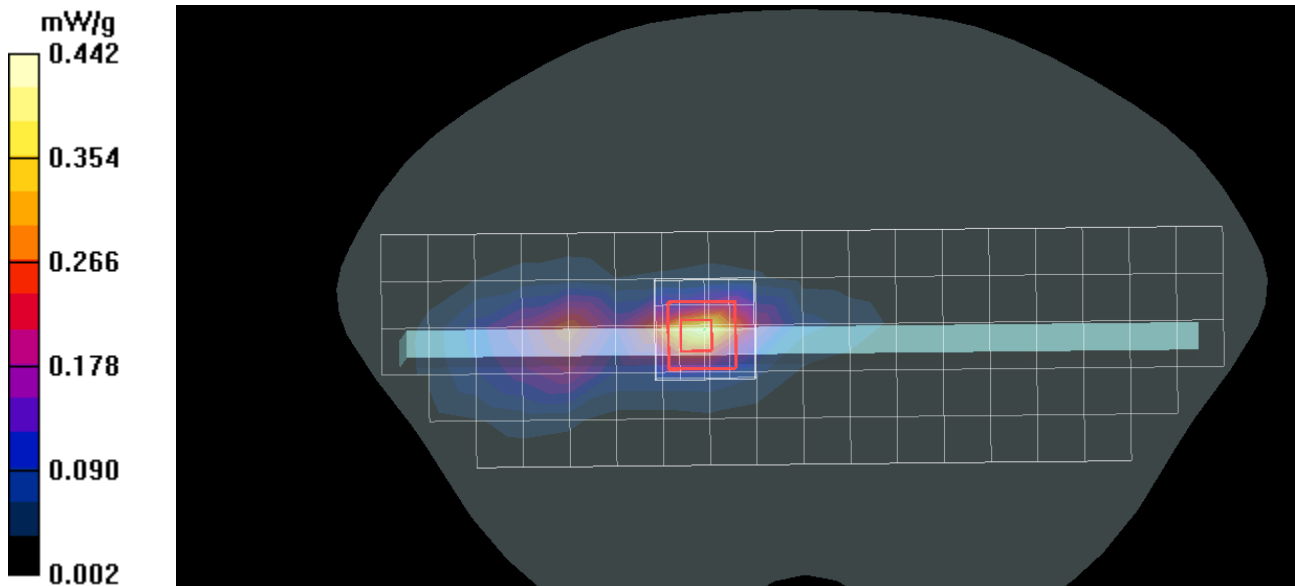
dx=8mm, dy=8mm, dz=5mm

Reference Value = 13.1 V/m; Power Drift = -0.086 dB

Peak SAR (extrapolated) = 0.758 W/kg

SAR(1 g) = 0.365 mW/g; SAR(10 g) = 0.157 mW/g

Maximum value of SAR (measured) = 0.442 mW/g



Test Laboratory: Motorola 5210 MHz WiFi - Top Edge

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11a 6 Mbps Chn 40 Battery Model #: INTERNAL Test Configuration = TOP Edge 0mm from Phantom

Communication System: 5210MHz Band - 802.11a; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5-6 GHz SPEAG Tissue BODY; Medium parameters used: $f = 5210$ MHz; $\sigma = 5.92$ mho/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(4.16, 4.16, 4.16); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Long Edge Area Scan - Body (10mm) (31x8x1):

Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 2.09 mW/g

SAM Phone Against Flat Section/7x7x12 Zoom Scan (5-6GHz) (7x7x6)/Cube 0: Measurement grid:

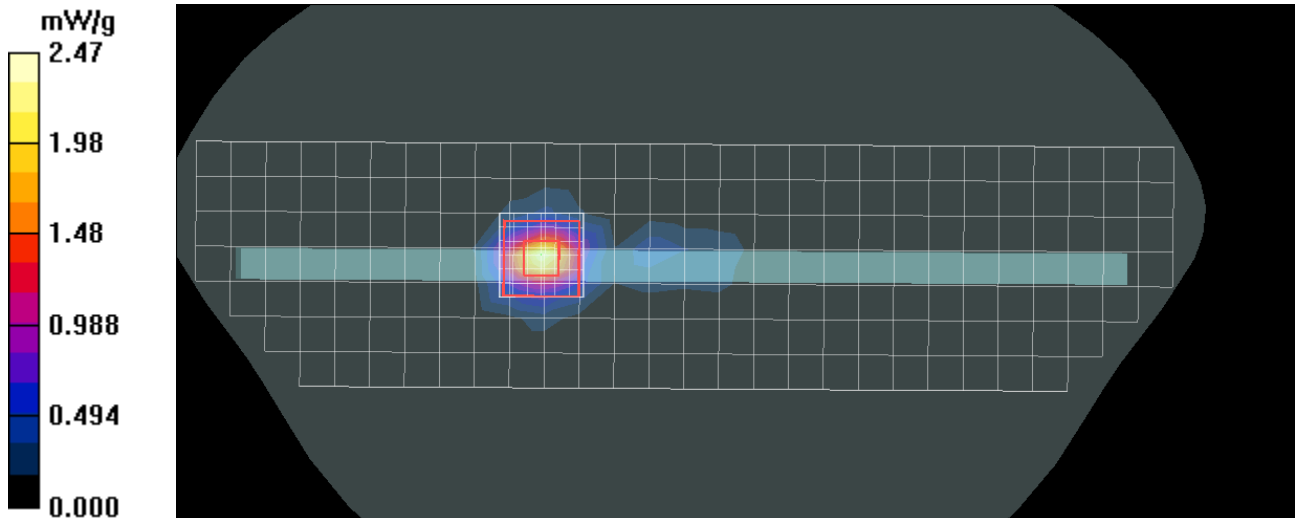
dx=4mm, dy=4mm, dz=2mm

Reference Value = 19.3 V/m; Power Drift = 0.168 dB

Peak SAR (extrapolated) = 4.66 W/kg

SAR(1 g) = 1.19 mW/g; SAR(10 g) = 0.348 mW/g

Maximum value of SAR (measured) = 2.47 mW/g



Test Laboratory: Motorola 5875 MHz WiFi - Top Edge

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11a 6 Mbps Chn 165 Battery Model #: INTERNAL Test Configuration =Top Edge of DUT 0mm from Phantom

Communication System: 5785MHz Band - 802.11a; Frequency: 5825 MHz;Duty Cycle: 1:1

Medium: 5-6 GHz SPEAG Tissue BODY; Medium parameters used: $f = 5785 \text{ MHz}$; $\sigma = 6.74 \text{ mho/m}$; $\epsilon_r = 47.3$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(3.76, 3.76, 3.76); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Long Edge Area Scan - Body (10mm) (31x8x1):

Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 1.80 mW/g

SAM Phone Against Flat Section/7x7x12 Zoom Scan (5-6GHz) (7x7x6)/Cube 0: Measurement grid:

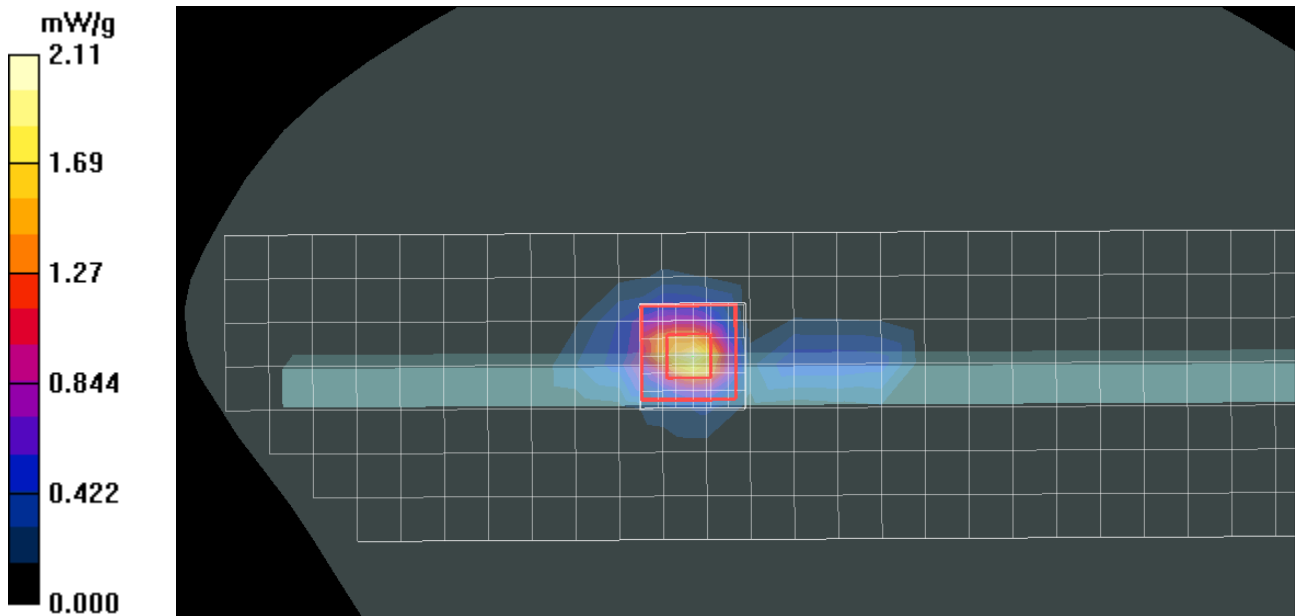
$dx=4\text{mm}$, $dy=4\text{mm}$, $dz=2\text{mm}$

Reference Value = 12.5 V/m; Power Drift = -0.079 dB

Peak SAR (extrapolated) = 4.16 W/kg

SAR(1 g) = 0.955 mW/g; SAR(10 g) = 0.266 mW/g

Maximum value of SAR (measured) = 2.11 mW/g



Test Laboratory: Motorola 5210 MHz WiFi - Back Surface

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11a 6 Mbps Chn 40 Battery Model #: INTERNAL Test Configuration = BACK Surface 0mm from Phantom

Communication System: 5210MHz Band - 802.11a; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: 5-6 GHz SPEAG Tissue BODY; Medium parameters used: $f = 5210$ MHz; $\sigma = 5.92$ mho/m; $\epsilon_r = 48.1$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(4.16, 4.16, 4.16); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Partial Face (front/back) Area Scan - Normal Body

(10mm) (31x8x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.60 mW/g

SAM Phone Against Flat Section/7x7x12 Zoom Scan (5-6GHz) (7x7x6)/Cube 0: Measurement grid:

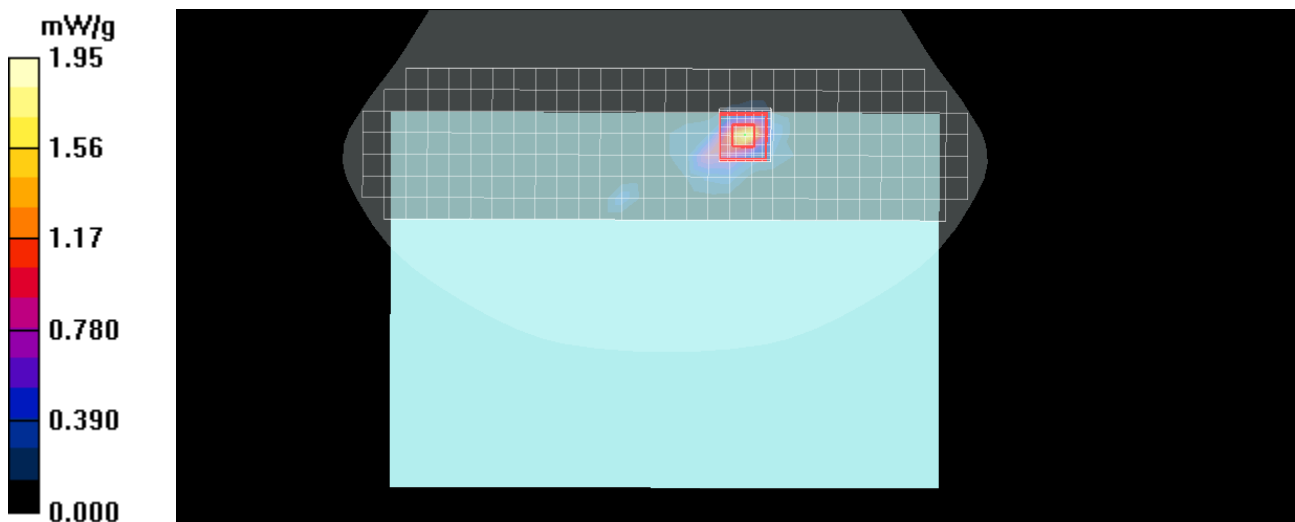
dx=4mm, dy=4mm, dz=2mm

Reference Value = 13.8 V/m; Power Drift = 0.036 dB

Peak SAR (extrapolated) = 3.61 W/kg

SAR(1 g) = 0.867 mW/g; SAR(10 g) = 0.244 mW/g

Maximum value of SAR (measured) = 1.95 mW/g



Test Laboratory: Motorola 5875 MHz WiFi - Back Surface

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11a 6 Mbps Chn 153 Battery Model #: INTERNAL Test Configuration = BACK of DUT 0mm from Phantom

Communication System: 5785MHz Band - 802.11a; Frequency: 5765 MHz; Duty Cycle: 1:1

Medium: 5-6 GHz SPEAG Tissue BODY; Medium parameters used: $f = 5785$ MHz; $\sigma = 6.77$ mho/m; $\epsilon_r = 46.8$; $\rho = 1000$ kg/m³

DASY4 Configuration:

- Probe: EX3DV4 - SN3728; ConvF(3.76, 3.76, 3.76); Calibrated: 5/20/2011
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 11/11/2010
- Phantom: R3 5GHz BODY SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1106;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Partial Face (front/back) Area Scan - Normal Body (10mm) (31x8x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 2.03 mW/g

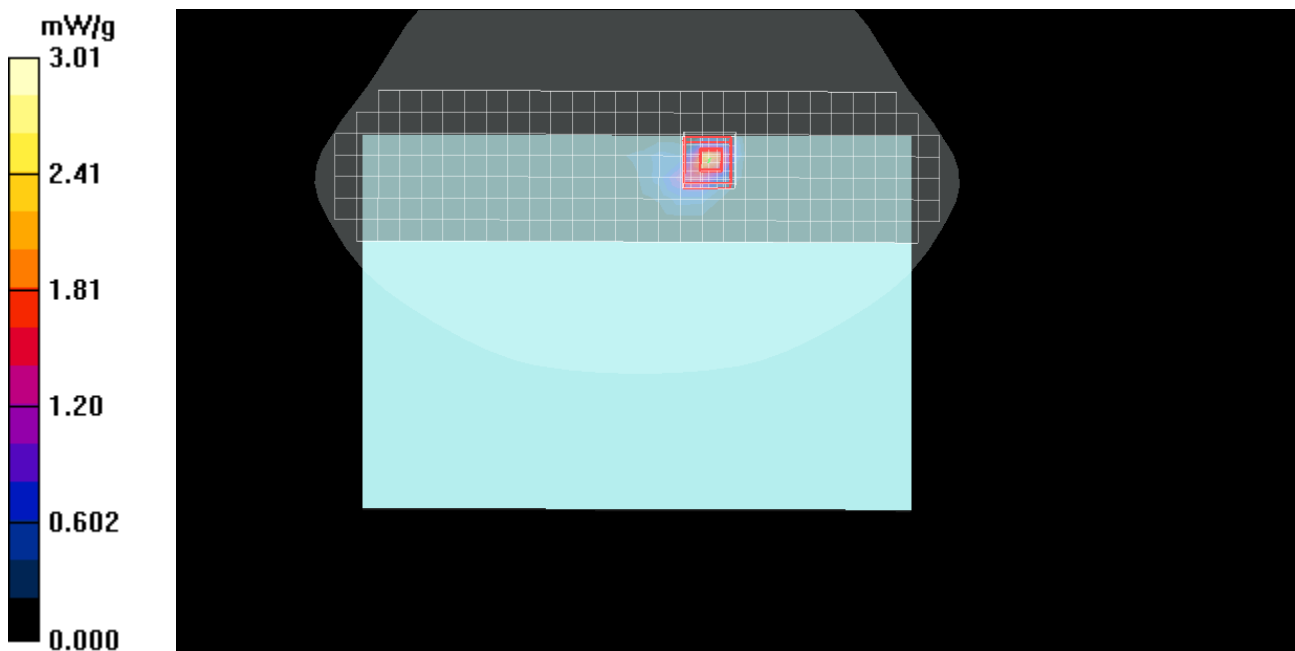
SAM Phone Against Flat Section/7x7x12 Zoom Scan (5-6GHz) (7x7x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 12.0 V/m; Power Drift = 0.157 dB

Peak SAR (extrapolated) = 8.03 W/kg

SAR(1 g) = 1.25 mW/g; SAR(10 g) = 0.331 mW/g

Maximum value of SAR (measured) = 3.01 mW/g



Test Laboratory: Motorola 2450 MHz WiFi - Back Surface

DUT: Serial: KPE00G0052, FCC ID: IHDP56MF1

Procedure Notes: 802.11n 28.9 Mbps Battery Model #: INTERNAL Accessory Model # = Back Surface 0mm from Phantom

Communication System: Wi-Fi 2450; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: 2450 Glycol Body; Medium parameters used: $f = 2450 \text{ MHz}$; $\sigma = 1.92 \text{ mho/m}$; $\epsilon_r = 52$; $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.33, 4.33, 4.33); Calibrated: 3/11/2011
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn702; Calibrated: 4/14/2011
- Phantom: R#2 Glycol SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1136;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

SAM Phone Against Flat Section/Tablet Partial Face (front/back) Area Scan - Normal Body

(15mm) (21x6x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (measured) = 1.32 mW/g

SAM Phone Against Flat Section/5x5x7 Zoom Scan ($\leq 3\text{GHz}$) (5x5x7)/Cube 0: Measurement grid:

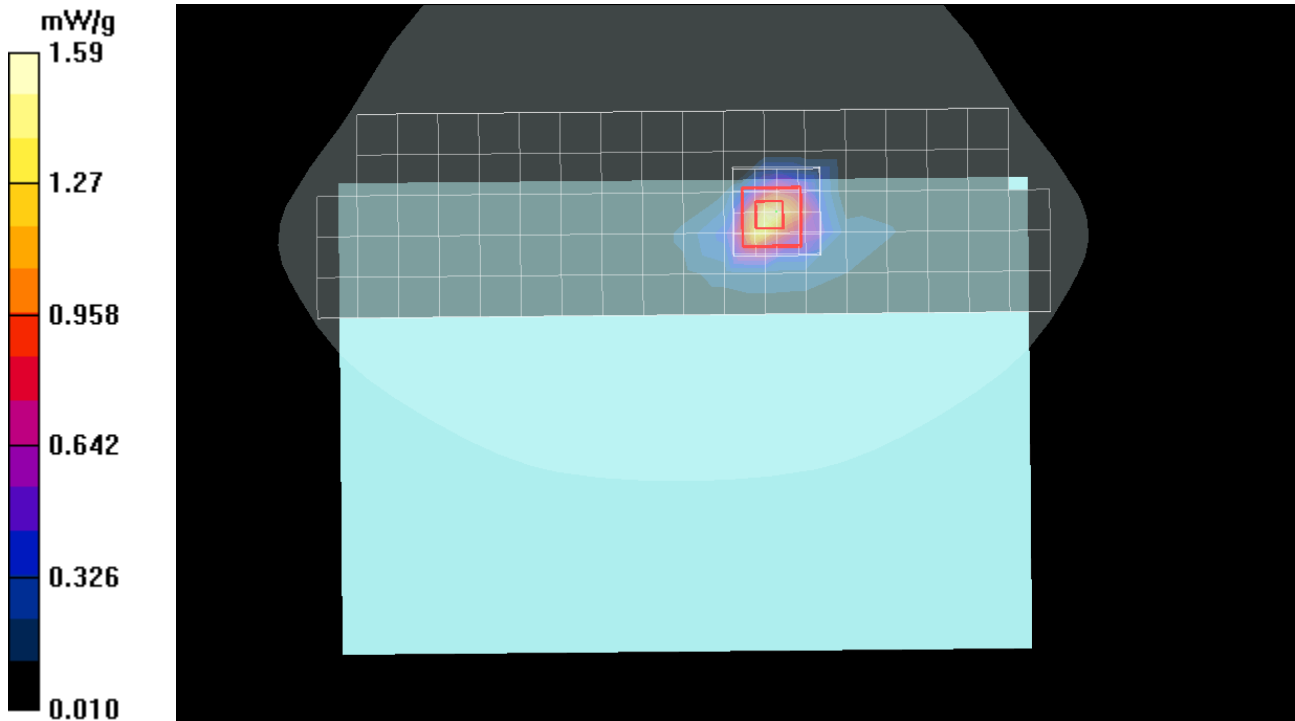
$dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 17.3 V/m; Power Drift = 0.077 dB

Peak SAR (extrapolated) = 3.68 W/kg

SAR(1 g) = 1.42 mW/g; SAR(10 g) = 0.600 mW/g

Maximum value of SAR (measured) = 1.59 mW/g



Appendix 3

Measurement Uncertainty Budget

Uncertainty Budget for Device Under Test, for 2 GHz to 3 GHz

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i> = <i>f</i> (<i>d</i> , <i>k</i>)	<i>f</i>	<i>g</i>	<i>h</i> = <i>c</i> × <i>f</i> / <i>e</i>	<i>i</i> = <i>c</i> × <i>g</i> / <i>e</i>	<i>k</i>
Uncertainty Component	Description IEEE1528(2003) / IEC62209-1(2005)	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 [ES3DV3]	E.2.1 / 7.2.1	5.5	N	1.00	1	1	5.5	5.5	∞
Axial Isotropy	E.2.2 / 7.2.1.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	E.2.2 / 7.2.1.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3 / 7.2.1.5	1.0	R	1.73	1	1	0.6	0.6	∞
Linearity	E.2.4 / 7.2.1.3	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5 / 7.2.1.4	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6 / 7.2.1.6	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	E.2.7 / 7.2.1.7	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	E.2.8 / 7.2.1.8	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	E.6.1 / 7.2.3.6	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1 / 7.2.3.6	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mech. Tolerance	E.6.2 / 7.2.2.1	0.4	R	1.73	1	1	0.2	0.2	∞
Probe Positioning w.r.t Phantom	E.6.3 / 7.2.2.3	1.4	R	1.73	1	1	0.8	0.8	∞
Max. SAR Evaluation (ext., int., avg.)	E.5 / 7.2.4	3.4	R	1.73	1	1	2.0	2.0	∞
Test sample Related									
Test Sample Positioning	E.4.2 / 7.2.2.4	3.4	N	1.00	1	1	3.4	3.4	79
Device Holder Uncertainty	E.4.1 / 7.2.2.4.2	4.5	N	1.00	1	1	4.5	4.5	11
SAR drift	6.6.2 / 7.2.3.5	0.0	R	1.73	1	1	0.0	0.0	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	E.3.1 / 7.2.2.2	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)	E.3.2 / 7.2.3.3	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	E.3.3 / 7.2.3.3	2.5	N	1.00	0.64	0.43	1.6	1.1	6
Liquid Permittivity (target)	E.3.2 / 7.2.3.4	10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity (measurement)	E.3.2 / 7.2.3.4	2.3	N	1.00	0.6	0.49	1.4	1.1	6
Combined Standard Uncertainty			RSS				11	11	392
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				22	22	

Uncertainty Budget for Device Under Test for 3 to 6 GHz

<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	Description IEC62209- 2(2010)	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 [EX3DV4]	7.2.2.1	6.6	N	1.00	1	1	6.6	6.6	∞
Axial Isotropy	7.2.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Hemispherical Isotropy	7.2.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	7.2.2.6	2.0	R	1.73	1	1	1.2	1.2	∞
Linearity	7.2.2.5	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	7.2.2	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	7.2.2.7	0.3	N	1.00	1	1	0.3	0.3	∞
Response Time	7.2.2.8	1.1	R	1.73	1	1	0.6	0.6	∞
Integration Time	7.2.2.9	1.1	R	1.73	1	1	0.6	0.6	∞
RF Ambient Conditions - Noise	7.2.4.5	3.0	R	1.73	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	7.2.4.5	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mech. Tolerance	7.2.3.1	1.0	R	1.73	1	1	0.6	0.6	∞
Probe Positioning w.r.t Phantom	7.2.3.3	4.0	R	1.73	1	1	2.3	2.3	∞
Max. SAR Evaluation (ext., int., avg.)	7.2.5.3	4.0	R	1.73	1	1	2.3	2.3	∞
Test sample Related									
Test Sample Positioning	7.2.3.4	3.4	N	1.00	1	1	3.4	3.4	79
Device Holder Uncertainty	7.2.3.4	4.5	N	1.00	1	1	4.5	4.5	11
SAR drift	7.2.2.10	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty	7.2.3.2	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity (target)		5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity (measurement)	7.2.4.3	3.4	N	1.00	0.64	0.43	2.2	1.5	6
Liquid Permittivity (target)		10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity (measurement)	7.2.4.3	2.6	N	1.00	0.6	0.49	1.6	1.3	6
Combined Standard Uncertainty			RSS				13	12	566
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				25	24	

Appendix 4

Probe Calibration Certificate



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 **Motorola MDb**

Certificate No: **EX3-3728_May11**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3728**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v3**
Calibration procedure for dosimetric E-field probes

Calibration date: **May 20, 2011**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	
			Issued: May 20, 2011
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- 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 EX3DV4

SN:3728

Manufactured: October 19, 2009
Calibrated: May 20, 2011

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3728

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	0.48	0.45	0.51	± 10.1 %
DCP (mV) ^B	99.5	100.3	100.3	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^C (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	110.9	±1.9 %
			Y	0.00	0.00	1.00	113.4	
			Z	0.00	0.00	1.00	115.0	

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.

^C 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:3728

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)
5200	36.0	4.66	4.64	4.64	4.64	0.42	1.80	± 13.1 %
5300	35.9	4.76	4.34	4.34	4.34	0.42	1.80	± 13.1 %
5600	35.5	5.07	4.01	4.01	4.01	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.13	4.13	4.13	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:3728

Calibration Parameter Determined in Body Tissue Simulating Media

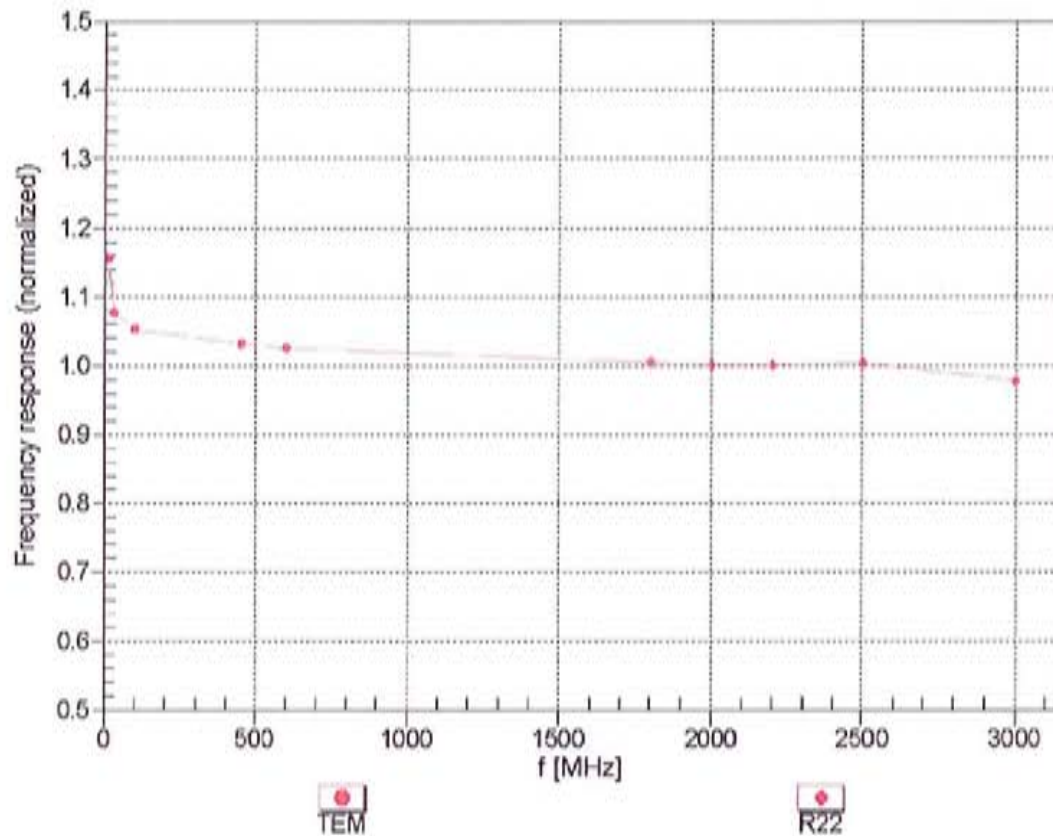
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
5200	49.0	5.30	4.16	4.16	4.16	0.50	1.90	± 13.1 %
5300	48.9	5.42	3.91	3.91	3.91	0.52	1.90	± 13.1 %
5600	48.5	5.77	3.41	3.41	3.41	0.55	1.90	± 13.1 %
5800	48.2	6.00	3.76	3.76	3.76	0.55	1.90	± 13.1 %

^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

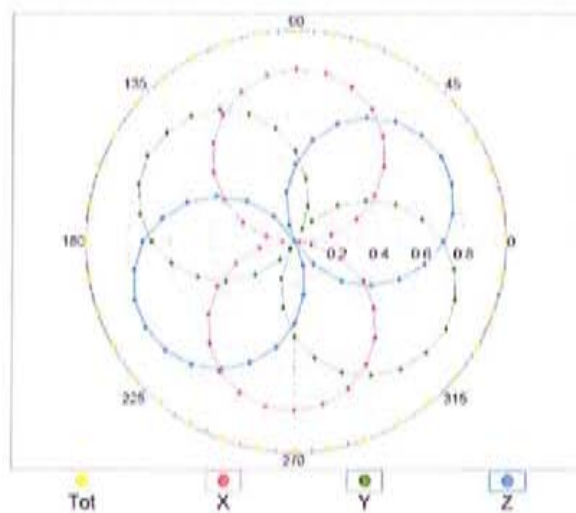
(TEM-Cell:ifi110 EXX, Waveguide: R22)



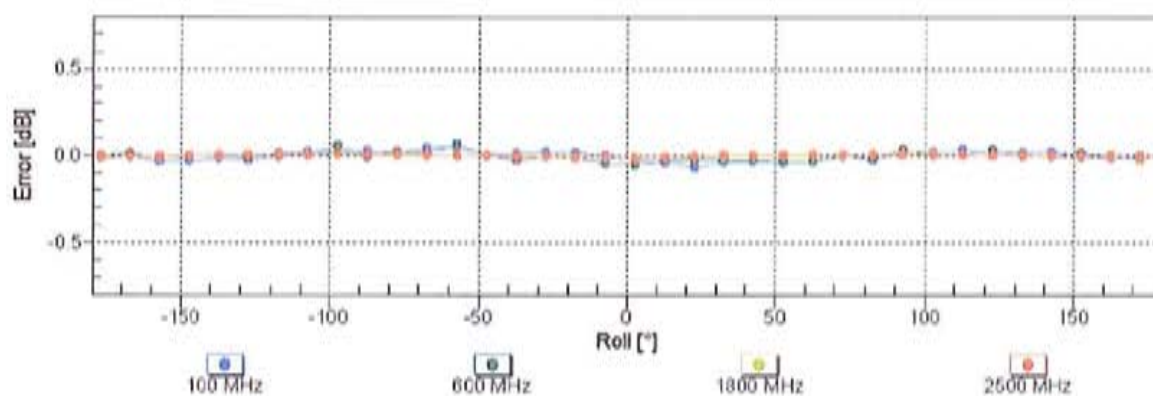
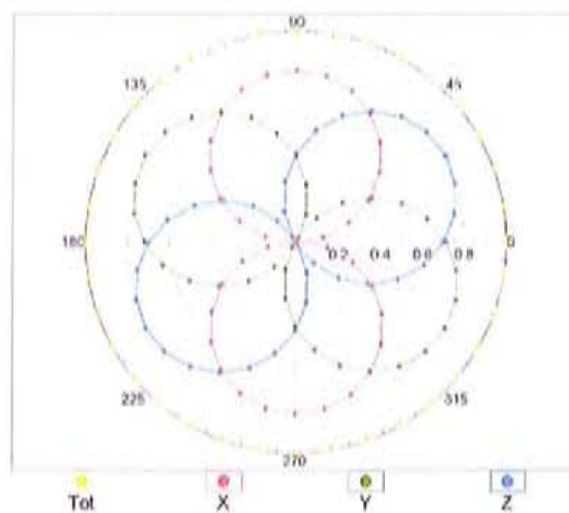
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

$f=600$ MHz, TEM

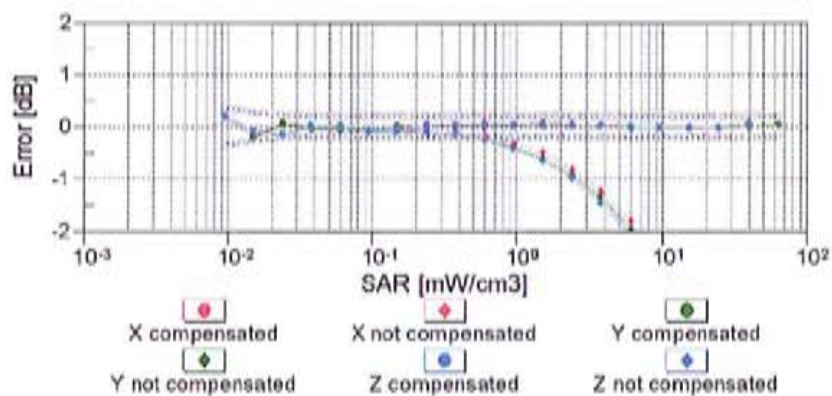
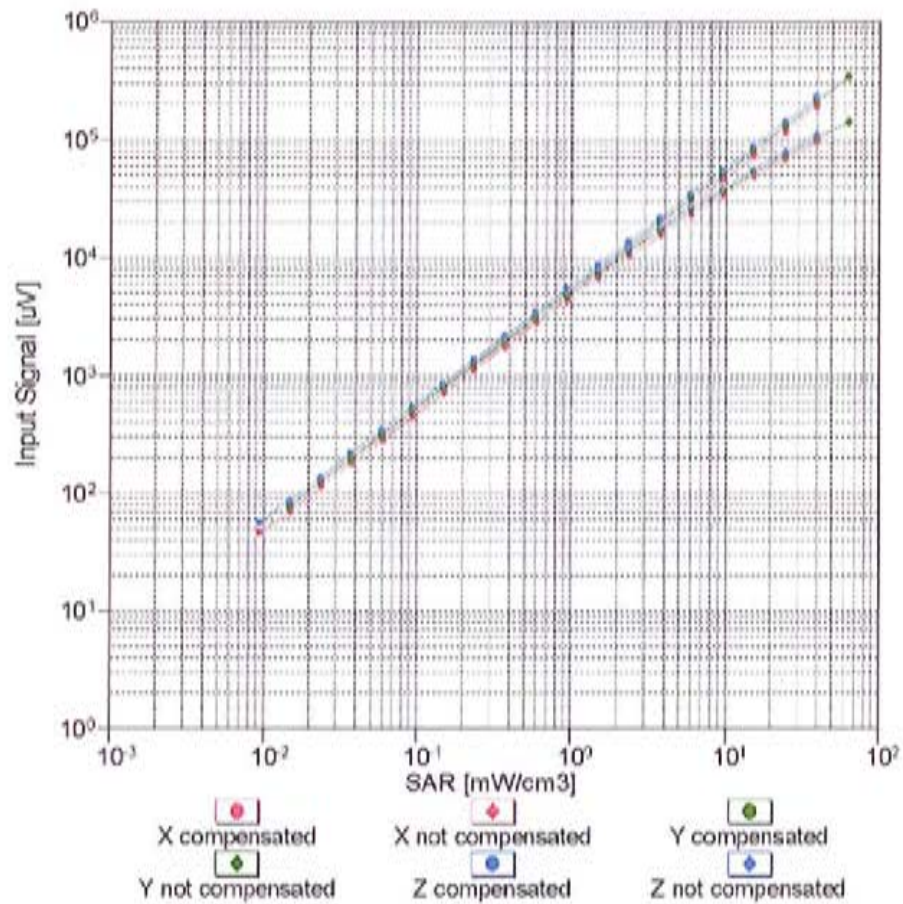


$f=1800$ MHz, R22



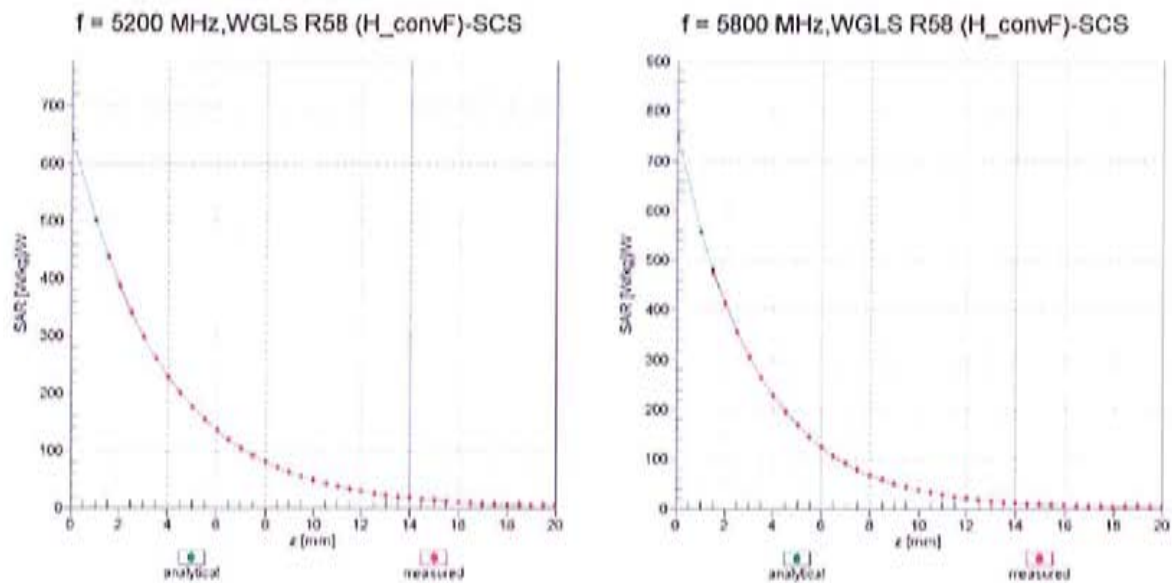
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



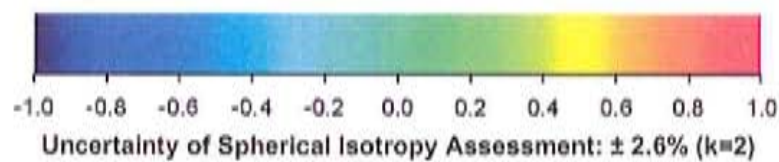
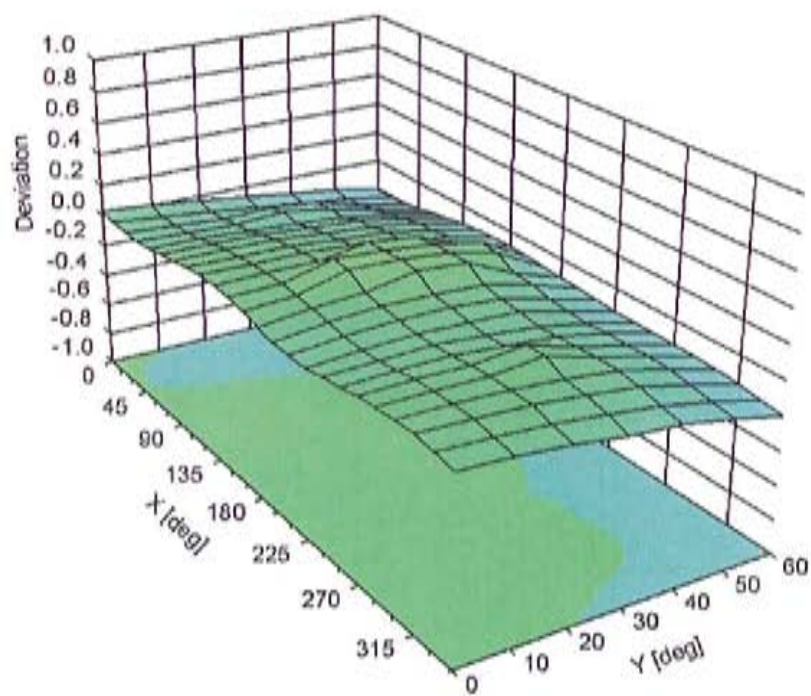
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3728

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	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



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Accreditation No.: **SCS 108**

Client **Motorola MDb**

Certificate No: **ES3-3184_Mar11**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3184**

Calibration procedure(s) **QA CAL-01.v7, QA CAL-23.v4, QA CAL-25.v3**
Calibration procedure for dosimetric E-field probes

Calibration date: **March 11, 2011**

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	01-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	01-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	01-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	23-Apr-10 (No. DAE4-654_Apr10)	Apr-11
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: March 16, 2011			
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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- 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:3184

Manufactured: August 19, 2008
Calibrated: March 11, 2011

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3184

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V/m})^2$) ^A	1.27	1.40	1.27	± 10.1 %
DCP (mV) ^B	96.8	98.9	99.5	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc ^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	110.8	±3.0 %
			Y	0.00	0.00	1.00	117.2	
			Z	0.00	0.00	1.00	107.9	

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3184

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)
835	41.5	0.90	6.11	6.11	6.11	1.00	1.04	± 12.0 %
1810	40.0	1.40	5.11	5.11	5.11	0.93	1.08	± 12.0 %
1950	40.0	1.40	4.93	4.93	4.93	0.96	1.07	± 12.0 %
2450	39.2	1.80	4.48	4.48	4.48	0.73	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:3184

Calibration Parameter Determined in Body Tissue Simulating Media

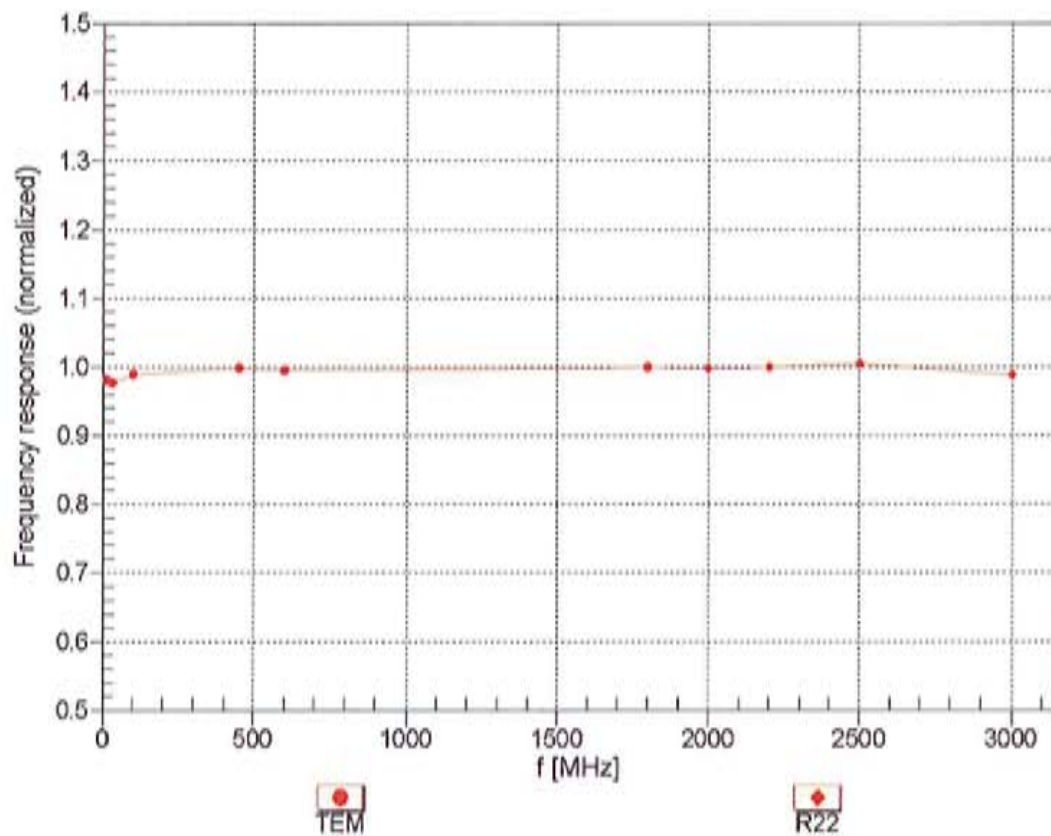
f (MHz) ^G	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.10	6.10	6.10	1.00	1.00	± 12.0 %
1810	53.3	1.52	4.90	4.90	4.90	0.87	1.26	± 12.0 %
1950	53.3	1.52	4.86	4.86	4.86	0.73	1.38	± 12.0 %
2450	52.7	1.95	4.33	4.33	4.33	1.00	1.03	± 12.0 %

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

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

Frequency Response of E-Field

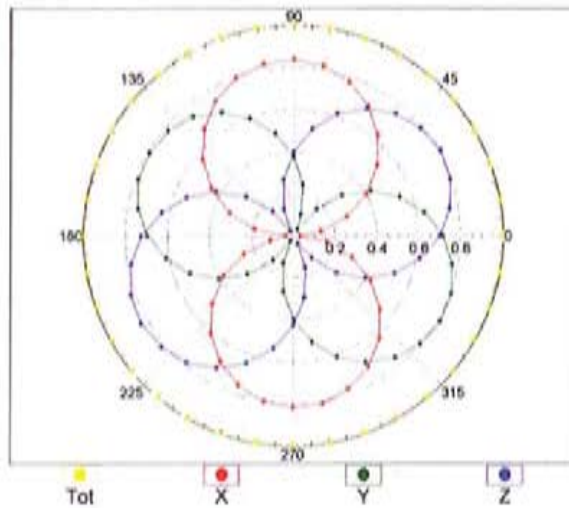
(TEM-Cell: ifi110 EXX, Waveguide: R22)



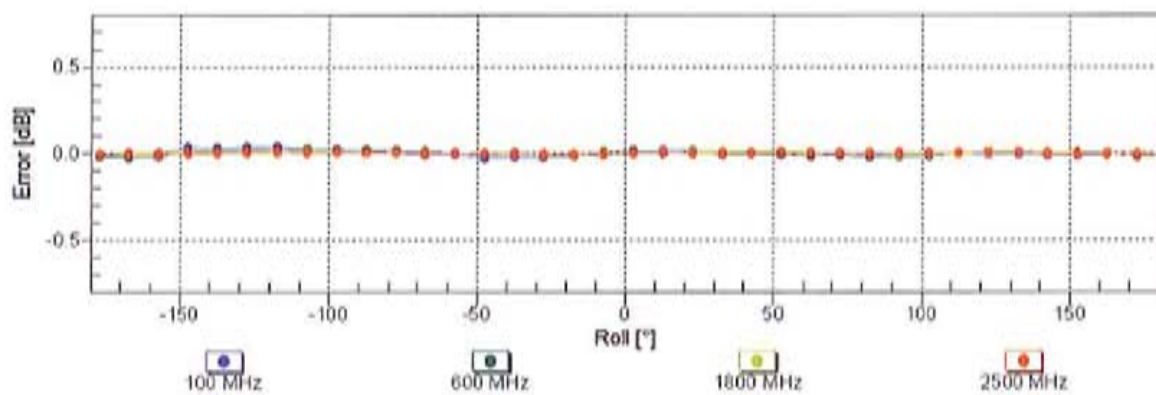
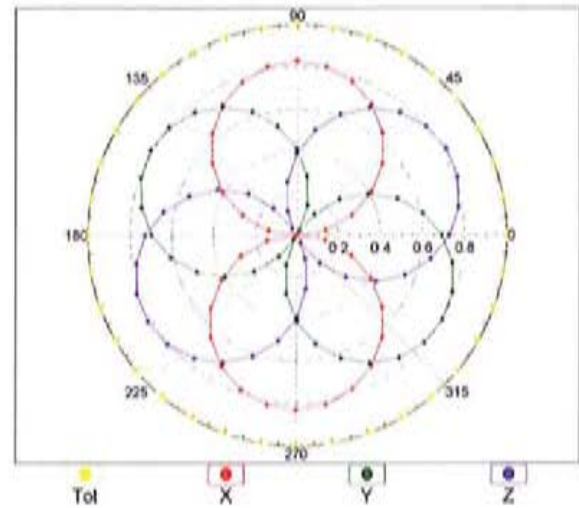
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

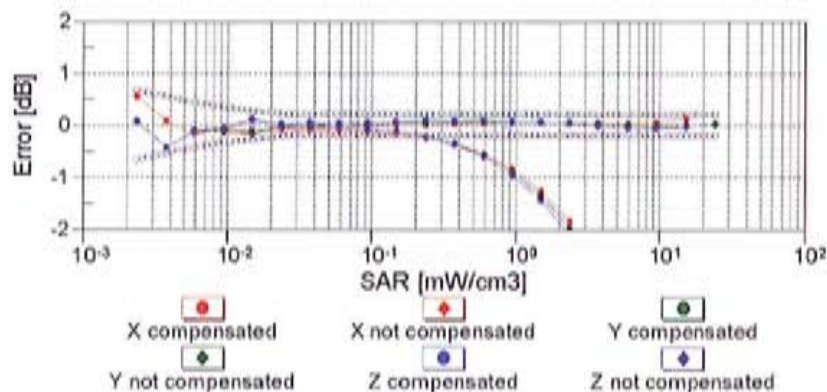
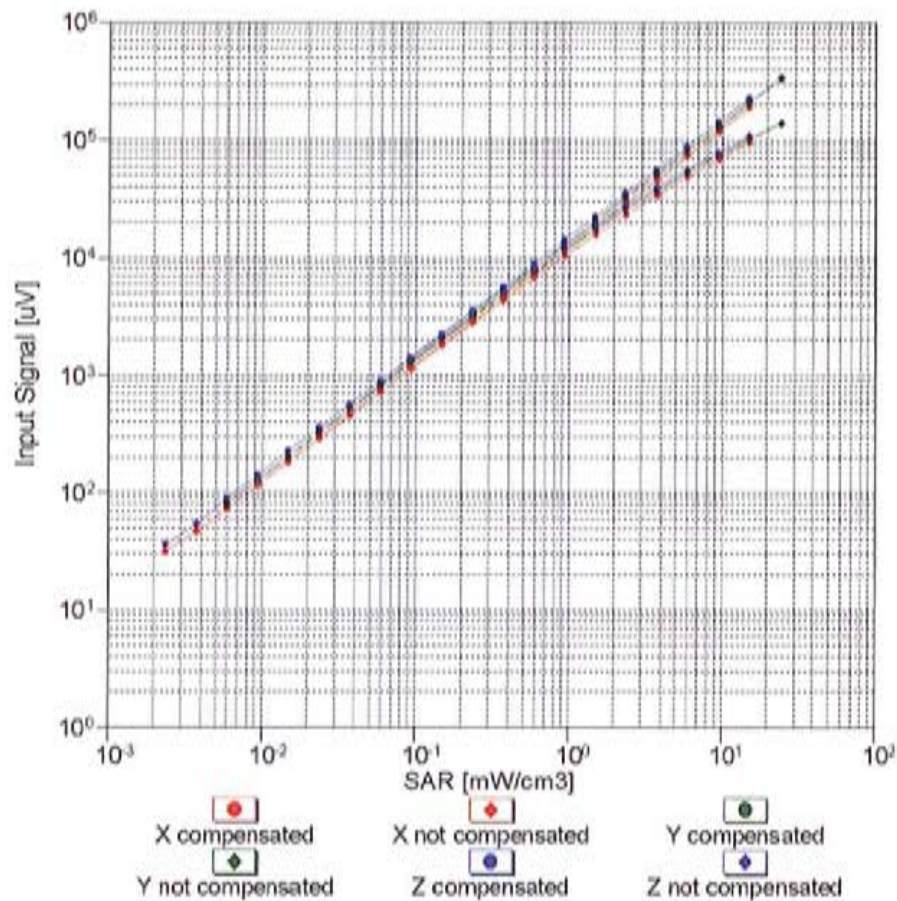


f=1800 MHz, R22



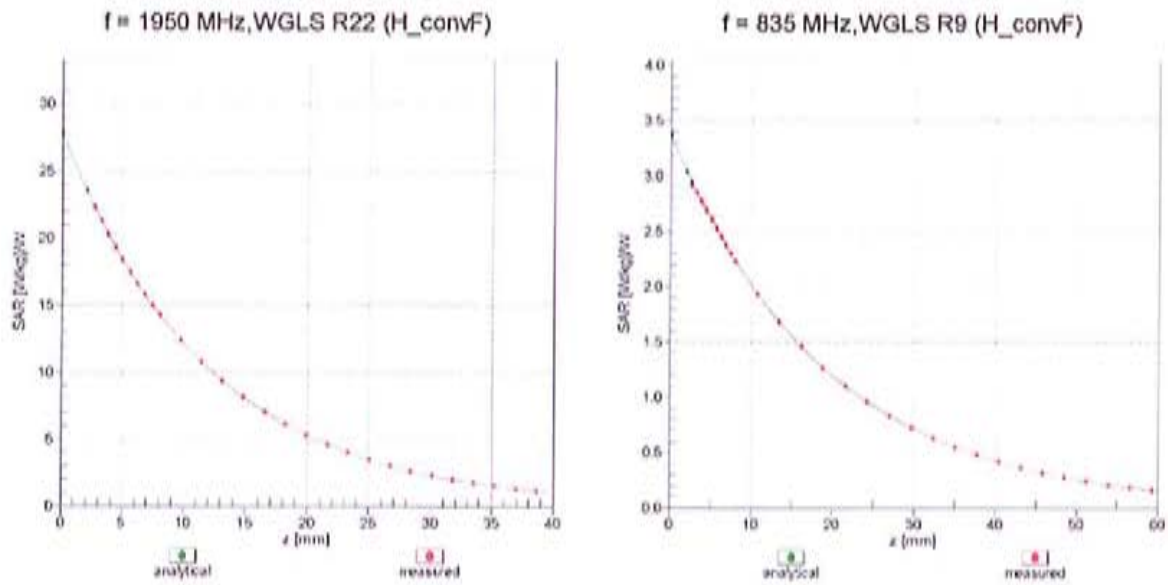
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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

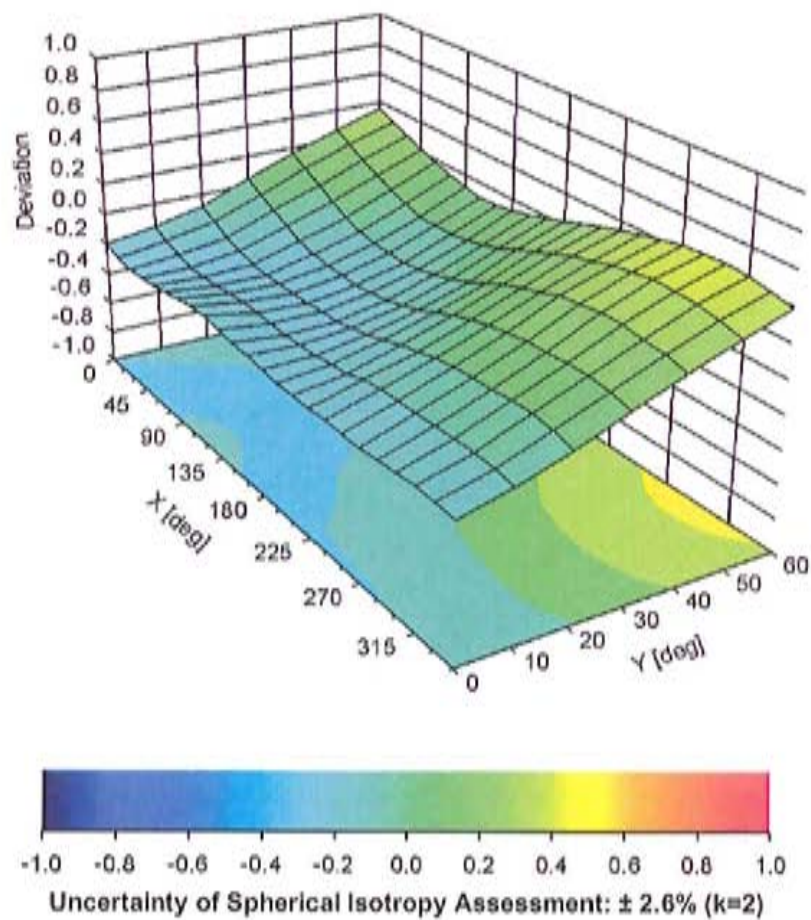


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3184**Other Probe Parameters**

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

Appendix 5

Dipole Characterization Certificate



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Accreditation No.: **SCS 108**

Client **Motorola MDb**

Certificate No: **D2450V2-766_Jul11**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 766**

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

Calibration date: **July 15, 2011**

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	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: July 15, 2011

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
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 $\pm$ 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 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.85 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	54.8 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.43 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.6 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.5 $\pm$ 6 %	1.99 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.4 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.97 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.7 mW / g $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.9 \Omega + 1.4 j\Omega$
Return Loss	- 30.0 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.3 \Omega + 2.4 j\Omega$
Return Loss	- 30.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.156 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.

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	August 10, 2004

DASY5 Validation Report for Head TSL

Date: 7/12/2011

Test Laboratory: SPEAG

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 766

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HBBL 1900-3800V3

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.85$ mho/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 4/29/2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 7/4/2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, Version 52.6 (2)
- SEMCAD X Version 14.4.5 (3634)

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

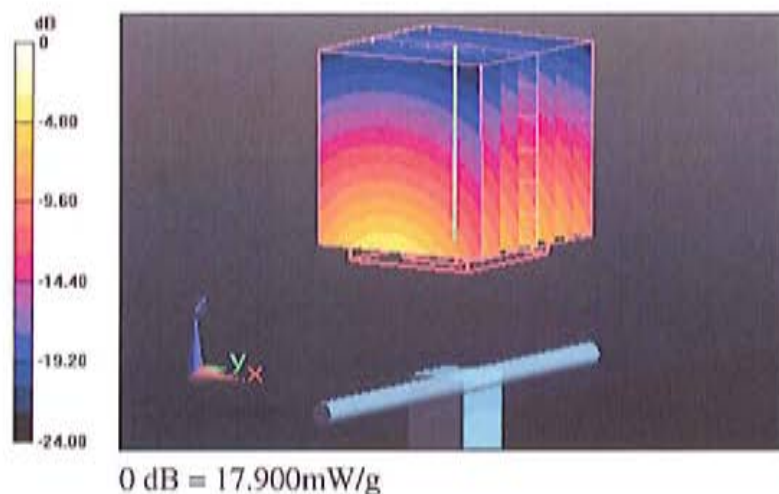
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.9 V/m; Power Drift = 0.05 dB

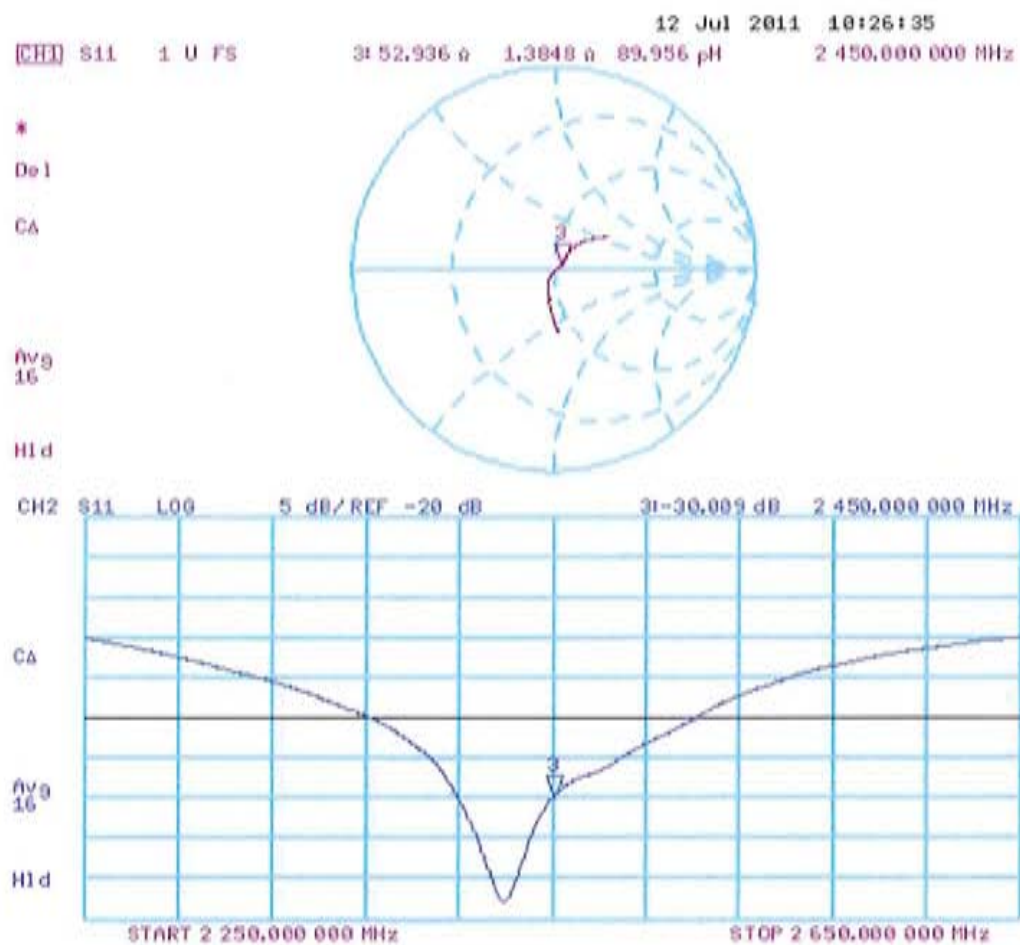
Peak SAR (extrapolated) = 28.918 W/kg

SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.43 mW/g

Maximum value of SAR (measured) = 17.900 mW/g



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.07.2011

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 766

Communication System: CW; Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

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

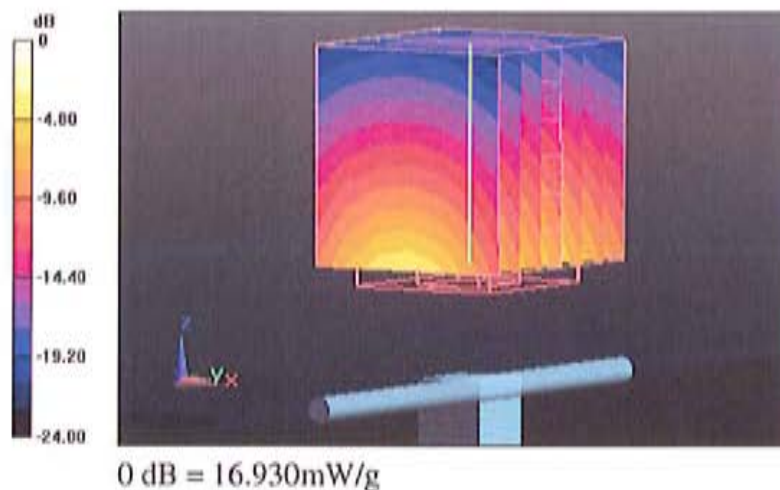
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.545 V/m; Power Drift = 0.02 dB

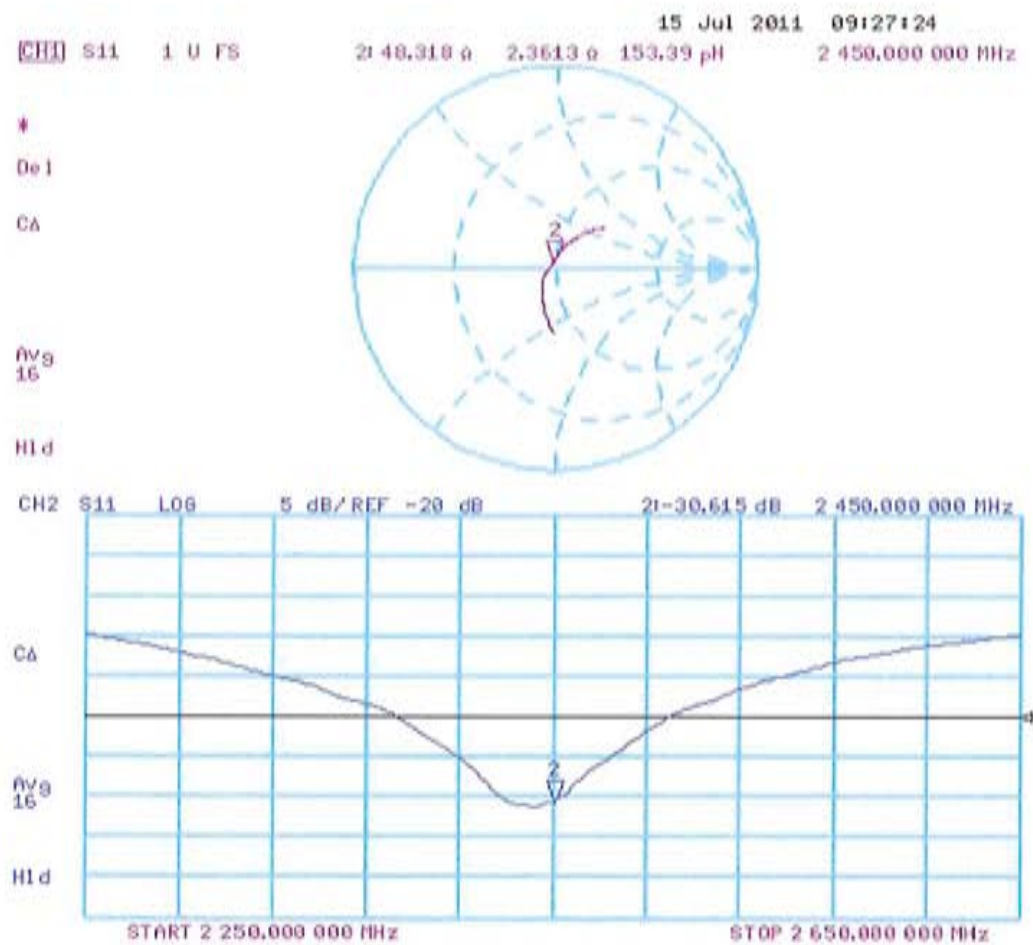
Peak SAR (extrapolated) = 26.210 W/kg

SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.97 mW/g

Maximum value of SAR (measured) = 16.925 mW/g



Impedance Measurement Plot for Body TSL





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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Motorola MDb**

Certificate No: D2450V2-740_Mar11

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 740**

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

Calibration date: **March 17, 2011**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 08327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician
Approved by:	Name Katja Pokovic	Function Technical Manager

Signature

Issued: March 21, 2011

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz $\pm$ 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 $\pm$ 0.2) °C	38.7 $\pm$ 6 %	1.72 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.0 $\pm$ 0.2) °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 mW / g
SAR normalized	normalized to 1W	52.8 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	53.8 mW / g $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.16 mW / g
SAR normalized	normalized to 1W	24.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.8 mW / g $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	51.5 ± 6 %	1.92 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °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 mW / g
SAR normalized	normalized to 1W	51.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	51.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.88 mW / g
SAR normalized	normalized to 1W	23.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	23.5 mW / g ± 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.3 Ω + 2.6 j Ω
Return Loss	- 27.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9 Ω + 5.3 j Ω
Return Loss	- 25.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.164 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 18, 2003

DASY5 Validation Report for Head TSL

Date/Time: 17.03.2011 12:12:34

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:740

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.72$ mho/m; $\epsilon_r = 38.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Head/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

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

Reference Value = 100.2 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 26.990 W/kg

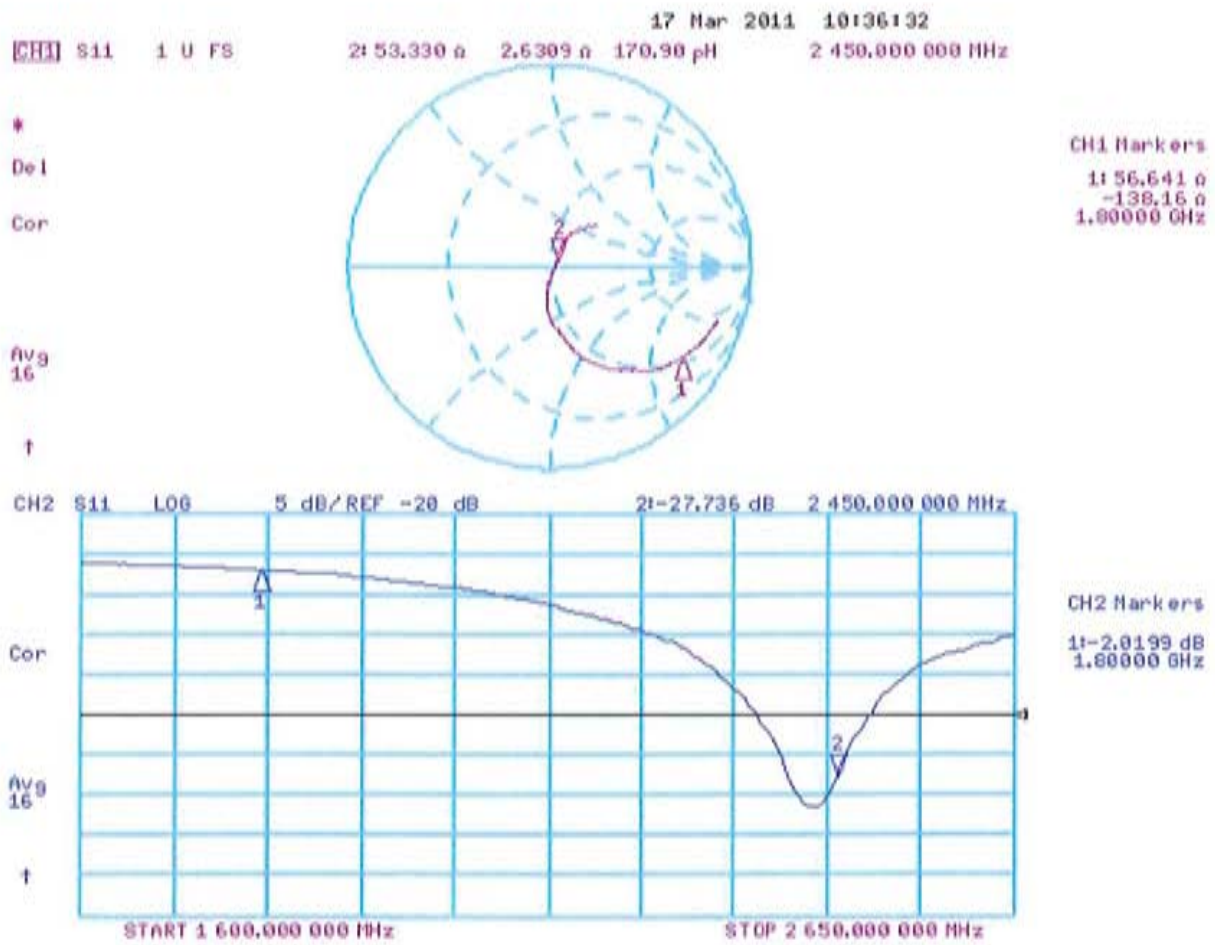
SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.16 mW/g

Maximum value of SAR (measured) = 17.012 mW/g



0 dB = 17.010mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date/Time: 17.03.2011 14:38:41

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:740

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.92$ mho/m; $\epsilon_r = 51.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

Body/d=10mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

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

Reference Value = 96.402 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 27.038 W/kg

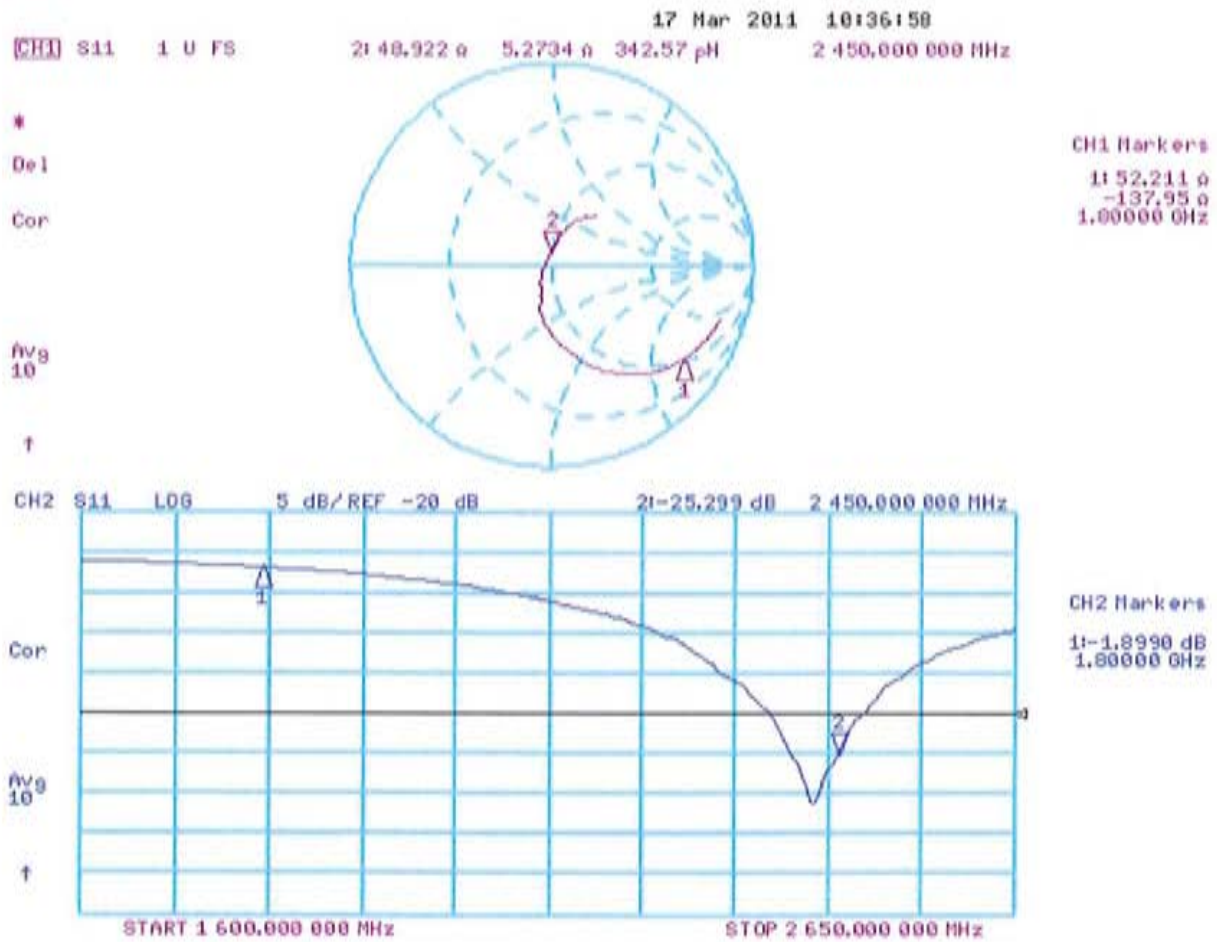
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.88 mW/g

Maximum value of SAR (measured) = 16.855 mW/g



0 dB = 16.850mW/g

Impedance Measurement Plot for Body TSL





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 **Motorola MDb**

Certificate No: **D5GHzV2-1088_May11**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1088**

Calibration procedure(s) **QA CAL-22.v1
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **May 20, 2011**

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	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01360)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe EX3DV4	SN: 3503	04-Mar-11 (No. EX3-3503_Mar11)	Mar-12
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

Calibrated by: **Claudio Leubler** Laboratory Technician

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: May 24, 2011

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



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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**

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.

Measurement Conditions

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Area Scan resolution	dx, dy = 10 mm	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	
Frequency	5200 MHz $\pm$ 1 MHz 5800 MHz $\pm$ 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 $\pm$ 0.2) °C	36.3 $\pm$ 6 %	4.54 mho/m $\pm$ 6 %
Head TSL temperature during test	(22.0 $\pm$ 0.2) °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	8.01 mW / g
SAR normalized	normalized to 1W	80.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	80.2 mW / g $\pm$ 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.29 mW / g
SAR normalized	normalized to 1W	22.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.9 mW / g $\pm$ 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	35.3 ± 6 %	5.14 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °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	7.91 mW / g
SAR normalized	normalized to 1W	79.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	79.0 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.23 mW / g
SAR normalized	normalized to 1W	22.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	22.3 mW / g ± 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	48.8 ± 6 %	5.40 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.56 mW / g
SAR normalized	normalized to 1W	75.6 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.5 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.12 mW / g
SAR normalized	normalized to 1W	21.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	21.2 mW / g ± 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	47.6 ± 6 %	6.21 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.55 mW / g
SAR normalized	normalized to 1W	75.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	75.4 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.09 mW / g
SAR normalized	normalized to 1W	20.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.9 mW / g ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	50.8 Ω - 9.6 j Ω
Return Loss	-20.4 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.9 Ω - 2.7 j Ω
Return Loss	-25.4 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.5 Ω - 8.2 j Ω
Return Loss	-21.7 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.3 Ω - 1.5 j Ω
Return Loss	-24.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.205 ns
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After long term use with 40 W 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.

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 21, 2009

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1088

Communication System: CW; Frequency: 5200 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: HSL 502 A

Medium parameters used: $f = 5200$ MHz; $\sigma = 4.54$ mho/m; $\epsilon_r = 36.3$; $\rho = 1000$ kg/m³,

Medium parameters used: $f = 5800$ MHz; $\sigma = 5.14$ mho/m; $\epsilon_r = 35.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41), ConvF(4.81, 4.81, 4.81); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

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 = 65.020 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 29.625 W/kg

SAR(1 g) = 8.01 mW/g; SAR(10 g) = 2.29 mW/g

Maximum value of SAR (measured) = 18.318 mW/g

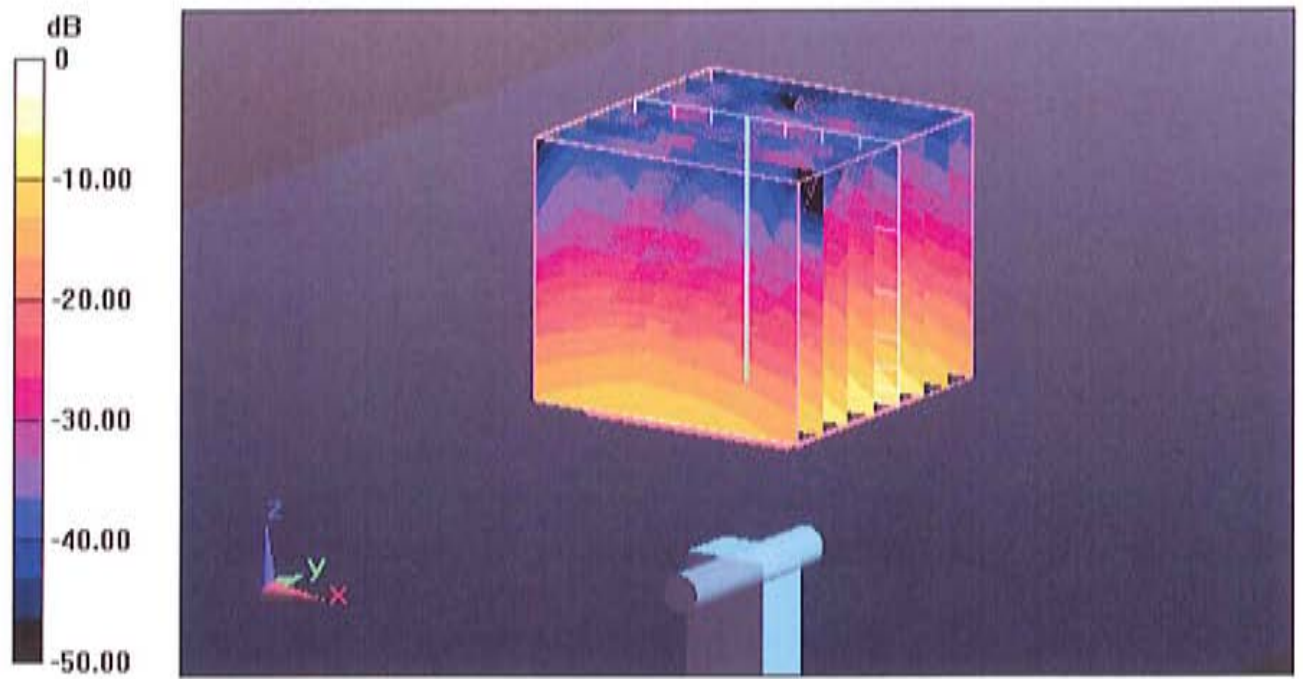
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 61.692 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 33.004 W/kg

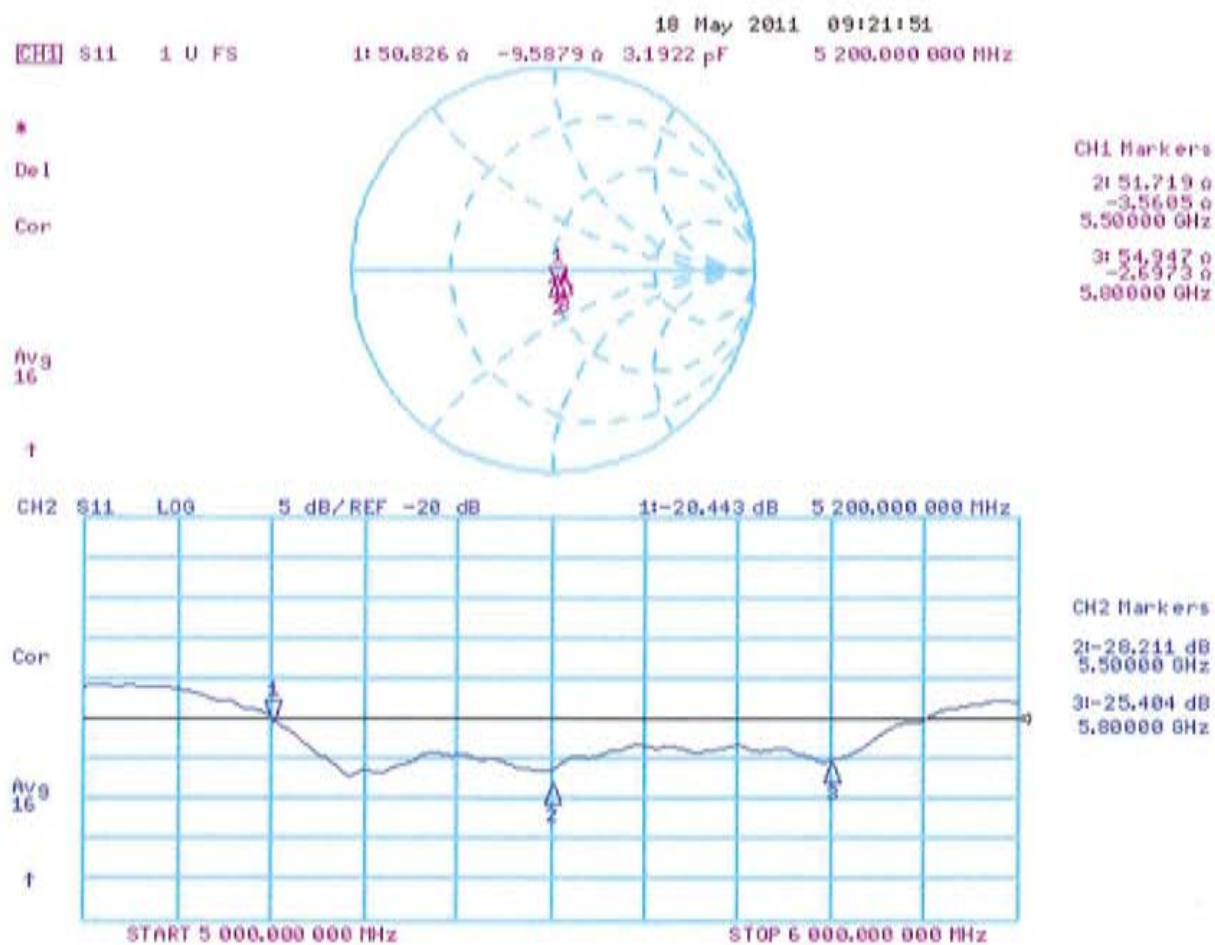
SAR(1 g) = 7.91 mW/g; SAR(10 g) = 2.23 mW/g

Maximum value of SAR (measured) = 18.971 mW/g



0 dB = 18.970mW/g

Impedance Measurement Plot for Head TSL



Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1088

Communication System: CW; Frequency: 5200 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: MSL 501

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.4$ mho/m; $\epsilon_r = 48.8$; $\rho = 1000$ kg/m³;

Medium parameters used: $f = 5800$ MHz; $\sigma = 6.21$ mho/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91), ConvF(4.38, 4.38, 4.38); Calibrated: 04.03.2011
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.2 Build (424)
- Postprocessing SW: SEMCAD X, V14.4.4 Build (2829)

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 = 58.718 V/m; Power Drift = 0.0076 dB

Peak SAR (extrapolated) = 29.266 W/kg

SAR(1 g) = 7.56 mW/g; SAR(10 g) = 2.12 mW/g

Maximum value of SAR (measured) = 17.287 mW/g

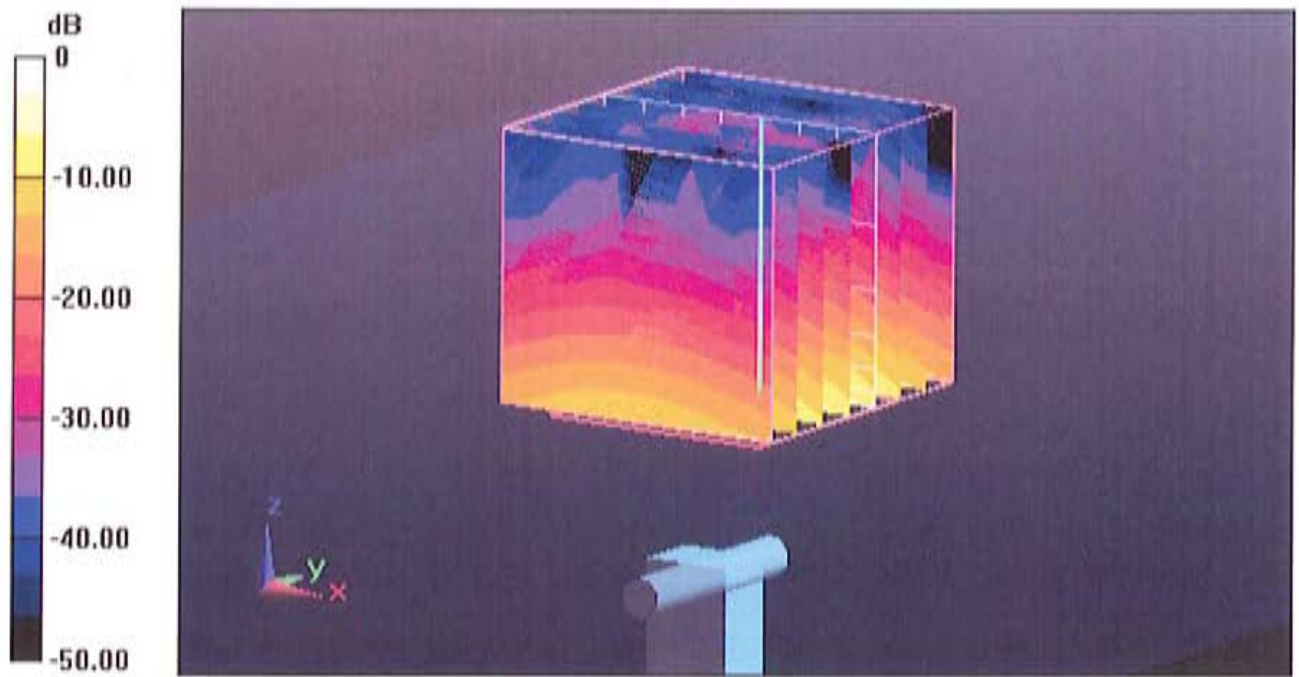
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 55.349 V/m; Power Drift = 0.0025 dB

Peak SAR (extrapolated) = 34.817 W/kg

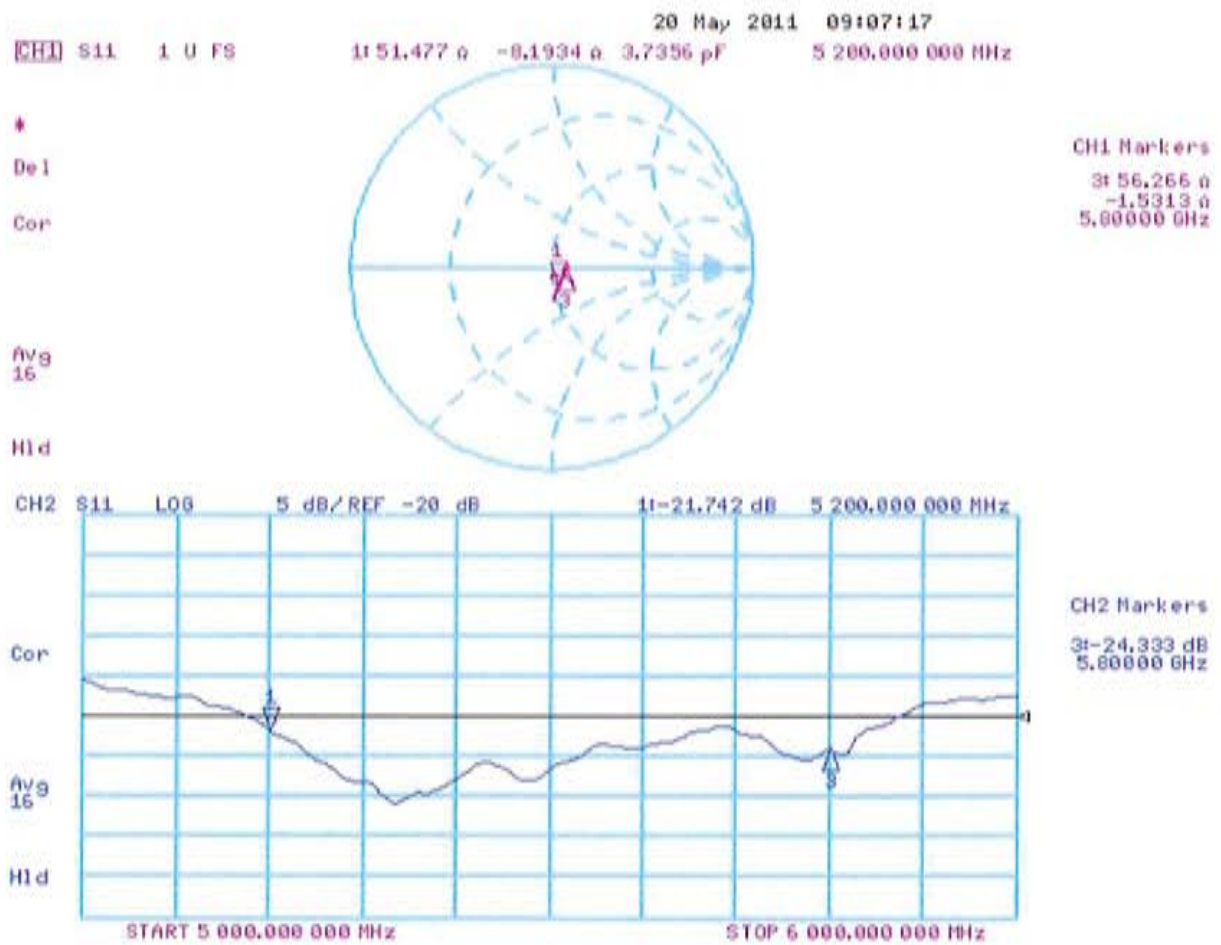
SAR(1 g) = 7.55 mW/g; SAR(10 g) = 2.09 mW/g

Maximum value of SAR (measured) = 18.476 mW/g



0 dB = 18.480mW/g

Impedance Measurement Plot for Body TSL



END OF REPORT