



# MOTOROLA

## Class II Permissive Change Portable Cellular Phone SAR Test Report

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

**Test Report #:** 23908-2F Class II Rev. A  
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**Test Laboratory:** Motorola Mobility, Inc. - Product Safety & Compliance Laboratory  
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This laboratory is accredited to ISO/IEC 17025-2005 to perform the following tests:

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

(none)

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## 1. Introduction

The Motorola Mobile Devices Business Product Safety Laboratory has performed measurements of the maximum potential exposure to the user of the portable cellular phone covered by this test report when used in the WiFi hotspot mode. The Specific Absorption Rate (SAR) of this product was measured. The portable cellular phone was tested in accordance with [1], [4] and [5]. The SAR values measured for the portable cellular phone are below the maximum recommended levels of 1.6 W/kg in a 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 phone are 0.50 W/kg for body-worn use. These measurements were performed using a Dasy4™ v4.7 system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich Switzerland.

## 2. Description of the Device Under Test

### 2.1 Antenna description

Antenna for 1800/1900 MHz Bands

<b>Type</b>	Internal	
<b>Location</b>	Top Rear of Transceiver	
<b>Dimensions</b>	Length	56 mm
	Width	13 mm

Antenna for 850/900 MHz Bands

<b>Type</b>	Internal	
<b>Location</b>	Bottom Rear of Transceiver	
<b>Dimensions</b>	Length	54 mm
	Width	12 mm

Antenna for Bluetooth/Wi-Fi

<b>Type</b>	Internal	
<b>Location</b>	Right-Side Rear of Transceiver	
<b>Dimensions</b>	Length	15 mm
	Width	2 mm

## 2.2 Device description<sup>1</sup>

Serial Number(s)	351574040016601							
Mode(s) of Operation	GSM 850	GSM 900	GSM 1800	GSM 1900	WCDMA 850	WCDMA 1900	Wi-Fi 802.11b/g/n	Bluetooth
Modulation Mode(s)	GMSK	GMSK	GMSK	GMSK	QPSK	QPSK	BPSK	GFSK
Maximum Output Power Setting	33.0 dBm	33.0 dBm	30.5 dBm	30.5 dBm	24.0 dBm	23.5 dBm	20 dBm	10 dBm
Duty Cycle	1:8	1:8	1:8	1:8	1:1	1:1	1:1	1:1
Transmitting Frequency Range(s)	824.2 - 848.8 MHz	880.2 - 914.8 MHz	1710.2 - 1784.8 MHz	1850.2 - 1909.8 MHz	826.4 - 846.6 MHz	1852.4 - 1907.6 MHz	2412.0 - 2462.5 MHz	2402.0 - 2483.5 MHz
Production Unit or Identical Prototype (47 CFR §2.908)	Identical Prototype							
Device Category	Portable							
RF Exposure Limits	General Population / Uncontrolled							

Mode(s) of Operation	GPRS 850				GPRS 900				GPRS 1800				GPRS 1900			
Modulation	GMSK				GMSK				GMSK				GMSK			
Maximum Output Power Setting	33.0	<b>31.0</b>	29.0	27.0	33.0	<b>31.0</b>	29.0	27.0	30.5	<b>28.5</b>	26.5	24.5	30.5	<b>28.5</b>	26.5	24.5
Duty Cycle	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8
Transmitting Frequency Range(s)	824.2 - 848.8 MHz				880.2 - 914.8 MHz				1710.2 - 1784.8 MHz				1850.2 - 1909.8 MHz			

Mode(s) of Operation	EDGE 850				EDGE 900				EDGE 1800				EDGE 1900			
Modulation	8PSK				8PSK				8PSK				8PSK			
Maximum Output Power Setting	28.5	<b>26.5</b>	24.5	22.5	28.5	<b>26.5</b>	24.5	22.5	27.5	<b>25.5</b>	23.5	21.5	27.5	<b>25.5</b>	23.5	21.5
Duty Cycle	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8	1:8	<b>2:8</b>	3:8	4:8
Transmitting Frequency Range(s)	824.2 - 848.8 MHz				880.2 - 914.8 MHz				1710.2 - 1784.8 MHz				1850.2 - 1909.8 MHz			

<sup>1</sup> **Bolded** entries in the tables 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 WCDMA modes

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

Band	Channel	Conducted power (dBm) for WCDMA modes		Conducted Power (dBm) for WCDMA – HSDPA (Rel 5) Modes				Conducted Power (dBm) for WCDMA – HSPA (HSUPA/HSDPA-Rel 6) Modes				
		RMC	AMR	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 1	Subtest 2	Subtest 3	Subtest 4	Subtest 5
WCDMA 850	4132	24.08	24.08	24.13	24.12	24.10	24.16	24.08	24.12	24.07	24.12	24.12
	4180	24.18	24.07	24.06	24.19	24.19	24.19	24.02	24.21	24.20	24.17	24.18
	4233	24.02	23.95	23.96	23.88	23.97	23.90	24.02	23.90	23.93	23.88	23.97
WCDMA 1900	9262	23.99	23.99	24.15	24.12	24.24	24.21	24.10	24.13	24.21	24.18	24.24
	9400	23.98	23.96	24.05	24.05	24.14	24.09	24.01	24.00	24.08	24.07	24.10
	9538	23.90	23.89	23.86	23.89	23.91	23.86	23.93	23.96	23.98	24.00	24.00

#### Maximum Power Reduction (MPR)

According to 3GPP 25.101 sub-clause 6.2.2, the maximum output power is allowed to be reduced by following the table.

**Table 6.1A: UE maximum output power with HS-DPCCH and E-DCH**

UE transmit channel configuration	CM (dB)	MPR (dB)
For all combinations of; DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH	$0 \leq CM \leq 3.5$	MAX (CM-1, 0)
Note 1: CM = 1 for $\beta_c/\beta_d = 12/15$ , $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.		

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

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

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

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

### 2.3.2 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 table below. SAR testing for 802.11 modes was performed with the transmitter mode and data rate set to the configurations highlighted in bold below.

Band	Channel	Conducted Power (dBm) for 802.11b Mode Data Rates			
		1 Mbps	2 Mbps	5.5 Mbps	11 Mbps
Wi-Fi 2450 MHz	1	<b>17.46</b>	17.40	17.23	17.17
	6	<b>18.07</b>	18.06	17.95	17.85
	11	<b>18.49</b>	18.56	18.32	18.59

Band	Chnl	Conducted Power (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	14.62	14.32	14.27	14.07	14.00	13.95	12.43	12.47
	6	17.47	17.28	16.87	16.49	14.52	14.68	13.08	13.25
	11	17.98	17.83	17.56	17.16	15.30	15.25	13.82	13.84

Band	Chnl	Conducted Power (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	14.21	14.24	13.77	13.91	13.81	12.30	12.34	11.47
	6	17.10	16.64	16.29	14.58	14.57	13.11	12.97	12.05
	11	17.97	17.32	17.00	15.30	15.21	13.76	13.67	12.89

Band	Chnl	Conducted Power (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	14.14	14.24	13.64	13.84	13.68	12.20	12.25	11.35
	6	17.06	16.60	16.17	14.55	14.40	12.89	12.94	12.04
	11	17.72	17.26	16.80	15.13	15.03	13.51	13.52	12.59

### 3. Test Equipment Used

#### 3.1 Dosimetric System

The Motorola Mobile Devices Business Product Safety & Compliance Laboratory utilizes a Dosimetric Assessment System (Dasy4™ v4.7) manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. All the SAR measurements are taken within a shielded enclosure. The overall 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	440	Feb-17-2010	Feb-17-2011
E-Field Probe ES3DV3	3184	Sep-18-2009	Sep-18-2010
DASY4™ DAE V1	703	Sep-17-2009	Sep-17-2010
E-Field Probe ES3DV3	3037	Sep-18-2009	Sep-18-2010
Dipole Validation Kit, DV835V2	436TR	Mar-17-2010	Mar-17-2011
Dipole Validation Kit, DV1800V2	272TR	Mar-17-2010	Mar-17-2011
Dipole Validation Kit, DV2450V2	766	Mar-17-2010	Mar-17-2011

#### 3.2 Additional Equipment

Description	Serial Number	Cal Date	Cal Due Date
Signal Generator HP8648C	3847A04822	Apr-22-2009	Apr-22-2011
Power Meter E4419B	GB39511082	Apr-24-2009	Apr-24-2011
Power Sensor #1 - E9301A	US39210915	Dec-04-2009	Dec-04-2010
Power Sensor #2 - E9301A	US39210916	Nov-16-2009	Nov-16-2010
Signal Generator HP8648C	3847A04843	Apr-22-2009	Apr-22-2011
Power Meter E4419B	US39250622	Dec-22-2009	Dec-22-2011
Power Sensor #1 - E9301A	US39210929	Nov-19-2009	Nov-19-2010
Power Sensor #2 - E9301A	US39210930	Nov-19-2009	Nov-19-2010
Signal Generator HP8648C	3847A04810	Oct-30-2009	Oct-30-2011
Power Meter E4419B	GB39511087	Dec-22-2009	Dec-22-2011
Power Sensor #1 - E9301A	US39211007	Dec-04-2009	Dec-04-2010
Power Sensor #2 - E9301A	US39211008	Dec-04-2009	Dec-04-2010
Network Analyzer HP8753ES	US39172529	Jun-04-2010	Jun-04-2011
Dielectric Probe Kit HP85070C	US99360070		

#### 4. Electrical parameters of the tissue simulating liquid

Prior to conducting SAR measurements, the relative permittivity,  $\epsilon_r$ , and the conductivity,  $\sigma$ , 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].

E-field probes calibrated at 1810 MHz were used for "1900 MHz" band (1850 MHz - 1910 MHz) SAR measurements. FCC KDB 450824 provides additional requirements on page 3 of 6 for SAR testing that is performed with probe calibration points that are more than 50 MHz removed from the measured bands. The KDB requires; "(2) When nominal tissue dielectric parameters are specified in the probe calibration data, the tissue dielectric parameters measured for routine measurements should be less than the target  $\epsilon_r$  and higher than the target Sigma values to minimize SAR underestimations". The 1900 MHz simulated tissues listed below meet this criteria.

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			$\epsilon_r$	$\sigma$ (S/m)	Temp (°C)
835	Body	Measured, Aug-02-2010	55.7	1.00	20.4
		Recommended Limits	55.2 $\pm$ 5%	0.97 $\pm$ 5%	18-25
1880	Body	Measured, Aug-02-2010	51.0	1.58	20.0
		Recommended Limits	53.3 $\pm$ 5%	1.52 $\pm$ 5%	18-25
2450	Body	Measured, Aug-10-2010	49.7	2.01	19.7
		Recommended Limits	52.7 $\pm$ 10%	1.95 $\pm$ 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	--

## 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). The tissue stimulant depth was verified to be 15.0 cm  $\pm$  0.5 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)
			$\epsilon_r$	$\sigma$ (S/m)		
835	Measured, Aug-02-2010	9.25	40.5	0.90	20.0	20.4
	Recommended Limits	9.59	41.5 $\pm 5\%$	0.90 $\pm 5\%$	18-25	18-25
1800	Measured, Aug-02-2010	36.75	39.1	1.37	20.1	20.2
	Recommended Limits	38.36	40.0 $\pm 5\%$	1.40 $\pm 5\%$	18-25	18-25
2450	Measured, Aug-10-2010	54.50	36.7	1.84	20.1	19.9
	Recommended Limits	54.55	39.2 $\pm 10\%$	1.80 $\pm 5\%$	18-25	18-25

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3184	835	6.26	8 of 9
		1800	5.14	8 of 9
	3037	2450	4.41	8 of 9

## 6. Test Results

The test sample was operated using an actual transmission through a base station simulator. The base station simulator was set up to the proper channel, transmitter power level and transmit mode of operation. The phone was tested in the configurations stipulated in [1], [4] and [5]. The phone was positioned into these configurations using the device holder supplied with the DASY4™ SAR measurement system. The default settings for the “coarse” and “cube” scans were chosen and used for measurements. The grid spacing of the course scan was set to 15 mm or less as shown in the SAR plots included in Appendix 2 and 3. Please refer to the DASY4™ manual for additional information on SAR scanning procedures and algorithms used.

The Cellular Phone model covered by this report has the following battery options:  
Model SNN5877A - 1500 mAH Battery

The battery with the highest capacity is the SNN5877A. This battery was used to do all of the SAR testing. The phone was placed in the SAR measurement system with a fully charged battery. The configurations that resulted in the highest SAR values were tested using the other batteries listed above.

The location of peak SAR for a handset is a function of the type of antenna implemented, the frequencies of transmission, the configuration of phone placement against the measurement phantom, the shape of the measurement phantom, any unintended secondary radiating elements on the DUT, etc.. Therefore the location of peak SAR may not coincide with the location of the transmitting antenna.

### 6.1 Body Worn - Mobile Hotspot Test Results

The DUT is capable of functioning as a Wi-Fi to Cellular mobile hotspot. Additional SAR testing was performed according to the interim test guidelines provided at the October 2010 TCB Workshop. Testing was performed with a separation of 25 mm between the DUT and the “flat” phantom. The DUT was positioned for SAR tests with the front and back surfaces facing the phantom, and also with the edges facing the phantom in which the transmitting antenna is < 2.5 cm from the edge. Each transmit band was utilized for SAR testing, but only the “mode” within each band that exhibited the highest SAR results from section 6.2 was used.

The SAR results shown in tables 1 through 4 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to [6]. Also shown are the temperature of the simulated tissue after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is  $\text{Extrapolated SAR} = \text{Measured SAR} * 10^{-(\text{drift}/10)}$ . 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 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 4. All other test conditions measured lower SAR values than those included in Appendix 4.

A “flat” phantom was for the body-worn tests. This “flat” phantom is made out of 1” thick natural High Density Polyethylene with a thickness at the bottom equal to 2.0 mm. It measures 52.7 cm(long) x 26.7 cm(wide) x 21.2 cm(tall).

The simulated tissue depth was verified to be 15.0 cm ± 0.5 cm for frequencies below 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 phone.

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3184	835	6.08	8 of 9
		1800	4.84	8 of 9
	3037	2450	4.29	8 of 9

Body-Worn; Front of Phone 25 mm from Phantom								
f (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10 g SAR value		1 g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	32.88						
	Channel 190	32.83	20.6	-0.049	0.116	0.12	0.156	0.16
	Channel 251	32.92						
GSM 1900	Channel 512	30.57						
	Channel 661	30.46	20.0	0.036	0.023	0.02	0.037	0.04
	Channel 810	30.41						
WCDMA 850	Channel 4132	24.08						
	Channel 4180	24.18	20.4	0.161	0.129	0.13	0.175	0.18
	Channel 4233	24.02						
WCDMA 1900	Channel 9262	23.43						
	Channel 9400	23.45	20.0	-0.072	0.038	0.04	0.060	0.06
	Channel 9538	23.38						
WI-FI 2450 802.11b 1 Mbps	Channel 1	17.46						
	Channel 6	18.07	19.7	-0.567	0.006	0.01	0.011	0.01
	Channel 11	18.49						

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

Evaluation for Simultaneous SAR Body-Worn, Front of Phone 25 mm from Phantom Summation of Highest SAR Values							
Cellular Mode	Wi-Fi Mode	Cellular Mode 10 g SAR Value (W/kg)	Wi-Fi Mode 10 g SAR Value (W/kg)	Combined 10 g SAR Value (W/kg)	Cellular Mode 1 g SAR Value (W/kg)	Wi-Fi Mode 1 g SAR Value (W/kg)	Combined 1 g SAR Value (W/kg)
GSM 850	Wi-Fi 2450 802.11b, 1 Mbps	0.12	0.01	0.13	0.16	0.01	0.17
GSM 1900		0.02	0.01	0.03	0.04	0.01	0.05
WCDMA 850		0.13	0.01	0.14	0.18	0.01	0.19
WCDMA 1900		0.04	0.01	0.05	0.06	0.01	0.07

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

Body-Worn; Back of Phone 25 mm from Phantom								
f (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10 g SAR value		1 g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	32.88						
	Channel 190	32.83	20.6	0.018	0.166	0.17	0.225	0.23
	Channel 251	32.92						
GSM 1900	Channel 512	30.57						
	Channel 661	30.46	20.0	-0.014	0.154	0.15	0.256	0.26
	Channel 810	30.41						
WCDMA 850	Channel 4132	24.08						
	Channel 4180	24.18	20.4	0.050	0.200	0.20	0.271	0.27
	Channel 4233	24.02						
WCDMA 1900	Channel 9262	23.43						
	Channel 9400	23.45	20.0	-0.027	0.297	0.30	0.496	0.50
	Channel 9538	23.38						
WI-FI 2450 802.11b 1 Mbps	Channel 1	17.46	19.7	-0.024	0.019	0.02	0.030	0.03
	Channel 6	18.07	19.7	0.035	0.015	0.01	0.023	0.02
	Channel 11	18.49	19.7	-0.100	0.012	0.01	0.019	0.02

Table 3: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

Evaluation for Simultaneous SAR Body-Worn, Back of Phone 25 mm from Phantom Summation of Highest SAR Values							
Cellular Mode	Wi-Fi Mode	Cellular Mode 10 g SAR Value (W/kg)	Wi-Fi Mode 10 g SAR Value (W/kg)	Combined 10 g SAR Value (W/kg)	Cellular Mode 1 g SAR Value (W/kg)	Wi-Fi Mode 1 g SAR Value (W/kg)	Combined 1 g SAR Value (W/kg)
GSM 850	Wi-Fi 2450 802.11b, 1 Mbps	0.17	0.02	0.19	0.23	0.03	0.30
GSM 1900		0.18	0.02	0.20	0.26	0.03	0.29
WCDMA 850		0.20	0.02	0.22	0.27	0.03	0.30
WCDMA 1900		0.30	0.02	0.32	0.50	0.03	0.53

Table 4: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

GPRS Class 10 (2 Uplink Timeslots) Body-Worn; Back of Phone 25 mm from Phantom								
$f$ (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10 g SAR value		1 g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	30.81						
	Channel 190	30.81	19.5	0.003	0.149	0.15	0.201	0.20
	Channel 251	30.86						
GSM 1900	Channel 512	28.48						
	Channel 661	28.40	19.1	-0.023	0.140	0.14	0.231	0.23
	Channel 810	28.37						

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

EDGE Class 10 (2 Uplink Timeslots) Body-Worn; Back of Phone 25 mm from Phantom								
$f$ (MHz)	Description	Conducted Output Power (dBm)	Temp (°C)	Drift (dB)	10 g SAR value		1 g SAR value	
					Measured (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Extrapolated (W/kg)
GSM 850	Channel 128	26.62						
	Channel 190	26.58	19.5	-0.077	0.057	0.06	0.076	0.08
	Channel 251	26.34						
GSM 1900	Channel 512	25.56						
	Channel 661	25.46	19.1	-0.049	0.076	0.08	0.126	0.13
	Channel 810	25.31						

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

## **References**

- [1] CENELEC, en62209-1:2006 “Human Exposure to Radio Frequency Fields From Hand - Held and Body - Mounted Wireless Communication Devices – Human Models, Instrumentation, and Procedures”
- [2] CENELEC, en50360:2001 “Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)”.
- [3] ANSI / IEEE, C95.1 1999 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 - Aug-02-2010 835 MHz

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 436TR; FCC ID: IHDP56LD1**

Procedure Notes: 835MHz System Performance Check; Dipole Sn# 436TR; Input Power = 200 mW

Sim.Temp@meas = 20.4°C; Sim.Temp@SPC = 20.4°C; Room Temp @ SPC = 20.0°C

Communication System: CW - Dipole; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: VALIDATION Only

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.9 \text{ mho/m}$ ;  $\epsilon_r = 40.5$ ;  $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(6.26, 6.26, 6.26); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R#4 Sugar SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1131;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

### Daily SPC Check/Dipole Area Scan (4x9x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$ ; Maximum value of SAR (measured) = 1.77 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 = 48.1 V/m; Power Drift = -0.011 dB; Peak SAR (extrapolated) = 2.62 W/kg

**SAR(1 g) = 1.85 mW/g; SAR(10 g) = 1.22 mW/g;** Maximum value of SAR (measured) = 2.00 mW/g

### Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0:

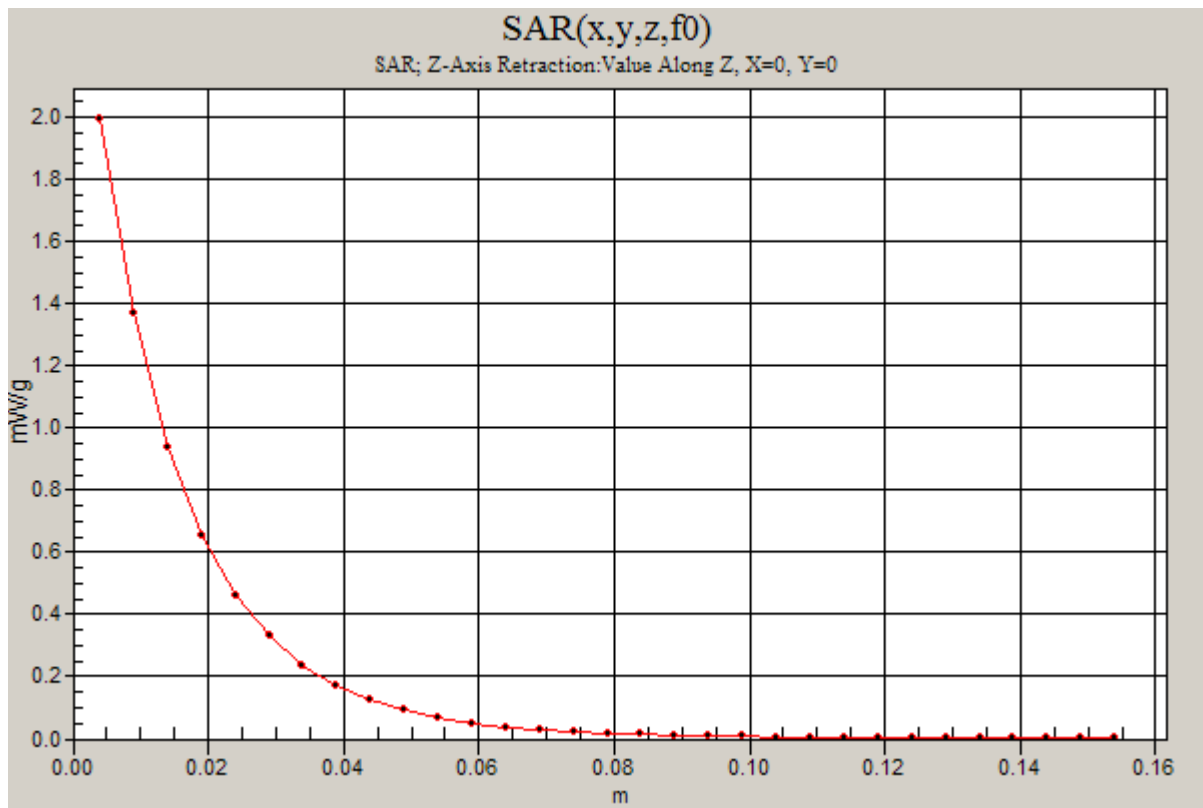
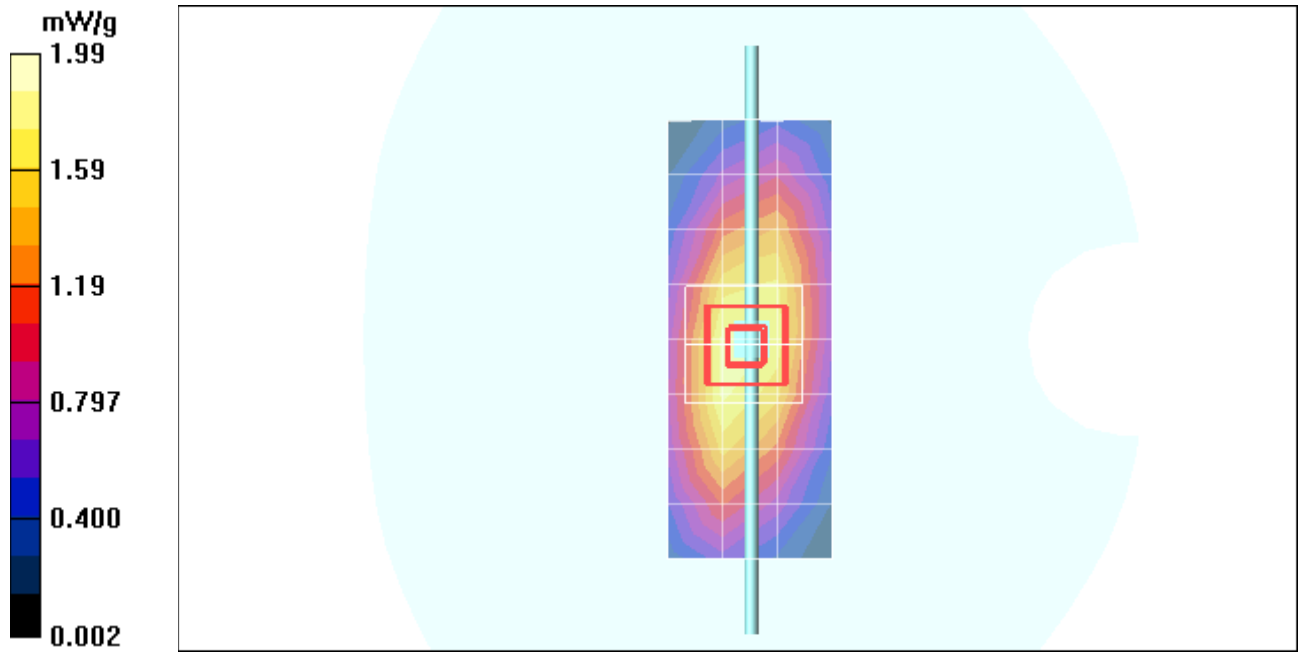
Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 48.1 V/m; Power Drift = -0.011 dB; Peak SAR (extrapolated) = 2.68 W/kg

**SAR(1 g) = 1.88 mW/g; SAR(10 g) = 1.24 mW/g;** Maximum value of SAR (measured) = 2.04 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) = 1.99 mW/g



## Test Laboratory: Motorola - Aug-02-2010 1800 MHz

**DUT: Dipole 1800 MHz; Type: D1800V2; Serial: D1800V2 - SN: 272TR; FCC ID: IHDP56LD1**

Procedure Notes: 1800MHz System Performance Check; Dipole Sn# 272TR; Input Power = 200 mW

Sim.Temp@meas = 20.1°C; Sim.Temp@SPC = 20.2°C; Room Temp @ SPC = 20.1°C

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

Medium: VALIDATION Only

Medium parameters used:  $f = 1800$  MHz;  $\sigma = 1.37$  mho/m;  $\epsilon_r = 39.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(5.14, 5.14, 5.14); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R4 : Sect.1, Amy Twin, Rev.3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

### Daily SPC Check/Dipole Area Scan (9x4x1):

Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 6.12 mW/g

### Daily SPC Check/0-Degree 5x5x7 Cube (5x5x7)/Cube 0:

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

Reference Value = 79.9 V/m; Power Drift = -0.022 dB; Peak SAR (extrapolated) = 12.5 W/kg

**SAR(1 g) = 7.35 mW/g; SAR(10 g) = 3.96 mW/g; Maximum value of SAR (measured) = 8.25 mW/g**

### Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0:

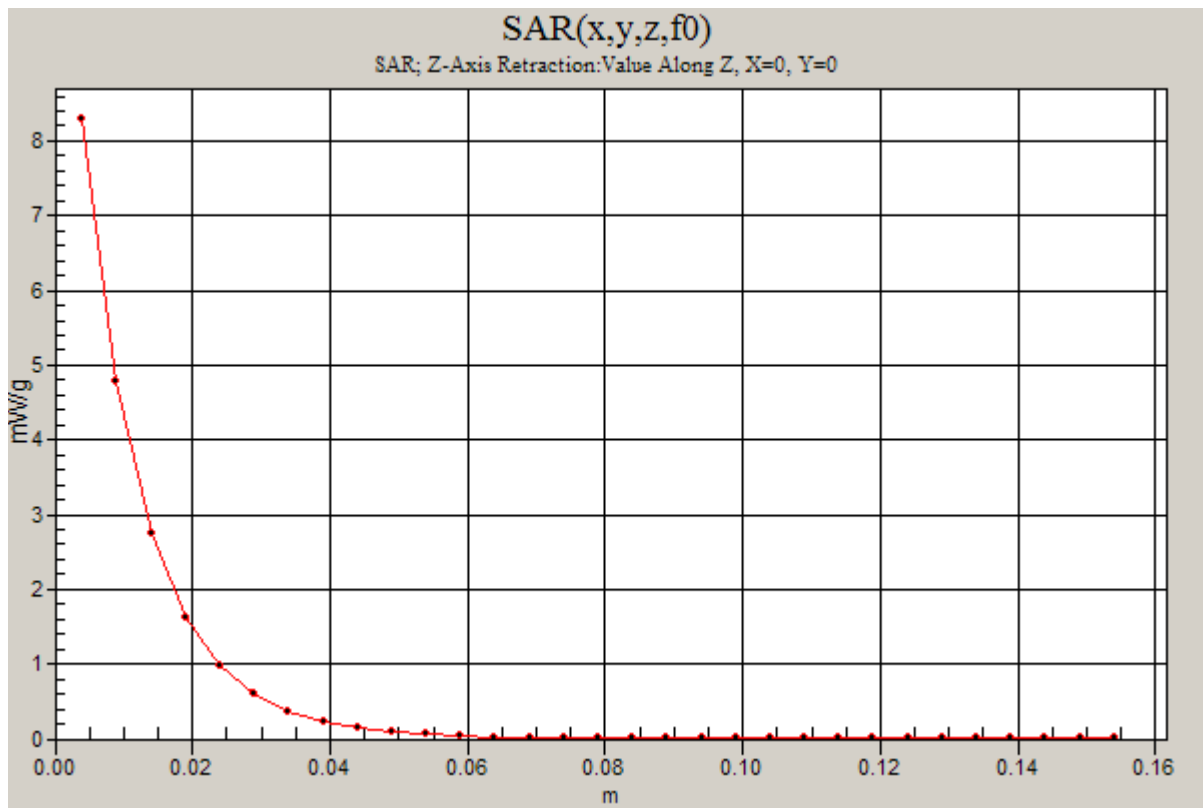
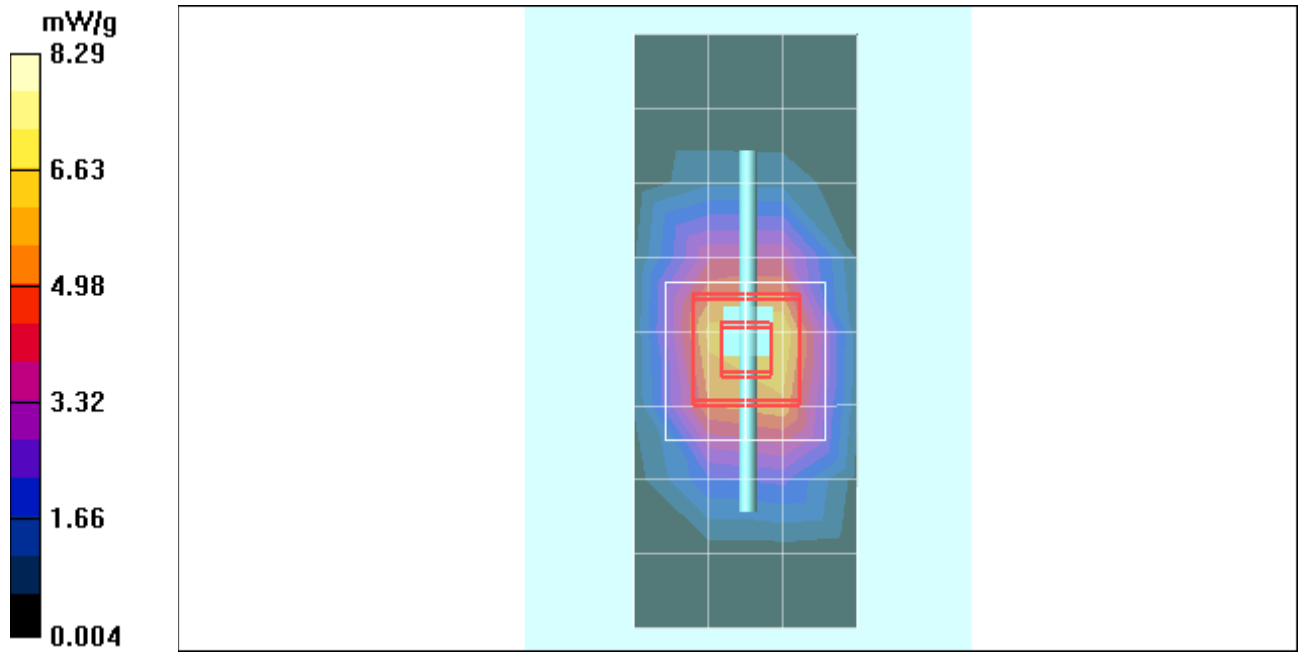
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 79.9 V/m; Power Drift = -0.022 dB; Peak SAR (extrapolated) = 12.9 W/kg

**SAR(1 g) = 7.55 mW/g; SAR(10 g) = 4.05 mW/g; Maximum value of SAR (measured) = 8.44 mW/g**

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

Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 8.29 mW/g



## Test Laboratory: Motorola - Aug-10-2010 2450 MHz

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 766; FCC ID: IHDP56LD1**

Procedure Notes: 2450 MHz System Performance Check; Dipole Sn# 766; Input Power = 200 mW

Sim.Temp@meas = 19.9°C; Sim.Temp@SPC = 19.9°C; Room Temp @ SPC = 20.1°C

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

Medium: VALIDATION Only

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 36.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3037; ConvF(4.41, 4.41, 4.41); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn703; Calibrated: 9/17/2009
- Phantom: R1\_Glycol, SAM (extended range), Rev.1 (25-Mar-05); Type: SAM v4.0; Serial: TP-1139;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

### Daily SPC Check/Dipole Area Scan (4x9x1):

Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 9.91 mW/g

### Daily SPC Check/0-Degree, 5x5x7 Cube (5x5x7)/Cube 0:

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

Reference Value = 82.2 V/m; Power Drift = -0.061 dB; Peak SAR (extrapolated) = 21.3 W/kg

**SAR(1 g) = 10.9 mW/g; SAR(10 g) = 5.19 mW/g; Maximum value of SAR (measured) = 12.3 mW/g**

### Daily SPC Check/90-Degree 5x5x7 Cube (5x5x7)/Cube 0:

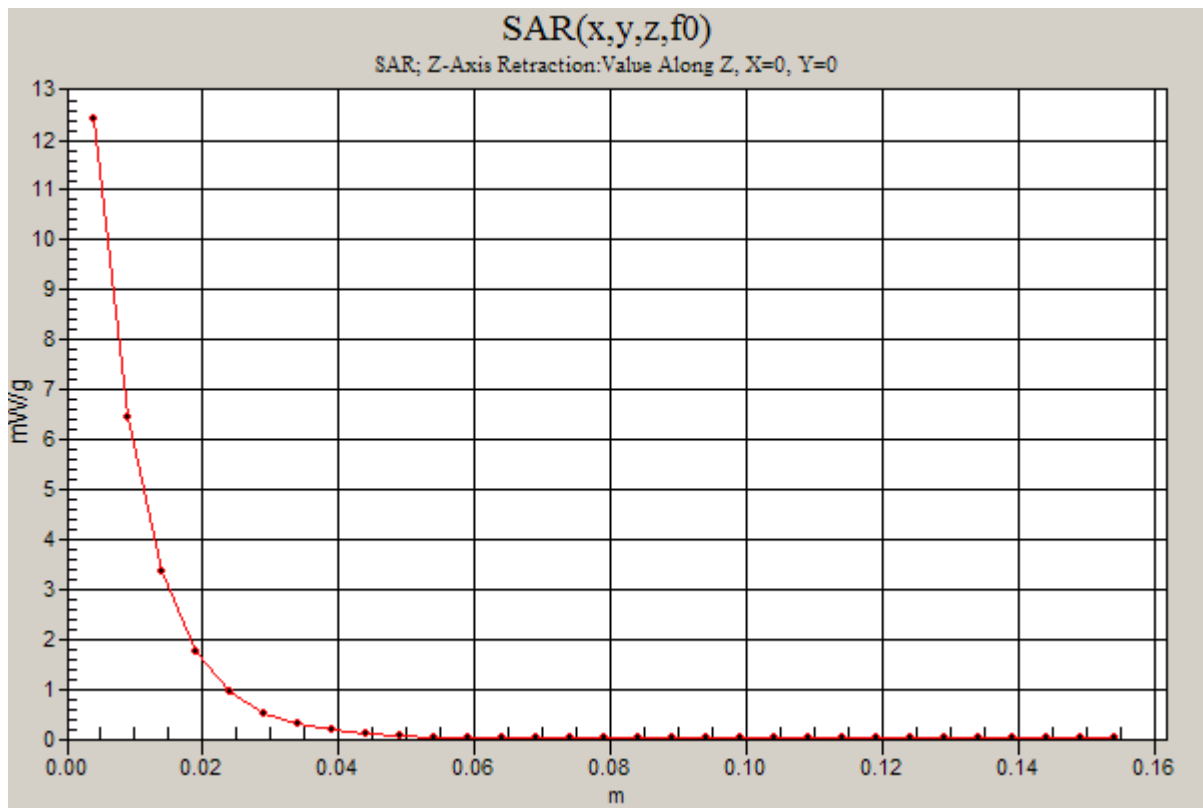
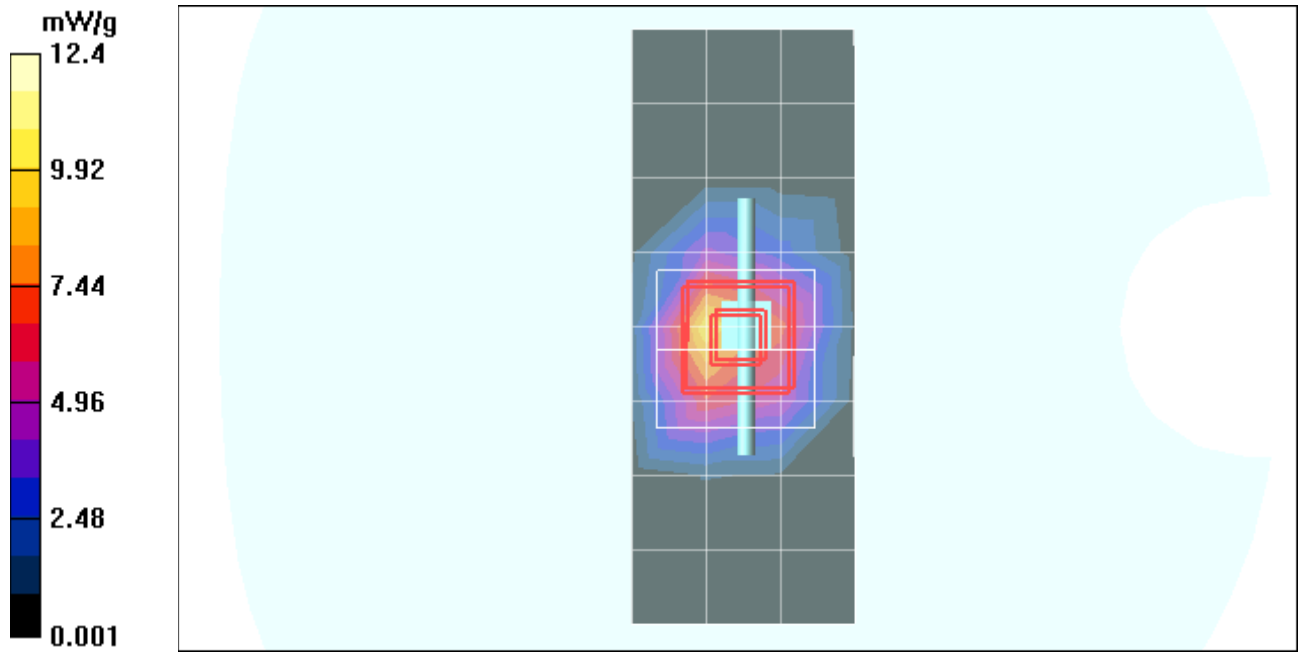
Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 82.2 V/m; Power Drift = -0.061 dB; Peak SAR (extrapolated) = 21.9 W/kg

**SAR(1 g) = 10.8 mW/g; SAR(10 g) = 5.05 mW/g; Maximum value of SAR (measured) = 12.0 mW/g**

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

Measurement grid: dx=20mm, dy=20mm, dz=5mm; Maximum value of SAR (measured) = 12.4 mW/g



## **Appendix 2**

### **SAR distribution plots for Body Worn Configuration (WiFi Hot Spot Mode)**

## Test Laboratory: Motorola - GSM 850 Body-Worn

Serial: 351574040016601; FCC ID: IHDP56LD1

Procedure Notes: Pwr Step: 5; Antenna Position: Internal; Battery Model #: SNN5877A

Device Position: Body Worn, Back of Phone 25 mm from Phantom

Communication System: GSM 850; Frequency: 836.6 MHz; Channel Number: 190; Duty Cycle: 1:8.3

Medium: Low Freq Body

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1$  mho/m;  $\epsilon_r = 55.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(6.08, 6.08, 6.08); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R4 : Sect.2, Amy Twin, Rev.3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

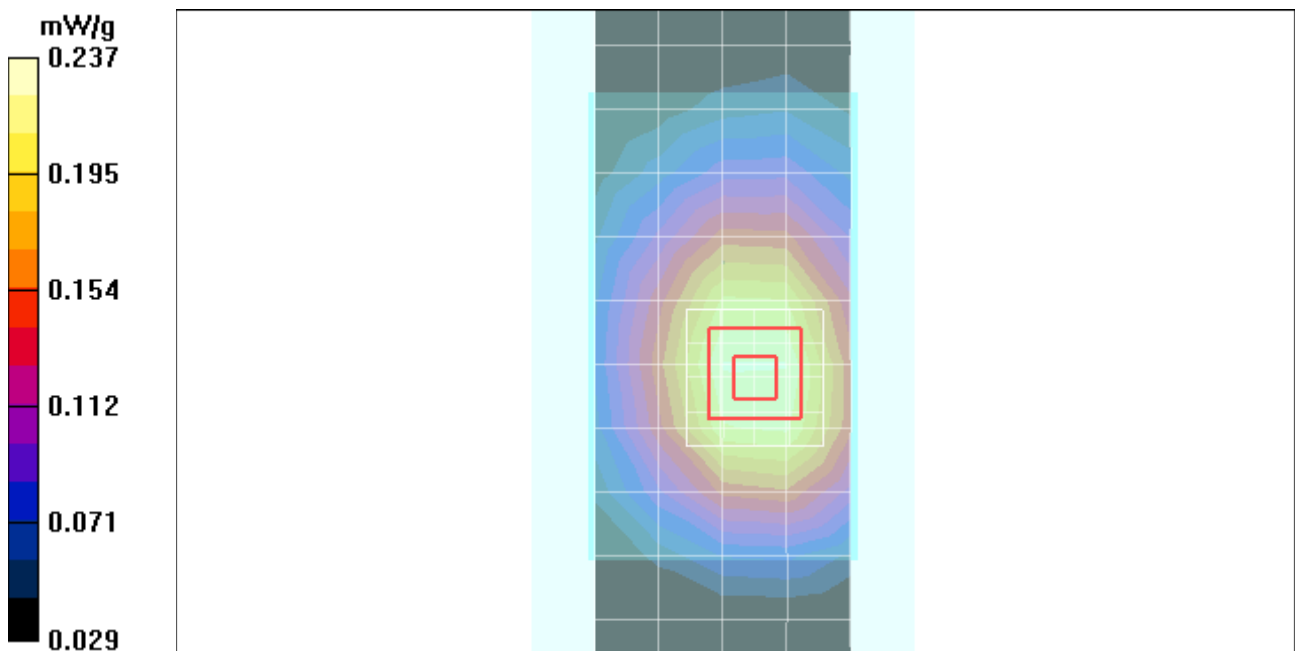
Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 0.225 mW/g

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

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

Reference Value = 15.1 V/m; Power Drift = 0.018 dB; Peak SAR (extrapolated) = 0.284 W/kg

**SAR(1 g) = 0.225 mW/g; SAR(10 g) = 0.166 mW/g; Maximum value of SAR (measured) = 0.237 mW/g**



## Test Laboratory: Motorola - WCDMA 850 Body-Worn

Serial: 351574040016601; FCC ID: IHDP56LD1

Procedure Notes: Pwr Step: All up Bits; Antenna Position: Internal; Battery Model #: SNN5877A

Device Position: Body Worn, Back of Phone 25 mm from Phantom

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

Medium: Low Freq Body

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1 \text{ mho/m}$ ;  $\epsilon_r = 55.7$ ;  $\rho = 1000 \text{ kg/m}^3$

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(6.08, 6.08, 6.08); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R4 : Sect.2, Amy Twin, Rev.3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

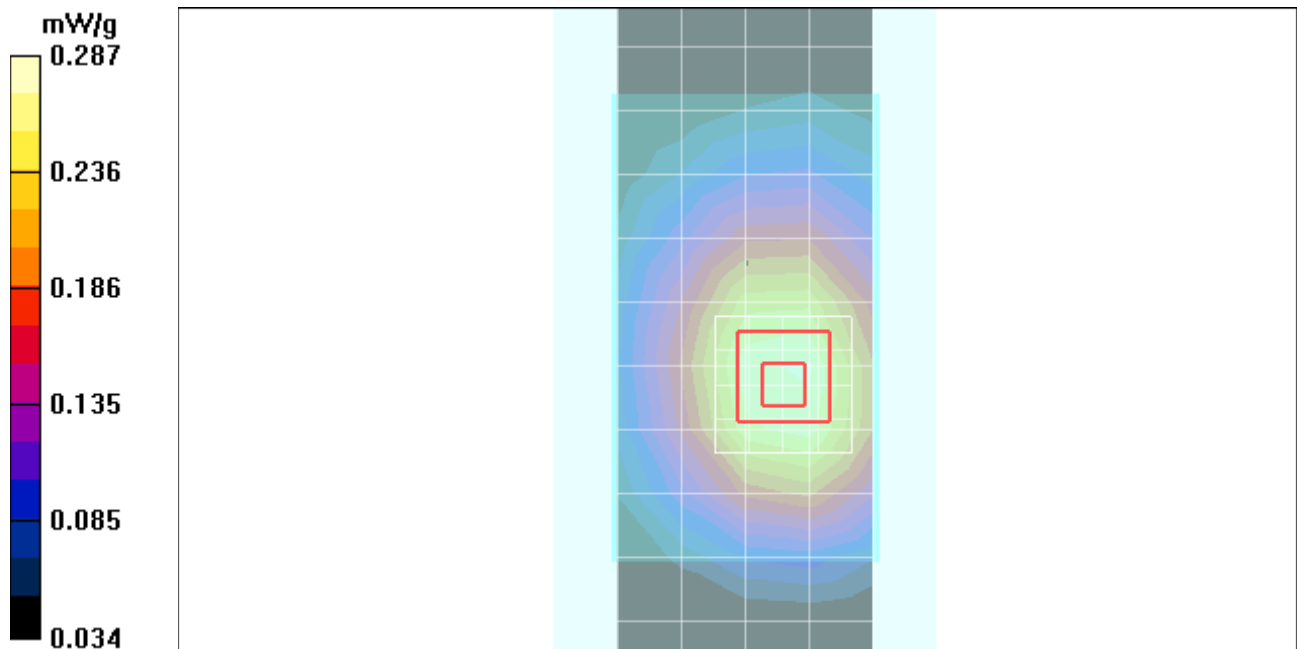
Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$ ; Maximum value of SAR (measured) = 0.274 mW/g

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

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

Reference Value = 16.4 V/m; Power Drift = 0.050 dB; Peak SAR (extrapolated) = 0.344 W/kg

**SAR(1 g) = 0.271 mW/g; SAR(10 g) = 0.200 mW/g; Maximum value of SAR (measured) = 0.287 mW/g**



## Test Laboratory: Motorola - GSM 1900 Body-Worn

Serial: 351574040016601; FCC ID: IHDP56LD1

Procedure Notes: Pwr Step: 0; Antenna Position: Internal; Battery Model #: SNN5877A

Device Position: Body Worn, Back of Phone 25 mm from Phantom

Communication System: GSM 1900; Frequency: 1880 MHz; Channel Number: 661; Duty Cycle: 1:8.3

Medium: Regular Glycol Body 1750/1880

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 51$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.84, 4.84, 4.84); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R4 : Sect.1, Amy Twin, Rev.3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

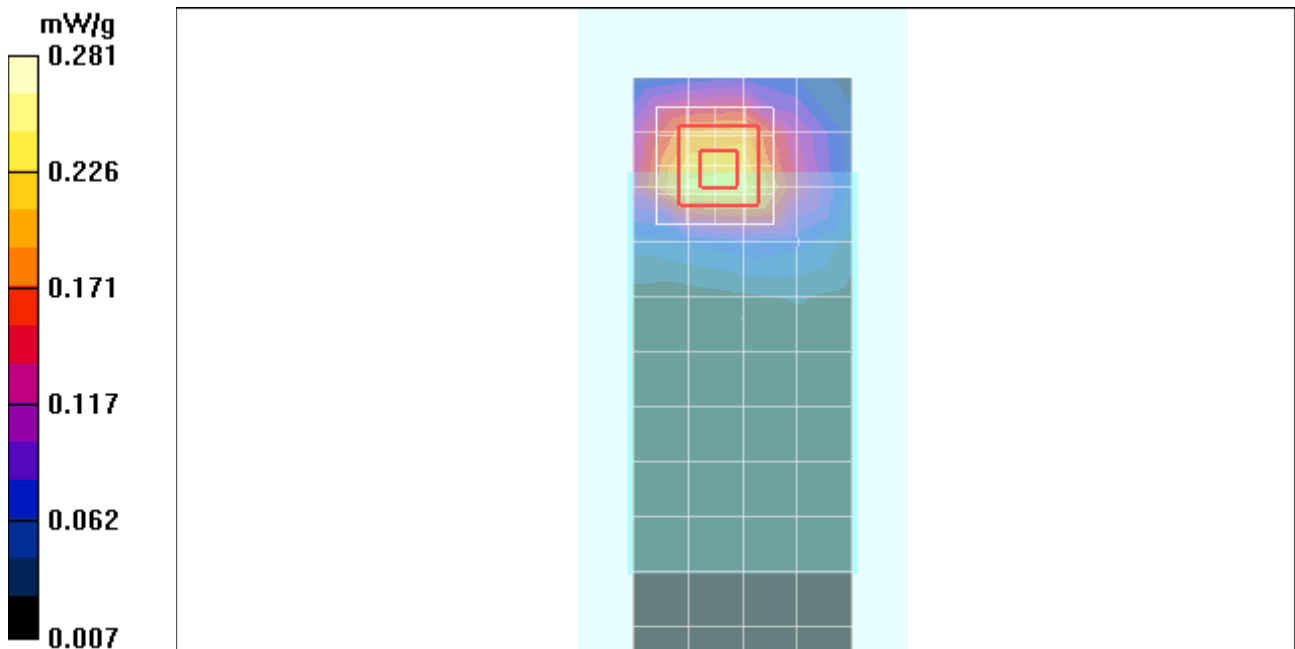
Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 0.239 mW/g

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

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

Reference Value = 13.1 V/m; Power Drift = -0.014 dB; Peak SAR (extrapolated) = 0.393 W/kg

**SAR(1 g) = 0.256 mW/g; SAR(10 g) = 0.154 mW/g; Maximum value of SAR (measured) = 0.281 mW/g**



## Test Laboratory: Motorola - WCDMA 1900 Body-Worn

Serial: 351574040016601; FCC ID: IHDP56LD1

Procedure Notes: Pwr Step: All up Bits; Antenna Position: Internal; Battery Model #: SNN5877A

Device Position: Body Worn, Back of Phone 25 mm from Phantom

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

Medium: Regular Glycol Body 1750/1880

Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 51$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3184; ConvF(4.84, 4.84, 4.84); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn440; Calibrated: 2/17/2010
- Phantom: R4 : Sect.1, Amy Twin, Rev.3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

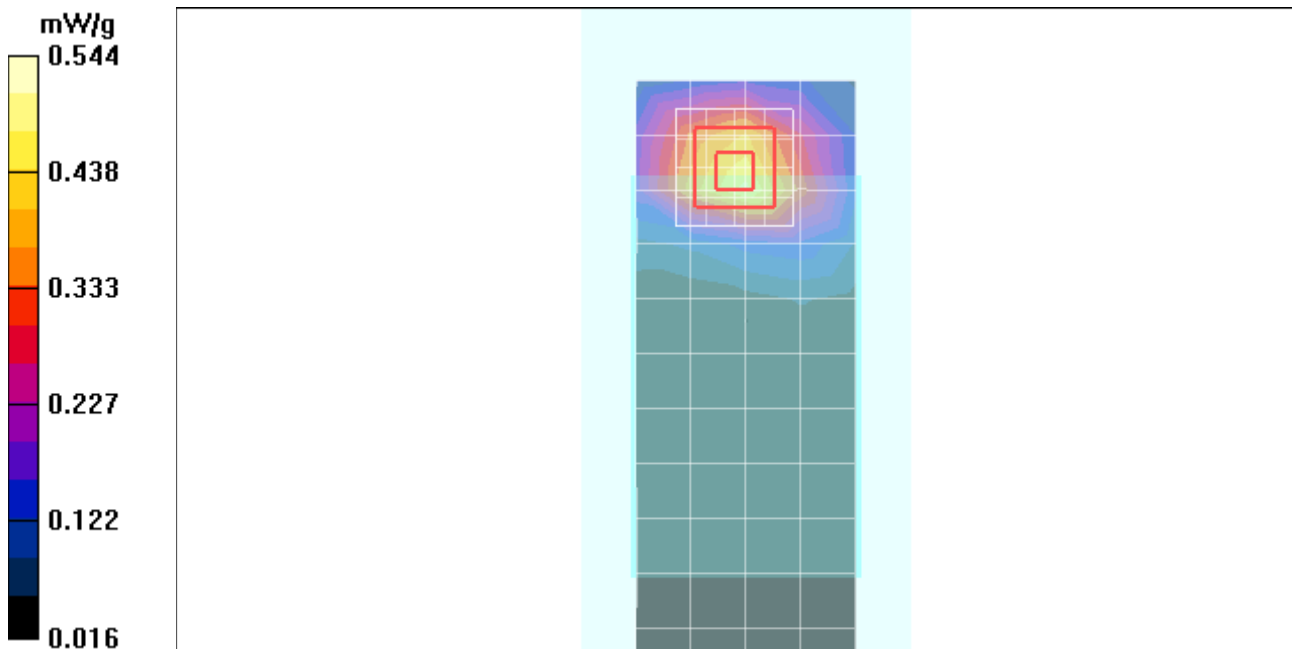
Measurement grid: dx=15mm, dy=15mm; Maximum value of SAR (measured) = 0.488 mW/g

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

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

Reference Value = 18.9 V/m; Power Drift = -0.027 dB; Peak SAR (extrapolated) = 0.760 W/kg

**SAR(1 g) = 0.496 mW/g; SAR(10 g) = 0.297 mW/g; Maximum value of SAR (measured) = 0.544 mW/g**



## Test Laboratory: Motorola - Wi-Fi 2450 Body-Worn

Serial: 351574040016601; FCC ID: IHDP56LD1

Procedure Notes: Pwr Step: N/A; Antenna Position: Internal; Battery Model #: SNN5877A

Device Position: Body Worn, Back of Phone 25 mm from Phantom

Device Mode: 802.11b mode, 1 Mbps data rate

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

Medium: 2450 Glycol Body

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 49.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

DASY4 Configuration:

- Probe: ES3DV3 - SN3037; ConvF(4.29, 4.29, 4.29); Calibrated: 9/18/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn703; Calibrated: 9/17/2009
- Phantom: R1\_ Section 2, Amy Twin, Rev3 (3-Feb-10); Type: Amy Twin Flat; Serial: n/a;
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

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

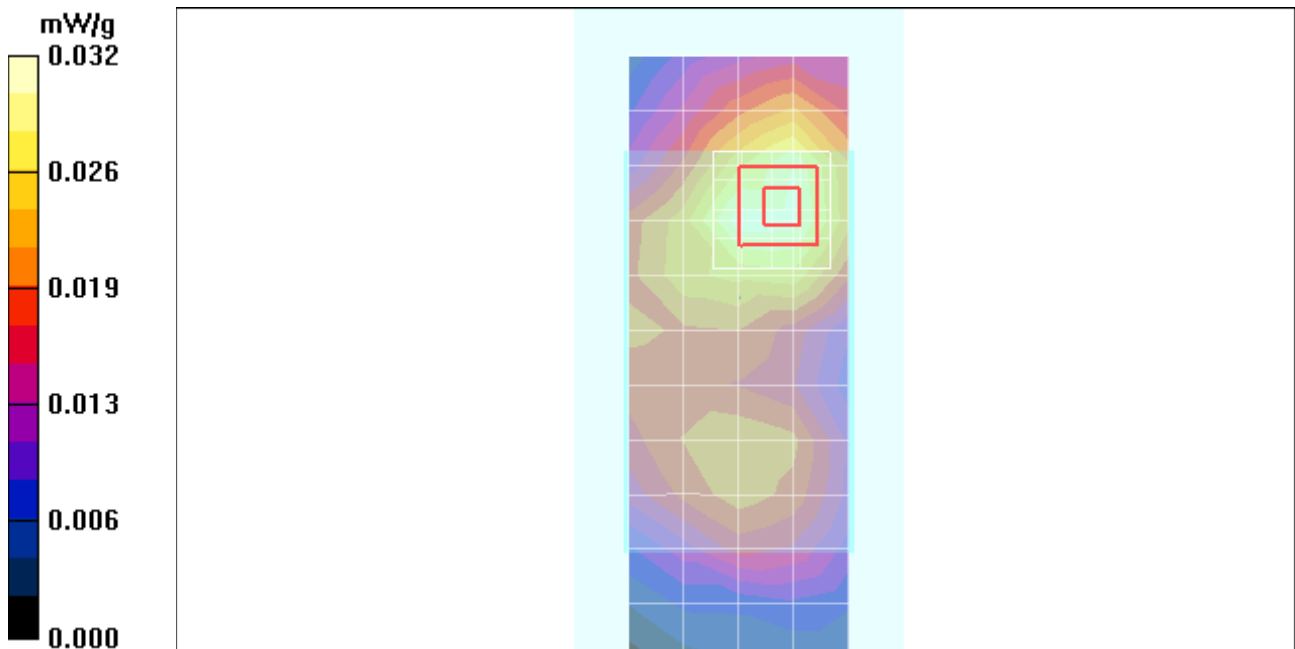
Measurement grid:  $dx=15$ mm,  $dy=15$ mm; Maximum value of SAR (measured) = 0.031 mW/g

### Amy Twin Phone Template to Shift Cube/5x5x7 Zoom Scan ( $\leq 3$ GHz) (5x5x7)/Cube 0:

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

Reference Value = 3.70 V/m; Power Drift = -0.024 dB; Peak SAR (extrapolated) = 0.049 W/kg

**SAR(1 g) = 0.030 mW/g; SAR(10 g) = 0.019 mW/g; Maximum value of SAR (measured) = 0.032 mW/g**



## **Appendix 3**

### **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: **ES3-3184\_Sep09**

**CALIBRATION CERTIFICATE**

Object **ES3DV3 - SN:3184**

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

Calibration date: **September 18, 2009**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

Calibrated by: **Jeton Kastrati** (Name) / **Laboratory Technician** (Function) / *[Signature]* (Signature)

Approved by: **Katja Pokovic** (Name) / **Technical Manager** (Function) / *[Signature]* (Signature)

Issued: September 21, 2009

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



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**

### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ 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<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* *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<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* *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  $\pm 50$  MHz to  $\pm 100$  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
Last calibrated:	September 22, 2008
Recalibrated:	September 18, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

## DASY - Parameters of Probe: ES3DV3 SN:3184

### Sensitivity in Free Space<sup>A</sup>

NormX	1.28 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.36 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.27 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$

### Diode Compression<sup>B</sup>

DCP X	91 mV
DCP Y	92 mV
DCP Z	95 mV

### Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

### Boundary Effect

**TSL**                      **835 MHz**      **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		<b>3.0 mm</b>	<b>4.0 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	11.1	7.3
SAR <sub>be</sub> [%]	With Correction Algorithm	0.8	0.5

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

Sensor Center to Phantom Surface Distance		<b>3.0 mm</b>	<b>4.0 mm</b>
SAR <sub>be</sub> [%]	Without Correction Algorithm	12.1	8.3
SAR <sub>be</sub> [%]	With Correction Algorithm	0.8	0.4

### Sensor Offset

Probe Tip to Sensor Center                      **2.0 mm**

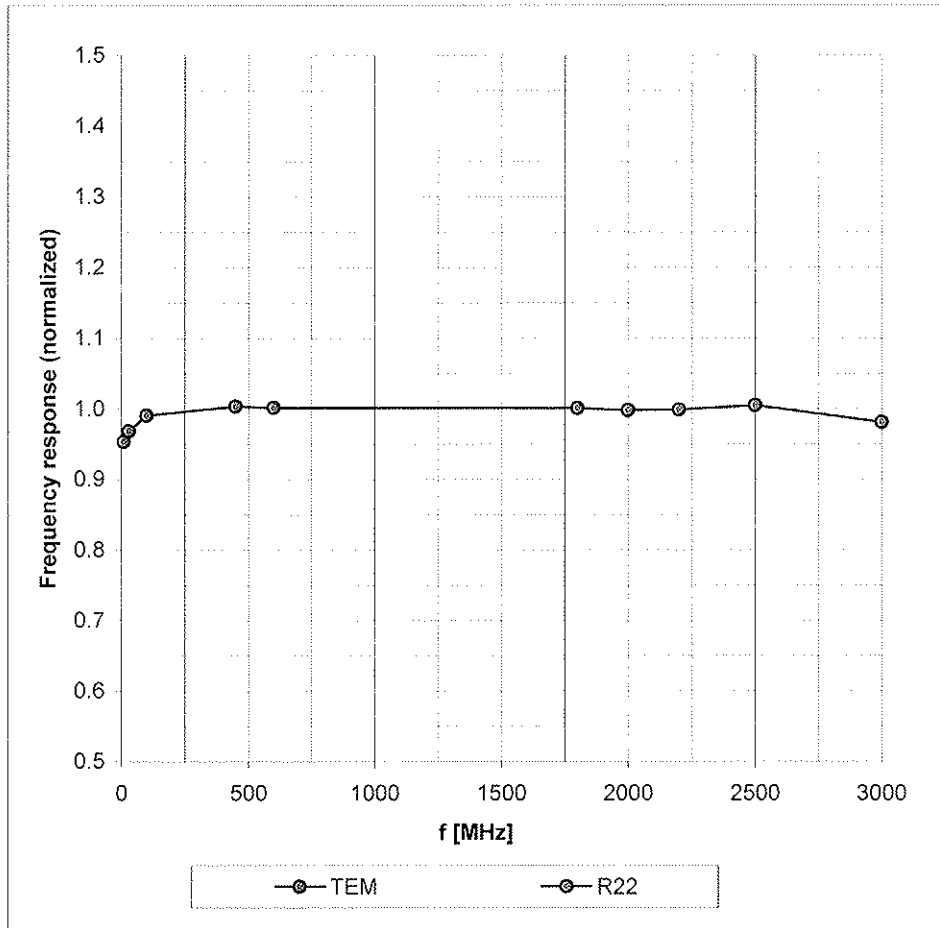
**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

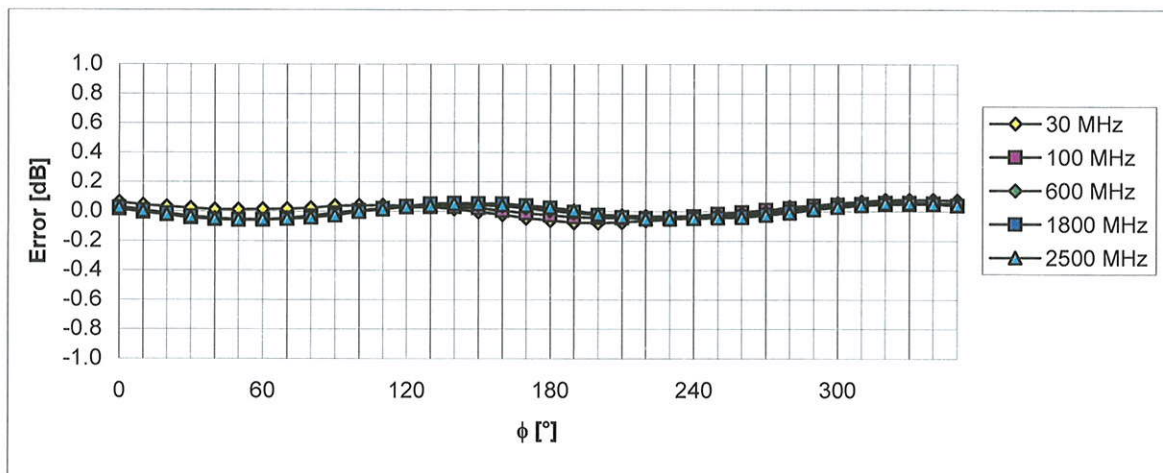
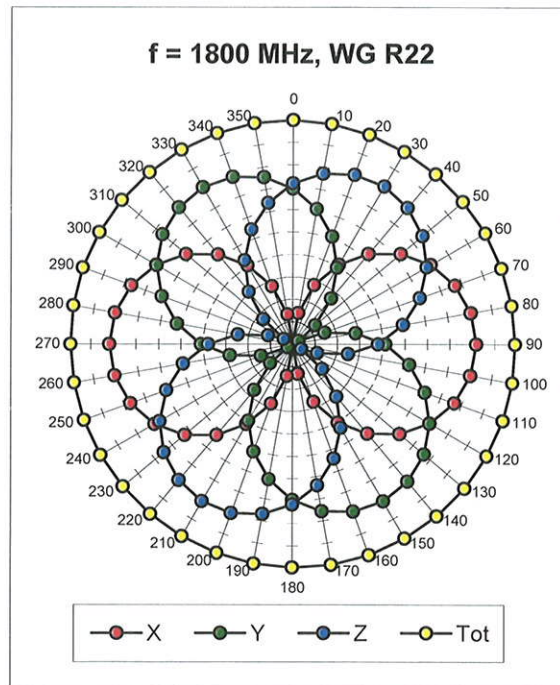
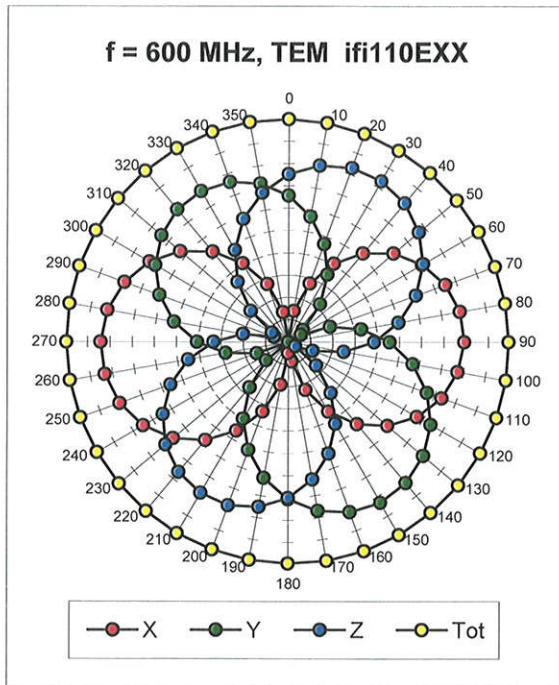
# Frequency Response of E-Field

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



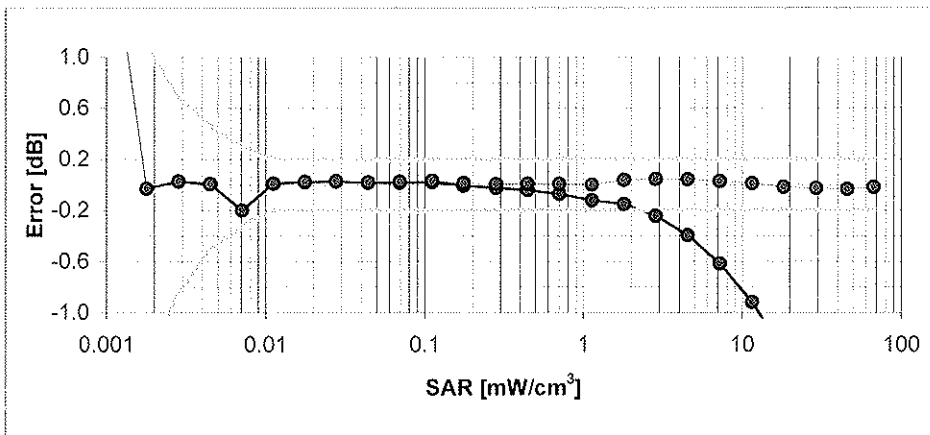
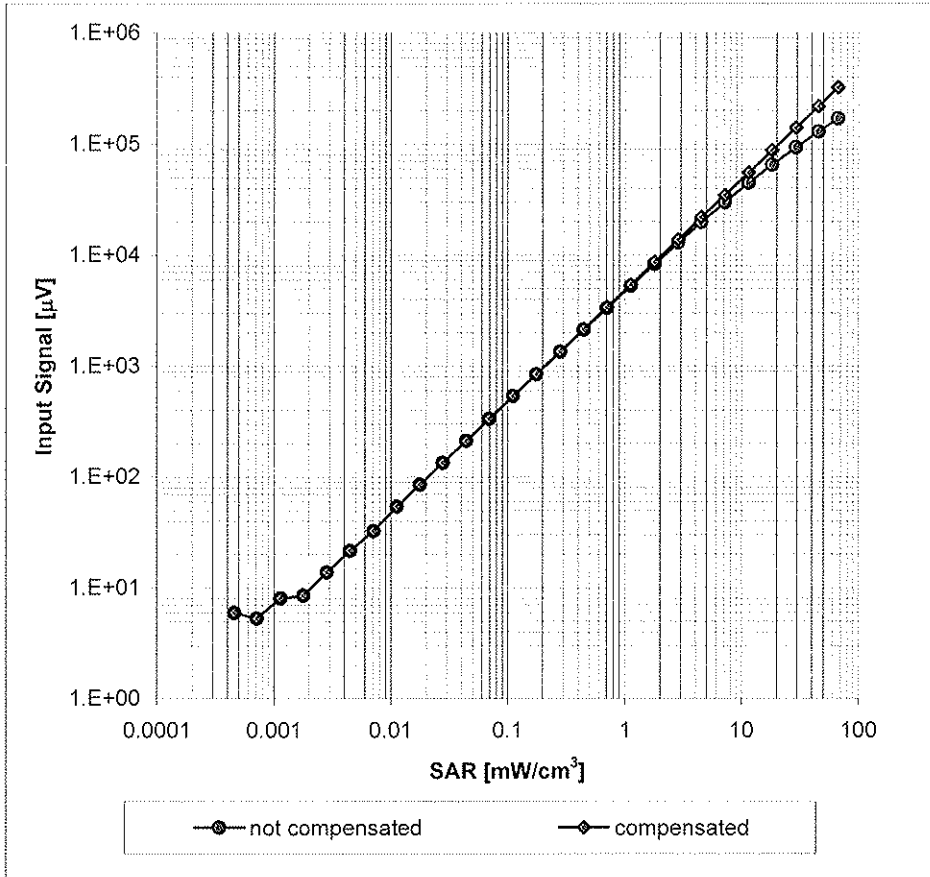
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

## Receiving Pattern ( $\phi$ ), $\vartheta = 0^\circ$



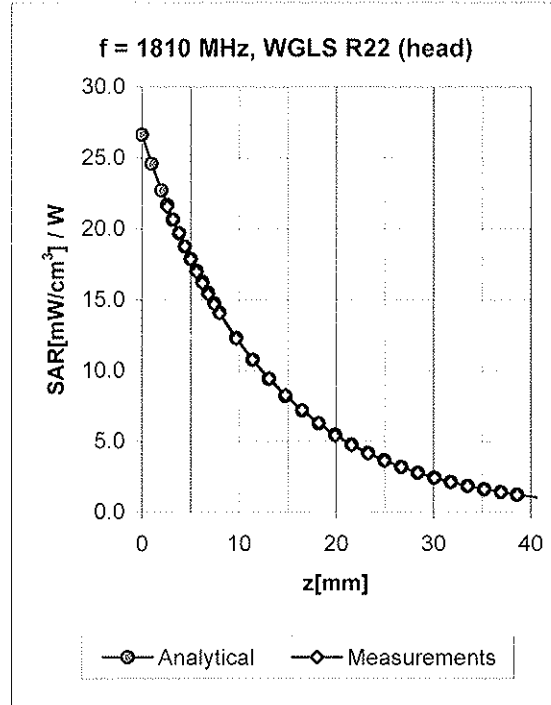
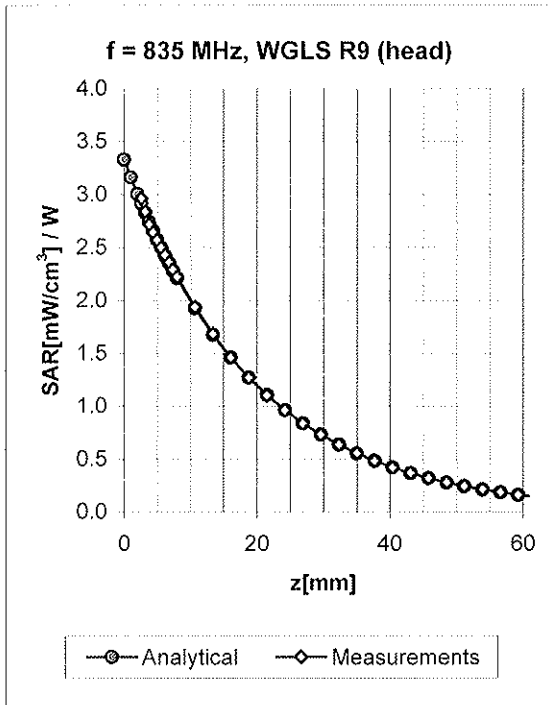
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

### Dynamic Range $f(SAR_{head})$ (Waveguide R22, $f = 1800$ MHz)



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

## Conversion Factor Assessment

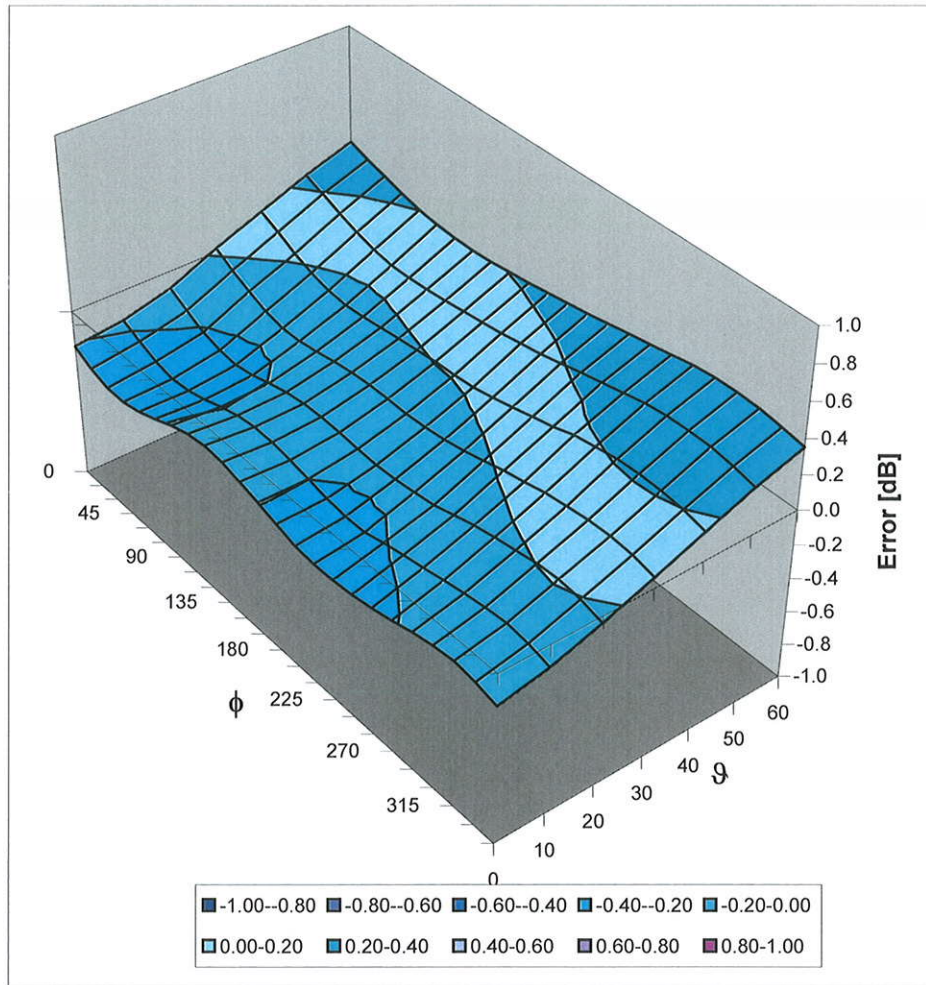


f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.27	2.21	6.26 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.26	2.94	5.14 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.23	3.55	4.94 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.34	2.33	4.44 ± 11.0% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.32	1.92	6.08 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.37	2.02	4.84 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.30	2.95	4.81 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.99	1.20	4.28 ± 11.0% (k=2)

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

# Deviation from Isotropy in HSL

Error ( $\phi$ ,  $\vartheta$ ),  $f = 900$  MHz



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



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: **ES3-3037\_Sep09**

## CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3037**

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

Calibration date: **September 18, 2009**

Condition of the calibrated item **In Tolerance**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: September 21, 2009

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



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**

### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ 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<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  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:3037

Manufactured:	August 21, 2003
Last calibrated:	September 23, 2008
Recalibrated:	September 18, 2009

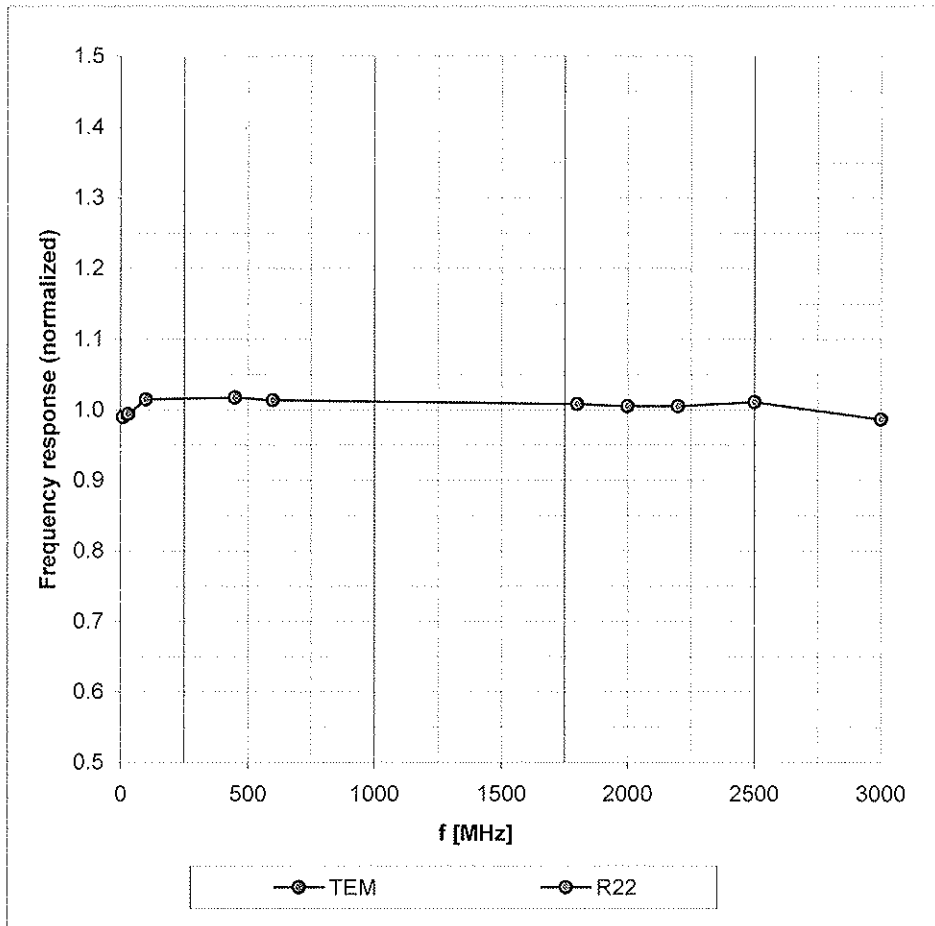
Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



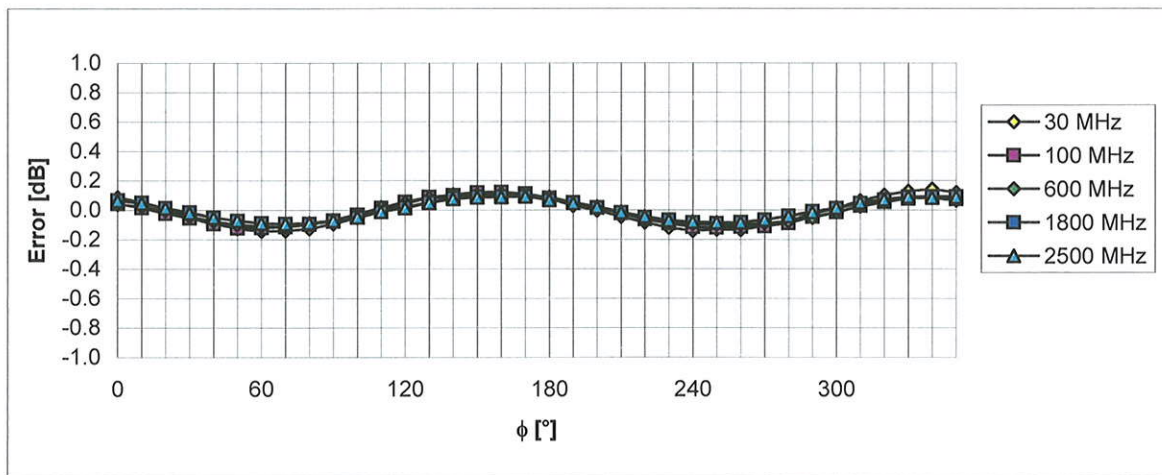
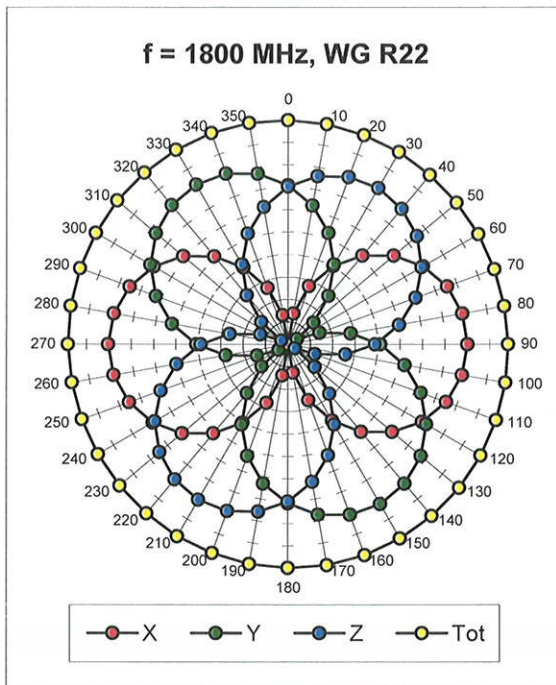
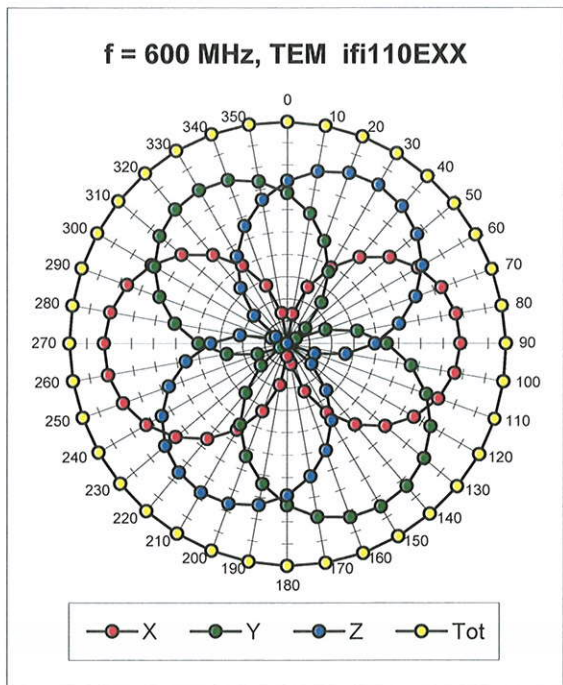
# Frequency Response of E-Field

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



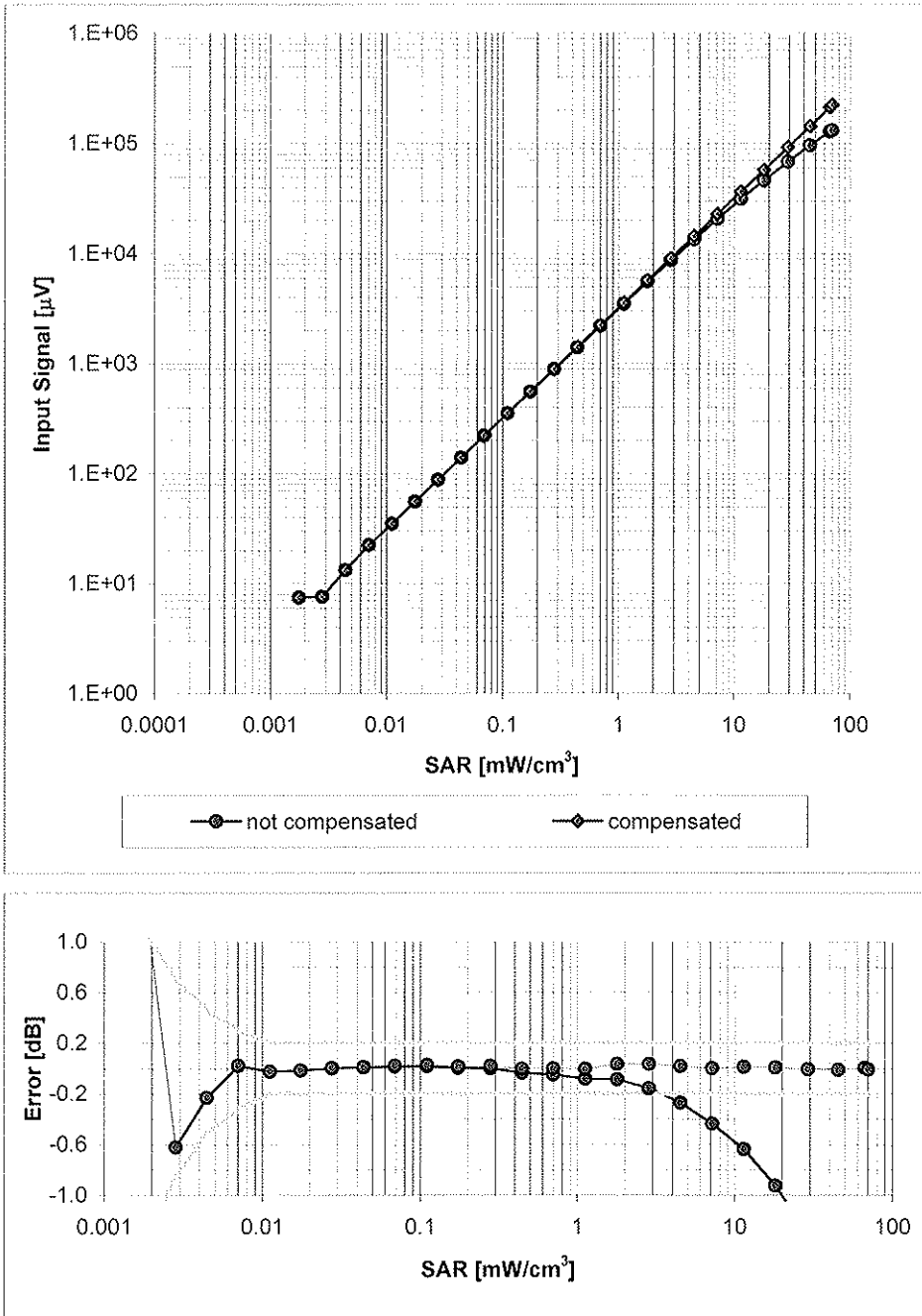
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

### Receiving Pattern ( $\phi$ ), $\vartheta = 0^\circ$



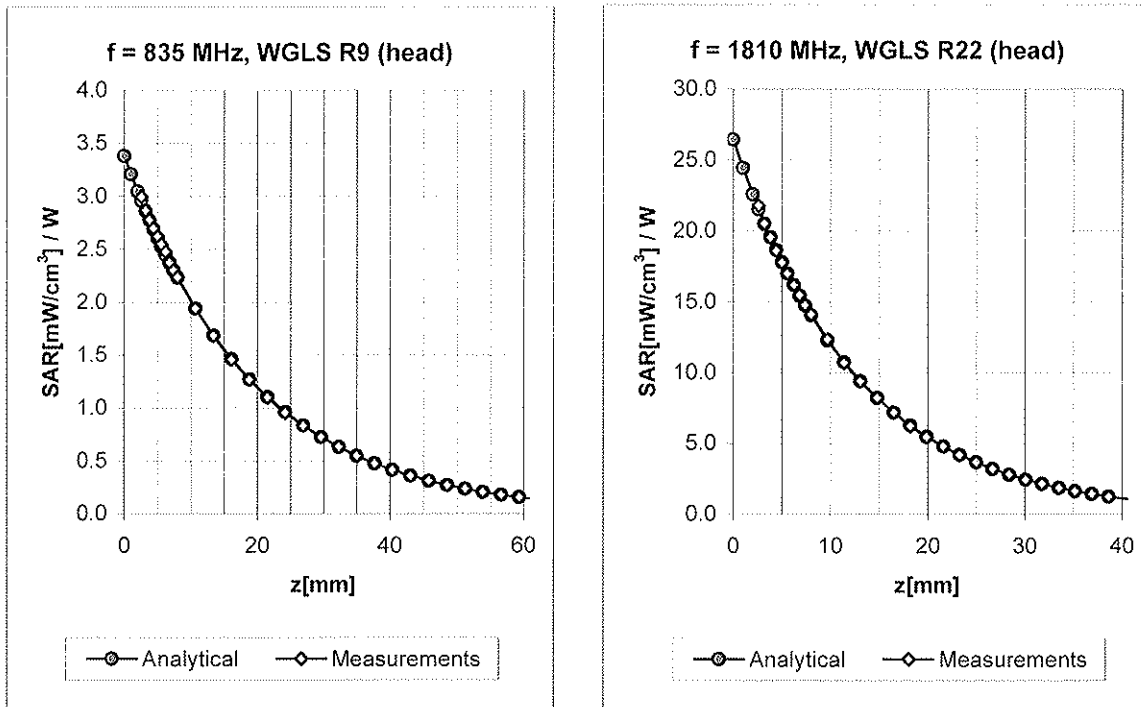
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

### Dynamic Range f(SAR<sub>head</sub>) (Waveguide R22, f = 1800 MHz)



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

## Conversion Factor Assessment

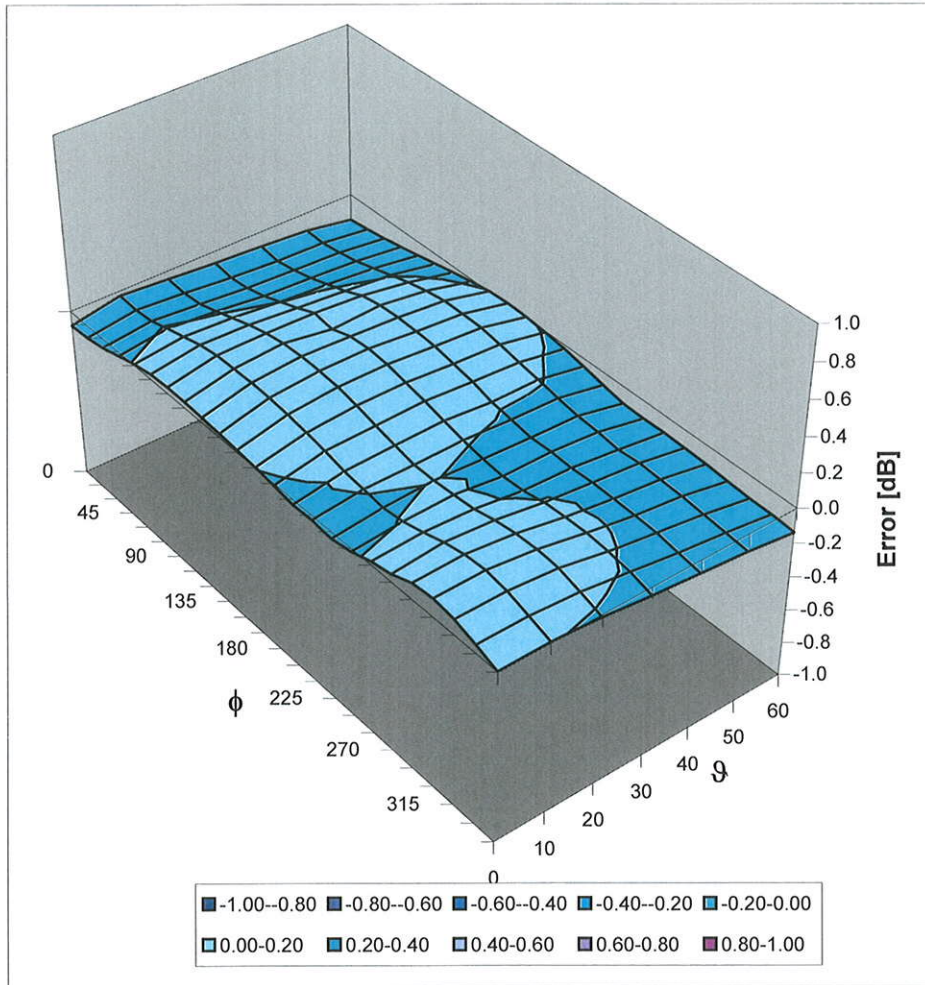


f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
835	± 50 / ± 100	Head	41.5 ± 5%	0.90 ± 5%	0.34	1.78	6.25 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.37	1.74	5.05 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.40	1.62	4.87 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.35	1.96	4.41 ± 11.0% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	0.97 ± 5%	0.75	1.16	6.17 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.36	1.94	4.96 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.27	3.10	4.78 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.70	1.18	4.29 ± 11.0% (k=2)

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

# Deviation from Isotropy in HSL

Error ( $\phi, \vartheta$ ),  $f = 900$  MHz



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

## **Appendix 4**

### **Measurement Uncertainty Budget**

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

## **Appendix 5**

### **Dipole Characterization Certificate**

# Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

835 MHz	
Reference Target:	9.56 (W/kg)
Measurement Uncertainty (k=1):	9.0%
Measurement Period:	26March09 - 15Mar10
# of tests performed:	244
Grand Average:	9.59 (W/kg)
% Delta (Average - Reference Target)	0.3%
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT
<u>Applies to Dipole SN's:</u> 432tr, 417tr, 420tr, 422tr, 423tr, 424tr, 425tr, 431tr, 434tr, 421tr, 436tr	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
835 MHz	9.59	41.5 +/- 5%	0.90 +/- 5%


-Approvals-

Submitted by:  Date:

Signed: 

Comments:

Approved by:  Date:

Signed: 

Comments:

# Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

1800 MHz	
Reference Target:	38.4 (W/kg)
Measurement Uncertainty (k=1):	9.0%
Measurement Period:	26March09 - 15Mar10
# of tests performed:	654
Grand Average:	38.36 (W/kg)
% Delta (Average - Reference Target)	-0.1%
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT
<u>Applies to Dipole SN's:</u> 246tr, 250tr, 251tr, 259tr, 263tr, 271tr, 272tr, 276tr, 277tr, 279tr, 280tr, 281tr, 283tr, 284tr, 2d128, 2d129	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
1800 MHz	38.36	40.0 +/- 5%	1.40 +/- 5%


-Approvals-

Submitted by:  Date:

Signed: 

Comments:

Approved by:  Date:

Signed: 

Comments:

# Certification of System Performance Check Targets

FCD-1806, rev-1

-Historical Data-

2450 MHz	
Reference Target:	52.4 (W/kg)
Measurement Uncertainty (k=1):	9.0%
Measurement Period:	26March09 - 15Mar10
# of tests performed:	159
Grand Average:	54.55 (W/kg)
% Delta (Average - Reference Target)	4.1%
Is % Delta <= Expanded Measurement Uncertainty (k=2)?	Yes
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT
Applies to Dipole SN's:	
740, 766, 767, 788, 789	

-New System Performance Check Targets- per WI-0396

(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity Target +/- %	Conductivity (S/m) Target +/- %
2450 MHz	54.55	39.2 +/- 10%	1.80 +/- 5%

-Approvals-

Submitted by:  Date:

Signed: 

Comments:

Approved by:  Date:

Signed: 

Comments:

**END OF REPORT**