MOTOROLA

Portable Cellular Phone SAR Test Report

Tests Requested By:	Motorola Mobility, Inc. 600 N. US Highway 45 Libertyville, IL 60048
Test Report #:	25081-1F
Date of Report:	Aug-14-2012
Date of Test:	Jun-27-2012 to Jul-24-2012
FCC ID #:	IHDT56NS8
Generic Name:	M0D12
Test Laboratory:	Motorola Mobility, Inc. - ADR Test Services Laboratory No.1 Wang Jing East Road, Chaoyang District Beijing, P. R. China, 100102
Report Author:	HaiLiang Tang RF Engineer

Accreditation:

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

Tests:	Procedures:
Electromagnetic Specific Absorption Rate	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)

2404

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:

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	14-Aug-2012	Initial report release
Rev. A	22-Aug-2012	Updated per FCC inquiry Aug-16

1. Introduction

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

Per direction of the FCC, the following SAR test data is being provided to demonstrate the device's effective utilization of power reduction conditions specified in Exhibit 12 - Operational Description. The values in the table in Section 6.0 are provided solely for purposes of confirming compliant power reduction operation and do not represent maximum SAR values of the product. For maximum reported SAR compliance values, refer to the Exhibit 11 SAR test report.

2. Description of the Device Under Test

2.1 Device Signaling

Serial Number(s) (Functional Use)	LSJE260037 (GSM/WCDMA mobile hotspot SAR testing)
Production Unit or Identical Prototype (47 CFR §2..908)	Identical Prototype
Device Category	Portable (Mobile Station Class B)
RF Exposure Limits	General Population / Uncontrolled

Mode(s) of Operation	Modulation Mode(s)	Maximum Output Power Setting	Duty Cycle	Transmitting Frequency Range(s)
GSM 850	GMSK	33.5 dBm	1:8	824.2 - 848.8 MHz
GSM 1900	GMSK	31.5 dBm	1:8	1850.2 - 1909.8 MHz
WCDMA 850	QPSK	24.5 dBm	1:1	826.4 - 846.6 MHz
WCDMA 1900	QPSK	24.6 dBm	1:1	1852.4 - 1907.6 MHz
Wi-Fi 802.11b/g/n	BPSK	19.8 dBm	1:1	2412.0 - 2462.0 MHz
Bluetooth	GFSK	9.7 dBm	1:1	2402.0 – 2480.0 MHz

GSM Data Functionality	GPRS/EDGE Class 12 (4 uplink timeslots; 4 downlink timeslots; 5 total timeslots per frame)
	Class B (DTM not supported)

Mode(s) of Operation	GPRS/EDGE 850				GPRS/EDGE 1900			
Modulation	GMSK				GMSK			
Maximum Output Power Setting (dBm)	33.5	**31.5**	29.5	27.5	31.5	**29.5**	27.5	25.5
Time Average Output Power Setting (dBm)	24.5	**25.5**	25.3	24.5	22.5	**23.5**	23.3	22.5
Duty Cycle	1:8	**2:8**	3:8	4:8	1:8	**2:8**	3:8	4:8
Transmitting Frequency Range(s)	824.2 - 848.8 MHz				1850.2 - 1909.8 MHz			

Mode(s) of Operation	EDGE 850				EDGE 1900			
Modulation	8PSK				8PSK			
Maximum Output Power Setting (dBm)	28	26	24	22	27	25	23	21
Time Average Output Power Setting (dBm)	19	20	19.8	19	18	19	18.8	18
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Transmitting Frequency Range(s)	824.2 - 848.8 MHz				1850.2 - 1909.8 MHz			

2.1.1 Power limit reduction for Mobile Hotspot functionality

The DUT utilizes reduced limits for the maximum transmit power when the mobile hotspot functionality is enabled. A table of the reduced limits used for testing are given below. A complete description of this functionality is provided in the "Operational Description" contained within Exhibit 12. The implementation to trigger the reduction in power requires the device to be radiating, which prevents conducted power measurements of this functionality without modification to the unit.

Mode(s) of Operation	WCDMA 850	WCDMA 1900
Channel Ranges	4132 - 4233	9262 - 9538
Maximum Output Power Setting (dBm)	24.5	24.6
Reduced Maximum Output Power Setting (dBm)	24.5	21.6

Mode(s) of Operation	GPRS/EDGE 850				GPRS/EDGE 1900			
Modulation	GMSK				GMSK			
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Maximum Output Power Setting (dBm)	33.5	**31.5**	29.5	27.5	31.5	**29.5**	27.5	25.5
Time Average Output Power Setting (dBm)	24.5	**25.5**	25.3	24.5	22.5	**23.5**	23.3	22.5
Reduced Maximum Output Power Setting (dBm)	33.5	**31.5**	29.5	27.5	29.5	**27.5**	25.5	23.5
Reduced Time Average Output Power Setting (dBm)	24.5	**25.5**	25.3	24.5	20.5	**21.5**	21.3	20.5

Mode(s) of Operation	EDGE 850				EDGE 1900			
Modulation	8PSK				8PSK			
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Maximum Output Power Setting (dBm)	28	26	24	22	27	25	23	21
Time Average Output Power Setting (dBm)	19	20	19.8	19	18	19	18.8	18
Reduced Maximum Output Power Setting (dBm)	28	26	24	22	25	23	21	19
Reduced Time Average Output Power Setting (dBm)	19	20	19.8	19	16	17	16.8	16

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Mobility ADR Test Services Laboratory utilizes a Dosimetric Assessment System (DASY5™ v4.7 or DASY52™) 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 ±10.8% (K=1) with an expanded uncertainty of ±21.6% (K=2). The overall 1 g RSS uncertainty of the measurement system is ±11.1% (K=1) with an expanded uncertainty of ±22.2% (K=2). The measurement uncertainty budget is given in Appendix 6. 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
DASY5™ DAE V1	1313	Jan-20-2012	Jan-20-2013
E-Field Probe ES3DV3	3180	Jan-11-2012	Jan-11-2013
S.A.M. Phantom used for 800/900 MHz	TP-1154		
S.A.M. Phantom used for 1800/1900/2450 MHz	TP-1684		
Dipole Validation Kit, DV835V2	425TR	Jul-08-2011	Jul-08-2013
Dipole Validation Kit, DV1800V2	2d129	Jul-22-2011	Jul-22-2013
Dipole Validation Kit, DV2450V2	788	Jul-12-2011	Jul-12-2013

3.2 Additional Equipment

Description	Serial Number	Cal Date	Cal Due Date
Power Meter E4419B	MY45101158	Mar-16-2012	Mar-16-2013
Power Meter 437B	3110A05196	Mar-16-2012	Mar-16-2013
Power Sensor - 8481A	MY41096757	Mar-16-2012	Mar-16-2013
Power Meter E4419B	MY45101158	Mar-16-2012	Mar-16-2013
Power Sensor #1 - E9301A	MY41497903	Mar-16-2012	Mar-16-2013
Power Sensor #2 - E9301A	US39211011	Mar-16-2012	Mar-16-2013
Amplifier - Mini Circuits ZHL42	101705		
3dB Fixed Attenuator 8491A	MY39263202	Feb-23-2012	Feb-23-2013
10dB Fixed Attenuator 8491A	MY39263155	Feb-23-2012	Feb-23-2013
Dual Directional Coupler 778D	18369	Mar-16-2012	Mar-16-2013
Power Supply HP6632B	MY43002619	Mar-19-2012	Mar-19-2013
Signal Generator HP8648C	3847A04633	Mar-14-2012	Mar-14-2013
Network Analyzer E5071B	MY42301800	Jan-28-2012	Jan-28-2013
Dielectric Probe Kit DAK-3.5	1028		

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 $\rho = 1\ ^{g}/_{cm^3}$ 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 Er 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		
			ε_r	σ (S/m)	Temp (°C)
835	**Body**	**Measured,** Jul-02-2012	53.8	1	19.6
		Measured, Jul-03-2012	53.3	0.99	19.6
		Measured, Jul-04-2012	53.6	1	19.3
		Measured, Jul-06-2012	53.4	0.99	19.6
		Recommended Limits	55.4 ±5%	0.966 ±5%	18-25
1880	**Body**	**Measured,** Jul-07-2012	50.9	1.56	19.4
		Recommended Limits	53.3 ±5%	1.52 ±5%	18-25
2450	**Body**	**Measured,** Jul-17-2012	51.5	1.97	19.5
		Measured, Jul-18-2012	51.5	2.02	19.1
		Recommended Limits	52.7 ±5%	1.95 ±5%	18-25

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

Ingredient	782 / 835 / 900 MHz Head	782 / 835 / 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 Verifications

A system accuracy verification of the DASY5™ 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 ±10% from the target SAR indicated in Appendix 7. These frequencies are within ±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 cm ± 0.5 cm. Z-axis scans showing the SAR penetration are also included in Appendix 1.

System Accuracy Verification Measurements for Body SAR Measurements						
f (MHz)	Description	SAR (W/kg), 1 gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
			ε_r	σ (S/m)		
835	**Measured,** Jul-05-2012	9.8	53.6	1	20.8	19.8
	Recommended Limits	9.35	55.2 ±5%	0.97 ±5%	18-25	18-25
1800	**Measured,** Jul-07-2012	35.3	51.2	1.46	21	19.8
	Measured, Jul-10-2012	35.4	51.2	1.5	21	20.7
	Recommended Limits	38.8	53.3 ±5%	1.52 ±5%	18-25	18-25
2450	**Measured,** Jul-18-2012	50.5	51.5	2.02	21.1	19.6
	Recommended Limits	51.2	52.7 ±5%	1.95 ±5%	18-25	18-25

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3180	835	5.97	6 of 11
		1810	5.09	6 of 11
		2450	4.46	6 of 11

6. Test Results

The test sample was operated using an actual transmission through a base station simulator. Wi-Fi testing was conducted using manufacturer test mode software, per guidance given in FCC KDB 248227. The base station simulator or test software was set up for the proper channels, transmitter power levels and transmit modes 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 DASY5™ 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 through 4. Please refer to the DASY5™ manual for additional information on SAR scanning procedures and algorithms used.

The DUT covered by this report has an integrated battery (p/n SNN5916A – 2000mAH) that is not intended for removal by the end user.

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 SAR results shown in tables 5 through 6 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:

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

The SAR reported at the end of the measurement process by the DASY5™ 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 3. All other test conditions measured lower SAR values than those included in Appendix 3.

A SPEAG™ MFP V5.1 C Triple Modular Phantom was used for the body-worn tests. The triple modular phantom consists of three identical modules that can be installed and removed separately without emptying the liquid. Each module of the triple phantom is constructed of glass-fiber reinforced vinylester (VG-GF) with a thickness at the bottom of 2.0 mm. It measures 29.2 cm(long) by 17.8 cm(wide) by 17.8 cm(tall). Alternately, a "flat" phantom was used for the body-worn tests. This "flat" phantom is made out of 1" thick natural High Density Polyethylene with a thickness at the bottom of 2.0 mm. It measures 52.7 cm(long) by 26.7 cm(wide) by 21.2 cm(tall). The simulated tissue depth was verified to be 15.0 cm ± 0.5 cm. The same device holder described in section 6 was used for positioning the phone.

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3180	835	5.97	6 of 11
		1810	5.09	6 of 11
		2450	4.46	6 of 11

Per direction of the FCC, the following SAR test data is being provided to demonstrate the device's effective utilization of power reduction conditions specified in Exhibit 12 - Operational Description. The values in the table are provided solely for purposes of confirming compliant power reduction operation and do not represent maximum SAR values of the product. For maximum reported SAR compliance values, refer to the Exhibit 11 SAR test report.

Mobile Hotspot, Phone 10 mm from Phantom									
				1 g SAR value w/o Pwr Reduction		***1 g SAR value w/ Pwr Reduction***		**Pwr Reduction Specification (dB)**	**Measured Pwr Reduction (dB)**
***F* (MHz)**	**Mode**	**Test Configuration**	**Channel**	**Measured (W/kg)**	**Extrapolated (W/kg)**	**Measured (W/kg)**	**Extrapolated (W/kg)**		
835	**GPRS 850 class 12 (2 Upslots)**	Back of Device 10 mm from Phantom	128						
			190	0.409	0.41				
			251						
	WCDMA 850, 12.2 kbps RMC	Back of Device 10 mm from Phantom	4132						
			4180	0.414	0.41				
			4233						
1880	**GPRS 1900 class 12 (2 Upslots)**	Bottom Edge of Device 10 mm from Phantom	512						
			661	1.56	1.58	0.997	1	2	2
			810						
	WCDMA 1900, 12.2 kbps RMC	Bottom Edge of Device 10 mm from Phantom	9262						
			9400	1.81	1.82	1.08	1.1	3	2.2
			9538						

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

SAR distribution plots for Body Worn Test Results

Date/Time: 7/12/2012 10:08:29 AM

Test Laboratory: Motorola - GPRS1900 Hotspot Bottom edge

Serial: LSJE260037; FCC ID:IHDT56NS8

Procedure Notes: Pwr Step: 00 Antenna Position: internal; Battery Model #: internal
DEVICE POSITION: Bottom Edge of Phone 10mm from Phantom
Communication System: _GPRS Class 10; Frequency: 1880 MHz;
Communication System Channel Number: 661; Duty Cycle: 1:4.14954
Medium: Regular Glycol Body 1750/1880;
Medium parameters used: f = 1880 MHz; σ = 1.56 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3

DASY4 Configuration:

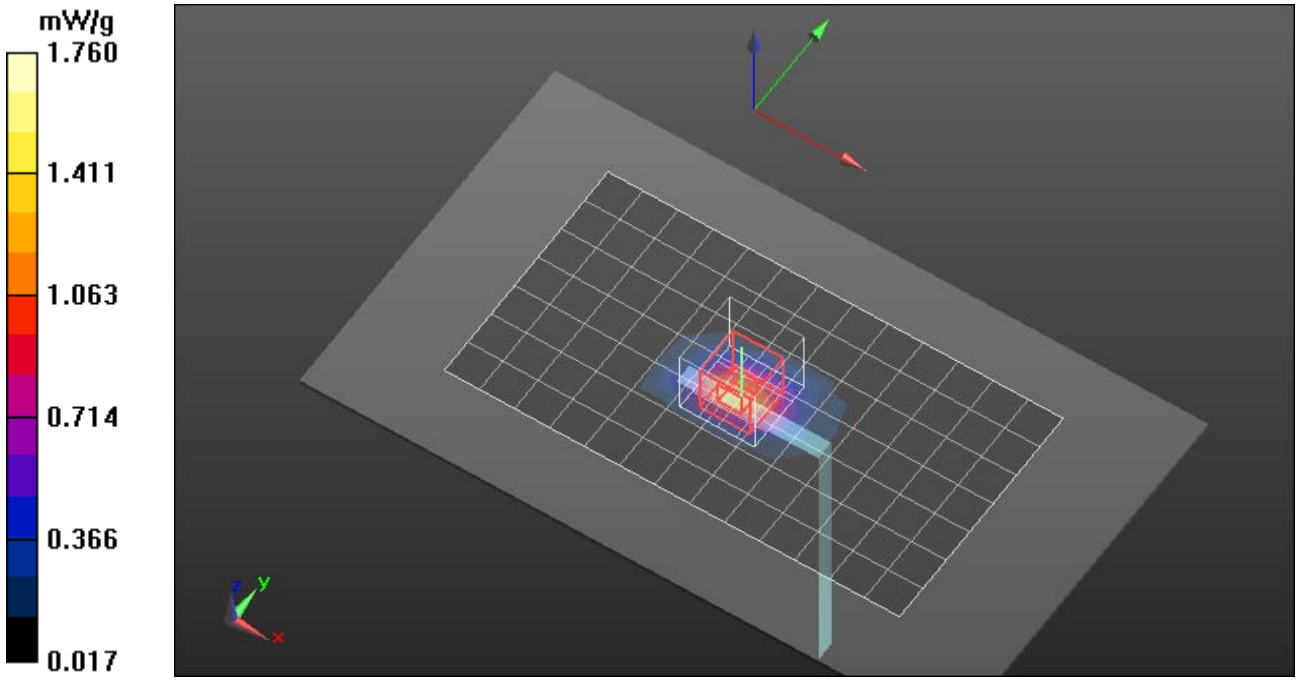
- Probe: ES3DV3 - SN3180; ConvF(5.09, 5.09, 5.09); Calibrated: 1/11/2012
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1313; Calibrated: 1/20/2012
- Phantom: R#-12, Triple Flat Phantom 5.1C (Rev.3); Type: QD 000 P51 CA; Serial: n/a;
- ; SEMCAD X Version 14.6.4 (4989)

DASY5, Triple Flat Phone Template - Rev.5 (6-April-12)/Triple Flat Phone Template/Area Scan - Normal Body (15mm) (14x8x1):

Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.340 mW/g

DASY5, Triple Flat Phone Template - Rev.5 (6-April-12)/Triple Flat Phone Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.311 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 2.9830
SAR(1 g) = 1.56 mW/g; SAR(10 g) = 0.728 mW/g
Maximum value of SAR (measured) = 1.760 mW/g



Date/Time: 7/12/2012 3:49:31 PM

Test Laboratory: Motorola - WCDMA1900 Hotspot Bottom edge

Serial: LSJE260037; FCC ID:IHDT56NS8
Procedure Notes: Pwr Step: All up; Antenna Position: internal; Battery Model #: internal
DEVICE POSITION: Bottom Edge of Phone 10mm from Phantom
Communication System: _WCDMA; Frequency: 1880 MHz;
Communication System Channel Number: 9400; Duty Cycle: 1:1
Medium: Regular Glycol Body 1750/1880;
Medium parameters used: f = 1880 MHz; σ = 1.56 mho/m; ε_r = 50.7; ρ = 1000 kg/m^3

DASY4 Configuration:

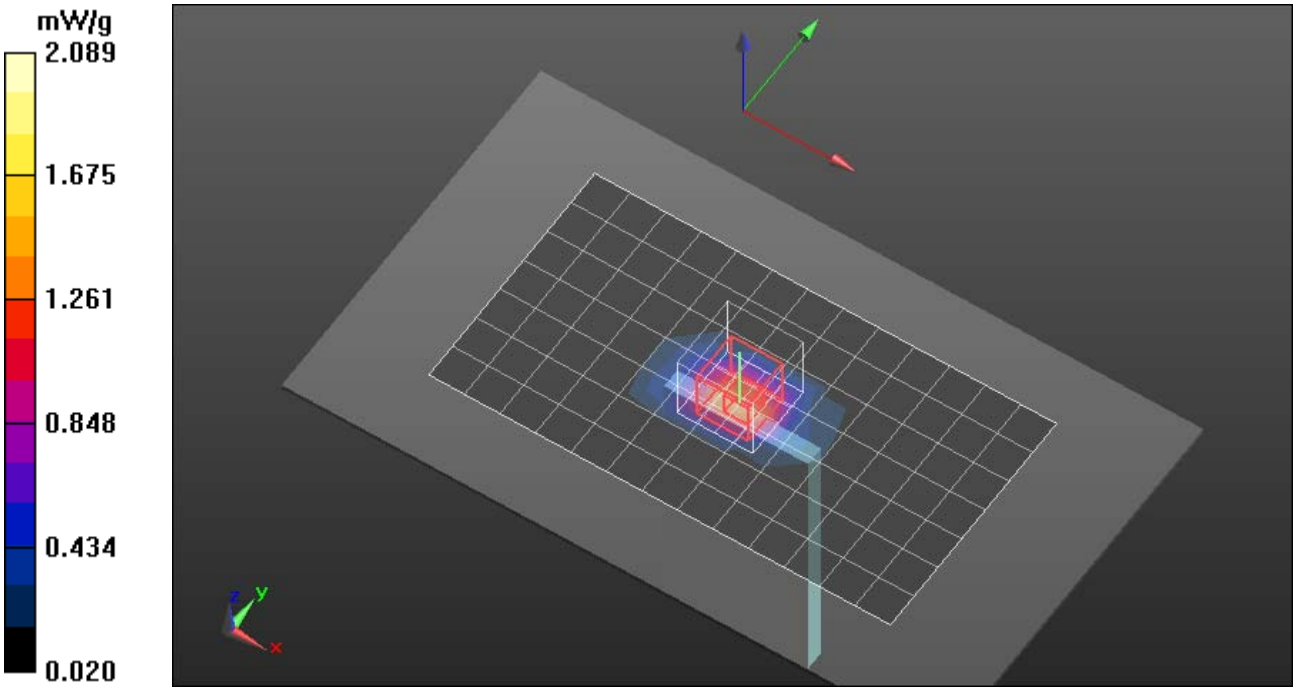
- Probe: ES3DV3 - SN3180; ConvF(5.09, 5.09, 5.09); Calibrated: 1/11/2012
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1313; Calibrated: 1/20/2012
- Phantom: R#-12, Triple Flat Phantom 5.1C (Rev.3); Type: QD 000 P51 CA; Serial: n/a;
- ; SEMCAD X Version 14.6.4 (4989)

DASY5, Triple Flat Phone Template - Rev.5 (6-April-12)/Triple Flat Phone Template/Area Scan - Normal Body (15mm) (14x8x1):

Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.275 mW/g

DASY5, Triple Flat Phone Template - Rev.5 (6-April-12)/Triple Flat Phone Template/5x5x7 Zoom Scan (<=3GHz) (5x5x7)/Cube 0:

Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.229 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.3270
SAR(1 g) = 1.81 mW/g; SAR(10 g) = 0.884 mW/g
Maximum value of SAR (measured) = 2.089 mW/g



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