



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
Motorola Mobility, Inc. - ADR Test Services Laboratory

Test Laboratory: No.1 Wang Jing East Road, Chaoyang District
Beijing, P. R. China, 100102

HaiLiang Tang

Report Author:

RF Engineer

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

Accreditation:



2404

<p><u>Tests:</u> Electromagnetic Specific Absorption Rate</p>	<p><u>Procedures:</u> 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)</p>
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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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This test report shall not be reproduced except in full, without written approval of the laboratory. The results and statements contained herein relate only to the items tested. The names of individuals involved may be mentioned only in connection with the statements or results from this report. Motorola encourages all feedback, both positive and negative, on this test report.

Table of Contents

1. Introduction3

2. Description of the Device Under Test4

 2.1 Antenna description.....4

 2.2 Device Signaling.....5

 2.2.1 Power limit reduction for Mobile Hotspot functionality6

 2.3 Device Conducted Power Measurements7

 2.3.1 GSM modes.....7

 2.3.2 WCDMA modes.....8

 2.3.3 Wi-Fi 802.11 modes9

3. Test Equipment Used10

 3.1 Dosimetric System10

 3.2 Additional Equipment.....10

4. Electrical parameters of the tissue simulating liquid11

5. System Accuracy Verifications.....13

6. Test Results15

 6.1 Head Adjacent Test Results16

 6.2 Body Worn Test Results.....19

 6.3 Mobile Hotspot Test Results21

 6.4 Description and Evaluation of Simultaneous Transmitters.....25

References28

Appendix 1: SAR distribution comparisons for System Accuracy Verifications

Appendix 2: SAR distribution plots for Head Adjacent Test Results

Appendix 3: SAR distribution plots for Body Worn Test Results

Appendix 4: SAR distribution plots for Mobile Hotspot Test Results

Appendix 5: Measurement Uncertainty Budget

Appendix 6: Probe Calibration Certificate

Appendix 7: Dipole Characterization Certificate

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
Rev. B	27-Aug-2012	Updated per FCC inquiry Aug-22 Added verbiage under the picture in pg 4 to address Q1. Added footnote in pg 27/28 to address Q2 and revised 5GHz simultaneous SAR for Q4.

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].

For ANSI / IEEE C95.1 (1 g), the final stand-alone SAR readings for this phone are given in the table below. These measurements were performed using a DASYS²™ system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich Switzerland.

Transmit Band	Head SAR (1 g^w/kg)	Body SAR (1 g^w/kg)	Mobile Hotspot SAR (1 g^w/kg)
GSM 850	0.33	0.39	0.41
GSM 1900	1.05	0.19	1.33
WCDMA 850	0.26	0.25	0.41
WCDMA 1900	1.39	0.23	1.4
Wi-Fi 2.45 GHz	0.5	0.04	0.36

2. Description of the Device Under Test

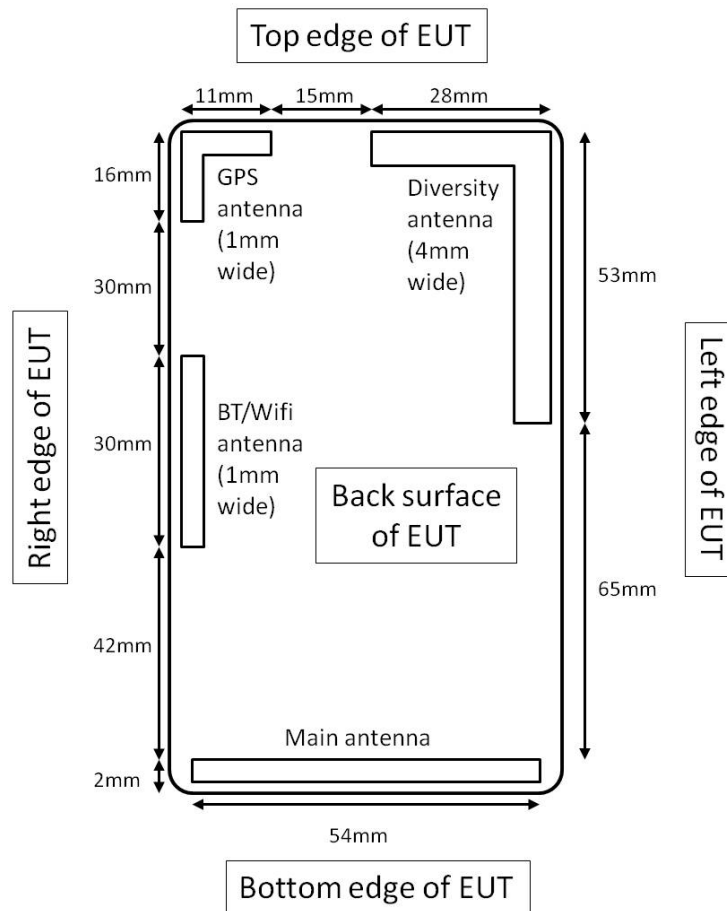
2.1 Antenna description

Main (850/1900 MHz) Antenna

Type	Internal	
Location	Bottom of Transceiver	
Dimensions	Width	2.00 mm
	Length	54.00 mm

Bluetooth/Wi-Fi (2.4/5 GHz) Antenna

Type	Internal	
Location	Right-Side Rear of Transceiver	
Dimensions	Width	1.00 mm
	Length	30.00 mm



Note that the diversity antenna is for receive operations only.

2.2 Device Signaling¹

Serial Number(s) (Functional Use)	LSJE260037 (GSM/WCDMA/Wi-Fi 2.4 GHz head/body/SAR testing) LSJE260008 (Wi-Fi 2.4 GHz conducted power measurements)
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)
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Mode(s) of Operation	GPRS/EDGE 850				GPRS/EDGE 1900			
	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			
	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			

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

2.2.1 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

2.3 Device Conducted Power Measurements

2.3.1 GSM modes

Band	Channel	Conducted power (dBm) for GSM modes ² (Burst Average Power)								
		GSM <i>CS Voice</i> (1 Slot)	GPRS <i>PS Data</i> (1 Slot)	EDGE <i>PS Data</i> (1 Slot)	GPRS <i>PS Data</i> (2 Slots)	EDGE <i>PS Data</i> (2 Slots)	GPRS <i>PS Data</i> (3 Slots)	EDGE <i>PS Data</i> (3 Slots)	GPRS <i>PS Data</i> (4 Slots)	EDGE <i>PS Data</i> (4 Slots)
GSM 850	128	33.34	33.36	28.22	31.69	26.25	29.68	24.34	27.65	22.18
	190	33.33	33.37	28.19	31.64	26.14	29.61	24.27	27.59	22.18
	251	33.41	33.46	28.28	31.66	26.35	29.67	24.47	27.63	22.27
GSM 1900	512	31.52	31.33	26.96	29.35	24.97	27.47	23.33	25.54	21.30
	661	31.39	31.23	27.01	29.37	25.08	27.52	23.34	25.62	21.40
	810	31.35	31.16	27.18	29.46	25.16	27.63	23.36	25.71	21.34

Band	Channel	Conducted power (dBm) for GSM modes ² (Source-Based Time-Averaged Power)								
		GSM <i>CS Voice</i> (1 Slot)	GPRS <i>PS Data</i> (1 Slot)	EDGE <i>PS Data</i> (1 Slot)	GPRS <i>PS Data</i> (2 Slots)	EDGE <i>PS Data</i> (2 Slots)	GPRS <i>PS Data</i> (3 Slots)	EDGE <i>PS Data</i> (3 Slots)	GPRS <i>PS Data</i> (4 Slots)	EDGE <i>PS Data</i> (4 Slots)
GSM 850	128	24.34	24.36	19.22	25.69	20.25	25.42	20.08	24.65	19.18
	190	24.33	24.37	19.19	25.64	20.14	25.35	20.01	24.59	19.18
	251	24.41	24.46	19.28	25.66	20.35	25.41	20.21	24.63	19.27
GSM 1900	512	22.52	22.33	17.96	23.35	18.97	23.21	19.07	22.54	18.3
	661	22.39	22.23	18.01	23.37	19.08	23.26	19.08	22.62	18.4
	810	22.35	22.16	18.18	23.46	19.16	23.37	19.1	22.71	18.34

² *CS Voice* denotes circuit-switched transmission for voice calling, and *PS Data* denotes packet-switched transmission for data sessions.

2.3.2 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	24.38	24.5	24.41	24.4	24.41	24.43	24.42	24.44	24.45	24.44	24.44
	4180	24.31	24.45	24.36	24.35	24.36	24.37	24.36	24.38	24.38	24.37	24.38
	4233	24.32	24.52	24.43	24.42	24.43	24.45	24.43	24.43	24.44	24.43	24.43
WCDMA 1900	9262	24.59	24.73	24.76	24.75	24.78	24.8	24.53	24.58	24.62	24.67	24.66
	9400	24.63	24.75	24.77	24.76	24.78	24.8	24.55	24.6	24.62	24.65	24.65
	9538	24.68	24.77	24.75	24.75	24.76	24.78	24.56	24.59	24.61	24.64	24.64

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 $\beta_c/\beta_d = 12/15$, $\beta_{ns}/\beta_c = 24/15$. 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.

2.3.3 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 average conducted power measurements for each mode are shown in the tables below. SAR testing for 802.11 was performed with the transmitter set to the lowest data rate on the default test channels **highlighted in bold** in the tables below. The head and body positions that resulted in the highest SAR values were further tested on the additional channels and higher data rates **highlighted in pink** in the tables below.

Band	Channel	Average Conducted Power (dBm) for 802.11b Mode Data Rates			
		1 Mbps	2 Mbps	5.5 Mbps	11 Mbps
Wi-Fi 2450 MHz	1	19.16	19.4	19.57	19.76
	6	19.35	19.87	20.09	19.97
	11	19.37	19.53	19.92	20.02

Band	Channel	Average 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	18.33	18.42	18.05	18.32	16.56	16.62	15.26	15.17
	6	18.82	18.91	18.48	18.65	17.03	17.05	15.65	15.69
	11	18.95	18.87	18.59	18.45	16.97	17.03	15.74	15.75

Band	Channel	Average 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	17.42	18.19	18.04	16.78	16.66	15.22	15.24	14.37
	6	17.91	18.55	18.49	17.12	17.23	15.69	15.63	14.69
	11	17.93	18.43	18.57	17.16	17.26	15.63	15.66	14.76

Band	Channel	Average 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	17.44	17.97	17.94	16.65	16.6	15.12	15.14	14.2
	6	18.03	18.37	18.39	17.04	17.01	15.56	15.54	14.64
	11	17.85	18.41	18.51	17.03	17.12	15.54	15.58	14.74

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 $\pm 10.8\%$ (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 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 SPEAG DAK-3.5 Dielectric Assessment 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 ϵ_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		
			ϵ_r	σ (S/m)	Temp (°C)
835	Head	Measured, Jun-29-2012	41.4	0.93	19.6
		Measured, Jul-02-2012	41.2	0.93	19.3
		Measured, Jul-02-2012	41.3	0.93	19.1
		Measured, Jul-03-2012	40.5	0.92	19.3
		Measured, Jul-23-2012	40.5	0.91	19.7
		Recommended Limits	41.78 ±5%	0.896 ±5%	18-25
	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	Head	Measured, Jul-02-2012	39.3	1.47	21.3
		Measured, Jul-03-2012	39	1.44	21.2
		Measured, Jul-03-2012	38.9	1.47	20.4
		Measured, Jul-05-2012	38.8	1.47	20.2
		Measured, Jul-06-2012	39	1.47	20.4
		Measured, Jul-09-2012	39.7	1.46	21.4
		Measured, Jul-23-2012	39.5	1.45	20.8
		Recommended Limits	40.0 ±5%	1.40 ±5%	18-25
	Body	Measured, Jul-07-2012	50.9	1.56	19.4
		Recommended Limits	53.3 ±5%	1.52 ±5%	18-25
2450	Head	Measured, Jul-16-2012	37.4	1.88	19.3
		Measured, Jul-17-2012	37.4	1.87	19.3
		Measured, Jul-20-2012	37.6	1.84	19.8
		Recommended Limits	39.2 ±5%	1.80 ±5%	18-25
	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 Head 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, Jun-29-2012	9.9	41.4	0.93	20.6	19.8
	Measured, Jul-02-2012	10	41.2	0.93	21.2	19.5
	Measured, Jul-03-2012	9.95	41.3	0.93	21.4	19.9
	Measured, Jul-04-2012	9.85	40.5	0.92	20.9	19.9
	Measured, Jul-23-2012	9.85	40.5	0.91	21.4	19.8
	Recommended Limits	9.13	41.5 ±5%	0.90 ±5%	18-25	18-25
1800	Measured, Jul-04-2012	36.1	39.4	1.39	20.9	20.1
	Measured, Jul-06-2012	36.45	39.4	1.39	20.8	20.1
	Measured, Jul-23-2012	35.9	40	1.37	21.3	20.5
	Recommended Limits	38.5	40.0 ±5%	1.40 ±5%	18-25	18-25
2450	Measured, Jul-16-2012	55	37.4	1.88	21.4	19.8
	Recommended Limits	55.2	39.2 ±5%	1.80 ±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 head SAR measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3180	835	6.07	5 of 11
		1810	5.20	5 of 11
		2450	4.51	5 of 11

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.

6.1 Head Adjacent Test Results

The SAR results shown in tables 1 through 4 are maximum SAR values averaged over 1 gram of phantom tissue, to demonstrate compliance to [3] and also over 10 grams of phantom tissue, to demonstrate compliance to the [6]. Also shown are the temperature of the simulated tissue after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is:

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

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

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

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3180	835	6.07	5 of 11
		1810	5.20	5 of 11
		2450	4.51	5 of 11

Left Head Cheek Position															
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
835	GSM 850, CS Voice	SNN5916A	128												
			190	19.5	-0.03	33.33		0.116		0.12	0.155		0.16		
			251												
	WCDMA 850, 12.2 kbps RMC		4132												
			4180	19.6	-0.18	24.31		0.184		0.19	0.247		0.26	5x5x7	A33
1880	GPRS 1900, PS Data 2 Uplots	512	19.4	-0.33	29.35		0.577		0.62	0.973		1.05	5x5x7	A32	
		661	19.5	0.04	29.37		0.551		0.55	0.944		0.94			
		810	19.4	-0.01	29.46		0.488		0.49	0.839		0.84			
	GSM 1900, CS Voice	512	19.3	0.02	31.52		0.526		0.53	0.895		0.9			
		661	19.3	0.09	31.39		0.488		0.49	0.842		0.84			
		810	19.8	-0.17	31.35		0.383		0.4	0.646		0.67			
		WCDMA 1900, 12.2 kbps RMC	9262	19.7	-0.04	24.59		0.825		0.83	1.38		1.39	5x5x7	A34
	9400		19.7	-0.02	24.63		0.775		0.78	1.31		1.32			
	9538		19.6	-0.01	24.68		0.679		0.68	1.16		1.16			
	2450	802.11b, 1 Mbps ³	1												
6															
11			19.1	0.63	19.37		0.0943		0.09	0.188		0.19			

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

Right Head Cheek Position															
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
835	GSM 850, CS Voice	SNN5916A	128												
			190	19.4	-0.06	33.33		0.117		0.12	0.158		0.16		
			251												
	GPRS 850, PS Data 2 Uplots		190	19.4	-0.2	31.64		0.235		0.25	0.312		0.33	5x5x7	A31
			4132												
1880	WCDMA 850, 12.2 kbps RMC	4180	19.5	-0.06	24.31		0.164		0.17	0.218		0.22			
		4233													
		512													
	GSM 1900, CS Voice	661	19.5	-0.17	31.39		0.285		0.3	0.477		0.5			
		810													
2450	802.11b, 1 Mbps	9262													
		9400	19.6	-0.04	24.63		0.471		0.48	0.777		0.78			
		9538													
	802.11b, 2 Mbps	1	19.1	0.12	19.16		0.0887		0.09	0.219		0.22			
		6	19.1	0.05	19.35		0.123		0.12	0.3		0.3			
		11	19.1	-0.07	19.37		0.156		0.16	0.381		0.39			
	802.11b, 5.5 Mbps	1													
		6	19	0.18	19.87		0.122		0.12	0.297		0.3			
		11													
		1	19	0.21	19.57		0.0947		0.09	0.228		0.23			
802.11b, 11 Mbps	6	19	0.37	20.09		0.14		0.14	0.339		0.34				
	11	19	0.13	19.92		0.203		0.2	0.504		0.5	5x5x7	A35		
	1	19.1	0.12	19.76		0.0887		0.09	0.219		0.22				
	6	19.1	0.05	19.97		0.123		0.12	0.3		0.3				
	11	19.1	-0.07	20.02		0.156		0.16	0.381		0.39				

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

³ LHC position is NOT the worst-case for head configuration, so only SAR measured at Ch 11 for 802.11b. SAR tests are conducted at RHC position for 802.11b 1Mbps, 2Mbps, 5.5Mbps and 11Mbps.

Left Head 15° Tilt Position																
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	
835	GSM 850, CS Voice	SNN5916A	128													
			190	19.5	0.13	33.33		0.0823		0.08	0.108		0.11			
			251													
	WCDMA 850, 12.2 kbps RMC		4132													
			4180	19.6	0.16	24.31		0.144		0.14	0.189		0.19	5x5x7	A38	
1880	GSM 1900, CS Voice		512													
			661	19.8	0.05	31.39		0.191		0.19	0.311		0.31			
			810													
	WCDMA 1900, 12.2 kbps RMC		9262													
			9400	19.7	0.02	24.63		0.334		0.33	0.543		0.54			
2450	802.11b, 1 Mbps		9538													
			1													
			6													
				11	19.1	0.1	19.37		0.0449		0.04	0.0929		0.09	5x5x7	A40

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

Right Head 15° Tilt Position															
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
835	GSM 850, CS Voice	SNN5916A	128												
			190	19.4	-0.01	33.33		0.0858		0.09	0.112		0.11	5x5x7	A36
			251												
	WCDMA 850, 12.2 kbps RMC		4132												
			4180	19.5	0.16	24.31		0.129		0.13	0.169		0.17		
1880	GSM 1900, CS Voice		4233												
			512												
			661	19.4	0.02	31.39		0.217		0.22	0.376		0.38	5x5x7	A37
	WCDMA 1900, 12.2 kbps RMC		810												
			9262												
2450	802.11b, 1 Mbps		9400	19.6	-0.06	24.63		0.39		0.4	0.667		0.68	5x5x7	A39
			9538												
			1												
				6											
				11	19.3	0.71	19.37		0.0442		0.04	0.0911		0.09	

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

6.2 Body Worn Test Results

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:

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

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

There are no body-worn accessories available for this phone at the time of testing thus the device was tested per the Supplement C testing guidelines for devices that do not have body-worn accessories. A separation distance of 25 mm between the device and the flat phantom was used for testing body-worn SAR. The chosen separation distance of 25 mm is utilized in order to support any case or holder accessories offered or to be offered by Motorola for this product. The device was tested with the front and back of the device facing the phantom. Both sides of the device were tested for Body SAR for the purpose of including the SAR evaluation for body-worn accessories that support the device with the front side facing the user.

The cellular phone was also tested in data mode operations. For these tests, a separation distance of 25 mm between the device and the flat phantom was used. The device was tested in the worst-case SAR position and channel configuration from the voice-mode body-worn testing.

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

Body-Worn, Front of Phone 25 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	
835	GSM 850, CS Voice	SNN5916A	128													
			190	19.8	-0.06	33.33		0.144		0.15	0.192		0.19			
			251													
	WCDMA 850, 12.2 kbps RMC		4132													
			4180	19.8	0.04	24.31		0.189		0.19	0.252		0.25			
1880	GSM 1900, CS Voice	SNN5916A	4233													
			512													
			661	19.7	-0.02	31.39		0.0727		0.07	0.111		0.11			
	WCDMA 1900, 12.2 kbps RMC		810													
			9262													
2450	802.11b, 1 Mbps	SNN5916A	9400	19.6	0.05	24.63		0.134		0.13	0.208		0.21			
			9538													
			1													
			6													
			11	19.4	0.18	19.37		0.00657		0.01	0.0134		0.01			

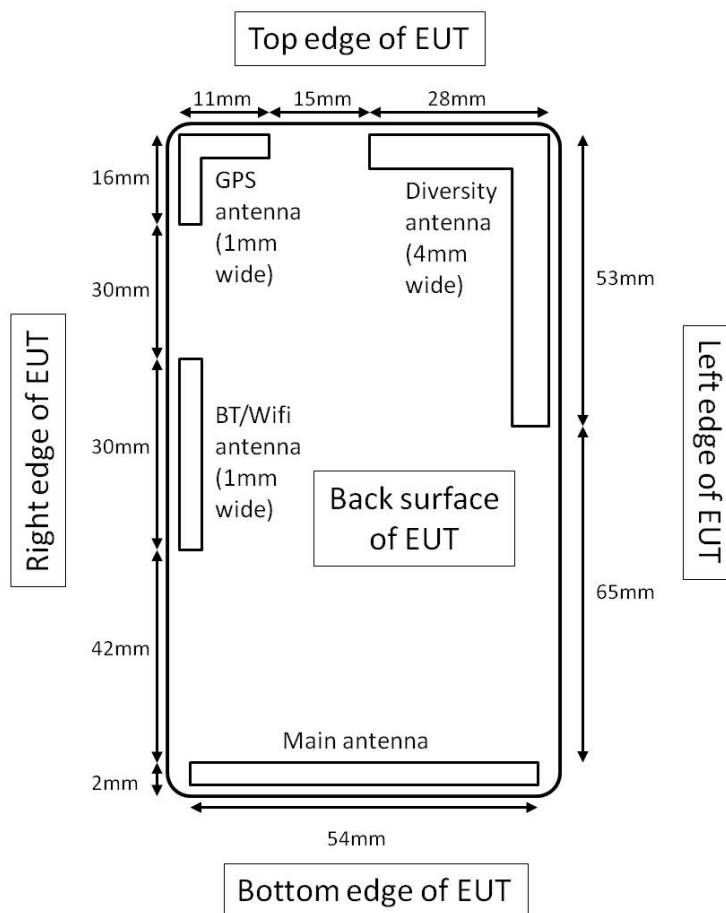
Table 5: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

Body-Worn, Back of Phone 25 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
835	GSM 850, CS Voice	SNN5916A	128												
			190	19.8	-0.13	33.33		0.143		0.15	0.191		0.2		
			251												
	GPRS 850, PS Data 2 Uplots		190	19.8	0.12	31.64		0.292		0.29	0.392		0.39	5x5x7	A42
			4132												
1880	WCDMA 850, 12.2 kbps RMC	SNN5916A	4180	19.7	-0.01	24.31		0.189		0.19	0.253		0.25	5x5x7	A44
			4233												
			512												
	GSM 1900, CS Voice		661	19.7	0.03	31.39		0.0937		0.09	0.153		0.15		
			810												
2450	802.11b, 1 Mbps	SNN5916A	661	19.7	0.02	29.37		0.117		0.12	0.191		0.19	5x5x7	A43
			9262												
			9400	19.6	0.08	24.63		0.14		0.14	0.226		0.23	5x5x7	A45
	802.11b, 2 Mbps		9538												
1		19.4	0.1	19.16		0.0089		0.01	0.0164		0.02				
6		19.4	0.39	19.35		0.0132		0.01	0.0244		0.02				
11		19.4	-0.03	19.37		0.0197		0.02	0.0354		0.04				
6		19.4	-0.02	19.87		0.0117		0.01	0.022		0.02				
11															
802.11b, 5.5 Mbps		1	19.3	-0.02	19.57		0.00869		0.01	0.0162		0.02			
		6	19.3	0.2	20.09		0.0126		0.01	0.0227		0.02			
		11	19.4	0.18	19.92		0.0248		0.02	0.0427		0.04	5x5x7	A46	
802.11b, 11 Mbps		1	19.4	0.53	19.76		0.00852		0.01	0.0154		0.02			
		6	19.4	0.17	19.97		0.0115		0.01	0.0205		0.02			
	11	19.4	0.21	20.02		0.0205		0.02	0.0364		0.04				

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

6.3 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 per FCC KDB 941225 D06. Testing was performed with a separation of 1 cm 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.



Mobile Hotspot Surfaces for SAR testing						
Mode	Front	Back	Left	Right	Top	Bottom
GSM	Yes	Yes	Yes	Yes	No	Yes
WCDMA	Yes	Yes	Yes	Yes	No	Yes
Wi-Fi	Yes	Yes	No	Yes	No	No

The SAR results shown in tables 7 through 11 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 DUT utilizes a reduced limit for the maximum transmit power when the mobile hotspot functionality is enabled, as described above in 2.2.2. A complete description of this functionality is provided in the “Operational Description” contained within Exhibit 12.

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 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 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	3180	835	5.97	6 of 11
		1810	5.09	6 of 11
		2450	4.46	6 of 11

Mobile Hotspot, Bottom Edge of Phone 10 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 or Limit ³ (dBm)	Reduction Target (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page	
835	GPRS 850, PS Data (2 Uplots)	SNN5916A	128													
			190	19.7	-0.17	31.64	0	0.0127		0.01	0.0227		0.02			
			251													
	4132															
	WCDMA 850, 12.2 kbps RMC		4180	19.6	-0.01	24.31	0	0.0151		0.02	0.0276		0.03			
1880	GPRS 1900, PS Data (2 Uplots)	512	20.2	-0.06	29.35	-2	0.379		0.38	0.787		0.8				
		661	20.3	0.02	29.37	-2	0.469		0.47	0.997		1				
		810	20.2	-0.06	29.46	-2	0.614		0.62	1.31		1.33	5x5x7	A49		
	WCDMA 1900, 12.2 kbps RMC	9262	19.5	0.01	24.59	-3	0.5		0.5	1.07		1.07				
		9400	19.5	-0.07	24.63	-3	0.503		0.51	1.08		1.1				
		9538	19.5	-0.03	24.68	-3	0.656		0.66	1.39		1.4	5x5x7	A51		

Table 7: SAR measurement results at the highest possible output power, measured against the ICNIRP and ANSI SAR Limit.

³ For tests with power limit reductions employed, measured conducted power is not available by device design. Per FCC direction, measured power is replaced with the reduced maximum power limit for the device mode under test.

Mobile Hotspot, Left Edge of Phone 10 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 or Limit ⁴ (dBm)	Reduction Target (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page
835	GPRS 850, PS Data (2 Uplots)	SNN5916A	128												
			190	19.7	0.04	31.64	0	0.182	⊗	0.18	0.267	⊗	0.27		
			251												
	4132														
	4180		19.3	-0.08	24.31	0	0.192	⊗	0.2	0.283	⊗	0.29			
1880	GPRS 1900, PS Data (2 Uplots)	SNN5916A	4233												
			512												
			661	20.2	0.04	29.37	-2	0.181	⊗	0.18	0.307	⊗	0.31		
	810														
	9262														
WCDMA 1900, 12.2 kbps RMC	SNN5916A	9400	19.9	-0.03	24.63	-3	0.237	⊗	0.24	0.405	⊗	0.41			
		9538													

Table 8: SAR measurement results at the highest possible output power, measured against the ICNIRP and ANSI SAR Limit.

Mobile Hotspot, Right Edge of Phone 10 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 or Limit ⁴ (dBm)	Reduction Target (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page
835	GPRS 850, PS Data (2 Uplots)	SNN5916A	128												
			190	19.7	0.01	31.64	0	0.165	⊗	0.17	0.241	⊗	0.24		
			251												
	4132														
	4180		19.4	0.03	24.31	0	0.182	⊗	0.18	0.268	⊗	0.27			
1880	GPRS 1900, PS Data (2 Uplots)	SNN5916A	4233												
			512												
			661	20.2	0.01	29.37	-2	0.0325	⊗	0.03	0.0587	⊗	0.06		
	810														
	9262														
WCDMA 1900, 12.2 kbps RMC	SNN5916A	9400	19.5	-0.16	24.63	-3	0.0242	⊗	0.03	0.0442	⊗	0.05			
		9538													
2450	802.11b, 1 Mbps	SNN5916A	1												
			6												
			11	19.3	0.02	19.37	0	0.0796	⊗	0.08	0.151	⊗	0.15		

Table 9: SAR measurement results at the highest possible output power, measured against the ICNIRP and ANSI SAR Limit.

⁴ For tests with power limit reductions employed, measured conducted power is not available by device design. Per FCC direction, measured power is replaced with the reduced maximum power limit for the device mode under test.

⁵ For tests with power limit reductions employed, measured conducted power is not available by device design. Per FCC direction, measured power is replaced with the reduced maximum power limit for the device mode under test.

Mobile Hotspot, Front of Phone 10 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 or Limit ⁶ (dBm)	Reduction Target (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page
835	GPRS 850, PS Data (2 Uplots)	SNN5916A	128												
			190	19.7	0.03	31.64	0	0.273	0.273	0.27	0.354	0.354	0.35		
			251												
	WCDMA 850, 12.2 kbps RMC		4132												
			4180	19.3	-0.03	24.31	0	0.291	0.291	0.29	0.377	0.377	0.38		
1880	GPRS 1900, PS Data (2 Uplots)	512													
		661	20.2	-0.07	29.37	-2	0.261	0.261	0.27	0.502	0.502	0.51			
		810													
	WCDMA 1900, 12.2 kbps RMC	9262													
		9400	19.8	-0.05	24.63	-3	0.366	0.366	0.37	0.726	0.726	0.73			
2450	802.11b, 1 Mbps	9538													
		1													
		6													
			11	19.2	0.212	19.37	0	0.039	0.039	0.04	0.0781	0.0781	0.08		

Table 10: SAR measurement results at the highest possible output power, measured against the ICNIRP and ANSI SAR Limit.

Mobile Hotspot, Back of Phone 10 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 or Limit ⁷ (dBm)	Reduction Target (dB)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Measured (W/kg)	Corrected (W/kg)	Extrapolated (W/kg)	Grid	Plot Page
835	GPRS 850, PS Data (2 Uplots)	SNN5916A	128												
			190	19.5	0.01	31.64	0	0.308	0.308	0.31	0.409	0.409	0.41	5x5x7	A48
			251												
	WCDMA 850, 12.2 kbps RMC		4132												
			4180	19.3	0.01	24.31	0	0.31	0.31	0.31	0.414	0.414	0.41	5x5x7	A50
1880	GPRS 1900, PS Data (2 Uplots)	4233													
		512	20.1	-0.06	29.35	-2	0.395	0.395	0.4	0.764	0.764	0.77			
		661	20.1	-0.04	29.37	-2	0.464	0.464	0.47	0.933	0.933	0.94			
	WCDMA 1900, 12.2 kbps RMC	810	20	-0.04	29.46	-2	0.554	0.554	0.56	1.16	1.16	1.17			
		9262													
2450	802.11b, 1 Mbps	9400	20.2	-0.01	24.63	-3	0.378	0.378	0.38	0.731	0.731	0.73			
		9538													
		1	19.1	0.33	19.16	0	0.0734	0.0734	0.07	0.147	0.147	0.15			
	802.11b, 2 Mbps	6	19.1	-0.15	19.35	0	0.103	0.103	0.11	0.204	0.204	0.21			
		11	19.1	0.42	19.37	0	0.164	0.164	0.16	0.326	0.326	0.33	5x5x7	A52	
	802.11b, 5.5 Mbps	1													
		6	19.3	-0.17	19.87	0	0.0855	0.0855	0.09	0.169	0.169	0.18			
		11													
		1	19.2	0.12	19.57	0	0.0633	0.0633	0.06	0.124	0.124	0.12			
		6	19.2	0.41	20.09	0	0.086	0.086	0.09	0.171	0.171	0.17			
		11	19.1	0.14	19.92	0	0.124	0.124	0.12	0.243	0.243	0.24			
802.11b, 11 Mbps	1	18.9	0.25	19.76	0	0.0601	0.0601	0.06	0.121	0.121	0.12				
	6	18.9	0.19	19.97	0	0.0919	0.0919	0.09	0.182	0.182	0.18				
			11	19	0.62	20.02	0	0.125	0.125	0.13	0.249	0.249	0.25		

Table 11: SAR measurement results at the highest possible output power, measured against the ICNIRP and ANSI SAR Limit.

⁶ For tests with power limit reductions employed, measured conducted power is not available by device design. Per FCC direction, measured power is replaced with the reduced maximum power limit for the device mode under test.

⁷ For tests with power limit reductions employed, measured conducted power is not available by device design. Per FCC direction, measured power is replaced with the reduced maximum power limit for the device mode under test.

6.4 Description and Evaluation of Simultaneous Transmitters

Per "SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas" (FCC KDB 648474), the necessity of stand-alone and simultaneous SAR testing was evaluated for the licensed and unlicensed transmitters of the device under test.

By device design the GSM/WCDMA transmitter may operate simultaneously with either the Wi-Fi 802.11 transmitter or the Bluetooth transmitter. The separation distance between the Wi-Fi 802.11/Bluetooth antenna and the main antenna is 4.2 cm. Pictorial representation of the antenna locations and separation distances are given in Exhibit 7d. Note that Bluetooth mode is not intended for use in configurations against the head, and this evaluation considers only the body-worn configurations.

The Bluetooth transmitter of the device under test can be excluded from stand-alone and simultaneous SAR evaluation, per the highlighted requirements from FCC KDB 648474, as follows:

1. The highest output conducted power measured for Bluetooth on the device under test is 9.33 mW [≤ 12 mW]
2. The separation distance between the Bluetooth antenna and the main antenna is 4.2 cm [≥ 2.5 cm]

The Wi-Fi and the Bluetooth cannot transmit simultaneously, so there is no co-location test requirement for Wi-Fi and Bluetooth. GSM supports voice and data transmission, though not simultaneously. WCDMA supports voice and data transmission simultaneously.

Description of Simultaneous Transmit Capabilities				
Transmitter Combinations		Scenario Supported?	Supported for Mobile Hotspot?	Notes
#1	GSM (CS Voice) + GSM (PS Data)	No	No	DUT system architecture does not support simultaneous voice and data (except on WCDMA), multiple voice channels, or multiple data channels during a single session on the cellular network.
#2	WCDMA (Voice) + WCDMA (Data)	Yes	Yes	
#3	GSM (CS Voice) + WCDMA (Data)	No	No	
#4	WCDMA (Voice) + GSM (PS Data)	No	No	
#5	GSM (PS Data) + WCDMA (Data)	No	No	
#6	GSM (CS Voice) + WCDMA (Voice)	No	No	
#7	GSM (CS Voice) + Wi-Fi	Yes	No	Supported for voice plus background data.
#8	WCDMA (Voice) + Wi-Fi	Yes	No	
#9	GSM (PS Data) + Wi-Fi	Yes	Yes	Supported for mobile hotspot operation.
#10	WCDMA (Data) + Wi-Fi	Yes	Yes	

For the transmitters requiring stand-alone SAR testing (GSM, WCDMA, and Wi-Fi 802.11), the KDB guidelines direct that if the sum of the 1 g SAR measured for the simultaneously transmitting antennas is less than the SAR limit, SAR measurement for simultaneous transmission is not required. Further, if the SAR-to-peak-location separation ratio for two simultaneously transmitting antennas is less than 0.3 then SAR measurement for simultaneous transmission is likewise not required. Evaluations of the head, body, and mobile hotspot simultaneous SAR summations for the worst-case SAR transmitter configurations are presented in the tables below.

The following SAR summations for simultaneous evaluation are provided to demonstrate a GSM or WCDMA voice link with a simultaneous data link on Wi-Fi.

Evaluations for Simultaneous SAR, Head and Body positions															
		Transmitter Stand-Alone 1 g SAR Values (W/kg)					1 g SAR Summations (W/kg)								
Transmitter Combination							#7	#7	#8	#8	#7	#7	#8	#8	
Position	Band	GSM 850	GSM 1900	WCDMA 850	WCDMA 1900	Wi-Fi 2450	Wi-Fi 5 GHz	GSM 850 + Wi-Fi 2450	GSM 1900 + Wi-Fi 2450	WCDMA 850 + Wi-Fi 2450	WCDMA 1900 + Wi-Fi 2450	GSM 850 + Wi-Fi 5GHz	GSM 1900 + Wi-Fi 5GHz	WCDMA 850 + Wi-Fi 5GHz	WCDMA 1900 + Wi-Fi 5GHz
	Left Head Cheek		0.16	1.05	0.26	1.39	0.209 ⁸	0.027	0.35	1.24	0.45	1.599	0.187	1.077	0.287
Left Head 15° Tilt		0.11	0.31	0.19	0.54	0.09	0.012	0.2	0.4	0.28	0.63	0.122	0.322	0.202	0.552
Right Head Cheek		0.33	0.5	0.22	0.78	0.39	0.096	0.72	0.89	0.61	1.17	0.426	0.596	0.316	0.876
Right Head 15° Tilt		0.11	0.38	0.17	0.68	0.09	0.028	0.2	0.47	0.26	0.77	0.138	0.408	0.198	0.708
Body Worn, Front of Phone 25 mm from Phantom		0.19	0.11	0.25	0.21	0.01	0.041	0.2	0.12	0.26	0.22	0.231	0.151	0.291	0.251
Body Worn, Back of Phone 25 mm from Phantom		0.39	0.19	0.25	0.23	0.04	0.135	0.43	0.23	0.29	0.27	0.525	0.325	0.385	0.365

The following Mobile Hotspot (10 mm separation) position SAR summations for simultaneous evaluation are provided to demonstrate a data link (over GSM or WCDMA) with a simultaneous data link on Wi-Fi (to client devices).

Evaluations for Simultaneous SAR, Mobile Hotspot (10 mm separation) positions										
Mobile Hotspot functionality enabled										
		Transmitter Stand-Alone 1 g SAR Values (W/kg)					1 g SAR Summations (W/kg)			
Transmitter Combination							#9	#9	#10	#10
Position	Band	GSM 850	GSM 1900	WCDMA 850	WCDMA 1900	Wi-Fi 2450	GSM 850 + Wi-Fi 2450	GSM 1900 + Wi-Fi 2450	WCDMA 850 + Wi-Fi 2450	WCDMA 1900 + Wi-Fi 2450
	Bottom Edge of DUT 10 mm from Phantom		0.02	1.33	0.03	1.4	0.209⁸	0.02	1.33	0.03
Left Edge of DUT 10 mm from Phantom		0.27	0.31	0.29	0.41	0.09	0.27	0.31	0.29	0.41
Right Edge of DUT 10 mm from Phantom		0.24	0.06	0.27	0.05	0.15	0.39	0.21	0.42	0.2
Front Surface of DUT 10 mm from Phantom		0.35	0.51	0.38	0.73	0.08	0.43	0.59	0.46	0.81
Back Surface of DUT 10 mm from Phantom		0.41	1.17	0.41	0.73	0.36 ⁸	0.74	1.53	0.74	1.06

As no summation of transmitter SAR values results in a value greater than the compliance limit, no measurements for simultaneous SAR are required.

⁸ The maximum measured SAR for these configurations have been scaled up based on Wi-Fi maximum rated output power of production unit.

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)”