



MOTOROLA

Portable Cellular Phone SAR Test Report

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

Test Report #: 24832-1F
Date of Report: Jan-09-2012
Date of Test: Nov-23-2011 to Dec-22-2011
FCC ID #: IHDT56NA1
Generic Name: M0C12

Test Laboratory: Motorola Mobility, Inc. - ADR Test Services Laboratory
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This laboratory is accredited to ISO/IEC 17025-2005 to perform the following tests:

Accreditation:



2404

Tests:
Electromagnetic Specific Absorption Rate

Procedures:
IEC 62209-1
RSS-102
IEEE 1528 - 2003
FCC OET Bulletin 65 (including Supplement C)
Australian Communications Authority Radio
Communications (Electromagnetic Radiation –
Human Exposure) Standard 2003
CENELEC EN 50360
ARIB Std. T-56 (2002)

On the following products or types of products:

Wireless Communications Devices (Examples): Two Way Radios; Portable Phones (including Cellular, Licensed Non-Broadcast and PCS); Low Frequency Readers; and Pagers

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:

Statement of Compliance:

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.

Powers in the tables provided in section 2.3 represent output powers for the SAR test configurations applicable and may not represent the highest output powers for all capabilities.

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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.

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Revision History

Revision Version	Date	Notes
Rev. 0	Jan-06-2012	Initial report release
Rev. A	Jan-09-2012	Correction to EDGE limits and tests results

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. For ANSI / IEEE C95.1 (1 g), the highest simultaneous-transmission SAR readings for this phone are 1.11 W/kg (by summation). These measurements were performed using a Dasy4™ v4.7 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	0.54	0.18	0.17
GSM 1900	0.45	0.16	0.31
WCDMA 1700	0.60	0.29	0.75
WCDMA 1900	0.89	0.25	0.70
Wi-Fi 2.45 GHz	0.57	0.03	0.21

2. Description of the Device Under Test

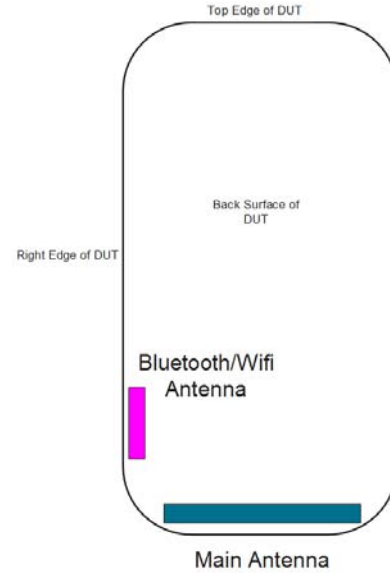
2.1 Antenna description

Main GSM/WCDMA (800/1700/1900 MHz) Antenna

Type	Internal	
Location	Bottom Rear of Transceiver	
Dimensions	Width	45.5 mm
	Length	12.4 mm

Bluetooth/Wi-Fi 2 GHz Antenna

Type	Internal	
Location	Right Edge of Transceiver	
Dimensions	Width	4.1 mm
	Length	15.9 mm



2.2 Device Signaling¹

Serial Number(s) (Functional Use)	LJRL280167 (GSM/WCDMA conducted power measurements, GSM/WCDMA SAR testing) LJRL280111 (Wi-Fi 2.4 GHz SAR testing, WCDMA 1700 mobile hotspot SAR testing) LJRL280084 (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	30.5 dBm	1:8	1850.2 - 1909.8 MHz
WCDMA 1700	QPSK	24.0 dBm	1:1	1712.4 - 1752.6 MHz
WCDMA 1900	QPSK	24.0 dBm	1:1	1852.4 - 1907.6 MHz
Wi-Fi 802.11b/g/n	BPSK	17.5 dBm	1:1	2412.0 - 2462.0 MHz
Bluetooth	GFSK	10.0 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			
	GMSK				GMSK			
Maximum Output Power Setting (dBm)	33.5	30.5	28.7	27.5	30.5	27.5	25.7	24.5
Time Average Output Power Setting (dBm)	24.5	24.5	24.4	24.5	21.5	21.5	21.4	21.5
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)	28.0	27.0	25.0	23.0	27.0	27.0	25.0	23.0
Time Average Output Power Setting (dBm)	19.0	21.0	20.7	20.0	18.0	21.0	20.7	20.0
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 were 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. Tables 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 1700	WCDMA 1900
Channel Ranges	1312 - 1513	9262 - 9538
Maximum Output Power Setting (dBm)	24.0	24.0
Reduced Maximum Output Power Setting (dBm)	19.0	19.0

Mode(s) of Operation	GPRS/EDGE 850				GPRS/EDGE 1900			
	GMSK				GMSK			
Modulation								
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	30.5	28.7	27.5	30.5	27.5	25.7	24.5
Time Average Output Power Setting (dBm)	24.5	24.5	24.4	24.5	21.5	21.5	21.4	21.5
Reduced Maximum Output Power Setting (dBm)	27.5	24.5	22.7	21.5	24.5	21.5	19.7	18.5
Reduced Time Average Output Power Setting (dBm)	18.5	18.5	18.4	18.5	15.5	15.5	15.4	15.5

Mode(s) of Operation	EDGE 850				EDGE 1900			
	8PSK				8PSK			
Modulation								
Duty Cycle	1:8	2:8	3:8	4:8	1:8	2:8	3:8	4:8
Maximum Output Power Setting (dBm)	28.0	27.0	25.0	23.0	27.0	27.0	25.0	23.0
Time Average Output Power Setting (dBm)	19.0	21.0	20.7	20.0	18.0	21.0	20.7	20.0
Reduced Maximum Output Power Setting (dBm)	22.0	21.0	19.0	17.0	21.0	21.0	19.0	17.0
Reduced Time Average Output Power Setting (dBm)	13.0	15.0	14.7	14.0	12.0	15.0	14.7	14.0

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)	GPRS <i>PS Data</i> (2 Slots)	GPRS <i>PS Data</i> (3 Slots)	GPRS <i>PS Data</i> (4 Slots)	EDGE <i>PS Data</i> (1 Slot)	EDGE <i>PS Data</i> (2 Slots)	EDGE <i>PS Data</i> (3 Slots)	EDGE <i>PS Data</i> (4 Slots)
GSM 850	128	33.14	32.97	29.61	28.13	27.03	26.97	25.87	23.63	21.76
	190	33.19	33.02	29.55	28.38	26.77	26.90	25.73	23.62	21.65
	251	33.07	32.90	29.42	27.96	26.72	26.72	25.54	23.78	21.62
GSM 1900	512	29.70	29.62	26.34	24.80	23.54	25.78	25.73	24.02	22.10
	661	29.63	29.44	26.62	24.88	23.21	25.74	25.61	24.18	22.00
	810	29.32	29.37	26.69	24.75	23.48	25.49	25.44	23.93	21.95

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)	GPRS <i>PS Data</i> (2 Slots)	GPRS <i>PS Data</i> (3 Slots)	GPRS <i>PS Data</i> (4 Slots)	EDGE <i>PS Data</i> (1 Slot)	EDGE <i>PS Data</i> (2 Slots)	EDGE <i>PS Data</i> (3 Slots)	EDGE <i>PS Data</i> (4 Slots)
GSM 850	128	24.14	23.97	23.61	23.87	24.03	17.97	19.87	19.37	18.76
	190	24.19	24.02	23.55	24.12	23.77	17.90	19.73	19.36	18.65
	251	24.07	23.90	23.42	23.70	23.72	17.72	19.54	19.52	18.62
GSM 1900	512	20.70	20.62	20.34	20.54	20.54	16.78	19.73	19.76	19.10
	661	20.63	20.44	20.62	20.62	20.21	16.74	19.61	19.92	19.00
	810	20.32	20.37	20.69	20.49	20.48	16.49	19.44	19.67	18.95

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 1700	1312	23.25	23.27	23.27	23.32	23.37	23.42	23.31	23.37	23.48	23.41	23.49
	1413	23.33	23.34	23.32	23.33	23.38	23.46	23.35	23.45	23.48	23.44	23.53
	1513	23.31	23.31	23.31	23.35	23.26	23.40	23.36	23.39	23.43	23.35	23.47
WCDMA 1900	9262	23.15	23.13	23.09	23.24	23.28	23.25	23.17	23.28	23.34	23.24	23.37
	9400	23.14	23.16	23.16	23.29	23.31	23.30	23.25	23.27	23.37	23.25	23.31
	9538	22.95	23.03	22.97	23.16	23.11	23.05	23.11	23.11	23.14	23.08	23.10

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	16.39	16.37	17.03	16.96
	6	16.72	16.56	17.28	17.23
	11	16.71	16.67	17.44	17.53

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	16.70	16.93	16.23	16.18	13.88	13.86	12.27	12.22
	6	17.29	17.22	16.69	16.46	14.43	14.38	12.86	12.90
	11	16.87	16.87	16.94	16.70	14.57	14.52	12.99	12.93

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	16.68	16.14	16.10	13.99	13.78	12.13	12.10	11.26
	6	16.99	16.80	16.47	14.32	14.39	12.77	12.72	11.54
	11	16.95	16.66	16.53	14.62	14.44	12.83	12.84	11.83

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	16.44	15.95	15.69	13.76	13.67	11.93	11.92	11.04
	6	17.02	16.44	16.33	14.27	14.21	12.47	12.45	11.47
	11	16.72	16.59	16.83	14.50	14.38	12.63	12.66	11.76

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Mobility ADR Test Services Laboratory utilizes a Dosimetric Assessment System (Dasy4™ v4.7) manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. All the SAR measurements are taken within a shielded enclosure. The overall 10 g RSS uncertainty of the measurement system is $\pm 10.8\%$ (K=1) with an expanded uncertainty of $\pm 21.6\%$ (K=2). The overall 1 g RSS uncertainty of the measurement system is $\pm 11.1\%$ (K=1) with an expanded uncertainty of $\pm 22.2\%$ (K=2). The measurement uncertainty budget is given in Appendix 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
DASY4™ DAE V1	650	Jun-20-2011	Jun-20-2012
E-Field Probe ES3DV3	3183	Sep-22-2011	Sep-22-2012
DASY4™ DAE V1	699	Sep-22-2011	Sep-22-2012
E-Field Probe ES3DV3	3115	Jan-12-2011	Jan-12-2012
DASY4™ DAE V1	376	Aug-31-2011	Aug-31-2012
E-Field Probe ES3DV3	3124	Aug-23-2011	Aug-23-2012
S.A.M. Phantom used for 800/900 MHz	TP-1132		
S.A.M. Phantom used for 1800/1900/2450 MHz	TP-1162		
S.A.M. Phantom used for 1800/1900/2450 MHz	TP-1318		
Dipole Validation Kit, DV835V2	420TR	Jul-08-2011	Jul-08-2012
Dipole Validation Kit, DV835V2	422TR	Mar-18-2011	Mar-18-2012
Dipole Validation Kit, DV1800V2	250TR	Mar-17-2011	Mar-17-2012
Dipole Validation Kit, DV1800V2	259TR	Mar-17-2011	Mar-17-2012
Dipole Validation Kit, DV1800V2	272TR	Jul-11-2011	Jul-11-2012
Dipole Validation Kit, DV2450V2	863	Mar-17-2011	Mar-17-2012

3.2 Additional Equipment

Description	Serial Number	Cal Date	Cal Due Date
Signal Generator HP8648C	3847A04810	Oct-03-2011	Oct-03-2012
Power Meter E4419B	GB39511090	Aug-15-2011	Aug-15-2012
Power Sensor #1 - E9301A	US39210917	Nov-22-2011	Nov-22-2012
Power Sensor #2 - E9301A	US39210918	Nov-22-2011	Nov-22-2012
Signal Generator HP8648C	3847A04845	Aug-15-2011	Aug-15-2012
Power Meter E4419B	GB39510900	Apr-01-2011	Apr-01-2012
Power Sensor #1 - E9301A	US39211007	Aug-25-2011	Aug-25-2012
Power Sensor #2 - E9301A	US39211008	Aug-25-2011	Aug-25-2012
Signal Generator HP8648C	3847A04632	Aug-15-2011	Aug-15-2012
Power Meter E4419B	GB39511086	Nov-14-2011	Nov-14-2012
Power Sensor #1 - E9301A	US39210915	Sep-15-2011	Sep-15-2012
Power Sensor #2 - E9301A	US39210916	Sep-15-2011	Sep-15-2012
Network Analyzer HP8753ES	US39172529	Sep-12-2011	Sep-12-2012
Dielectric Probe Kit HP85070C	US99360070		

4. Electrical parameters of the tissue simulating liquid

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

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, Nov-23-2011	41.4	0.91	20.0
		Recommended Limits	41.5 ±5%	0.90 ±5%	18-25
	Body	Measured, Nov-25-2011	53.8	0.97	19.6
		Measured, Dec-22-2011	55.8	0.98	19.3
		Recommended Limits	55.2 ±5%	0.97 ±5%	18-25
1730	Head	Measured, Nov-28-2011	39.1	1.39	20.6
		Recommended Limits	40.1 ±5%	1.36 ±5%	18-25
	Body	Measured, Nov-26-2011	52.1	1.49	21.0
		Measured, Dec-19-2011	51.6	1.49	21.4
		Recommended Limits	53.5 ±5%	1.48 ±5%	18-25
1880	Head	Measured, Nov-27-2011	39.0	1.47	20.7
		Measured, Nov-28-2011	38.4	1.40	20.6
		Recommended Limits	40.0 ±5%	1.40 ±5%	18-25
	Body	Measured, Nov-26-2011	50.7	1.57	21.1
		Measured, Dec-02-2011	51.2	1.58	20.7
		Measured, Dec-21-2011	51.5	1.57	19.8
		Recommended Limits	53.3 ±5%	1.52 ±5%	18-25
2450	Head	Measured, Nov-29-2011	37.3	1.85	21.0
		Recommended Limits	39.2 ±10%	1.80 ±5%	18-25
	Body	Measured, Nov-30-2011	50.7	1.95	20.8
		Measured, Dec-01-2011	50.2	1.93	20.5
		Recommended Limits	52.7 ±10%	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 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 8. These frequencies are within $\pm 10\%$ of the compliance test mid-band frequency as required in [1] and [5]. The test was conducted on the same days as the measurement of the DUT. Recommended limits for permittivity and conductivity, specified in [5], are shown in the table below. The obtained results from the system accuracy verification are also displayed in the table below. SAR values are normalized to 1 W forward power delivered to the dipole. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values. The distributions of SAR compare well with those of the reference measurements (see Appendix 1). For frequencies below 3 GHz, the simulated tissue depth was verified to be $15.0 \text{ cm} \pm 0.5 \text{ cm}$. Z-axis scans showing the SAR penetration are also included in Appendix 1.

System Accuracy Verification Measurements for Head SAR Measurements							
f (MHz)	Description	Dipole	SAR (W/kg), 1 gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
				ϵ_r	σ (S/m)		
835	Measured, Nov-23-2011	420TR	9.95	41.4	0.91	21.3	19.7
	Recommended Limits	420TR	9.13	$41.5 \pm 5\%$	$0.90 \pm 5\%$	18-25	18-25
1800	Measured, Nov-27-2011	272TR	37.00	39.4	1.38	21.3	20.2
	Measured, Nov-28-2011	272TR	38.85	38.8	1.46	21.4	20.2
	Recommended Limits	272TR	37.3	$40.0 \pm 5\%$	$1.40 \pm 5\%$	18-25	18-25
2450	Measured, Nov-29-2011	863	54.5	37.3	1.85	21.5	20.5
	Recommended Limits	863	54.2	$39.2 \pm 10\%$	$1.80 \pm 5\%$	18-25	18-25

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

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ES3DV3	3183	835	6.04	5 of 11
		1810	5.15	5 of 11
E-Field Probe ES3DV3	3115	2450	4.39	5 of 11

System Accuracy Verification Measurements for Body SAR Measurements							
f (MHz)	Description	Dipole	SAR (W/kg), 1 gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
				ϵ_r	σ (S/m)		
835	Measured, Nov-25-2011	420TR	9.80	53.8	0.97	21.3	19.8
	Recommended Limits	420TR	9.39	55.2 ±5%	0.97 ±5%	18-25	18-25
	Measured, Dec-22-2011	422TR	9.30	55.8	0.98	21.6	19.3
	Recommended Limits	422TR	9.77	55.2 ±5%	0.97 ±5%	18-25	18-25
1800	Measured, Dec-19-2011	259TR	39.40	51.4	1.57	21.7	21.3
	Recommended Limits	259TR	37.5	53.3 ±5%	1.52 ±5%	18-25	18-25
	Measured, Nov-26-2011	272TR	39.75	50.9	1.47	21.3	20.5
	Measured, Dec-02-2011	272TR	39.50	51.6	1.48	21.5	20.4
	Recommended Limits	272TR	37.1	53.3 ±5%	1.52 ±5%	18-25	18-25
	Measured, Dec-20-2011	250TR	38.45	51.8	1.47	21.3	20.6
	Recommended Limits	250TR	38.6	53.3 ±5%	1.52 ±5%	18-25	18-25
2450	Measured, Nov-30-2011	863	58.0	50.7	1.95	21.5	20.8
	Measured, Dec-01-2011	863	57.0	50.2	1.93	21.4	19.3
	Recommended Limits	863	52.8	52.7 ±10%	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	3124	1810	4.69	6 of 11
E-Field Probe ES3DV3	3183	835	6.05	6 of 11
		1810	4.75	6 of 11
E-Field Probe ES3DV3	3115	2450	4.12	6 of 11

6. Test Results

For GSM/WCDMA modes, 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 DASY4™ SAR measurement system. The default settings for the “coarse” and “cube” scans were chosen and used for measurements. The grid spacing of the coarse scan was set to 15 mm or less as shown in the SAR plots included in Appendices 2 through 4. 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 SNN5875A - 1820 mAH battery

- Model SNN5843A - 1390 mAH battery

- Model SNN5891A - 1550 mAH battery

The battery with the highest capacity is the model SNN5875A. This battery was used to do most 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.

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 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 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	3183	835	6.04	5 of 11
		1810	5.15	5 of 11
E-Field Probe ES3DV3	3115	2450	4.39	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)	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	GSM 850, CS Voice	SNN5875A	128												
			190	20.0	0.130	33.19		0.387		0.39	0.513		0.51		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.6	-0.012	23.33		0.346		0.35	0.578		0.58		
			1513												
		SNN5843A	1413	19.0	0.037	23.33		0.351		0.35	0.589		0.59		
		SNN5891A	1413	19.3	0.080	23.33		0.357		0.36	0.600		0.60	5x5x7	A30
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	20.5	-0.130	29.63		0.253		0.26	0.433		0.45	5x5x7	A31
			810												
	GPRS 1900, PS Data (4 Uplots)	SNN5875A	661	19.3	-0.170	23.21		0.242		0.25	0.414		0.43		
			EDGE 1900, PS Data (2 Uplots)	661	19.2	0.001	25.61		0.238		0.24	0.410		0.41	
	GSM 1900, CS Voice	SNN5843A	661	20.6	0.054	29.63		0.260		0.26	0.445		0.45		
	GSM 1900, CS Voice	SNN5891A	661	20.6	0.048	29.63		0.262		0.26	0.451		0.45		
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262	20.5	-0.150	23.15		0.425		0.44	0.722		0.75		
			9400	20.5	0.038	23.14		0.490		0.49	0.829		0.83		
			9538	20.5	0.001	22.95		0.509		0.51	0.873		0.87		
SNN5843A			9538	20.5	-0.008	22.95		0.518		0.52	0.893		0.89	5x5x7	A32
		SNN5891A	9538	20.5	-0.021	22.95		0.498		0.50	0.854		0.86		
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	20.5	-0.042	16.72		0.074		0.07	0.145		0.15		
			11												

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)	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	GSM 850, CS Voice	SNN5875A	128												
			190	19.0	-0.080	33.19		0.406		0.41	0.534		0.54	5x5x7	A29
			251												
	GPRS 850, PS Data (4 Uplots)	SNN5875A	190	19.8	0.028	26.77		0.284		0.28	0.379		0.38		
			EDGE 850, PS Data (2 Uplots)	190	19.8	0.110	25.73		0.138		0.14	0.182		0.18	
	GSM 850, CS Voice	SNN5843A	190	19.8	-0.230	33.19		0.383		0.40	0.504		0.53		
GSM 850, CS Voice	SNN5891A	190	19.6	-0.089	33.19		0.388		0.40	0.512		0.52			
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	19.2	0.350	23.33		0.195		0.20	0.387		0.39		
			1513												
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	19.6	0.041	29.63		0.138		0.14	0.223		0.22		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9400	20.5	0.015	23.14		0.281		0.28	0.452		0.45		
			9538												
2450	802.11b, 1 Mbps	SNN5875A	1	20.5	0.007	16.39		0.201		0.20	0.460		0.46		
			6	20.5	0.057	16.72		0.205		0.21	0.470		0.47		
			11	20.5	0.070	16.71		0.247		0.25	0.565		0.57	5x5x7	A33
	802.11b, 1 Mbps	SNN5843A	11	19.8	0.127	16.71		0.229		0.23	0.505		0.51		
			SNN5891A	11	20.2	0.009	16.71		0.227		0.23	0.505		0.51	
	802.11b, 5.5 Mbps	SNN5875A	1	20.5	0.062	17.03		0.168		0.17	0.377		0.38		
			6	20.5	0.049	17.28		0.176		0.18	0.395		0.40		
			11	20.5	0.006	17.44		0.229		0.23	0.519		0.52		
	802.11b, 11 Mbps	SNN5875A	1	20.5	0.058	16.96		0.185		0.19	0.426		0.43		
			6	20.5	-0.009	17.23		0.194		0.19	0.446		0.45		
			11	19.8	0.001	17.53		0.226		0.23	0.496		0.50		
	802.11g, 6 Mbps	SNN5875A	1	20.2	-0.028	16.70		0.161		0.16	0.363		0.37		
			6	20.2	-0.006	17.29		0.172		0.17	0.392		0.39		
	802.11g, 9 Mbps	SNN5875A	1	20.2	-0.075	16.93		0.174		0.18	0.400		0.41		
			6	20.2	0.049	17.22		0.156		0.16	0.352		0.35		
	802.11n, 6.5 Mbps (800 ns GI)	SNN5875A	1	20.1	0.065	16.68		0.137		0.14	0.309		0.31		
			6	20.1	-0.101	16.99		0.190		0.19	0.444		0.45		
	802.11n, 7.2 Mbps (400 ns GI)	SNN5875A	6	20.1	0.003	17.02		0.186		0.19	0.430		0.43		

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

Left Head 15° Tilt Position															
f (MHz)	Mode	Battery/Accessory	Channel	Temp (°C)	Drift (dB)	DUT Power		10 g SAR value			1 g SAR value			Test Plot	
						Measured (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	GSM 850, CS Voice	SNN5875A	128												
			190	19.2	-0.045	33.19		0.201		0.20	0.265		0.27		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.6	-0.055	23.33		0.101		0.10	0.160		0.16		
			1513												
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	20.5	-0.059	29.63		0.099		0.10	0.161		0.16		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	20.5	0.091	23.14		0.181		0.18	0.286		0.29		
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	20.5	0.020	16.72		0.045		0.04	0.086		0.09	5x5x7	A38
			11												

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)	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	GSM 850, CS Voice	SNN5875A	128												
			190	19.3	-0.090	33.19		0.216		0.22	0.284		0.29	5x5x7	A34
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	19.2	0.120	23.33		0.119		0.12	0.190		0.19	5x5x7	A35
			1513												
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	20.6	0.040	29.63		0.103		0.10	0.170		0.17	5x5x7	A36
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	20.5	-0.060	23.14		0.195		0.20	0.314		0.32	5x5x7	A37
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	20.5	-0.045	16.72		0.036		0.04	0.066		0.07		
			11												

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 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 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	3183	835	6.05	6 of 11
		1810	4.75	6 of 11
E-Field Probe ES3DV3	3115	2450	4.12	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)	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	GSM 850, CS Voice	SNN5875A	128												
			190	19.8	0.280	33.19		0.107		0.11	0.142		0.14		
			251												
	GPRS 850, PS Data (4 Uplots)	SNN5843A	190	18.9	0.140	26.77		0.138		0.14	0.184		0.18	5x5x7	A40
			EDGE 850, PS Data (2 Uplots)	190	18.9	0.130	25.73		0.063		0.06	0.084		0.08	
	GPRS 850, PS Data (4 Uplots)	SNN5843A	190	18.6	0.210	26.77		0.131		0.13	0.174		0.17		
SNN5891A		190	18.6	0.200	26.77		0.129		0.13	0.172		0.17			
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.9	0.075	23.33		0.113		0.11	0.182		0.18		
			1513												
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	19.3	-0.019	29.63		0.075		0.08	0.121		0.12		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9400	19.2	0.005	23.14		0.115		0.12	0.186		0.19		
			9538												
2450	802.11b, 1 Mbps	SNN5875A	1	19.7	0.020	16.39		0.014		0.01	0.024		0.02		
			6	19.7	0.145	16.72		0.014		0.01	0.024		0.02		
			11	19.7	-0.081	16.71		0.016		0.02	0.029		0.03		
	802.11b, 1 Mbps	SNN5843A	11	19.7	0.110	16.71		0.019		0.02	0.032		0.03	5x5x7	A44
		SNN5891A	11	19.7	0.014	16.71		0.018		0.02	0.032		0.03		
	802.11b, 5.5 Mbps	SNN5875A	1	19.7	0.088	17.03		0.015		0.02	0.026		0.03		
			6	19.7	0.028	17.28		0.014		0.01	0.026		0.03		
			11	19.7	0.045	17.44		0.018		0.02	0.031		0.03		
	802.11b, 11 Mbps	SNN5875A	1	19.7	0.093	16.96		0.015		0.02	0.027		0.03		
			6	19.7	0.035	17.23		0.014		0.01	0.026		0.03		
			11	19.7	0.028	17.53		0.017		0.02	0.029		0.03		
	802.11g, 6 Mbps	SNN5875A	1	20.3	-0.022	16.70		0.011		0.01	0.019		0.02		
			6	20.3	-0.014	17.29		0.011		0.01	0.019		0.02		
	802.11g, 9 Mbps	SNN5875A	1	20.3	0.005	16.93		0.011		0.01	0.019		0.02		
			6	20.3	-0.174	17.22		0.011		0.01	0.019		0.02		
	802.11n, 6.5 Mbps (800 ns GI)	SNN5875A	1	20.0	-0.029	16.68		0.011		0.01	0.019		0.02		
			6	20.0	-0.115	16.99		0.011		0.01	0.019		0.02		
802.11n, 7.2 Mbps (400 ns GI)	SNN5875A	6	20.3	-0.008	17.02		0.011		0.01	0.019		0.02			

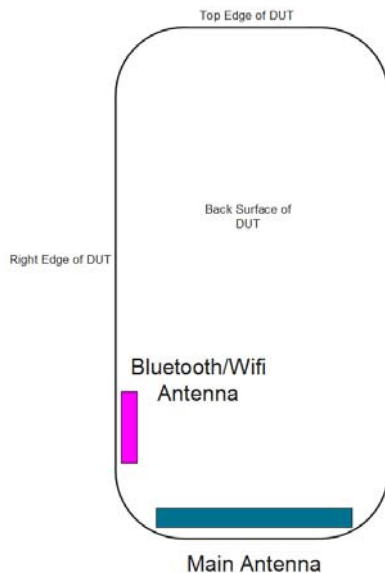
Table 5: SAR measurement results at the highest possible output power, measured in a body-worn position against the ICNIRP and ANSI SAR Limit.

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)	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	GSM 850, CS Voice	SNN5875A	128												
			190	19.8	-0.033	33.19		0.103		0.10	0.139		0.14		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.8	0.071	23.33		0.167		0.17	0.271		0.27		
			1513												
		SNN5843A	1413	20.6	0.060	23.33		0.176		0.18	0.285		0.29	5x5x7	A41
SNN5891A	1413	20.6	-0.025	23.33		0.172		0.17	0.279		0.28				
1880	GSM 1900, CS Voice	SNN5875A	512												
			661	19.3	0.050	29.63		0.090		0.09	0.148		0.15		
			810												
	GPRS 1900, PS Data (4 Uplots)	SNN5875A	661	19.3	0.065	23.21		0.083		0.08	0.136		0.14		
			EDGE 1900, PS Data (2 Uplots)	661	19.5	0.510	25.61		0.084		0.08	0.146		0.15	
	GSM 1900, CS Voice	SNN5843A	661	19.3	0.030	29.63		0.098		0.10	0.160		0.16	5x5x7	A42
	GSM 1900, CS Voice	SNN5891A	661	19.3	-0.037	29.63		0.097		0.10	0.159		0.16		
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	19.2	0.140	23.14		0.149		0.15	0.245		0.25		
9538															
SNN5843A	9400	19.3	0.170	23.14		0.152		0.15	0.251		0.25	5x5x7	A43		
SNN5891A	9400	19.3	0.140	23.14		0.150		0.15	0.248		0.25				
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	19.7	0.144	16.72		0.013		0.01	0.022		0.02		
			11												

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 at the October 2010 TCB Workshop. 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/WCDMA	YES	YES	YES	YES	NO	YES
Wi-Fi	YES	YES	NO	YES	NO	YES

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 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 DUT utilizes reduced limits for the maximum transmit power when the mobile hotspot functionality is enabled, as described above in 2.2.1. 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	3183	835	6.05	6 of 11
		1810	4.75	6 of 11
E-Field Probe ES3DV3	3124	1810	4.69	6 of 11
E-Field Probe ES3DV3	3115	2450	4.12	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 (4 Uplots)	SNN5875A	128												
			190	19.7	-0.023	21.5	-6	0.003		0.00	0.005		0.01		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.2	0.170	19.0	-5	0.371		0.37	0.746		0.75	5x5x7	A47
			1513												
		SNN5843A	1413	19.7	0.180	19.0	-5	0.358		0.36	0.717		0.72		
SNN5891A	1413	19.6	0.170	19.0	-5	0.355		0.36	0.712		0.71				
1880	GPRS 1900, PS Data (4 Uplots)	SNN5875A	512												
			661	19.8	-0.180	18.5	-6	0.148		0.15	0.301		0.31	5x5x7	A48
		810													
	SNN5843A	661	19.2	0.006	18.5	-6	0.143		0.14	0.284		0.28			
	SNN5891A	661	19.2	0.036	18.5	-6	0.140		0.14	0.281		0.28			
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	19.9	0.088	16.72		0.059		0.06	0.109		0.11		
			11												

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 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 (4 Uplots)	SNN5875A	128												
			190	19.7	-0.420	21.5	-6	0.057	⊗	0.06	0.081	⊗	0.09		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	20.1	0.300	19.0	-5	0.057	⊗	0.06	0.095	⊗	0.09		
			1513												
1880	GPRS 1900, PS Data (4 Uplots)	SNN5875A	512												
			661	19.8	-0.085	18.5	-6	0.025	⊗	0.03	0.042	⊗	0.04		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	19.1	0.093	19.0	-5	0.063	⊗	0.06	0.107	⊗	0.11		
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 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 (4 Uplots)	SNN5875A	128												
			190	19.7	-0.026	21.5	-6	0.056	⊗	0.06	0.079	⊗	0.08		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	19.9	0.130	19.0	-5	0.013	⊗	0.01	0.019	⊗	0.02		
			1513												
1880	GPRS 1900, PS Data (4 Uplots)	SNN5875A	512												
			661	19.8	0.096	18.5	-6	0.004	⊗	0.00	0.008	⊗	0.01		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	19.1	0.043	19.0	-5	0.011	⊗	0.01	0.02	⊗	0.02		
9538															
2450	802.11b, 1 Mbps	SNN5875A	1	19.3	0.054	16.39	⊗	0.085	⊗	0.08	0.171	⊗	0.17		
			6	19.9	-0.123	16.72	⊗	0.091	⊗	0.09	0.186	⊗	0.19		
			11	19.3	0.050	16.71	⊗	0.102	⊗	0.10	0.209	⊗	0.21	5x5x7	A50
	802.11b, 1 Mbps	SNN5843A	11	19.3	-0.005	16.71	⊗	0.097	⊗	0.10	0.199	⊗	0.20		
			SNN5891A	11	19.3	-0.014	16.71	⊗	0.095	⊗	0.10	0.194	⊗	0.19	
	802.11b, 5.5 Mbps	SNN5875A	1	19.3	-0.014	17.03	⊗	0.082	⊗	0.08	0.165	⊗	0.17		
			6	19.3	0.046	17.28	⊗	0.085	⊗	0.08	0.171	⊗	0.17		
			11	19.3	-0.084	17.44	⊗	0.099	⊗	0.10	0.203	⊗	0.21		
	802.11b, 11 Mbps	SNN5875A	1	19.3	0.019	16.96	⊗	0.081	⊗	0.08	0.164	⊗	0.16		
			6	19.3	-0.014	17.23	⊗	0.087	⊗	0.09	0.178	⊗	0.18		
			11	19.3	-0.048	17.53	⊗	0.093	⊗	0.09	0.191	⊗	0.19		
	802.11g, 6 Mbps	SNN5875A	1	19.3	0.071	16.70	⊗	0.059	⊗	0.06	0.119	⊗	0.12		
			6	19.3	-0.068	17.29	⊗	0.063	⊗	0.06	0.128	⊗	0.13		
	802.11g, 9 Mbps	SNN5875A	1	19.3	0.068	16.93	⊗	0.062	⊗	0.06	0.127	⊗	0.13		
			6	19.3	0.059	17.22	⊗	0.061	⊗	0.06	0.125	⊗	0.13		
802.11n, 6.5 Mbps (800 ns GI)	SNN5875A	1	19.3	0.015	16.68	⊗	0.063	⊗	0.06	0.129	⊗	0.13			
		6	19.3	0.046	16.99	⊗	0.059	⊗	0.06	0.120	⊗	0.12			
802.11n, 7.2 Mbps (400 ns GI)	SNN5875A	6	19.3	-0.006	17.02	⊗	0.058	⊗	0.06	0.117	⊗	0.12			

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

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 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 (4 Uplots)	SNN5875A	128												
			190	19.7	0.170	21.5	-6	0.120		0.12	0.161		0.16		
			251												
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	19.8	0.160	19.0	-5	0.207		0.21	0.393		0.39		
			1513												
1880	GPRS 1900, PS Data (4 Uplots)	SNN5875A	512												
			661	19.3	-0.014	18.5	-6	0.107		0.11	0.202		0.20		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	19.0	0.075	19.0	-5	0.204		0.20	0.389		0.39		
			9538												
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	19.9	-0.117	16.72		0.083		0.09	0.153		0.16		
			11												

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 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 (4 Uplots)	SNN5875A	128												
			190	19.7	0.260	21.5	-6	0.130		0.13	0.174		0.17	5x5x7	A46
			251												
		SNN5843A	190	19.7	0.180	21.5	-6	0.120		0.12	0.160		0.16		
		SNN5891A	190	19.7	0.120	21.5	-6	0.108		0.11	0.146		0.15		
1730	WCDMA 1700, 12.2 kbps RMC	SNN5875A	1312												
			1413	19.2	-0.086	19.0	-5	0.297		0.30	0.582		0.59		
			1513												
1880	GPRS 1900, PS Data (4 Uplots)	SNN5875A	512												
			661	19.3	0.110	18.5	-6	0.131		0.13	0.256		0.26		
			810												
	WCDMA 1900, 12.2 kbps RMC	SNN5875A	9262												
			9400	19.1	-0.046	19.0	-5	0.299		0.30	0.596		0.60		
		SNN5843A	9400	19.0	0.064	19.0	-5	0.347		0.35	0.700		0.70	5x5x7	A49
		SNN5891A	9400	19.0	0.011	19.0	-5	0.341		0.34	0.689		0.69		
2450	802.11b, 1 Mbps	SNN5875A	1												
			6	19.9	-0.036	16.72		0.063		0.06	0.131		0.13		
			11												

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

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 1.22 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 10 mW [$< 12 \text{ mW}$]
2. The separation distance between the Bluetooth antenna and the main antenna is 1.22 cm [$< 2.5 \text{ cm}$]
3. The highest 1-g Body-Worn SAR values for primary transmitters are: [$< 1.2 \text{ W/kg}$]
 GSM 850 (0.17 W/kg); GSM 1900 (0.31 W/kg); WCDMA 1700 (0.75 W/kg); WCDMA 1900 (0.70 W/kg); Wi-Fi 2450 (0.21 W/kg)

Description of Simultaneous Transmit Capabilities			
Transmitter Combinations	Scenario Supported?	Supported for Mobile Hotspot?	Notes
#1	GSM (CS Voice) + GSM (PS Data)	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	
#3	GSM (CS Voice) + WCDMA (Data)	No	
#4	WCDMA (Voice) + GSM (PS Data)	No	
#5	GSM (PS Data) + WCDMA (Data)	No	
#6	GSM (CS Voice) + WCDMA (Voice)	No	
#7	GSM (CS Voice) + Wi-Fi	Yes	Supported for voice plus background data.
#8	WCDMA (Voice) + Wi-Fi	Yes	
#9	GSM (PS Data) + Wi-Fi	Yes	Supported for mobile hotspot operation.
#10	WCDMA (Data) + Wi-Fi	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
Position	Band	GSM 850	GSM 1900	WCDMA 1700	WCDMA 1900	Wi-Fi 2450	GSM 850 + Wi-Fi 2450	GSM 1900 + Wi-Fi 2450	WCDMA 1700 + Wi-Fi 2450	WCDMA 1900 + Wi-Fi 2450
	Left Head Cheek		0.51	0.45	0.60	0.89	0.15	0.66	0.60	0.75
Left Head 15° Tilt		0.27	0.16	0.16	0.29	0.09	0.36	0.25	0.25	0.38
Right Head Cheek		0.54	0.22	0.39	0.45	0.57	1.11	0.79	0.96	1.02
Right Head 15° Tilt		0.29	0.19	0.17	0.32	0.07	0.36	0.26	0.24	0.39
Body Worn, Front of Phone 25 mm from Phantom		0.18	0.12	0.18	0.19	0.03	0.21	0.15	0.21	0.22
Body Worn, Back of Phone 25 mm from Phantom		0.14	0.16	0.29	0.25	0.02	0.16	0.18	0.31	0.27

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 1700	WCDMA 1900	Wi-Fi 2450	GSM 850 + Wi-Fi 2450	GSM 1900 + Wi-Fi 2450	WCDMA 1700 + Wi-Fi 2450	WCDMA 1900 + Wi-Fi 2450
	Bottom Edge of DUT 10 mm from Phantom		0.01	0.31	0.75	0.57	0.11	0.12	0.42	0.86
Left Edge of DUT 10 mm from Phantom		0.09	0.09	0.04	0.11	0	0.09	0.09	0.04	0.11
Right Edge of DUT 10 mm from Phantom		0.08	0.01	0.02	0.02	0.21	0.29	0.22	0.23	0.23
Front Surface of DUT 10 mm from Phantom		0.16	0.20	0.39	0.39	0.16	0.32	0.36	0.55	0.55
Back Surface of DUT 10 mm from Phantom		0.17	0.26	0.59	0.70	0.13	0.30	0.39	0.72	0.83

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

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)”