FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE Std 1528-2003 and IEEE Std 1528a-2005

SAR EVALUATION REPORT

For
GSM/WCDMA Phone with WiFi/BT

Model: GT-S6310B
FCC ID: A3LGTS6310B

Report Number: 13I14974-4
Issue Date: 4/29/2013

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	4/29/2013	Initial Issue	--

Table of Contents

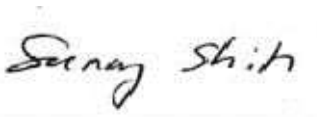
1. Attestation of Test Results

Applicant	Samsung Electronics Co., Ltd.			
DUT description	GSM/WCDMA Phone with WiFi/BT			
Model	GT-S6310B			
Test device is	An identical prototype			
Device category	Portable			
Exposure category	General Population/Uncontrolled Exposure			
Date tested	4/15/2013 – 4/23/2013			
The highest reported SAR values	RF exposure condition	Licensed	DTS	UNII
	Head	0.77 W/kg	0.27 W/kg	N/A W/kg
	Body-worn Accessory	0.93 W/kg	0.29 W/kg	N/A W/kg
	Wireless Router (Hotspot)	0.88 W/kg	0.29 W/kg	N/A W/kg
	Simultaneous Transmission	1.21 W/kg	1.21 W/kg	N/A W/kg
Applicable Standards	OET Bulletin 65 Supplement C IEEE Std 1528-2003 and IEEE Std 1528a-2005 FCC Published RF exposure KDB procedures, and TCB workshop updates			
Test Results	Pass			

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

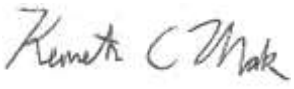
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:



Sunny Shih
WiSE Operations Manager
UL Verification Services Inc.

Prepared By:



Kenneth Mak
WiSE Laboratory Engineer
UL Verification Services Inc.

2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528-2003, IEEE Std 1528a-2005, the following FCC Published RF exposure KDB procedures and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05
- 648474 D04 SAR Handsets Multi Xmiter and Ant v01
- 941225 D01 SAR test for 3G devices v02
- 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- 941225 D06 Hot Spot SAR v01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01
- 865664 D02 SAR Reporting v01
- 690783 D01 SAR Listings on Grants v01r02

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4. Calibration and Uncertainty

4.1. Measuring Instrument Calibration

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due date
Network Analyzer	Agilent	8753ES	MY40001647	6/27/2013
Dielectronic Probe kit	SPEAG	DAK-3.5	1087	10/16/2013
Thermometer	Control Company	4242	122529162	9/19/2014
Synthesized Signal Generator	HP	8665B	3744A01084	5/3/2013
Power Meter	HP	438A	3513U04320	9/24/2013
Power Sensor	HP	8481A	2237A31744	9/24/2013
Power Sensor	HP	8481A	3318A95392	9/24/2013
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1620606	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	HP	6296A	2410A-05117	N/A
Synthesized Signal Generator	HP	8665B	3744A01155	3/6/2014
Power Meter	HP	438A	2822A05684	10/7/2013
Power Sensor	HP	8481A	2702A66876	9/24/2013
Power Sensor	HP	8482A	2349A08568	9/26/2013
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1622052	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
DC Power Supply	KENWOOD	PA36-3A	7060074	N/A
E-Field Probe	SPEAG	EX3DV4	3885	10/9/2013
E-Field Probe	SPEAG	EX3DV4	3901	2/13/2014
Data Acquisition Electronics	SPEAG	DAE4	1352	10/8/2013
Data Acquisition Electronics	SPEAG	DAE4	1357	2/5/2014
System Validation Dipole	SPEAG	D835V2	4d002	10/24/2013
System Validation Dipole	SPEAG	D1900V2	5d043	11/6/2013
System Validation Dipole	SPEAG	D2450V2	899	10/5/2013
Base Station Simulator	Agilent	8960	GB46160222	11/10/2013
Base Station Simulator	Agilent	8960	GB47050526	9/20/2013
Base Station Simulator	R & S	CMU200	106291	8/8/2013
Base Station Simulator	R & S	CMU200	838114/032	7/9/2013
Base Station Simulator	R & S	CMU200	106301	6/6/2013

4.2. Measurement Uncertainty

Measurement uncertainty for 30 MHz to 3 GHz averaged over 1 gram (Head)

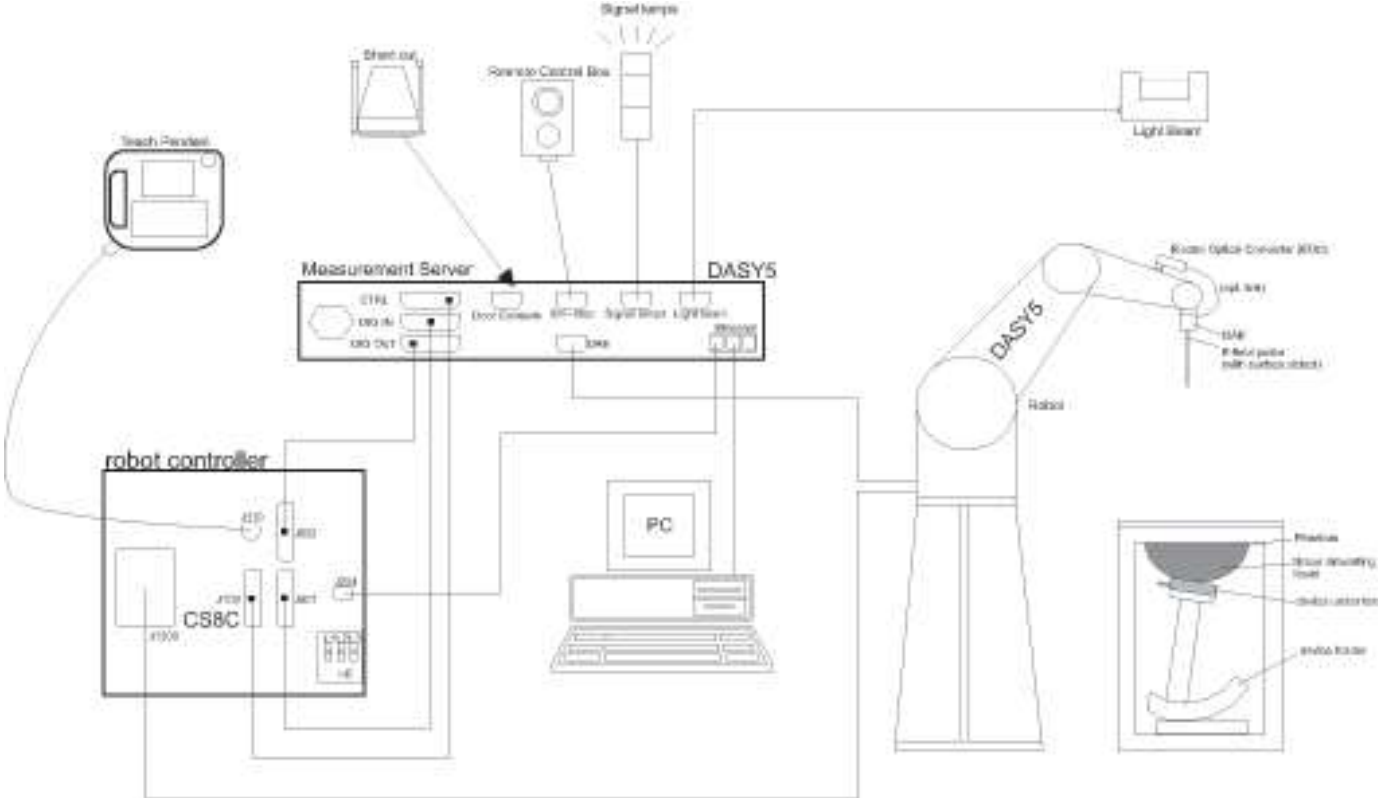
Component	Error, ±%	Prob Dist	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	**6.00**	Normal	1	1	6.00
Axial Isotropy	1.15	Rectangular	1.732	0.7	0.46
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7	0.93
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
Modulation Response	2.40	Rectangular	1.732	1	1.39
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner	0.40	Rectangular	1.732	1	0.23
Probe Positioning	2.90	Rectangular	1.732	1	1.67
Max.SAR Eval.	2.00	Rectangular	1.732	1	1.15
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder	3.60	Normal	1	1	3.60
Power Drift	5.00	Rectangular	1.732	1	2.89
Power Scaling	0.00	Rectangular	1.732	1	0.00
Phantom and Setup					
Phantom Uncertainty	6.10	Rectangular	1.732	1	3.52
SAR Correction	1.90	Rectangular	1.732	1	1.10
Liquid Permittivity - measurement	**3.19**	Rectangular	1.732	0.26	0.48
Liquid Conductivity - measurement	**2.87**	Rectangular	1.732	0.78	1.29
Liquid Permittivity - temperature uncertainty	0.40	Rectangular	1.732	0.23	0.05
Liquid Conductivity - temperature uncertainty	3.40	Rectangular	1.732	0.78	1.53
				Combined Standard Uncertainty Uc(y) =	10.02
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	20.03 %
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	1.59 dB

Measurement uncertainty for 30 MHz to 6 GHz averaged over 1 gram (Body)

Component	Error, ±%	Prob Dist	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	**6.55**	Normal	1	1	6.55
Axial Isotropy	1.15	Rectangular	1.732	0.7	0.46
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7	0.93
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
Modulation Response	2.40	Rectangular	1.732	1	1.39
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner	0.80	Rectangular	1.732	1	0.46
Probe Positioning	6.70	Rectangular	1.732	1	3.87
Max.SAR Eval.	4.00	Rectangular	1.732	1	2.31
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder	3.60	Normal	1	1	3.60
Power Drift	5.00	Rectangular	1.732	1	2.89
Power Scaling	0.00	Rectangular	1.732	1	0.00
Phantom and Setup					
Phantom Uncertainty	7.90	Rectangular	1.732	1	4.56
SAR Correction	1.90	Rectangular	1.732	1	1.10
Liquid Permittivity - measurement	**-3.87**	Rectangular	1.732	0.26	-0.58
Liquid Conductivity - measurement	**3.88**	Rectangular	1.732	0.78	1.75
Liquid Permittivity - temperature uncertainty	0.40	Rectangular	1.732	0.23	0.05
Liquid Conductivity - temperature uncertainty	3.40	Rectangular	1.732	0.78	1.53
				Combined Standard Uncertainty Uc(y) =	11.55
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	23.10 %
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	1.81 dB

5. Measurement System Description and Setup

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6. SAR Measurement Procedure

6.1. Normal SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01 (Draft)

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction.

6.2. Volume Scan Procedures

Step 1: Repeat Step 1-4 in Section 6.1

Step 2: Volume Scan
Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

Step 3: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

7. Device Under Test

7.1. General Information

Model: GT-S6310B GSM/GPRS 850/1900 and WCDMA/HSDPA/HSUPA 850 Phone with Bluetooth v3.0, 802.11b/g/n and Hotspot, EDGE Rx Only.	
Operating Configuration(s)	Held to head, Body-worn (Voice call)
Mobile Hotspot	☒ Mobile Hotspot (WiFi 2.4 GHz) ☐ Mobile Hotspot (WiFi 5 GHz) WiFi Hotspot mode permits the device to share its cellular data connection with other WiFi-enabled devices.
VoIP	Supported
RF Exposure Condition(s)	Head, Body-worn Accessory, Hotspot (Wireless router) -
Device Dimensions	Overall (Length x Width): 10.9 cm x 5.8 cm Overall Diagonal: 113.8 mm Display Diagonal: 84.6 mm
Accessory	Headset
Battery Options	☒ Standard – Lithium-ion battery, Rating 3.7 Vdc, 1300 mAh ☐ Extended (large capacity)

7.2. Wireless Technologies

Wireless Mode and Frequency Bands	GSM850/GSM1900, W-CDMA Band V, WiFi 802.11b/g/n, Bluetooth 2.4 GHz
Modulation	GSM (GMSK) / GPRS (GMSK) / EGPRS (8PSK), W-CDMA - UMTS Rel. 99 - HSDPA (Rel. 5, CAT 8) - HSUPA (Rel. 6, CAT 6) WiFi 802.11b/g/n HT20, Bluetooth Ver. 3.0
Duty Cycle	GSM Voice: 12.5%; GPRS 1 Slot: 12.5%; 2 Slots: 25%; 3 Slots: 37.5%; 4 Slots: 50% W-CDMA: 100% WiFi 802.11b/g/n: 100%
GPRS Multi-Slot Class	☐ Class 8 - One Up; ☐ Class 10 - Two Up; ☒ Class 12 - Four Up
Mobile Phone Capability	☐ Class A - Mobile phones can be connected to both GPRS and GSM services simultaneously. ☒ Class B - Mobile phones can be attached to both GPRS and GSM services, using one service at a time. ☐ Class C - Mobile phones are attached to either GPRS or GSM voice service. You need to switch manually between services

7.3. Simultaneous Transmission Condition

RF Exposure Condition	Capable Transmit Configurations
Head	GSM850/1900 MHz Voice + WiFi 2.4 GHz GSM850/1900 MHz Data + WiFi 2.4 GHz (VoIP) W-CDMA Band V + WiFi 2.4 GHz
Body-worn Accessory (Voice mode only)	GSM850/1900 MHz Voice + WiFi 2.4 GHz GSM850/1900 MHz Voice + BT GSM850/1900 MHz Data + WiFi 2.4 GHz (VoIP) GSM850/1900 MHz Data + BT (VoIP) W-CDMA Band V + WiFi 2.4 GHz W-CDMA Band V + BT
Wireless Router (Hotspot)	GPRS850/1900 MHz Data + WiFi 2.4 GHz W-CDMA Band V + WiFi 2.4 GHz
Note: WiFi 2.4 GHz and Bluetooth cannot transmit simultaneously.	

8. RF Exposure Conditions

Refer to Section 17 “Antenna Dimensions and Separation Distances” for the specific details of the antenna-to-antenna, antenna-to-edge(s) distances, and device orientation description.

8.1. Head Exposure Conditions

For WWAN and WiFi

Test Configurations	SAR Required	Note
Left Touch	Yes	
Left Tilt (15°)	Yes	
Right Touch	Yes	
Right Tilt (15°)	Yes	

8.2. Body-worn Accessory Exposure Conditions

For WWAN

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9.0 mm	Yes	

For WiFi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9.0 mm	Yes	

8.3. Hotspot Mode Exposure Conditions

For WWAN

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9.0 mm	Yes	
Edge 1	93 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR v01
Edge 2	7.0 mm	Yes	
Edge 3	5.0 mm	Yes	
Edge 4	6.0 mm	Yes	

For WiFi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9.0 mm	Yes	
Edge 1	9.0 mm	Yes	
Edge 2	3.0 mm	Yes	
Edge 3	81 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR v01
Edge 4	49 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR v01

9. RF Output Power Measurement

9.1. GSM850

	Min	Max
Tune-up Tolerance (dB):	-1.5	0.5

Output Power Tolerance (dBm)	Voice	GPRS 1 slot	GPRS 2 slots	GPRS 3 slots	GPRS 4 slots
Max	33.0	33.0	29.5	28.0	26.5
Target	**32.5**	**32.5**	**29.0**	**27.5**	**26.0**
Min	31.0	31.0	27.5	26.0	24.5

GSM (GMSK) - Voice Mode

Band	Ch No.	Freq. (MHz)	Avg burst Pwr (dBm)
850	128	824.2	32.7
	190	836.6	32.7
	251	848.8	32.7

GPRS (GMSK) - Coding Scheme: CS1

Band	Ch No.	Freq. (MHz)	Avg Power (dBm)				Avg Power (dBm)			
			1 time slot		2 time slots		3 time slots		4 time slots	
			Burst	Frame	Burst	Frame	Burst	Frame	Burst	Frame
850	128	824.2	32.7	**23.7**	29.2	23.2	27.8	23.5	26.4	23.4
	190	836.6	32.7	**23.7**	29.3	23.3	27.8	23.5	26.4	23.4
	251	848.8	32.7	**23.7**	29.3	23.3	27.8	23.5	26.4	23.4

EGPRS (8PSK) - Coding Scheme: MCS5

This mode is Rx only

Notes:

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Head & Body-worn Accessory: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 1 time slot, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) Mode because its output power is less than that of GPRS Mode

9.2. GSM1900

	Min	Max
Tune-up Tolerance (dB):	-1.5	0.5

Output Power Tolerance (dBm)	Voice	GPRS 1 slot	GPRS 2 slots	GPRS 3 slots	GPRS 4 slots
Max	30.0	30.0	30.0	27.5	25.5
Target	**29.5**	**29.5**	**29.5**	**27.0**	**25.0**
Min	28.0	28.0	28.0	25.5	23.5

GSM (GMSK) - Voice Mode

Band	Ch No.	Freq. (MHz)	Avg burst Pwr (dBm)
1900	512	1850.2	29.9
	661	1880.0	29.9
	810	1909.8	29.9

GPRS (GMSK) - Coding Scheme: CS1

Band	Ch No.	Freq. (MHz)	Avg Power (dBm)				Avg Power (dBm)			
			1 time slot		2 time slots		3 time slots		4 time slots	
			Burst	Frame	Burst	Frame	Burst	Frame	Burst	Frame
1900	512	1850.2	29.9	20.9	29.8	**23.8**	27.1	22.8	25.1	22.1
	661	1880.0	29.8	20.8	29.7	**23.7**	27.0	22.7	25.0	22.0
	810	1909.8	29.9	20.9	29.8	**23.8**	27.1	22.8	25.1	22.1

EGPRS (8PSK) - Coding Scheme: MCS5

This mode is Rx only

Notes:

The worst-case configuration and mode for SAR testing is determined to be as follows:

- Head & Body-worn Accessory: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 2 time slots, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) Mode because its output power is less than that of GPRS Mode

9.3. W-CDMA Band V

	Min	Max
Tune-up Tolerance (dB):	-1.5	0.5

Output Power Tolerance	Release 99 (dBm)	HSDPA (dBm)	HSUPA (dBm)
Max	22.5	22.5	22.5
Target	**22.0**	**22.0**	**22.0**
Min	20.5	20.5	20.5

Release 99

The following tests were completed according to the test requirements outlined in section 5.2 of the 3GPP TS34.121-1 specification. The DUT supports power Class 3, which has a nominal maximum output power of 24 dBm (+1.7/-3.7).

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Rel 99 (RMC, 12.2 kbps)	4132	826.4	22.4
		4183	836.6	22.3
		4233	846.6	22.3

HSDPA

The following 4 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
W-CDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set1			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	12/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	CM (dB)	0	1	1.5	1.5
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs =βhs/βc	30/15			

Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	22.4
		4183	836.6	22.5
		4233	846.6	22.5
	Subtest 2	4132	826.4	20.9
		4183	836.6	20.9
		4233	846.6	21.0
	Subtest 3	4132	826.4	19.5
		4183	836.6	19.5
		4233	846.6	19.5
	Subtest 4	4132	826.4	19.2
		4183	836.6	19.3
		4233	846.6	19.3

Maximum output power levels that are possible for all subtests reported.

Note(s):

KDB 941225 D01 – Body SAR is not required for HSDPA when the maximum average output of each RF channel with HSDPA active is less than ¼ dB higher than that measured without HSDPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is < 75% of the SAR limit.

HSPA (HSDPA & HSUPA)

The following 5 Sub-tests were completed according to Release 6 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	HSPA	HSPA	HSPA	HSPA	HSPA
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set1				
	HSUPA Test	HSUPA Loopback				
	Power Control Algorithm	Algorithm2				
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	15/15
	βec	209/225	12/15	30/15	2/15	24/15
	βc/βd	11/15	6/15	15/9	2/15	15/15
	βhs	22/15	12/15	30/15	4/15	30/15
	βed	1309/225	94/75	47/15 47/15	56/75	134/15
	CM (dB)	1.0	3.0	2.0	3.0	1.0
	MPR (dB)	0	2	1	2	0
HSDPA Specific Settings	DACK	8				
	DNAK	8				
	DCQI	8				
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	Ahs = βhs/βc	30/15				
HSUPA Specific Settings	D E-DPCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E_TFCIs	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27		E-TFCI 11 E-TFCI PO 4 E-TFCI 92 E-TFCI PO 18	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27	

Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	21.8
		4183	836.6	22.4
		4233	846.6	22.5
	Subtest 2	4132	826.4	20.6
		4183	836.6	20.6
		4233	846.6	20.7
	Subtest 3	4132	826.4	21.4
		4183	836.6	20.9
		4233	846.6	21.1
	Subtest 4	4132	826.4	19.7
		4183	836.6	19.8
		4233	846.6	19.9
	Subtest 5	4132	826.4	22.7
		4183	836.6	22.7
		4233	846.6	22.7

Note(s):

KDB 941225 D01 – Body SAR is not required for handsets with HSPA capabilities when the maximum average output of each RF channel with HSUPA/HSDPA active is less than ¼ dB higher than that measured without HSUPA/HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2kbps RMC is ≤ 75% of the SAR limit.

9.4. WiFi (2.4 GHz Band)

	Min	Max
Tune-up Tolerance (dB):	-1.5	0.5

Output Power Tolerance	IEEE 802.11 (dBm)		
	b	g	n (HT20)
Max	16.5	13.5	11.5
Target	**16.0**	**13.0**	**11.0**
Min	14.5	11.5	9.5

Required Test Channels per KDB 248227 D01

Mode	Band	**GHz**	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	**2.412**	1#	√	∇
		2.437	6	√	∇
		2.462	11#	√	∇

Notes:
√ = "default test channels"
∇ = possible 802.11g channels with maximum average output ¼ dB ≥ the "default test channels"
= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Results (Average Power)

Band (MHz)	Mode	Ch #	Freq. (MHz)	Avg Pwr (dBm)
2.4	802.11b	1	2412	16.3
		6	2437	16.3
		11	2462	16.3
	802.11g	1	2412	11.7
		6	2437	12.8
		11	2462	11.6
	802.11n (HT20)	1	2412	9.9
		6	2437	11.0
		11	2462	9.8

Note(s):
Per KDB 248227 D01, SAR is not required for 802.11g/HT20 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11b channels.

9.5. Bluetooth

Maximum tune-up tolerance limit is 7.5 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing. Refer to Section 14.1. Standalone SAR Test Exclusion Considerations

10. Tissue Dielectric Properties

IEEE Std 1528-2003 Table 2

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800 – 2000	40.0	1.40
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40

FCC OET Bulletin 65 Supplement C 01-01

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

10.1. Composition of Ingredients for the Tissue Material Used in the SAR Tests

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

10.2. Tissue Dielectric Parameter Check Results

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
4/15/2013	Head 835	e'	42.7700	Relative Permittivity (ϵ_r):	42.77	41.50	3.06	5
		e"	19.9400	Conductivity (σ):	0.93	0.90	**2.87**	5
	Head 820	e'	42.9300	Relative Permittivity (ϵ_r):	42.93	41.60	**3.19**	5
		e"	19.9700	Conductivity (σ):	0.91	0.90	1.34	5
	Head 850	e'	42.5900	Relative Permittivity (ϵ_r):	42.59	41.50	2.63	5
		e"	19.8500	Conductivity (σ):	0.94	0.92	2.53	5
4/15/2013	Body 835	e'	53.6500	Relative Permittivity (ϵ_r):	53.65	55.20	-2.81	5
		e"	21.5700	Conductivity (σ):	1.00	0.97	3.24	5
	Body 820	e'	53.7800	Relative Permittivity (ϵ_r):	53.78	55.28	-2.71	5
		e"	21.6300	Conductivity (σ):	0.99	0.97	1.83	5
	Body 850	e'	53.5000	Relative Permittivity (ϵ_r):	53.50	55.16	-3.00	5
		e"	21.4700	Conductivity (σ):	1.01	0.99	2.79	5
4/16/2013	Head 1900	e'	38.8900	Relative Permittivity (ϵ_r):	38.89	40.00	-2.78	5
		e"	13.4200	Conductivity (σ):	1.42	1.40	1.27	5
	Head 1850	e'	39.1000	Relative Permittivity (ϵ_r):	39.10	40.00	-2.25	5
		e"	13.3100	Conductivity (σ):	1.37	1.40	-2.20	5
	Head 1910	e'	38.8500	Relative Permittivity (ϵ_r):	38.85	40.00	-2.88	5
		e"	13.4100	Conductivity (σ):	1.42	1.40	1.73	5
4/17/2013	Body 1900	e'	51.3700	Relative Permittivity (ϵ_r):	51.37	53.30	-3.62	5
		e"	14.6600	Conductivity (σ):	1.55	1.52	1.89	5
	Body 1850	e'	51.5700	Relative Permittivity (ϵ_r):	51.57	53.30	-3.25	5
		e"	14.5100	Conductivity (σ):	1.49	1.52	-1.80	5
	Body 1910	e'	51.3300	Relative Permittivity (ϵ_r):	51.33	53.30	-3.70	5
		e"	14.6600	Conductivity (σ):	1.56	1.52	2.43	5
4/22/2013	Head 2450	e'	38.8600	Relative Permittivity (ϵ_r):	38.86	39.20	-0.87	5
		e"	13.4300	Conductivity (σ):	1.83	1.80	1.64	5
	Head 2410	e'	39.0000	Relative Permittivity (ϵ_r):	39.00	39.28	-0.71	5
		e"	13.3200	Conductivity (σ):	1.78	1.76	1.39	5
	Head 2475	e'	38.7700	Relative Permittivity (ϵ_r):	38.77	39.17	-1.02	5
		e"	13.4900	Conductivity (σ):	1.86	1.83	1.61	5
4/22/2013	Body 2450	e'	53.4100	Relative Permittivity (ϵ_r):	53.41	52.70	1.35	5
		e"	14.8700	Conductivity (σ):	2.03	1.95	**3.88**	5
	Body 2410	e'	53.5400	Relative Permittivity (ϵ_r):	53.54	52.76	1.48	5
		e"	14.7000	Conductivity (σ):	1.97	1.91	3.27	5
	Body 2475	e'	53.3000	Relative Permittivity (ϵ_r):	53.30	52.67	1.20	5
		e"	14.9800	Conductivity (σ):	2.06	1.99	3.85	5
4/23/2013	Body 835	e'	53.1500	Relative Permittivity (ϵ_r):	53.15	55.20	-3.71	5
		e"	21.7000	Conductivity (σ):	1.01	0.97	3.87	5
	Body 820	e'	53.3200	Relative Permittivity (ϵ_r):	53.32	55.28	-3.54	5
		e"	21.7100	Conductivity (σ):	0.99	0.97	2.21	5
	Body 850	e'	53.0200	Relative Permittivity (ϵ_r):	53.02	55.16	**-3.87**	5
		e"	21.5800	Conductivity (σ):	1.02	0.99	3.32	5

11. System Performance Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

11.1. System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm ± 0.5 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm ± 0.5 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

11.2. Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)		
				1g/10g	Head	Body
D835V2	4d002	10/24/12	835	1g	9.58	9.48
				10g	6.28	6.26
D1900V2	5d043	11/6/12	1900	1g	39.9	40.9
				10g	20.9	21.6
D2450V2	899	10/5/12	2450	1g	53.6	51.7
				10g	25.0	24.3

11.3. System Performance Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta ±10 %	Est./Zoom Ratio ±3 %	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W				
4/15/2013	D835V2	4d002	Head	1g	1.07	1.05	10.50	9.58	**9.60**	1.87	1,2
				10g	0.72	0.69	6.85	6.28	**9.08**		
4/15/2013	D835V2	4d002	Body	1g	1.05	1.03	10.3	9.48	8.65	1.90	
				10g	0.70	0.68	6.77	6.26	8.15		
4/16/2013	D1900V2	5d043	Head	1g	4.47	4.36	43.6	39.9	**9.27**	2.46	3,4
				10g	2.29	2.27	22.7	20.9	**8.61**		
4/17/2013	D1900V2	5d043	Body	1g	4.02	4.07	40.7	40.9	-0.49	-1.24	
				10g	2.02	2.16	21.6	21.6	0.00		
4/22/2013	D2450V2	899	Head	1g	5.36	5.29	52.9	53.6	-1.31	1.31	
				10g	2.35	2.40	24.0	25.0	-4.00		
4/22/2013	D2450V2	899	Body	1g	5.52	5.52	55.2	51.7	**6.77**	0.00	5,6
				10g	2.38	2.54	25.4	24.3	**4.53**		
4/23/2013	D835V2	4d002	Body	1g	1.00	0.99	9.92	9.48	4.64	0.80	
				10g	0.67	0.65	6.51	6.26	3.99		

12. SAR Test Results

12.1. GSM850

12.1.1. Head Exposure Conditions

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	Voice	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.472	0.51		
		251	848.8	33.0	32.7				1
Left Tilt (15°)	Voice	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.309	0.33		
		251	848.8	33.0	32.7				1
Right Touch	Voice	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.484	**0.52**	1	
		251	848.8	33.0	32.7				1
Right Tilt (15°)	Voice	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.294	0.32		
		251	848.8	33.0	32.7				1

Head Exposure Conditions (VoIP mode)

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	GPRS 1 Slot	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.444	0.48		
		251	848.8	33.0	32.7				1
Left Tilt (15°)	GPRS 1 Slot	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.295	0.32		
		251	848.8	33.0	32.7				1
Right Touch	GPRS 1 Slot	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.459	0.49		
		251	848.8	33.0	32.7				1
Right Tilt (15°)	GPRS 1 Slot	128	824.2	33.0	32.7				1
		190	836.6	33.0	32.7	0.280	0.30		
		251	848.8	33.0	32.7				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.1.2. Body-worn Accessory Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	Voice	10	128	824.2	33.0	32.7	0.765	0.82		
			190	836.6	33.0	32.7	0.865	**0.93**	2	
			251	848.8	33.0	32.7	0.818	0.88		
Front	Voice	10	128	824.2	33.0	32.7				1
			190	836.6	33.0	32.7	0.497	0.53		
			251	848.8	33.0	32.7				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.1.3. Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	GPRS 1 Slot	10	128	824.2	33.0	32.7	0.741	0.79		
			190	836.6	33.0	32.7	0.822	**0.88**	3	
			251	848.8	33.0	32.7	0.756	0.81		
Front	GPRS 1 Slot	10	128	824.2	33.0	32.7				1
			190	836.6	33.0	32.7	0.477	0.51		
			251	848.8	33.0	32.7				1
Edge 2	GPRS 1 Slot	10	128	824.2	33.0	32.7				1
			190	836.6	33.0	32.7	0.477	0.51		
			251	848.8	33.0	32.7				1
Edge 3	GPRS 1 Slot	10	128	824.2	33.0	32.7				1
			190	836.6	33.0	32.7	0.043	0.05		
			251	848.8	33.0	32.7				1
Edge 4	GPRS 1 Slot	10	128	824.2	33.0	32.7				1
			190	836.6	33.0	32.7	0.431	0.46		
			251	848.8	33.0	32.7				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.
2.

12.2. GSM1900

12.2.1. Head Exposure Conditions

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	Voice	512	1850.2	30.0	29.9				1
		661	1880.0	30.0	29.9	0.398	0.41		
		810	1909.8	30.0	29.9				1
Left Tilt (15°)	Voice	512	1850.2	30.0	29.9				1
		661	1880.0	30.0	29.9	0.182	0.19		
		810	1909.8	30.0	29.9				1
Right Touch	Voice	512	1850.2	30.0	29.9				1
		661	1880.0	30.0	29.9	0.262	0.27		
		810	1909.8	30.0	29.9				1
Right Tilt (15°)	Voice	512	1850.2	30.0	29.9				1
		661	1880.0	30.0	29.9	0.178	0.18		
		810	1909.8	30.0	29.9				1

Head Exposure Conditions (VoIP mode)

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	GPRS 2 slots	512	1850.2	30.0	29.8				1
		661	1880.0	30.0	29.7	0.714	**0.77**	4	
		810	1909.8	30.0	29.8				1
Left Tilt (15°)	GPRS 2 slots	512	1850.2	30.0	29.8				1
		661	1880.0	30.0	29.7	0.332	0.36		
		810	1909.8	30.0	29.8				1
Right Touch	GPRS 2 slots	512	1850.2	30.0	29.8				1
		661	1880.0	30.0	29.7	0.470	0.50		
		810	1909.8	30.0	29.8				1
Right Tilt (15°)	GPRS 2 slots	512	1850.2	30.0	29.8				1
		661	1880.0	30.0	29.7	0.320	0.34		
		810	1909.8	30.0	29.8				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.2.2. Body-worn Accessory Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	Voice	10	512	1850.2	30.0	29.9				1
			661	1880.0	30.0	29.9	0.348	**0.36**	5	
			810	1909.8	30.0	29.9				1
Front	Voice	10	512	1850.2	30.0	29.9				1
			661	1880.0	30.0	29.9	0.246	0.25		
			810	1909.8	30.0	29.9				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.2.3. Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	GPRS 2 slots	10	512	1850.2	30.0	29.8				1
			661	1880.0	30.0	29.7	0.690	**0.74**	6	
			810	1909.8	30.0	29.8				1
Front	GPRS 2 slots	10	512	1850.2	30.0	29.8				1
			661	1880.0	30.0	29.7	0.452	0.48		
			810	1909.8	30.0	29.8				1
Edge 2	GPRS 2 slots	10	512	1850.2	30.0	29.8				1
			661	1880.0	30.0	29.7	0.079	0.08		
			810	1909.8	30.0	29.8				1
Edge 3	GPRS 2 slots	10	512	1850.2	30.0	29.8				1
			661	1880.0	30.0	29.7	0.326	0.35		
			810	1909.8	30.0	29.8				1
Edge 4	GPRS 2 slots	10	512	1850.2	30.0	29.8				1
			661	1880.0	30.0	29.7	0.182	0.20		
			810	1909.8	30.0	29.8				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.3. W-CDMA Band V

12.3.1. Head Exposure Conditions

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	Rel 99 RMC 12.2kbps	4132	826.4	22.5	22.4				1
		4183	836.6	22.5	22.3	0.290	0.30		
		4233	846.6	22.5	22.3				1
Left Tilt (15°)	Rel 99 RMC 12.2kbps	4132	826.4	22.5	22.4				1
		4183	836.6	22.5	22.3	0.207	0.22		
		4233	846.6	22.5	22.3				1
Right Touch	Rel 99 RMC 12.2kbps	4132	826.4	22.5	22.4				1
		4183	836.6	22.5	22.3	0.307	**0.32**	7	
		4233	846.6	22.5	22.3				1
Right Tilt (15°)	Rel 99 RMC 12.2kbps	4132	826.4	22.5	22.4				1
		4183	836.6	22.5	22.3	0.196	0.21		
		4233	846.6	22.5	22.3				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.3.2. Body-worn Accessory & Hotspot Mode Exposure Conditions

Body-worn Accessory & Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	Rel 99 RMC 12.2kbps	10	4132	826.4	22.5	22.4				1
			4183	836.6	22.5	22.3	0.636	**0.67**	8	
			4233	846.6	22.5	22.3				1
Front	Rel 99 RMC 12.2kbps	10	4132	826.4	22.5	22.4				1
			4183	836.6	22.5	22.3	0.294	0.31		
			4233	846.6	22.5	22.3				1

Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Edge 2	Rel 99 RMC 12.2kbps	10	4132	826.4	22.5	22.4				1
			4183	836.6	22.5	22.3	0.317	0.33		
			4233	846.6	22.5	22.3				1
Edge 3	Rel 99 RMC 12.2kbps	10	4132	826.4	22.5	22.4				1
			4183	836.6	22.5	22.3	0.026	0.03		
			4233	846.6	22.5	22.3				1
Edge 4	Rel 99 RMC 12.2kbps	10	4132	826.4	22.5	22.4				1
			4183	836.6	22.5	22.3	0.260	0.27		
			4233	846.6	22.5	22.3				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.4. Wi-Fi (2.4 GHz Band)

12.4.1. Head Exposure Conditions

Test Position	Mode	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
				Tune-up limit	Meas.	Meas.	Scaled		
Left Touch	802.11b	1	2412	16.5	16.3				1
		6	2437	16.5	16.3	0.262	**0.27**	9	
		11	2462	16.5	16.3				1
Left Tilt (15°)	802.11b	1	2412	16.5	16.3				1
		6	2437	16.5	16.3	0.153	0.16		
		11	2462	16.5	16.3				1
Right Touch	802.11b	1	2412	16.5	16.3				1
		6	2437	16.5	16.3	0.158	0.17		
		11	2462	16.5	16.3				1
Right Tilt (15°)	802.11b	1	2412	16.5	16.3				1
		6	2437	16.5	16.3	0.175	0.18		
		11	2462	16.5	16.3				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.4.2. Body-worn Accessory Exposure Conditions

Body-worn Accessory & Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Rear	802.11b	10	1	2412	16.5	16.3				1
			6	2437	16.5	16.3	0.273	**0.29**	10	
			11	2462	16.5	16.3				1
Front	802.11b	10	1	2412	16.5	16.3				1
			6	2437	16.5	16.3	0.152	0.16		
			11	2462	16.5	16.3				1

Hotspot Mode Exposure Conditions

Test Position	Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.	Note
					Tune-up limit	Meas.	Meas.	Scaled		
Edge 1	802.11b	10	1	2412	16.5	16.3				1
			6	2437	16.5	16.3	0.049	0.05		
			11	2462	16.5	16.3				1
Edge 2	802.11b	10	1	2412	16.5	16.3				1
			6	2437	16.5	16.3	0.120	0.13		
			11	2462	16.5	16.3				1

Note(s):

1. According to KDB 447498, Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz.

12.5. Bluetooth

12.5.1. Standalone SAR Test Exclusion Considerations

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√f(GHz)] ≤ 3.0, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f_{(GHz)}$ is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

The test exclusions are applicable only when the minimum test separation distance is ≤ 50 mm and for transmission frequencies between 100 MHz and 6 GHz. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
7.5	6	10	2.480	0.9

Conclusion:

The computed value is < 3; therefore, Bluetooth qualifies for Standalone SAR test exclusion.

12.5.2. Estimated SAR

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[√$f_{(GHz)}$/x]* W/kg for test separation distances ≤ 50 mm;
  where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Estimated SAR Result for Body-worn Accessory Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 1-g SAR (W/kg)
Rear/Front	6	10	2.480	0.13

13. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

13.1. The Highest Measured SAR Configuration in Each Frequency Band

Head Exposure Condition

Not Applicable. Highest measured SAR is < 0.80 W/kg.

Body-worn Accessory Exposure Condition

Frequency band	Test Position	Mode	Ch. #	Freq. (MHz)	Measured 1g SAR (W/kg)
GSM850	Rear	Voice	190	836.6	0.865

Hotspot Mode Exposure Condition

Frequency band	Test Position	Mode	Ch. #	Freq. (MHz)	Measured 1g SAR (W/kg)
GSM850	Rear	GPRS 1 Slot	190	836.6	0.822

13.2. Repeated Measurement Results

Head Exposure Condition

Not Applicable. Highest measured SAR is < 0.80 W/kg.

Body-worn Accessory Exposure Condition

Frequency band	Test Position	Mode	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio	Note
					Original	Repeated		
GSM850	Rear	Voice	190	836.6	0.865	0.796	1.09	1

Hotspot Mode Exposure Condition

Frequency band	Test Position	Mode	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio	Note
					Original	Repeated		
GSM850	Rear	GPRS 1 Slot	190	836.6	0.822	0.735	1.12	1

Note(s):

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20.

14. Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance v05, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

A new threshold of 0.04 is also introduced in the draft KDB. Thus, in order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$$(SAR_1 + SAR_2)^{1.5} / Ri < 0.04$$

14.1. Head Exposure Conditions

Sum of the SAR for WWAN & WiFi 2.4 GHz Band

Test Position	Voice			Data	∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	W-CDMA Band V	WiFi 2.4 GHz	
Left Touch	0.51			0.27	0.78
		0.77		0.27	1.04
			0.30	0.27	0.58
Left Tilt	0.33			0.16	0.49
		0.36		0.16	0.52
			0.22	0.16	0.38
Right Touch	0.52			0.17	0.68
		0.50		0.17	0.67
			0.32	0.17	0.49
Right Tilt	0.32			0.18	0.50
		0.34		0.18	0.53
			0.21	0.18	0.39

Sum of the SAR with Scaled Values for the Worst-case Configuration

As the SAR for these configurations were measured at the maximum of tune-up tolerance limit, SAR scaling does not need to be applied.

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

14.2. Body-worn Accessory Exposure Conditions

Sum of the SAR for WWAN, WiFi 2.4 GHz Band, and Bluetooth

Test Position	Voice		Data	Data		∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	W-CDMA Band V	WiFi 2.4 GHz	Bluetooth 2.4 GHz	
Rear	0.93			0.29		**1.21**
		0.36		0.29		0.64
			0.67	0.29		0.95
	0.93				0.13	1.05
		0.36			0.13	0.48
			0.67		0.13	0.79
Front	0.53			0.16		0.69
		0.25		0.16		0.41
			0.31	0.16		0.47
	0.53				0.13	0.66
		0.25			0.13	0.38
			0.31		0.13	0.43

SAR to Peak Location Separation Ratio (SPLSR)
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:
Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

14.3. Hotspot Mode Exposure Conditions

Sum of the SAR for WWAN & WiFi 2.4 GHz Band

Test Position	Data				∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	W-CDMA Band V	WiFi 2.4 GHz	
Rear	0.88			0.29	1.17
		0.74		0.29	1.03
			0.67	0.29	0.95
Front	0.51			0.16	0.67
		0.48		0.16	0.64
			0.31	0.16	0.47
Edge 2	0.51			0.13	0.64
		0.09		0.13	0.21
			0.33	0.13	0.46

SAR to Peak Location Separation Ratio (SPLSR)
As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:
Simultaneous transmission SAR measurement (Volume Scan) is not required because the either sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

15. Appendixes

Refer to separated files for the following appendixes.

15.1. System Performance Check Plots

15.2. Highest SAR Test Plots

15.3. Calibration Certificate for E-Field Probe EX3DV4 - SN 3885

15.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3901

15.5. Calibration Certificate for D835V2 - SN 4d002

15.6. Calibration Certificate for D1900V2 - SN 5d043

15.7. Calibration Certificate for D2450V2 - SN 899