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

SAR EVALUATION REPORT

For
Portable Handset

Model: GT-S6312
FCC ID: A3LGTS6312

Report Number: 12I14770-03
Issue Date: 1/22/2013

Prepared for
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	1/22/2013	Initial Issue	--

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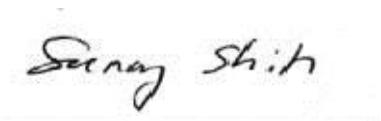
1. Attestation of Test Results

Applicant	Samsung Electronics Co., Ltd.		
DUT description	Portable Handset		
Model	GT-S6312		
Test device is	An identical prototype		
Device category	Portable		
Exposure category	General Population/Uncontrolled Exposure		
Date tested	12/26/2012 – 12/28/12		
RF Exposure Rule	Freq. Range	Highest Reported SAR	Limit
22	824-849 MHz	Head: 0.171 W/kg (Right Touch) Body-worn: 0.338 W/kg (Rear) Hotspot: W/kg 0.485 (Rear)	1.6 W/kg
24	1850-1910 MHz	Head: 0.511 W/kg (Left Touch) Body-worn: 0.515 W/kg (Rear) Hotspot: W/kg 0.929(Rear)	
15.247 (WiFi)	2412-2462 MHz	Head: 0.197 W/kg (Left Touch) Body-worn: 0.215 W/kg (Rear) Hotspot: 0.215 W/kg (Rear)	
Simultaneous transmission condition		1.144 W/kg (refer to Section 14.4) (The highest SAR across exposure conditions)	
Applicable Standards			Test Results
FCC Published RF exposure KDB procedures, TCB workshop updates and OET Bulletin 65 Supplement C, IEEE Std 1528-2003 and IEEE Std 1528a-2005			Pass

UL CCS 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 For UL CCS By:



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Prepared By:

Bobby Bayani
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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 and the following FCC Published RF exposure KDB procedures:

- 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

3. Facilities and Accreditation

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

UL CCS 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		
				MM	DD	Year
S-Parameter Network Analyzer	Agilent	8753ES	MY40001647	6	27	2013
Dielectronic Probe kit	SPEAG	SM DAK 040 CA	1082	9	18	2013
ENA Series Network Analyzer	Agilent	E5071B	MY42100131	2	11	2013
Dielectronic Probe kit	HP	85070E	594	N/A		
Synthesized Signal Generator	HP	8665B	3438A00633	2	22	2013
Power Meter	HP	438A	3513U04320	9	17	2013
Power Sensor A	HP	8481A	2237A31744	8	17	2013
Power Sensor B	HP	8481A	3318A95392	8	17	2013
Amplifier	MITEQ	4D00400600-50-30P	1622052	N/A		
Directional coupler	Werlatone	C8060-102	2149	N/A		
Synthesized Signal Generator	HP	8665B	3744A01084	5	3	2013
Power Meter	HP	438A	2822A05684	10	7	2013
Power Sensor A	HP	8481A	2702A66876	8	1	2013
Power Sensor B	HP	8482A	2349A08568	4	14	2013
Amplifier	MITEQ	4D00400600-50-30P	1620606	N/A		
Directional coupler	Werlatone	C8060-102	2141	N/A		
Base Station Simulator	R & S	CMU200	106301	6	6	2013
Base Station Simulator	R & S	CMU200	118339	5	20	2013
Thermometer	TRACEABLE	4242	122529162	9	19	2013
E-Field Probe	SPEAG	EX3DV4	3686	2	16	2013
E-Field Probe	SPEAG	EX3DV4	3871	8	20	2013
Data Acquisition Electronics	SPEAG	DAE4	1259	2	13	2013
Data Acquisition Electronics	SPEAG	DAE4	1343	8	20	2013
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
Power Meter	Agilent	N1912A	MY52310061	7	5	2013
Power Sensor Ch A	Agilent	N1921A	MY52260009	7	5	2013
Power Sensor Ch B	Agilent	N1921A	MY52270022	7	21	2013

4.2. Measurement Uncertainty

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram (Head)

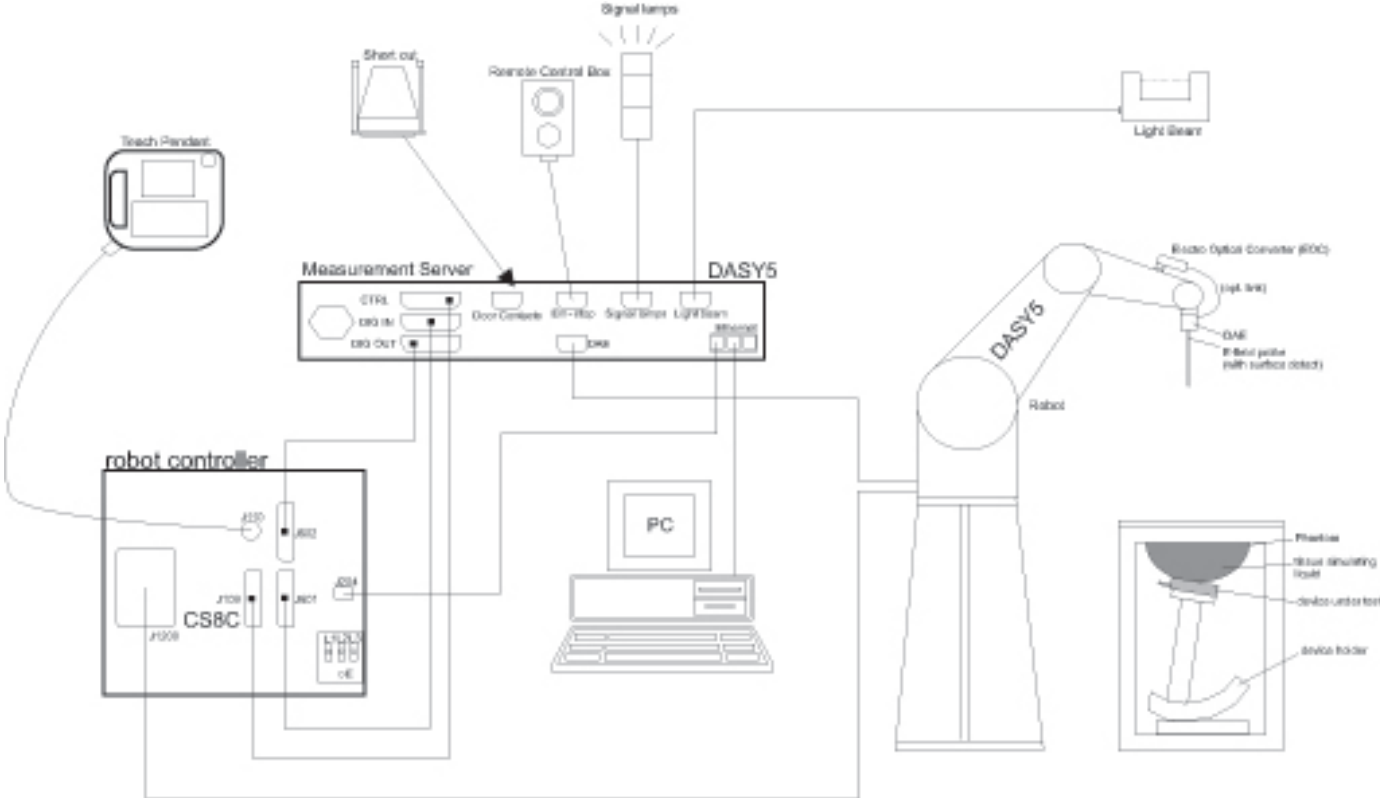
Component	Error, %	Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1)	**6.00**	Normal	1	1	6.00
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
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 Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement	**2.92**	Normal	1	0.64	1.87
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement uncertainty	**-4.46**	Normal	1	0.6	-2.68
				Combined Standard Uncertainty Uc(y) =	10.27
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	20.54 %
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	1.62 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)	**6.00**	Normal	1	1	6.00
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
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
Post-processing	4.00	Rectangular	1.732	1	2.31
Test Sample Related					
Device Holder	3.60	Normal	1	1	3.60
Test Sample Positioning	3.00	Normal	1	1	3.00
Power Scaling	1.00	Rectangular	1.732	1	0.58
Power Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Setup					
Phantom Uncertainty	7.90	Rectangular	1.732	1	4.56
SAR Correction	1.90	Rectangular	1.732	1	1.10
Liquid Conductivity - measurement	**4.37**	Rectangular	1.732	0.78	1.97
Liquid Permittivity - measurement	**-4.48**	Rectangular	1.732	0.26	-0.67
Liquid Conductivity - temperature uncertainty	5.22	Rectangular	1.732	0.78	2.35
Liquid Permittivity - temperature uncertainty	0.84	Rectangular	1.732	0.23	0.11
				Combined Standard Uncertainty Uc(y) =	11.57
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =	23.15 %
				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-S6312 Portable Handset	
Operating Configuration(s)	Held to head, Body-worn (Voice call)
RF Exposure Condition(s)	Head, Body-worn Accessory, Hotspot (wireless router) - WiFi Hotspot mode permits the device to share its cellular data connection with other 2.4 GHz WiFi-enabled devices (channels 1 - 11).
Device dimension (L x W)	10.9 cm x 5.8 cm
Accessory	Headset

7.2. Band and Air Interfaces

Wireless Mode and Frequency Bands	GSM850/GSM1900, WiFi 802.11b/g/n, Bluetooth 2.4 GHz
Modulation	GSM/GPRS/EGPRS (Rx only), WiFi 802.11b/g/n HT20, Bluetooth 3.0+EDR
Duty Cycle	GSM Voice: 12.5%; GPRS 1 Slot: 12.5%; 2 Slots: 25%; 3 Slots: 37.5%; 4 Slots: 50% 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
DTM (Dual Tx Mode) Class	Not Supported

7.3. Simultaneous Transmission Condition

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

8. 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 mm	Yes	

For WiFi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9 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 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 mm	Yes	
Edge 3	5 mm	Yes	
Edge 4	6 mm	Yes	

For WiFi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	0 mm	Yes	
Front	9 mm	Yes	
Edge 1	9 mm	Yes	
Edge 2	3 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

Target Power:

GSM (Voice): 32.5 dBm
GPRS 1 slot: 32.5 dBm
GPRS 2 slots: 31.5 dBm
GPRS 3 slots: 29.2 dBm
GPRS 4 slots: 27.2 dBm

Tune-up Tolerance: -1.5 dB / +0.5 dB

GSM (GMSK) - Voice Mode

Band	Ch No.	Freq. (MHz)	Avg burst Pwr (dBm)
850	128	824.2	32.3
	190	836.6	32.5
	251	848.8	32.6

GPRS (GMSK) - Coding Scheme: CS1

Band	Ch No.	Freq. (MHz)	Power (dBm)				Power (dBm)			
			1 time slot		2 time slots		3 time slots		4 time slots	
			Burst Avg	Frame Avg	Burst Avg	Frame Avg	Burst Avg	Frame Avg	Burst Avg	Frame Avg
850	128	824.2	32.3	23.3	**31.3**	**25.3**	28.9	24.6	27.2	24.2
	190	836.6	32.5	23.5	**31.4**	**25.4**	28.9	24.6	27.0	24.0
	251	848.8	32.6	23.6	**31.5**	**25.5**	29.1	24.8	27.2	24.2

8PSK (EGPRS) Mode - 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

9.2. GSM1900

Target Power:

GSM (Voice): 29.5 dBm
GPRS 1 slot: 29.5 dBm
GPRS 2 slots: 28.5 dBm
GPRS 3 slots: 26.2 dBm
GPRS 4 slots: 24.2 dBm

Tune-up Tolerance: -1.5 dB / +0.5 dB

GSM (GMSK) - Voice Mode

Band	Ch No.	Freq. (MHz)	Avg burst Pwr (dBm)
1900	512	1850.2	30.0
	661	1880.0	29.9
	810	1909.8	29.9

GPRS (GMSK) - Coding Scheme: CS1

Band	Ch No.	Freq. (MHz)	Power (dBm)				Power (dBm)			
			1 time slot		2 time slots		3 time slots		4 time slots	
			Burst Avg	Frame Avg	Burst Avg	Frame Avg	Burst Avg	Frame Avg	Burst Avg	Frame Avg
1900	512	1850.2	30.0	21.0	**28.6**	**22.6**	26.6	22.3	24.5	21.5
	661	1880.0	29.9	20.9	**28.5**	**22.5**	26.4	22.1	24.4	21.4
	810	1909.8	29.9	20.9	**28.5**	**22.5**	26.4	22.1	24.4	21.4

8PSK (EGPRS) Mode - 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

9.3. WiFi (2.4 GHz Band)

Target Power: b mode: 16.0 dBm
g mode: 14.0 dBm
n HT20 mode: 12.0 dBm
Tune-up Tolerance: -1.5 dB / +0.5 dB

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.

Mode	Ch #	Freq. (MHz)	Avg Pwr (dBm)	Note
802.11b	1	2412	**16.4**	
	6	2437	**16.5**	
	11	2462	**16.3**	
802.11g	1	2412	13.8	
	6	2437	14.3	
	11	2462	13.8	
802.11n (HT20)	1	2412	12.3	
	6	2437	12.3	
	11	2462	12.0	

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.

9.4. Bluetooth

Mode	Channel #	Freq. (MHz)	Conducted Avg Power	
			(dBm)	(mW)
V3.0 + EDR, GFSK	0	2402	4.9	3.07
	39	2441	5.4	3.44
	78	2480	5.5	3.55
V3.0 + EDR, π/4 DQPSK	0	2402	3.4	2.19
	39	2441	4.4	2.75
	78	2480	4.5	2.82
V3.0 + EDR, 8-DPSK	0	2402	3.4	2.19
	39	2441	4.4	2.75
	78	2480	4.5	2.82

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

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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 ±(%)
12/26/2012	Body 2450	e'	51.9000	Relative Permittivity (ϵ_r):	51.90	52.70	-1.52	5
		e"	14.1000	Conductivity (σ):	1.92	1.95	-1.50	5
	Body 2410	e'	52.0300	Relative Permittivity (ϵ_r):	52.03	52.76	-1.38	5
		e"	13.9200	Conductivity (σ):	1.87	1.91	-2.21	5
	Body 2475	e'	51.8200	Relative Permittivity (ϵ_r):	51.82	52.67	-1.61	5
		e"	14.1700	Conductivity (σ):	1.95	1.99	-1.77	5
12/26/2012	Head 2450	e'	37.5200	Relative Permittivity (ϵ_r):	37.52	39.20	-4.29	5
		e"	13.3900	Conductivity (σ):	1.82	1.80	1.34	5
	Head 2410	e'	37.6800	Relative Permittivity (ϵ_r):	37.68	39.28	-4.07	5
		e"	13.2600	Conductivity (σ):	1.78	1.76	0.93	5
	Head 2475	e'	37.4200	Relative Permittivity (ϵ_r):	37.42	39.17	-4.46	5
		e"	13.4500	Conductivity (σ):	1.85	1.83	1.31	5
12/26/2012	Head 835	e'	41.4500	Relative Permittivity (ϵ_r):	41.45	41.50	-0.12	5
		e"	19.9500	Conductivity (σ):	0.93	0.90	2.92	5
	Head 820	e'	41.6400	Relative Permittivity (ϵ_r):	41.64	41.60	0.09	5
		e"	20.0000	Conductivity (σ):	0.91	0.90	1.49	5
	Head 850	e'	41.2300	Relative Permittivity (ϵ_r):	41.23	41.50	-0.65	5
		e"	19.8600	Conductivity (σ):	0.94	0.92	2.58	5
12/27/2012	Body 1900	e'	50.9700	Relative Permittivity (ϵ_r):	50.97	53.30	-4.37	5
		e"	14.4100	Conductivity (σ):	1.52	1.52	0.16	5
	Body 1850	e'	51.2300	Relative Permittivity (ϵ_r):	51.23	53.30	-3.88	5
		e"	14.2800	Conductivity (σ):	1.47	1.52	-3.36	5
	Body 1910	e'	50.9100	Relative Permittivity (ϵ_r):	50.91	53.30	-4.48	5
		e"	14.4600	Conductivity (σ):	1.54	1.52	1.03	5
12/27/2012	Head 1900	e'	38.7900	Relative Permittivity (ϵ_r):	38.79	40.00	-3.03	5
		e"	13.3800	Conductivity (σ):	1.41	1.40	0.97	5
	Head 1850	e'	39.0600	Relative Permittivity (ϵ_r):	39.06	40.00	-2.35	5
		e"	13.3100	Conductivity (σ):	1.37	1.40	-2.20	5
	Head 1910	e'	38.7700	Relative Permittivity (ϵ_r):	38.77	40.00	-3.07	5
		e"	13.4000	Conductivity (σ):	1.42	1.40	1.65	5
12/28/2012	Body 835	e'	53.1312	Relative Permittivity (ϵ_r):	53.13	55.20	-3.75	5
		e"	21.8058	Conductivity (σ):	1.01	0.97	4.37	5
	Body 820	e'	53.2637	Relative Permittivity (ϵ_r):	53.26	55.28	-3.64	5
		e"	21.9775	Conductivity (σ):	1.00	0.97	3.47	5
	Body 850	e'	52.9916	Relative Permittivity (ϵ_r):	52.99	55.16	-3.93	5
		e"	21.6727	Conductivity (σ):	1.02	0.99	3.77	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				
12/26/2012	D2450V2	899	Head	1g	5.24	5.11	51.1	53.6	-4.66	2.48	
				10g	2.27	2.33	23.3	25.0	-6.80		
12/26/2012	D2450V2	899	Body	1g	5.38	5.38	53.8	51.7	**4.06**	0.00	1,2
				10g	2.32	2.48	24.8	24.3	2.06		
12/26/2012	D835V2	4d002	Head	1g	1.03	1.02	10.20	9.58	**6.47**	0.97	3,4
				10g	0.70	0.67	6.66	6.28	6.05		
12/27/2012	D1900V2	5d043	Head	1g	4.06	3.91	39.1	39.9	-2.01	3.69	
				10g	2.08	2.01	20.1	20.9	-3.83		
12/27/2012	D1900V2	5d043	Body	1g	4.05	4.00	40.0	40.9	-2.20	1.23	
				10g	2.06	2.09	20.9	21.6	-3.24		
12/28/2012	D835V2	4d002	Body	1g	1.01	0.99	9.85	9.48	3.90	2.48	
				10g	0.68	0.65	6.47	6.26	3.35		

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	32.3				1
		190	836.6	33.0	32.5	0.135	0.151	1	
		251	848.8	33.0	32.6				1
Left Tilt (15°)	Voice	128	824.2	33.0	32.3				1
		190	836.6	33.0	32.5	0.0923	0.104	2	
		251	848.8	33.0	32.6				1
Right Touch	Voice	128	824.2	33.0	32.3				1
		190	836.6	33.0	32.5	0.152	**0.171**	3	
		251	848.8	33.0	32.6				1
Right Tilt (15°)	Voice	128	824.2	33.0	32.3				1
		190	836.6	33.0	32.5	0.0978	0.110	4	
		251	848.8	33.0	32.6				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	32.3				1
			190	836.6	33.0	32.5	0.301	**0.338**	5	
			251	848.8	33.0	32.6				1
Front	Voice	10	128	824.2	33.0	32.3				1
			190	836.6	33.0	32.5	0.135	0.151	6	
			251	848.8	33.0	32.6				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 2 slots	10	128	824.2	32.0	31.3				1
			190	836.6	32.0	31.4	0.422	**0.485**	7	
			251	848.8	32.0	31.5				1
Front	GPRS 2 slots	10	128	824.2	32.0	31.3				1
			190	836.6	32.0	31.4	0.192	0.220	8	
			251	848.8	32.0	31.5				1
Edge 2	GPRS 2 slots	10	128	824.2	32.0	31.3				1
			190	836.6	32.0	31.4	0.207	0.238	9	
			251	848.8	32.0	31.5				1
Edge 3	GPRS 2 slots	10	128	824.2	32.0	31.3				1
			190	836.6	32.0	31.4	0.0177	0.020	10	
			251	848.8	32.0	31.5				1
Edge 4	GPRS 2 slots	10	128	824.2	32.0	31.3				1
			190	836.6	32.0	31.4	0.178	0.204	11	
			251	848.8	32.0	31.5				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. 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	30.0				1
		661	1880.0	30.0	29.9	0.499	**0.511**	1	
		810	1909.8	30.0	29.9				1
Left Tilt (15°)	Voice	512	1850.2	30.0	30.0				1
		661	1880.0	30.0	29.9	0.242	0.248	2	
		810	1909.8	30.0	29.9				1
Right Touch	Voice	512	1850.2	30.0	30.0				1
		661	1880.0	30.0	29.9	0.378	0.387	3	
		810	1909.8	30.0	29.9				1
Right Tilt (15°)	Voice	512	1850.2	30.0	30.0				1
		661	1880.0	30.0	29.9	0.262	0.268	4	
		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.

12.2.2. 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	30.0				1
			661	1880.0	30.0	29.9	0.503	**0.515**	5	
			810	1909.8	30.0	29.9				1
Front	Voice	10	512	1850.2	30.0	30.0				1
			661	1880.0	30.0	29.9	0.358	0.366	6	
			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	29.0	28.6	0.716	0.785	7	
			661	1880.0	29.0	28.5	0.762	0.855	8	
			810	1909.8	29.0	28.5	0.828	**0.929**	9	
Front	GPRS 2 slots	10	512	1850.2	29.0	28.6				1
			661	1880.0	29.0	28.5	0.549	0.616	10	
			810	1909.8	29.0	28.5				1
Edge 2	GPRS 2 slots	10	512	1850.2	29.0	28.6				1
			661	1880.0	29.0	28.5	0.0848	0.095	11	
			810	1909.8	29.0	28.5				1
Edge 3	GPRS 2 slots	10	512	1850.2	29.0	28.6				1
			661	1880.0	29.0	28.5	0.363	0.407	12	
			810	1909.8	29.0	28.5				1
Edge 4	GPRS 2 slots	10	512	1850.2	29.0	28.6				1
			661	1880.0	29.0	28.5	0.180	0.202	13	
			810	1909.8	29.0	28.5				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. Wi-Fi (2.4 GHz Band)

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	802.11b	1	2412	16.5	16.4				1
		6	2437	16.5	16.5	0.197	**0.197**	1	
		11	2462	16.5	16.3				1
Left Tilt (15°)	802.11b	1	2412	16.5	16.4				1
		6	2437	16.5	16.5	0.102	0.102	2	
		11	2462	16.5	16.3				1
Right Touch	802.11b	1	2412	16.5	16.4				1
		6	2437	16.5	16.5	0.109	0.109	3	
		11	2462	16.5	16.3				1
Right Tilt (15°)	802.11b	1	2412	16.5	16.4				1
		6	2437	16.5	16.5	0.115	0.115	4	
		11	2462	16.5	16.3				1

Note(s):
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 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	16.4				1
			6	2437	16.5	16.5	0.215	**0.215**	5	
			11	2462	16.5	16.3				1
Front	802.11b	10	1	2412	16.5	16.4				1
			6	2437	16.5	16.5	0.0786	0.0786	7	
			11	2462	16.5	16.3				1

Note(s):
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.

12.3.3. Hotspot Mode Exposure Conditions

Rear and Front Test Configuration is covered by 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		
Edge 1	802.11b	10	1	2412	16.5	16.4				1
			6	2437	16.5	16.5	0.0417	0.0417	8	
			11	2462	16.5	16.3				1
Edge 2	802.11b	10	1	2412	16.5	16.4				1
			6	2437	16.5	16.5	0.0861	0.0861	9	
			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.

13. Summary of Highest SAR Values

Results for highest SAR values for each frequency band and mode

Technology/ Band	Test configuration		Mode	Dist. (mm)	Freq. (MHz)	Power (dBm)	1g SAR (W/kg)
	Exposure	Position					
GSM850	Body	Rear	GPRS 2 slots	10	836.6	31.4	0.422
GSM1900	Body	Rear	GPRS 2 slots	10	1909.8	28.5	0.828
WiFi 2.4 GHz	Body	Rear	802.11b 1Mbps	10	2437	16.5	0.215

13.1. SAR Measurement Variability and Uncertainty

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.

Wireless Technologies	Test Configuration		Mode	Dist. (mm)	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio	Plot No.	Note
	Exposure	Position					Original	Repeated			
GSM850	Body	Rear	GPRS 2 Slots	10	190	836.6	0.422	N/A	N/A	N/A	2
GSM1900	Body	Rear	GPRS 2 Slots	10	810	1909.8	0.828	0.797	1.04	1	1
WiFi 2.4 GHz	Body	Rear	802.11b 1Mbps	10	6	2437.0	0.215	N/A	N/A	N/A	2

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.
2. Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg.
3. Repeated measurement was performed on the highest measured SAR configuration in each frequency band only.

13.2. SAR Plots (from Summary of Highest Measured SAR Values)

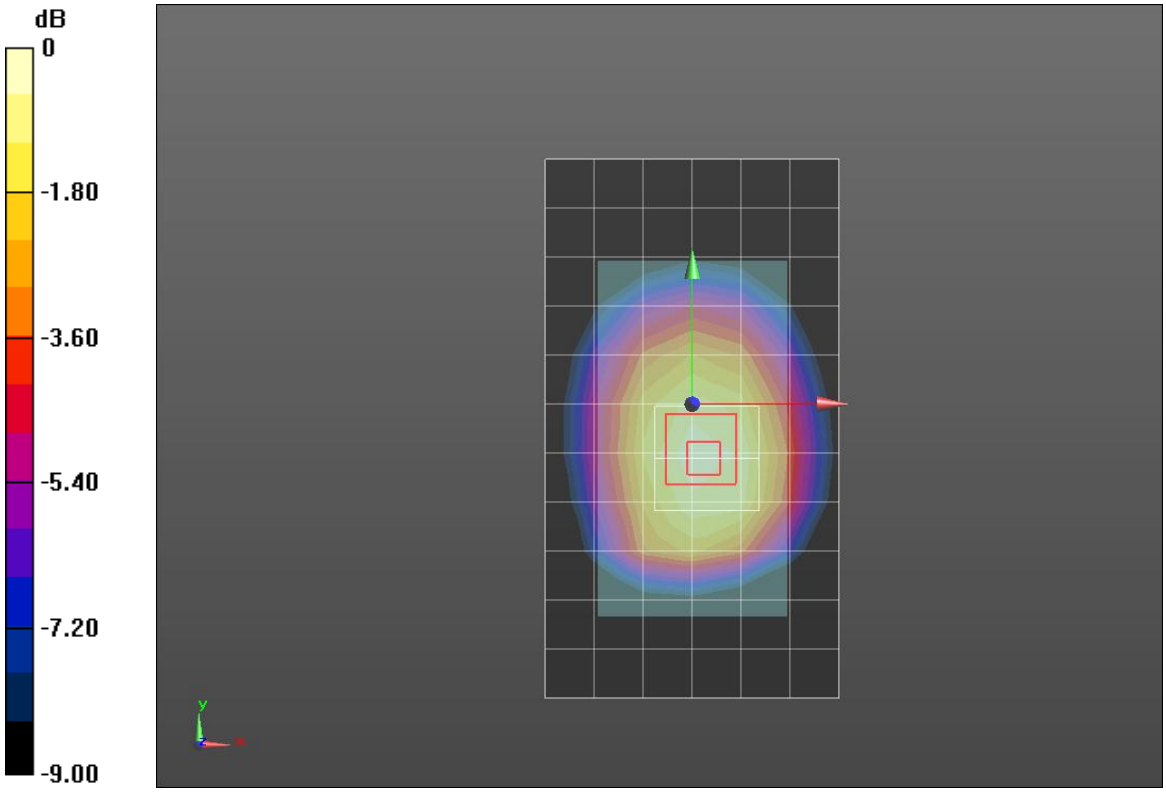
Test Laboratory: UL CCS SAR Lab E Date: 12/28/2012

GSM850

Frequency: 836.6 MHz; Duty Cycle: 1:4; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 836.6 MHz; σ = 1.014 mho/m; ε_r = 53.112; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1343; Calibrated: 8/20/2012
- Probe: EX3DV4 - SN3871; ConvF(9.68, 9.68, 9.68); Calibrated: 8/20/2012;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 B; Type: QDOVA002AA; Serial: 1180

Rear/GPRS 2 slots_ch 190/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.476 W/kg

Rear/GPRS 2 slots_ch 190/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.023 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.573 W/kg
SAR(1 g) = 0.422 W/kg; SAR(10 g) = 0.301 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.492 W/kg



0 dB = 0.492 W/kg = -3.08 dBW/kg

Test Laboratory: UL CCS SAR Lab E Date: 12/27/2012

GSM1900

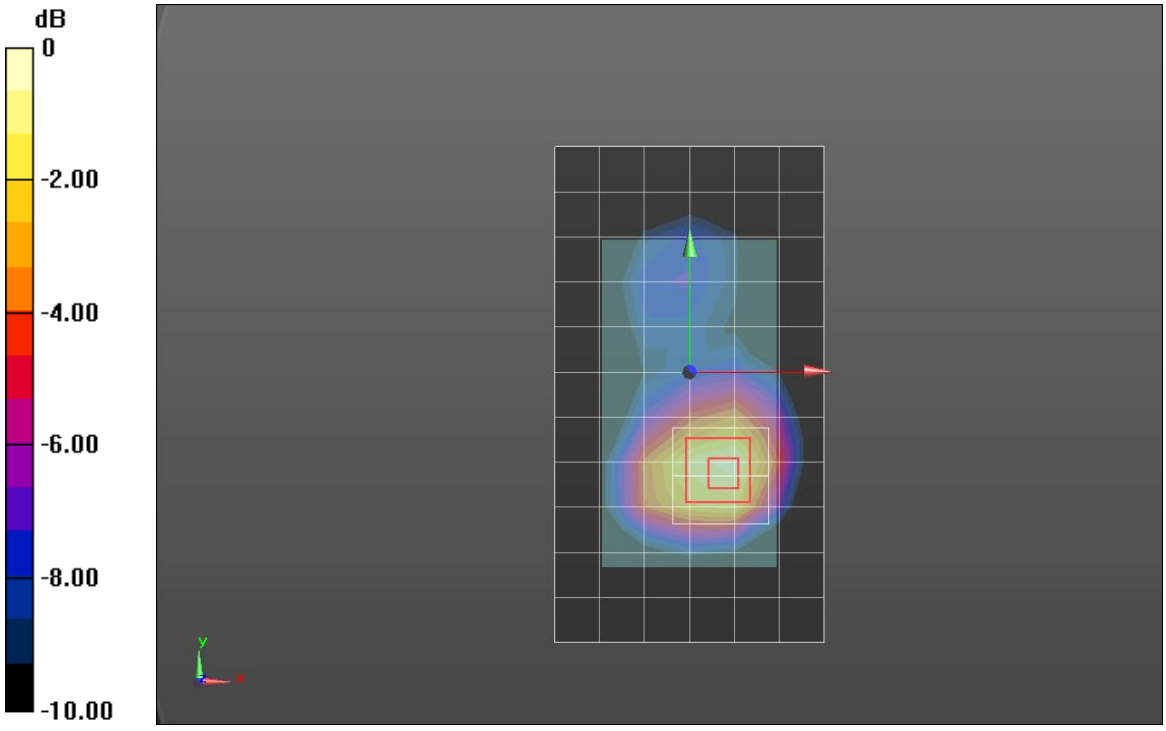
Frequency: 1909.8 MHz; Duty Cycle: 1:4; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used: f = 1910 MHz; σ = 1.536 mho/m; ε_r = 50.911; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1343; Calibrated: 8/20/2012
- Probe: EX3DV4 - SN3871; ConvF(7.83, 7.83, 7.83); Calibrated: 8/20/2012;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection (Locations From Previous Scan Used)), Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 A; Type: QDOVA002AA; Serial: 1180

Rear/GPRS 2slots_ch 810/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.998 W/kg

Rear/GPRS 2slots_ch 810/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 25.697 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.39 W/kg
SAR(1 g) = 0.828 W/kg; SAR(10 g) = 0.482 W/kg
Maximum value of SAR (measured) = 1.06 W/kg



0 dB = 1.06 W/kg = 0.25 dBW/kg

Test Laboratory: UL CCS SAR Lab B Date: 12/27/2012

WiFi2.4

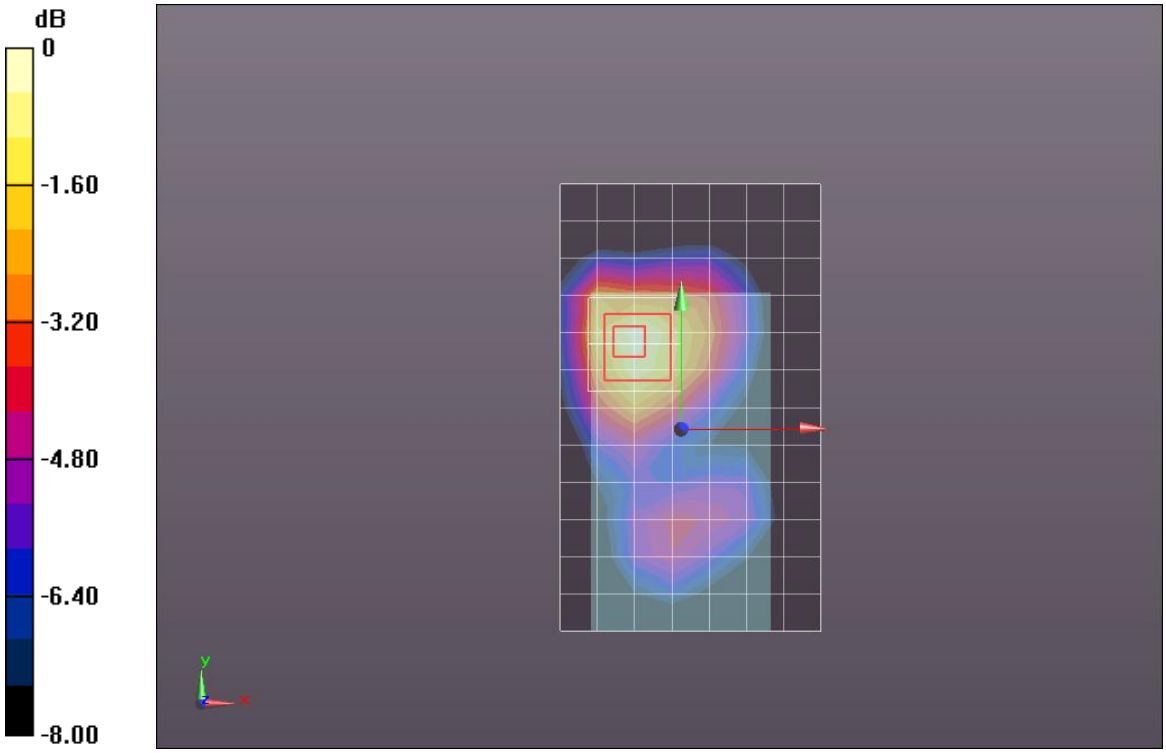
Frequency: 2437 MHz; Duty Cycle: 1:1; Room Ambient Temperature: 24.0°C; Liquid Temperature: 23.0°C
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.903 mho/m; ε_r = 51.922; ρ = 1000 kg/m^3
DASY5 Configuration:
- Area Scan Setting: Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Electronics: DAE4 Sn1259; Calibrated: 2/13/2012
- Probe: EX3DV4 - SN3686; ConvF(6.7, 6.7, 6.7); Calibrated: 2/16/2012;
- Sensor-Surface: 2.5mm (Mechanical Surface Detection)
- Phantom: ELI v5.0 (A); Type: QDOVA001BB; Serial: 1120

Rear/802.11b_ch 6 10mm/Area Scan (8x13x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.271 W/kg

Rear/802.11b_ch 6 10mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 11.957 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.401 W/kg
SAR(1 g) = 0.215 W/kg; SAR(10 g) = 0.118 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.283 W/kg



0 dB = 0.283 W/kg = -5.48 dBW/kg

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. Estimated SAR for Bluetooth

14.1.1. Standalone SAR Test Exclusion

Based on the criteria for Standalone SAR test exclusion listed in Section 4.3.1. of KDB 447498 D01 General RF Exposure Guidance v05:

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

Body-worn Accessory Exposure Conditions

Max. Power of Channel		Min. Test Spearation Distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
6	4	10	2.480	0.6

Conclusion:

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

14.1.2. Estimated SAR

As SAR was not measured for Bluetooth, estimated Standalone SAR values were computed for Bluetooth for the purpose of Simultaneous Transmission SAR Analysis using the following formula:

(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)]·[$\sqrt{f_{(GHz)}}/x$] W/kg,

With x = 7.5 for 1-g SAR

This standalone SAR estimation was performed in accordance with the separation distances listed in Section 17.“Antenna Locations” and only at the applicable simultaneous transmission test positions. The estimated SAR results are as follow:

Test Position	Max. Power of Channel (mW)	Min. Test Spearation Distance (mm)	Frequency (GHz)	Estimated 1-g SAR Values (W/kg)
Rear/Front	6	10	2.480	0.126

Note(s):

1. Power and distance are rounded to the nearest mW and mm before calculation
2. If the minimum test separation distance is <5mm then 5mm is used in the calculation

14.2. Head Exposure Conditions

Sum of the SAR for GSM & WiFi 2.4 GHz Band

Test Position	Voice		Data	∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	WiFi 2.4 GHz	
Left Touch	0.151		0.197	0.348
		0.511	0.197	0.708
Left Tilt	0.104		0.102	0.206
		0.248	0.102	0.350
Right Touch	0.171		0.109	0.280
		0.387	0.109	0.496
Right Tilt	0.110		0.115	0.225
		0.268	0.115	0.383

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.

14.3. Body-worn Accessory Exposure Conditions

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

Test Position	Voice		Data		∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	WiFi 2.4 GHz	Bluetooth 2.4 GHz	
Rear	0.338		0.215		0.553
		0.515	0.215		0.730
	0.338			0.126	0.464
		0.515		0.126	0.641
Front	0.151		0.0786		0.230
		0.366	0.0786		0.445
	0.151			0.126	0.277
		0.366		0.126	0.492

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.

14.4. Hotspot Mode Exposure Conditions

Sum of the SAR for GSM & WiFi 2.4 GHz Band

Test Position	Data		Data	∑ 1-g SAR (mW/g)
	GSM 850	GSM 1900	WiFi 2.4 GHz	
Rear	0.485		0.215	0.700
		0.929	0.215	**1.144**
Front	0.220		0.0786	0.299
		0.616	0.0786	0.695
Edge 1	0		0.0417	0.042
		0	0.0417	0.042
Edge 2	0.238		0.0861	0.324
		0.095	0.0861	0.181
Edge 3	0.020		0	0.020
		0.407	0	0.407
Edge 4	0.204		0	0.204
		0.202	0	0.202

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. SAR Test Plots for GSM850

15.3. SAR Test Plots for GSM1900

15.4. SAR Test Plots for WiFi 2.4 GHz Band

15.5. SAR Test Plots for Repeated Test

15.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3686

15.7. Calibration Certificate for E-Field Probe EX3DV4 - SN 3871

15.8. Calibration Certificate for D835V2 - SN 4d002

15.9. Calibration Certificate for D1900V2 - SN 5d043

15.10. Calibration Certificate for D2450V2 - SN 899