



SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093
IEEE Std 1528-2013**

For
GSM/WCDMA Phone + Bluetooth, WLAN 2.4GHZ b/g/n, & ANT+

**FCC ID: A3LSMG7202
Model Name: SM-G7202/D**

**Report Number: 14I19691-S1A
Issue Date: 1/21/2015**

Prepared for
**SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI
GYEONGGI-DO 443-742, SOUTH KOREA**

Prepared by
**UL Verification Services Inc.
47173 Benicia Street
Fremont, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888**



NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
--	1/20/2015	Initial Issue	--
A	1/21/2015	Section 6.1: Added Note describing NFC battery	Coltyce Sanders

Table of Contents

1.	Attestation of Test Results	5
2.	Test Specification, Methods and Procedures.....	6
3.	Facilities and Accreditation	7
4.	SAR Measurement System & Test Equipment.....	8
4.1.	<i>SAR Measurement System.....</i>	<i>8</i>
4.2.	<i>SAR Scan Procedures</i>	<i>9</i>
4.3.	<i>Test Equipment</i>	<i>11</i>
5.	Measurement Uncertainty.....	12
6.	Device Under Test (DUT) Information.....	13
6.1.	<i>DUT Description</i>	<i>13</i>
6.2.	<i>Wireless Technologies</i>	<i>13</i>
6.3.	<i>Nominal and Maximum Output Power</i>	<i>14</i>
7.	RF Exposure Conditions (Test Configurations).....	15
8.	Dielectric Property Measurements & System Check.....	16
8.1.	<i>Dielectric Property Measurements.....</i>	<i>16</i>
8.2.	<i>System Check</i>	<i>18</i>
9.	Conducted Output Power Measurements.....	20
9.1.	<i>GSM.....</i>	<i>20</i>
9.2.	<i>W-CDMA.....</i>	<i>22</i>
9.3.	<i>Wi-Fi DTS (2.4 GHz) Band.....</i>	<i>26</i>
9.4.	<i>Bluetooth.....</i>	<i>26</i>
10.	Measured and Reported (Scaled) SAR Results.....	27
10.1.	<i>GSM850.....</i>	<i>28</i>
10.2.	<i>GSM1900.....</i>	<i>28</i>
10.3.	<i>W-CDMA Band V.....</i>	<i>29</i>
10.4.	<i>W-CDMA Band II</i>	<i>29</i>
10.5.	<i>Wi-Fi (DTS Band).....</i>	<i>29</i>
10.6.	<i>Bluetooth</i>	<i>30</i>
11.	SAR Measurement Variability.....	31
12.	Simultaneous Transmission SAR Analysis	32
12.1.	<i>Sum of the SAR for GSM850 & Wi-Fi & BT</i>	<i>33</i>
12.2.	<i>Sum of the SAR for GSM1900 & Wi-Fi & BT</i>	<i>33</i>

12.3.	<i>Sum of the SAR for WCDMA Band V & Wi-Fi & BT</i>	33
12.4.	<i>Sum of the SAR for WCDMA Band II & Wi-Fi & BT</i>	34
Appendixes		35
A_14I19691v0	<i>SAR Photos & Ant. Locations</i>	35
B_14I19691v0	<i>SAR Highest Test Plots</i>	35
C_14I19691v0	<i>SAR System Check Plots</i>	35
D_14I19691v0	<i>SAR Tissue Ingredients</i>	35
E_14I19691v0	<i>SAR Probe Cal. Certificates</i>	35
F_14I19691v0	<i>SAR Dipole Cal. Certificates</i>	35

1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS				
FCC ID	A3LSMG7202				
Model Name	SM-G7202/D				
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Standard 1528-2013				
SAR Limits (W/Kg)					
Exposure Category	Peak spatial-average(1g of tissue)				
General population / Uncontrolled exposure	1.6				
The Highest Reported SAR (W/kg)					
RF Exposure Conditions		Equipment Class			
		Licensed	DTS	U-NII	DSS (BT)
Head		0.220	0.170	N/A	
Body-worn		0.899	0.326		
Hotspot/Wi-Fi Direct		0.899	0.326		
Simultaneous Tx	Head	0.347			
	Body-worn	1.087			
	Hotspot & Wi-Fi Direct	1.087			
Date Tested		12/22/2014 to 12/23/2014			
Test Results		Pass			
*Note: The Body-worn minimum separation distance is 15 mm. To cover both body-worn and hotspot RF exposure conditions, testing was performed at a separation distance of 10 mm. 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:			Prepared By:		
					
Devin Chang Senior Engineer UL Verification Services Inc.			Nathan Sousa Laboratory Engineer UL Verification Services Inc.		

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure [KDB](#) procedures:

- o 248227 D01 SAR meas for 802.11 v01r02
- o 447498 D01 General RF Exposure Guidance v05r02
- o 648474 D04 Handset SAR v01r02
- o 690783 D01 SAR Listings on Grants v01r03
- o 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- o 865664 D02 RF Exposure Reporting v01r01
- o 941225 D01 3G SAR Procedures v03
- o 941225 D06 Hotspot Mode v02

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at

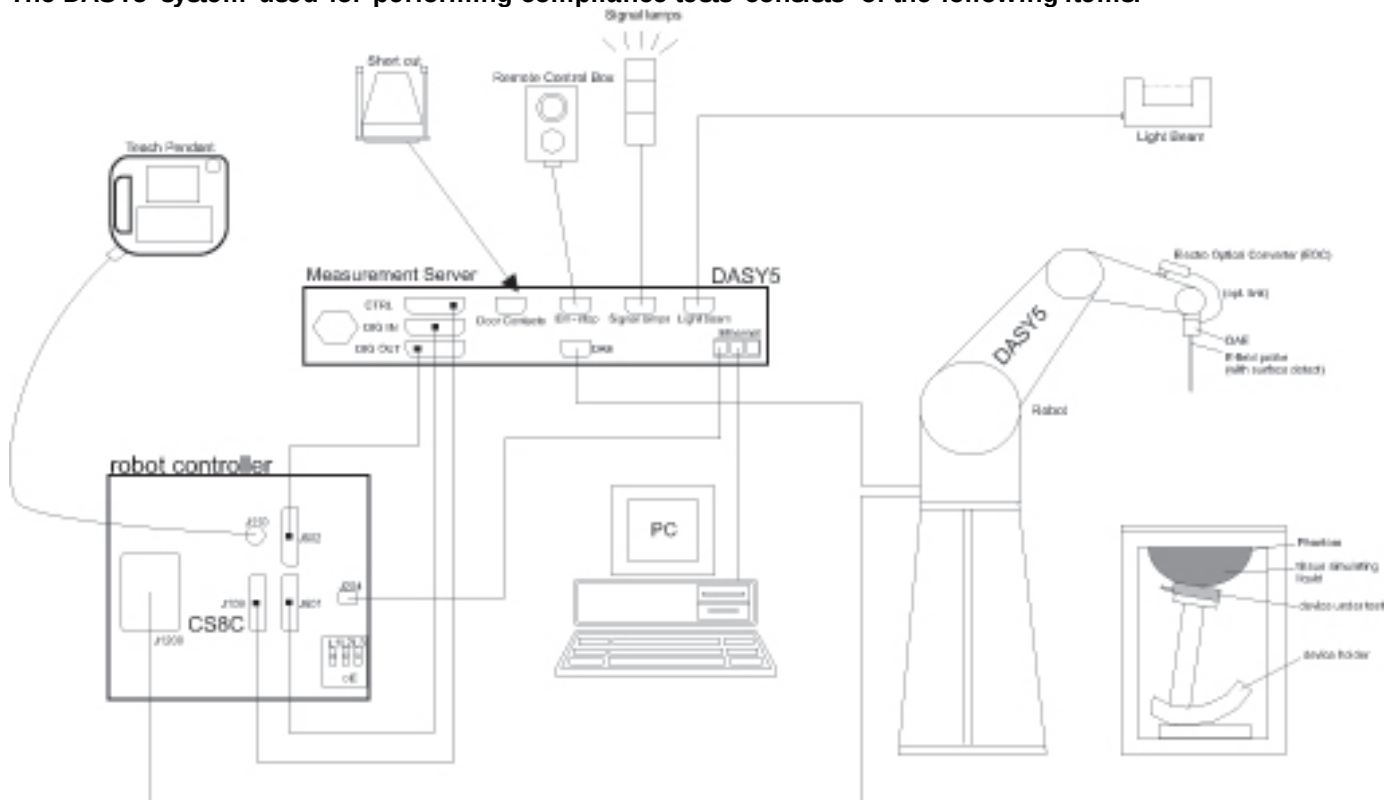
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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.
- 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.

4.2. SAR Scan Procedures

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

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	≤ 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 $\leq$ 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

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			≤ 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: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
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 <u>reported</u> SAR from the area scan based <i>1-g SAR estimation</i> 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.

4.3. Test Equipment

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.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	E753ES	MY40000980	4/7/2015
Dielectronic Probe kit	SPEAG	DAK-3.5	1082	9/16/2015
Dielectronic Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529163	10/8/2015
Thermometer	EXTECH	445703	CCS-200	3/24/2015

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
HP Signal Generator	HP	8665B	3546A00784	6/23/2015
Power Meter	HP	437B	3125U09516	10/6/2015
Power Meter	Agilent	N1911A	MY53060016	8/7/2015
Power Sensor	Agilent	E9323A	MY53070003	5/1/2015
Power Sensor	Agilent	8481A	3318A95392	10/6/2015
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1622052	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2711	N/A
DC Power Supply	Sorensen Ametek	XT20-3	1318A00530	N/A
Synthesized Signal Generator	Agilent	8665B	3438A00633	7/10/2015
Power Meter	HP	437B	3125U11347	8/27/2015
Power Meter	HP	437B	3125U16345	6/16/2015
Power Sensor	HP	8481A	2702A60780	6/16/2015
Power Sensor	HP	8481A	1926A16917	10/10/2015
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808938	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2710	N/A
DC Power Supply	HP	6296A	2841A-05955	N/A
E-Field Probe (SAR 1)	SPEAG	EX3DV4	3902	5/19/2015
E-Field Probe (SAR 3)	SPEAG	EX3DV4	3773	4/22/2015
E-Field Probe (SAR 4)	SPEAG	EX3DV4	3929	5/9/2015
Data Acquisition Electronics (SAR 1)	SPEAG	DAE3	427	1/21/2015
Data Acquisition Electronics (SAR 3)	SPEAG	DAE4	1380	7/23/2015
Data Acquisition Electronics (SAR 4)	SPEAG	DAE4	1377	8/27/2015
System Validation Dipole	SPEAG	D835V2	4d142	9/9/2015
System Validation Dipole	SPEAG	D1900V2	5d163	9/11/2015
System Validation Dipole	SPEAG	D2450V2	748	2/18/2015
System Validation Dipole	SPEAG	D2450V2	706	5/20/2015
Thermometer (SAR Lab 1)	EXTECH	445703	CCS-205	3/24/2015
Thermometer (SAR Lab 3)	EXTECH	445703	CCS-237	6/3/2015
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/3/2015

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY53040015	7/10/2015
Power Sensor	Agilent	N1921A	MY52020011	5/6/2015
Base Station Simulator	R & S	CMW500	135393-vQ	7/3/2015
Base Station Simulator	R & S	CMW500	137873-wG	7/14/2015
Base Station Simulator	R & S	CMW500	124594-HX	10/15/2015

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Standard 1528-2013 is not required in SAR reports submitted for equipment approval.

6. Device Under Test (DUT) Information

6.1. DUT Description

Model: SM-G7202/D	
Device Dimension	Overall (Length x Width): 146.19 mm x 69.6 mm Overall Diagonal: 156.77 mm Display Diagonal: 132.89 mm
Battery Back Cover	☒ Normal Battery Cover ☐ Normal Battery Cover with NFC ☐ Wireless Charger Battery Cover ☐ Wireless Charger Battery Cover with NFC ☐ The rechargeable battery is not user accessible.
Battery Options	☒ NFC – Lithium-ion battery, Rating 3.85Vdc, 9.63Wh ☐ Extended (large capacity) ☐ The rechargeable battery is not user accessible.
Accessory	Headset
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5 GHz)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☐ Wi-Fi Direct (Wi-Fi 5 GHz)

Notes:

Battery has a built-in NFC antenna from manufacture. According to the user manual, this application does not utilize the NFC antenna function.

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
GSM	850 1900	Voice (GMSK) GPRS (GMSK) EGPRS (8PSK)	GSM Voice: 12.5%; (E)GPRS: 1 Slot: 12.5%; 2 Slots: 25%, 3 Slots: 37.5%, 4 Slots: 50%,
	GPRS Multi-Slot Class: ☐ Class 8 - One Up ☐ Class 10 - Two Up ☐ Class 12 - Four Up ☒ Class 33 - Four Up DTM (Dual Transfer Mode): Not supported		
WCDMA (UMTS)	Band V Band II	UMTS Rel. 99 (Voice & Data) HSDPA (Cat 24) HSUPA (Cat 6) HSPA+	100%
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	100%
Bluetooth	2.4 GHz	Version 4.0 LE	77.5% (DH5)

6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1.(3) at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit

Upper limit (dB): -1.5 ~ 0.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
GSM850	Voice	33.0	33.5
	GPRS 1 slot	33.0	33.5
	GPRS 2 slots	30.5	31.0
	GPRS 3 slots	29.0	29.5
	GPRS 4 slots	27.5	28.0
	EGPRS 1 slot	27.5	28.0
	EGPRS 2 slots	27.0	27.5
	EGPRS 3 slots	25.5	26.0
	EGPRS 4 slots	24.5	25.0
GSM1900	Voice	29.5	30.0
	GPRS 1 slot	29.5	30.0
	GPRS 2 slots	27.5	28.0
	GPRS 3 slots	25.5	26.0
	GPRS 4 slots	24.0	24.5
	EGPRS 1 slot	26.0	26.5
	EGPRS 2 slots	25.0	25.5
	EGPRS 3 slots	24.0	24.5
	EGPRS 4 slots	23.0	23.5
W-CDMA Band V	R99	23.0	23.5
	HSDPA	22.5	23.0
	HSUPA	23.0	23.5
W-CDMA Band II	R99	22.5	23.0
	HSDPA	22.5	23.0
	HSUPA	22.5	23.0

Upper limit (dB): 0.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
WiFi 2.4 GHz	802.11b	17.0	17.5
	802.11g	14.0	14.5
	802.11n HT20	13.0	13.5
Bluetooth		9.0	9.5
Bluetooth LE		1.5	2.0

7. RF Exposure Conditions (Test Configurations)

Refer to “SAR Photos and Ant locations” Appendix for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required	Note
WWAN	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	< 25 mm	Yes	
			Edge 3 (Bottom)	< 25 mm	Yes	
			Edge 4 (Left)	< 25 mm	Yes	
WLAN	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot / Wi-Fi Direct	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	< 25 mm	Yes	
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	> 25 mm	No	1
			Edge 4 (Left)	< 25 mm	Yes	

Notes:

- SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within $\pm 2^\circ\text{C}$ 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.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

IEEE Standard 1528-2013

Refer to Table 3 within the IEEE Standard 1528-2013

Dielectric Property Measurements Results:

SAR Lab 1

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
12/22/2014	Head 2450	e'	37.6300	Relative Permittivity (ϵ_r):	37.63	39.20	-4.01	5
		e''	13.2800	Conductivity (σ):	1.81	1.80	0.51	5
	Head 2410	e'	37.7700	Relative Permittivity (ϵ_r):	37.77	39.28	-3.84	5
		e''	13.1900	Conductivity (σ):	1.77	1.76	0.40	5
	Head 2475	e'	37.5600	Relative Permittivity (ϵ_r):	37.56	39.17	-4.11	5
		e''	13.3000	Conductivity (σ):	1.83	1.83	0.18	5
12/23/2014	Body 2450	e'	50.4500	Relative Permittivity (ϵ_r):	50.45	52.70	-4.27	5
		e''	14.1200	Conductivity (σ):	1.92	1.95	-1.36	5
	Body 2410	e'	50.5700	Relative Permittivity (ϵ_r):	50.57	52.76	-4.15	5
		e''	13.9800	Conductivity (σ):	1.87	1.91	-1.79	5
	Body 2475	e'	50.3000	Relative Permittivity (ϵ_r):	50.30	52.67	-4.50	5
		e''	14.2100	Conductivity (σ):	1.96	1.99	-1.49	5

SAR Lab 3

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
12/22/2014	Head 835	e'	39.8600	Relative Permittivity (ϵ_r):	39.86	41.50	-3.95	5
		e''	19.1700	Conductivity (σ):	0.89	0.90	-1.11	5
	Head 820	e'	40.1300	Relative Permittivity (ϵ_r):	40.13	41.60	-3.54	5
		e''	19.2300	Conductivity (σ):	0.88	0.90	-2.41	5
	Head 850	e'	39.6800	Relative Permittivity (ϵ_r):	39.68	41.50	-4.39	5
		e''	19.1400	Conductivity (σ):	0.90	0.92	-1.14	5
12/22/2015	Body 835	e'	53.1200	Relative Permittivity (ϵ_r):	53.12	55.20	-3.77	5
		e''	21.7300	Conductivity (σ):	1.01	0.97	4.01	5
	Body 820	e'	53.3400	Relative Permittivity (ϵ_r):	53.34	55.28	-3.50	5
		e''	21.7600	Conductivity (σ):	0.99	0.97	2.44	5
	Body 850	e'	53.0300	Relative Permittivity (ϵ_r):	53.03	55.16	-3.86	5
		e''	21.5600	Conductivity (σ):	1.02	0.99	3.23	5

SAR Lab 4

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
12/22/2014	Head 1900	e'	40.2600	Relative Permittivity (ϵ_r):	40.26	40.00	0.65	5
		e''	13.3400	Conductivity (σ):	1.41	1.40	0.67	5
	Head 1850	e'	40.4000	Relative Permittivity (ϵ_r):	40.40	40.00	1.00	5
		e''	13.1900	Conductivity (σ):	1.36	1.40	-3.09	5
	Head 1910	e'	40.2000	Relative Permittivity (ϵ_r):	40.20	40.00	0.50	5
		e''	13.4100	Conductivity (σ):	1.42	1.40	1.73	5
12/22/2014	Body 1900	e'	51.6500	Relative Permittivity (ϵ_r):	51.65	53.30	-3.10	5
		e''	14.5300	Conductivity (σ):	1.54	1.52	0.99	5
	Body 1850	e'	51.7600	Relative Permittivity (ϵ_r):	51.76	53.30	-2.89	5
		e''	14.3500	Conductivity (σ):	1.48	1.52	-2.89	5
	Body 1910	e'	51.5900	Relative Permittivity (ϵ_r):	51.59	53.30	-3.21	5
		e''	14.5700	Conductivity (σ):	1.55	1.52	1.80	5

8.2. System 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 re-measured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 $\pm$ 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 $\geq$ 15.0 cm for SAR measurements $\leq$ 3 GHz and $\geq$ 10.0 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.

Reference Target SAR Values

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 (W/kg)		
				1g/10g	Head	Body
D835V2	4d142	9/9/2014	835	1g	8.91	9.22
				10g	5.77	6.05
D1900V2	5d163	9/11/2014	1900	1g	40.8	40.6
				10g	21.2	21.4
D2450V2	748	2/18/2014	2450	1g	51.6	50.7
				10g	24.0	23.7

System 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.

SAR Lab 1

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
12/22/2014	D2450V2	748	Head	1g	5.30	53.0	51.6	2.71	
				10g	2.38	23.8	24.0	-0.83	
12/23/2014	D2450V2	748	Body	1g	5.32	53.2	50.7	4.93	1,2
				10g	2.46	24.6	23.7	3.80	

SAR Lab 3

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
12/22/2014	D835V2	4d142	Head	1g	0.915	9.15	8.91	2.69	
				10g	0.600	6.00	5.77	3.99	
12/22/2014	D835V2	4d142	Body	1g	0.997	10.0	9.22	8.13	3,4
				10g	0.655	6.55	6.05	8.26	

SAR Lab 4

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
12/22/2014	D1900V2	5d163	Head	1g	4.13	41.3	40.8	1.23	
				10g	2.14	21.4	21.2	0.94	
12/22/2014	D1900V2	5d163	Body	1g	3.99	39.9	40.6	-1.72	5,6
				10g	2.07	20.7	21.4	-3.27	

9. Conducted Output Power Measurements

9.1. GSM

GSM850 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
850	GSM (Voice)	CS1	1	128	824.2	33.1	24.1
				190	836.6	32.9	23.9
				251	848.8	32.9	23.9
	GPRS (GMSK)	CS1	1	128	824.2	33.1	24.1
				190	836.6	32.9	23.9
				251	848.8	32.9	23.9
			2	128	824.2	30.9	24.9
				190	836.6	30.8	24.8
				251	848.8	30.7	24.7
			3	128	824.2	29.5	25.2
				190	836.6	29.5	25.2
				251	848.8	29.4	25.1
			4	128	824.2	27.7	24.7
				190	836.6	27.6	24.6
				251	848.8	27.4	24.4
	EGPRS (8PSK)	MCS5	1	128	824.2	27.9	18.9
				190	836.6	27.8	18.8
				251	848.8	27.8	18.8
			2	128	824.2	27.5	21.5
				190	836.6	27.5	21.5
				251	848.8	27.4	21.4
			3	128	824.2	25.3	21.0
				190	836.6	25.1	20.8
				251	848.8	25.0	20.7
			4	128	824.2	24.9	21.9
				190	836.6	24.7	21.7
				251	848.8	24.6	21.6

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 3 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

GSM1900 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
1900	GSM (Voice)	CS1	1	512	1850.2	29.9	20.9
				661	1880.0	30.0	21.0
				810	1909.8	30.0	21.0
	GPRS (GMSK)	CS1	1	512	1850.2	29.9	20.9
				661	1880.0	30.0	21.0
				810	1909.8	30.0	21.0
			2	512	1850.2	27.1	21.1
				661	1880.0	27.3	21.3
				810	1909.8	27.3	21.3
			3	512	1850.2	25.0	20.7
				661	1880.0	25.3	21.0
				810	1909.8	25.0	20.7
			4	512	1850.2	23.7	20.7
				661	1880.0	23.8	20.8
				810	1909.8	23.7	20.7
	EGPRS (8PSK)	MCS5	1	512	1850.2	25.9	16.9
				661	1880.0	26.1	17.1
				810	1909.8	26.1	17.1
			2	512	1850.2	25.5	19.5
				661	1880.0	25.5	19.5
				810	1909.8	25.5	19.5
			3	512	1850.2	23.0	18.7
				661	1880.0	23.3	19.0
				810	1909.8	23.1	18.8
			4	512	1850.2	22.8	19.8
				661	1880.0	23.0	20.0
				810	1909.8	22.8	19.8

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

9.2. W-CDMA

Release 99 Setup Procedures used to establish the test signals

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 2
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	β_c/β_d	8/15

HSDPA Setup Procedures used to establish the test signals

The following 4 Sub-tests were completed according to Release 7 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-Set 1			
	Power Control Algorithm	Algorithm 2			
	β_c	2/15	11/15	15/15	15/15
	β_d	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	β_c/β_d	2/15	12/15	15/8	15/4
	β_{hs}	4/15	24/15	30/15	30/15
HSDPA Specific Settings	MPR (dB)	0	0	0.5	0.5
	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			
	A _{hs} = β_{hs}/β_c	30/15			

HSPA (HSDPA & HSUPA) Setup Procedures used to establish the test signals

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				
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2 kbps RMC				
	HSDPA FRC	H-Set 1				
	HSUPA Test	HSPA				
	Power Control Algorithm	Algorithm 2				Algorithm 1
	β_c	11/15	6/15	15/15	2/15	15/15
	β_d	15/15	15/15	9/15	15/15	0
	β_{ec}	209/225	12/15	30/15	2/15	5/15
	β_c/β_d	11/15	6/15	15/9	2/15	15/1
	β_{hs}	22/15	12/15	30/15	4/15	5/15
	β_{ed}	1309/225	94/75	47/15	56/75	47/15
HSDPA Specific Settings	CM (dB)	1	3	2	3	1
	MPR (dB)	0	2	1	2	0
	DACK	8				0
	DNAK	8				0
	DCQI	8				0
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
HSUPA Specific Settings	CQI Repetition Factor (Table 5.2B.4)	2				
	A _{hs} = β_{hs}/β_c	30/15				
	E-DPDCCH	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	5	5	2	5	1
	Reference E-TFCI	11	11	11	11	67
	Reference E-TFCI PO	4	4	4	4	18
	Reference E-TFCI	67	67	92	67	67
	Reference E-TFCI PO	18	18	18	18	18
	Reference E-TFCI	71	71	71	71	71
	Reference E-TFCI PO	23	23	23	23	23
	Reference E-TFCI	75	75	75	75	75
	Reference E-TFCI PO	26	26	26	26	26
	Reference E-TFCI	81	81	81	81	81
	Reference E-TFCI PO	27	27	27	27	27
	Maximum Channelization Codes	2xSF2				SF4

HSPA+

Since 16QAM is not used for uplink, the uplink Category and release is same as HSUPA, i.e., CAT 6 Rel 6. Therefore, the RF conducted power is not measured.

Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Avg Pwr (dBm)
W-CDMA Band V	Rel 99	RMC, 12.2 kbps	4132	826.4	N/A	23.3
			4183	836.6	N/A	23.2
			4233	846.6	N/A	23.2
	HSDPA	Subtest 1	4132	826.4	0	22.7
			4183	836.6	0	22.7
			4233	846.6	0	22.7
		Subtest 2	4132	826.4	0	23.0
			4183	836.6	0	23.0
			4233	846.6	0	23.0
		Subtest 3	4132	826.4	0.5	22.3
			4183	836.6	0.5	20.6
			4233	846.6	0.5	22.3
		Subtest 4	4132	826.4	0.5	22.3
			4183	836.6	0.5	20.6
			4233	846.6	0.5	22.3
	HSUPA	Subtest 1	4132	826.4	0	22.3
			4183	836.6	0	22.3
			4233	846.6	0	22.0
		Subtest 2	4132	826.4	2	21.5
			4183	836.6	2	21.5
			4233	846.6	2	21.2
		Subtest 3	4132	826.4	1	21.8
			4183	836.6	1	21.8
			4233	846.6	1	21.9
		Subtest 4	4132	826.4	2	21.5
			4183	836.6	2	21.5
			4233	846.6	2	21.5
		Subtest 5	4132	826.4	0	22.8
			4183	836.6	0	22.9
			4233	846.6	0	22.7

Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Avg Pwr (dBm)
W-CDMA Band II	Rel 99	RMC, 12.2 kbps	9262	1852.4	N/A	23.0
			9400	1880.0	N/A	23.0
			9538	1907.6	N/A	22.8
	HSDPA	Subtest 1	9262	1852.4	0	23.0
			9400	1880.0	0	23.0
			9538	1907.6	0	22.8
		Subtest 2	9262	1852.4	0	23.0
			9400	1880.0	0	23.0
			9538	1907.6	0	22.8
		Subtest 3	9262	1852.4	0	23.0
			9400	1880.0	0	23.0
			9538	1907.6	0	22.8
		Subtest 4	9262	1852.4	0	23.0
			9400	1880.0	0	23.0
			9538	1907.6	0	22.8
	HSUPA	Subtest 1	9262	1852.4	0	22.2
			9400	1880.0	0	22.0
			9538	1907.6	0	22.4
		Subtest 2	9262	1852.4	2	21.0
			9400	1880.0	2	21.0
			9538	1907.6	2	21.0
		Subtest 3	9262	1852.4	1	22.0
			9400	1880.0	1	21.9
			9538	1907.6	1	21.9
		Subtest 4	9262	1852.4	2	21.0
			9400	1880.0	2	21.0
			9538	1907.6	2	21.0
		Subtest 5	9262	1852.4	0	23.0
			9400	1880.0	0	23.0
			9538	1907.6	0	22.8

9.3. Wi-Fi DTS (2.4 GHz) Band

Required Test Channels per KDB 248227 D01

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
2.4 (DTS)	802.11b	1 Mbps	1	2412	16.6	Yes
			6	2437	17.2	
			11	2462	17.5	
	802.11g	6 Mbps	1	2412	14.2	No
			6	2437	14.4	
			11	2462	14.1	
	802.11n (HT20)	MCS0	1	2412	13.3	No
			6	2437	13.5	
			11	2462	13.2	

Note(s):

- Per KDB 248227 D01, SAR is not required for 802.11g/n HT20 channels when the maximum average output power is less than $\frac{1}{4}$ dB higher than that measured on the corresponding 802.11b channels.

Power measurements to determine worst-case data rates

Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
802.11b	11	2462	1 Mbps	17.5	Yes
			2 Mbps	17.5	No
			5.5 Mbps	17.5	No
			11 Mbps	17.5	No

Note(s):

- Per KDB 248227 D01,
 - Testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is $< \frac{1}{4}$ dB higher than those measured at the lowest data rate.
 - Each channel should be tested at the lowest data rate in each mode channel BW configuration.

9.4. Bluetooth

Maximum tune-up tolerance limit is 9.5 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

Refer to Standalone SAR Test Exclusion Considerations Section.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

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
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 648474 D04 Handset SAR:

With headset attached, when the reported SAR for body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

KDB 941225 D01 SAR test for 3G devices:

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is $\leq \frac{1}{4}$ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

KDB 248227 D01 SAR Measurements Procedures for 802.11 a/b/g Transmitters v01r02 (pg.6):

Each channel should be tested at the lowest data rate in each a-b/g mode or 4.9 GHz channel BW configuration.

When the extrapolated maximum peak SAR for the maximum output channel is ≤ 1.6 W/kg and the 1-g averaged SAR is ≤ 0.8 W/kg, testing of other channels in the "default test channels" or "required test channels" configuration is optional.

10.1. GSM850

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Voice	0	Left Touch	190	836.6	33.5	32.9	0.139	0.160	1
			Left Tilt	190	836.6	33.5	32.9	0.072	0.083	
			Right Touch	190	836.6	33.5	32.9	0.096	0.110	
			Right Tilt	190	836.6	33.5	32.9	0.066	0.076	
Head VoIP	GPRS 3 Slots	0	Left Touch	190	836.6	29.5	29.5	0.198	0.198	2
			Left Tilt	190	836.6	29.5	29.5	0.097	0.097	
			Right Touch	190	836.6	29.5	29.5	0.144	0.144	
			Right Tilt	190	836.6	29.5	29.5	0.097	0.097	
Body-worn	Voice	10	Rear	190	836.6	33.5	32.9	0.246	0.282	3
			Front	190	836.6	33.5	32.9	0.154	0.177	
Body-worn(VoIP) & Hotspot	GPRS 3 Slots	10	Rear	190	836.6	29.5	29.5	0.339	0.339	4
Front			190	836.6	29.5	29.5	0.228	0.228		
Hotspot			Edge 2	190	836.6	29.5	29.5	0.083	0.083	
			Edge 3	190	836.6	29.5	29.5	0.117	0.117	
			Edge 4	190	836.6	29.5	29.5	0.255	0.255	

10.2. GSM1900

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Voice	0	Left Touch	661	1880.0	30.0	30.0	0.172	0.172	5
			Left Tilt	661	1880.0	30.0	30.0	0.079	0.079	
			Right Touch	661	1880.0	30.0	30.0	0.141	0.141	
			Right Tilt	661	1880.0	30.0	30.0	0.086	0.086	
Head VoIP	GPRS 2 Slots	0	Left Touch	661	1880.0	28.0	27.3	0.187	0.220	6
			Left Tilt	661	1880.0	28.0	27.3	0.088	0.103	
			Right Touch	661	1880.0	28.0	27.3	0.151	0.177	
			Right Tilt	661	1880.0	28.0	27.3	0.093	0.109	
Body-worn	Voice	10	Rear	661	1880.0	30.0	30.0	0.542	0.542	
			Front	661	1880.0	30.0	30.0	0.689	0.689	7
Body-worn(VoIP) & Hotspot	GPRS 2 Slots	10	Rear	661	1880.0	28.0	27.3	0.648	0.761	
			Front	512	1850.2	28.0	27.1	0.720	0.886	
				661	1880.0	28.0	27.3	0.765	0.899	8
				810	1909.8	28.0	27.3	0.699	0.821	
Hotspot			Edge 2	661	1880.0	28.0	27.3	0.065	0.077	
			Edge 3	661	1880.0	28.0	27.3	0.506	0.594	
			Edge 4	661	1880.0	28.0	27.3	0.156	0.183	

10.3. W-CDMA Band V

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	4183	836.6	23.5	23.2	0.113	0.121	9
			Left Tilt	4183	836.6	23.5	23.2	0.054	0.058	
			Right Touch	4183	836.6	23.5	23.2	0.087	0.093	
			Right Tilt	4183	836.6	23.5	23.2	0.068	0.073	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	4183	836.6	23.5	23.2	0.218	0.234	10
Front			4183	836.6	23.5	23.2	0.141	0.151		
Hotspot			Edge 2	4183	836.6	23.5	23.2	0.058	0.062	
			Edge 3	4183	836.6	23.5	23.2	0.073	0.078	
			Edge 4	4183	836.6	23.5	23.2	0.165	0.177	

10.4. W-CDMA Band II

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	9400	1880.0	23.0	23.0	0.165	0.165	
			Left Tilt	9400	1880.0	23.0	23.0	0.091	0.091	
			Right Touch	9400	1880.0	23.0	23.0	0.174	0.174	11
			Right Tilt	9400	1880.0	23.0	23.0	0.101	0.101	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	9400	1880.0	23.0	23.0	0.585	0.585	
Front			9400	1880.0	23.0	23.0	0.714	0.714	12	
Hotspot			Edge 2	9400	1880.0	23.0	23.0	0.062	0.062	
			Edge 3	9400	1880.0	23.0	23.0	0.495	0.495	
			Edge 4	9400	1880.0	23.0	23.0	0.161	0.161	

10.5. Wi-Fi (DTS Band)

Frequency Band	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
2.4 GHz	Head	802.11b 1 Mbps	0	Left Touch	11	2462.0	17.5	17.5	0.068	0.068	
				Left Tilt	11	2462.0	17.5	17.5	0.059	0.059	
				Right Touch	11	2462.0	17.5	17.5	0.170	0.170	13
				Right Tilt	11	2462.0	17.5	17.5	0.096	0.096	
	Body-won & Hotspot & Wi-Fi Direct	802.11b 1 Mbps	10	Rear	11	2462.0	17.5	17.5	0.326	0.326	14
				Front	11	2462.0	17.5	17.5	0.056	0.056	
	Hotspot & Wi-Fi Direct			Edge 1	11	2462.0	17.5	17.5	0.029	0.029	
				Edge 4	11	2462.0	17.5	17.5	0.144	0.144	

10.6. Bluetooth

Standalone SAR Test Exclusion Considerations & Estimated SAR

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:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$, for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

- $f_{(\text{GHz})}$ 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.

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:

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

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	SAR test exclusion Result*	Test Configuration	Estimated 1-g SAR (W/kg)
(dBm)	(mW)					
9.5	9	10	2.480	1.4	Rear/Front	0.187

Conclusion:

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

11. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. 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 .

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
850	GSM 850	Body-worn(VoIP) & Hotspot	Rear	No	0.339	N/A	N/A
	WCDMA Band V	Body-worn(VoIP) & Hotspot	Rear	No	0.218	N/A	N/A
1900	GSM 1900	Body-worn(VoIP) & Hotspot	Front	No	0.765	N/A	N/A
	WCDMA Band II	Body-worn(VoIP) & Hotspot	Front	No	0.714	N/A	N/A
2400	Wi-Fi 802.11b/g/n	Body-worn(VoIP) & Hotspot	Rear	No	0.326	N/A	N/A

Note(s):

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 .

12. Simultaneous Transmission SAR Analysis

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations	
Head	1	GSM(Voice)	+ Wi-Fi 2.4 GHz
	2	GSM(GPRS/EDGE)	+ Wi-Fi 2.4 GHz
	3	W-CDMA	+ Wi-Fi 2.4 GHz
Body-worn	1	GSM(Voice)	+ Wi-Fi 2.4 GHz
	2	GSM(Voice)	+ BT
	3	GSM(GPRS/EDGE)	+ Wi-Fi 2.4 GHz
	4	GSM(GPRS/EDGE)	+ BT
	5	W-CDMA	+ Wi-Fi 2.4 GHz
	6	W-CDMA	+ BT
Hotspot & Wi-Fi Direct	1	GSM(GPRS/EDGE)	+ Wi-Fi 2.4 GHz
	2	W-CDMA	+ Wi-Fi 2.4 GHz

Notes:

1. Wi-Fi only 2.4GHz supports Hotspot.
2. GPRS/EDGE and W-CDMA support Hotspot.
3. VoIP is supported in GPRS/EDGE and W-CDMA.
4. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio.

12.1. Sum of the SAR for GSM850 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① GSM850	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.198	0.068		0.266	No
	Left Tilt	① + ②	0.097	0.059		0.156	No
	Right Touch	① + ②	0.144	0.170		0.314	No
	Right Tilt	① + ②	0.097	0.096		0.193	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.339	0.326		0.665	No
		① + ③	0.339		0.187	0.526	No
	Front	① + ②	0.228	0.056		0.284	No
		① + ③	0.228		0.187	0.415	No
Hotspot	Edge 1	① + ②		0.029		0.029	No
	Edge 2	① + ②	0.083			0.083	No
	Edge 3	① + ②	0.117			0.117	No
	Edge 4	① + ②	0.255	0.144		0.399	No

12.2. Sum of the SAR for GSM1900 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① GSM1900	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.220	0.068		0.288	No
	Left Tilt	① + ②	0.103	0.059		0.162	No
	Right Touch	① + ②	0.177	0.170		0.347	No
	Right Tilt	① + ②	0.109	0.096		0.205	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.761	0.326		1.087	No
		① + ③	0.761		0.187	0.948	No
	Front	① + ②	0.899	0.056		0.955	No
		① + ③	0.899		0.187	1.086	No
Hotspot	Edge 1	① + ②		0.029		0.029	No
	Edge 2	① + ②	0.077			0.077	No
	Edge 3	① + ②	0.594			0.594	No
	Edge 4	① + ②	0.183	0.144		0.327	No

12.3. Sum of the SAR for WCDMA Band V & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① W-CDMA Band V	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.121	0.068		0.189	No
	Left Tilt	① + ②	0.058	0.059		0.117	No
	Right Touch	① + ②	0.093	0.170		0.263	No
	Right Tilt	① + ②	0.073	0.096		0.169	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.234	0.326		0.560	No
		① + ③	0.234		0.187	0.421	No
	Front	① + ②	0.151	0.056		0.207	No
		① + ③	0.151		0.187	0.338	No
Hotspot	Edge 1	① + ②		0.029		0.029	No
	Edge 2	① + ②	0.062			0.062	No
	Edge 3	① + ②	0.078			0.078	No
	Edge 4	① + ②	0.177	0.144		0.321	No

12.4. Sum of the SAR for WCDMA Band II & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① W-CDMA Band II	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.165	0.068		0.233	No
	Left Tilt	① + ②	0.091	0.059		0.150	No
	Right Touch	① + ②	0.174	0.170		0.344	No
	Right Tilt	① + ②	0.101	0.096		0.197	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.585	0.326		0.911	No
		① + ③	0.585		0.187	0.772	No
	Front	① + ②	0.714	0.056		0.770	No
		① + ③	0.714		0.187	0.901	No
Hotspot	Edge 1	① + ②		0.029		0.029	No
	Edge 2	① + ②	0.062			0.062	No
	Edge 3	① + ②	0.495			0.495	No
	Edge 4	① + ②	0.161	0.144		0.305	No

Conclusion:

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

Appendixes

Refer to separated files for the following appendixes.

A_14I19691v0 SAR Photos & Ant. Locations

B_14I19691v0 SAR Highest Test Plots

C_14I19691v0 SAR System Check Plots

D_14I19691v0 SAR Tissue Ingredients

E_14I19691v0 SAR Probe Cal. Certificates

F_14I19691v0 SAR Dipole Cal. Certificates

END OF REPORT