



SAR EVALUATION REPORT

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

For
GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n, ANT+ and NFC

**Model: SM-A500Y
FCC ID: A3LSMA500Y**

**Report Number: 14U19435-S1
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Prepared for
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NVLAP LAB CODE 200065-0

REVISION HISTORY

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--	12/4/2014	Initial Issue	--
A	12/12/2014	Section 1: Added note explaining test separation distance Sections 8.6,11.8 and 13: Updated BT target power and Estimated SAR	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO. LTD.				
FCC ID	A3LSMA500Y				
DUT Description	GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n, ANT+ and NFC				
Exposure Category	General Population/Uncontrolled Exposure				
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013				
Date tested	11/19/2014 - 11/25/2014				
The Highest Reported SAR (W/kg)					
RF Exposure Conditions		Equipment Class			
		Licensed	DTS	U-NII	DSS
Head		0.435	0.342	0.297	N/A
Body-worn		0.993	0.044	0.038	
Hotspot/Wi-Fi Direct		1.167		N/A	
Simultaneous Transmission	Head	0.777		0.732	
	Body-worn	1.022		0.993	
	Hotspot Wi-Fi Direct	1.167		N/A	
*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.			AJ Newcomer Laboratory Technician 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, and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05r02
- 648474 D04 Handset SAR v01r02
- 941225 D01 SAR test for 3G devices v02
- 941225 D05 SAR for LTE Devices v02r03
- 941225 D06 Hotspot Mode SAR v01r01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r03

3. Facilities and Accreditation

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

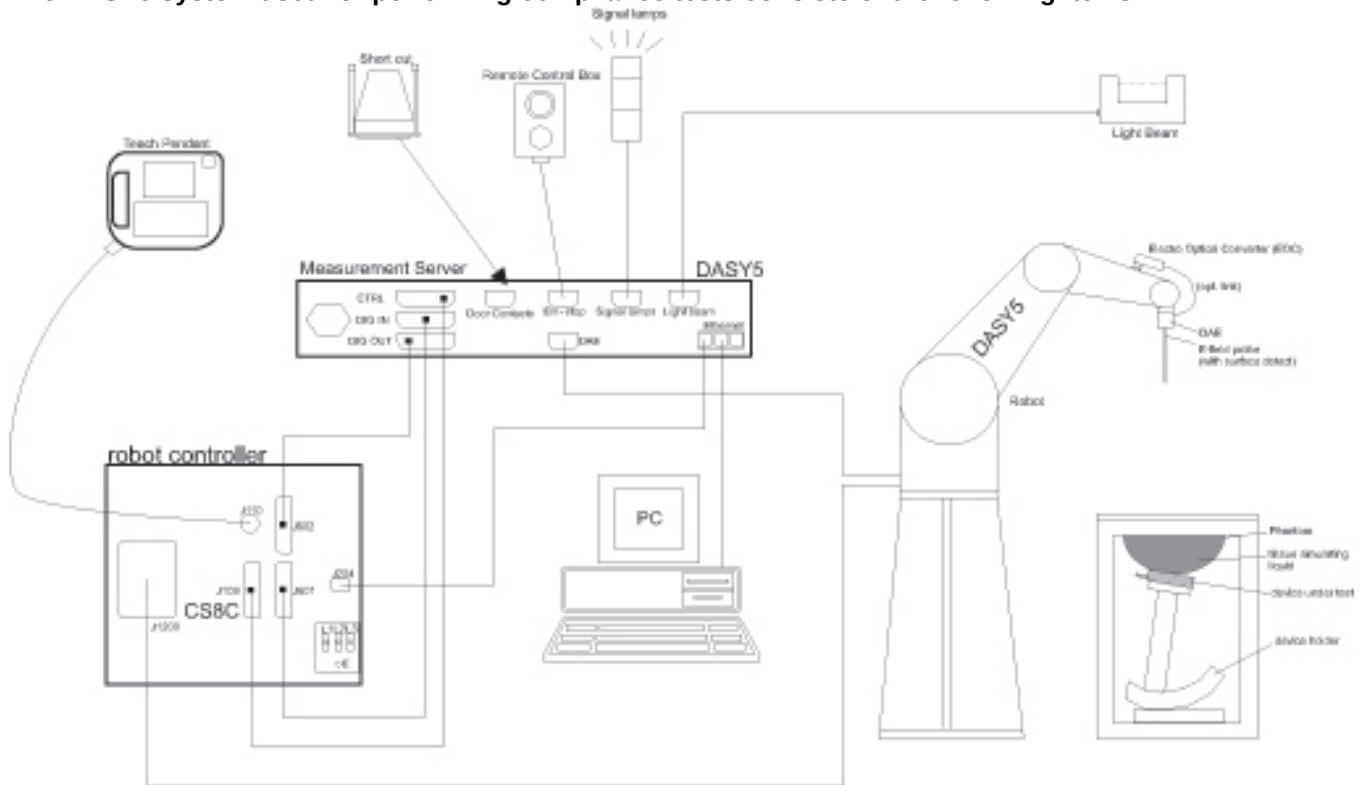
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

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.
- 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.

4.2. SAR Scan 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

	≤ 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	Agilent	N1911A	MY53060016	8/7/2015
Power Sensor	Agilent	E9323A	MY53070003	5/1/2015
Power Meter	HP	437B	3125U09516	10/6/2015
Power Sensor	HP	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	8/29/2015
Power Meter	HP	437B	3125U11347	8/27/2015
Power Sensor	HP	8481A	1926A16917	10/10/2015
Power Meter	HP	437B	3125U16345	6/16/2015
Power Sensor	HP	8481A	2702A60780	6/16/2015
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
E-Field Probe (SAR 5)	SPEAG	EX3DV4	3991	5/16/2015
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
Data Acquisition Electronics (SAR 5)	SPEAG	DAE4	1439	5/14/2015
System Validation Dipole	SPEAG	D835V2	4d142	9/9/2015
System Validation Dipole	SPEAG	D1900V2	5d163	9/11/2015
System Validation Dipole	SPEAG	D2450V2	706	5/20/2015
System Validation Dipole	SPEAG	D5GHzV2	1003	2/26/2015
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
Thermometer (SAR Lab 5)	EXTECH	445703	CCS-239	6/3/2015

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	135393	7/3/2015
Power Meter	Agilent	N1912A	MY53040015	7/10/2015
Power Sensor	Agilent	N1921A	MY52200012	9/26/2015

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 Std 1528-2013 is not required in SAR reports submitted for equipment approval.

6. Device Under Test (DUT) Information

6.1. DUT Description

Model: SM-A500Y	
Device Dimension	Overall (Length x Width): 139.3 mm x 70.3 mm Overall Diagonal: 150.8 mm Display Diagonal: 127 mm
Battery Back Cover	Device has a non-removable back cover
Battery Options	Device contains a non-removal battery
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, Ch.149 ~ Ch.165 only)
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, Ch.149 ~ Ch.165 only)

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%; GPRS/EGPRS: 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 and II	UMTS Rel. 99 (Voice & Data) HSDPA HSUPA DC-HSDPA HSPA+	100%
LTE (FDD)	Band 5	QPSK, 16QAM	100%
	Does this device SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No		
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	100%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40)	100%
Bluetooth	2.4 GHz	Version 4.0 LE	32.25% (DH1), 66.68% (DH3), 77.52% (DH5)

6.3. Nominal and Maximum Output Power

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	29.0	29.5
	GPRS 3 slots	29.0	29.5
	GPRS 4 slots	27.5	28.0
	EGPRS 1 slot	27.0	27.5
	EGPRS 2 slots	27.0	27.5
	EGPRS 3 slots	27.0	27.5
	EGPRS 4 slots	26.5	27.0
GSM1900	Voice	30.0	30.5
	GPRS 1 slot	30.0	30.5
	GPRS 2 slots	26.5	27.0
	GPRS 3 slots	26.0	26.5
	GPRS 4 slots	24.0	24.5
	EGPRS 1 slot	25.0	25.5
	EGPRS 2 slots	25.0	25.5
	EGPRS 3 slots	25.0	25.5
	EGPRS 4 slots	23.0	23.5
WCDMA Band V	R99	22.5	23.0
	HSDPA	22.0	22.5
	HSUPA	22.0	22.5
	DC-HSDPA	22.0	22.5
WCDMA Band II	R99	22.5	23.0
	HSDPA	22.0	22.5
	HSUPA	22.0	22.5
	DC-HSDPA	22.0	22.5
LTE Band 5	QPSK	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	13.0	13.5
	802.11n HT20	12.0	12.5
WiFi 5 GHz	802.11a	13.0	13.5
	802.11n HT20	12.0	12.5
	802.11n HT40	11.0	11.5
Bluetooth		10.5	11.0
Bluetooth LE		1.0	1.5

6.4. Simultaneous Transmission Condition

RF Exposure Condition	Capable Transmit Configurations
Head	1. GSM 850/1900 Voice + Wi-Fi 2.4/5GHz 2. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4/5GHz 3. WCDMA Band 2/5 + Wi-Fi 2.4/5GHz 4. LTE B5 + Wi-Fi 2.4/5GHz
Body-worn Accessory	1. GSM 850/1900 Voice + Wi-Fi 2.4/5GHz 2. GSM 850/1900 Voice + BT 3. GSM 850/1900 Voice + Wi-Fi 5GHz + BT 4. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4/5GHz 5. GSM 850/1900 (GPRS/EDGE) + BT 6. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 5GHz + BT 7. WCDMA Band 2/5 + Wi-Fi 2.4/5GHz 8. WCDMA Band 2/5 + BT 9. WCDMA Band 2/5+ Wi-Fi 5GHz + BT 10. LTE B5 + Wi-Fi 2.4/5GHz 11. LTE B5 + BT 12. LTE B5 + Wi-Fi 5GHz + BT
Wireless Router (Hotspot)	1. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4/5.8GHz 2. WCDMA Band 2/5 + Wi-Fi 2.4/5.8GHz 3. LTE B5 + Wi-Fi 2.4/5.8GHz
Notes: 1. Wi-Fi 2.4GHz and 5.8GHz supports Hotspot. 2. GPRS/EDGE, WCDMA and LTE support Hotspot. 3. VoIP is supported in LTE, WCDMA and GPRS. 4. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio. 5. Wi-Fi 5 GHz Radio can transmit simultaneously with Bluetooth Radio.	

6.5. General LTE SAR Test and Reporting Considerations

Item	Description																																																				
Frequency range, Channel Bandwidth, Numbers and Frequencies	Band 5	Frequency range: 824 - 849 MHz																																																			
		Channel Bandwidth																																																			
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz																																														
	Low			20450/ 829	20425/ 826.5	20415/ 825.5	20407/ 824.7																																														
	Mid			20525/ 836.5	20525/ 836.5	20525/ 836.5	20525/ 836.5																																														
	High			20600/ 844	20625/ 846.5	20635/ 847.5	20643/ 848.3																																														
LTE transmitter and antenna implementation	LTE has one (1) TX/RX antennas and one (1) Diversity antennas Refer to Appendix A.																																																				
Maximum power reduction (MPR)	<table><tr><th colspan="8">Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3</th></tr><tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</th><th rowspan="2">MPR (dB)</th></tr><tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr><tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr><tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr></table> MPR Built-in by design A-MPR (additional MPR) was disabled during SAR testing							Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3								Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1	16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1	16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3																																																					
Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)																																														
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz																																															
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1																																														
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1																																														
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2																																														
Power reduction	No																																																				
Spectrum plots for RB configurations	A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report																																																				

7. RF Exposure Conditions (Test Configurations)

Refer to “Photos and Antenna 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	10 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	No	1
			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	10 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	Yes	
			Edge 3 (Bottom)	> 25 mm	No	1
			Edge 4 (Left)	> 25 mm	No	1

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. Conducted Output Power Measurements

8.1. GSM850 and GSM1900

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	32.4	23.4
				190	836.6	32.5	23.5
				251	848.8	32.2	23.2
	GPRS (GMSK)	CS1	1	128	824.2	32.4	23.4
				190	836.6	32.5	23.5
				251	848.8	32.2	23.2
			2	128	824.2	29.5	23.5
				190	836.6	29.5	23.5
				251	848.8	29.5	23.5
			3	128	824.2	29.4	25.1
				190	836.6	29.5	25.2
				251	848.8	29.5	25.2
			4	128	824.2	27.6	24.6
				190	836.6	27.7	24.7
				251	848.8	27.7	24.7
	EGPRS (8PSK)	MCS5	1	128	824.2	26.9	17.9
				190	836.6	26.9	17.9
				251	848.8	27.0	18.0
			2	128	824.2	26.8	20.8
				190	836.6	26.9	20.9
				251	848.8	27.0	21.0
			3	128	824.2	26.9	22.6
				190	836.6	27.0	22.7
				251	848.8	27.0	22.7
			4	128	824.2	26.8	23.8
				190	836.6	26.9	23.9
				251	848.8	26.9	23.9

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	29.7	20.7
				661	1880.0	29.8	20.8
				810	1909.8	29.7	20.7
	GPRS (GMSK)	CS1	1	512	1850.2	29.7	20.7
				661	1880.0	29.8	20.8
				810	1909.8	29.7	20.7
			2	512	1850.2	27.0	21.0
				661	1880.0	27.0	21.0
				810	1909.8	27.0	21.0
			3	512	1850.2	26.4	22.1
				661	1880.0	26.4	22.1
				810	1909.8	26.4	22.1
			4	512	1850.2	24.1	21.1
				661	1880.0	24.1	21.1
				810	1909.8	24.0	21.0
	EGPRS (8PSK)	MCS5	1	512	1850.2	25.5	16.5
				661	1880.0	25.5	16.5
				810	1909.8	25.5	16.5
			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	25.5	21.2
				661	1880.0	25.5	21.2
				810	1909.8	25.5	21.2
			4	512	1850.2	23.5	20.5
				661	1880.0	23.4	20.4
				810	1909.8	23.5	20.5

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

8.2. WCDMA Band V and II

Release 99

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

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 2
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	β_c/β_d	8/15

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
WCDMA Band V	Rel 99 (RMC, 12.2 kbps)	4132	826.4	22.7
		4183	836.6	22.6
		4233	846.6	22.6
WCDMA Band II	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	22.9
		9400	1880.0	22.9
		9538	1907.6	22.9

HSDPA

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	
	Subtest	1	2	3	4
WCDMA 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	11/15	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			
	$A_{hs}=\beta_{hs}/\beta_c$	30/15			

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
WCDMA Band V	Subtest 1	4132	826.4	0	21.6
		4183	836.6	0	21.5
		4233	846.6	0	21.5
	Subtest 2	4132	826.4	0	21.6
		4183	836.6	0	21.6
		4233	846.6	0	21.6
	Subtest 3	4132	826.4	0.5	21.2
		4183	836.6	0.5	21.1
		4233	846.6	0.5	21.1
	Subtest 4	4132	826.4	0.5	21.2
		4183	836.6	0.5	21.2
		4233	846.6	0.5	21.1
WCDMA Band II	Subtest 1	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 2	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 3	9262	1852.4	0.5	21.8
		9400	1880.0	0.5	21.8
		9538	1907.6	0.5	21.8
	Subtest 4	9262	1852.4	0.5	21.8
		9400	1880.0	0.5	21.8
		9538	1907.6	0.5	21.8

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

HSPA (HSDPA & HSUPA)

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

	Mode	HSPA				
	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	11/15	15/9	2/15	15/0
	β_{hs}	22/15	12/15	30/15	4/15	5/15
	β_{ed}	1309/225	94/75	47/15 47/15	56/75	47/15
	CM (dB)	1	3	2	3	1
	MPR (dB)	0	2	1	2	0
HSDPA Specific Settings	DACK	8				0
	DNAK	8				0
	DCQI	8				0
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	$A_{hs} = \beta_{hs}/\beta_c$	30/15				
HSUPA Specific Settings	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

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
WCDMA Band V	Subtest 1	4132	826.4	0	21.4
		4183	836.6	0	21.1
		4233	846.6	0	21.3
	Subtest 2	4132	826.4	2	20.2
		4183	836.6	2	20.4
		4233	846.6	2	20.5
	Subtest 3	4132	826.4	1	20.7
		4183	836.6	1	20.5
		4233	846.6	1	20.5
	Subtest 4	4132	826.4	2	20.5
		4183	836.6	2	20.5
		4233	846.6	2	20.3
WCDMA Band II	Subtest 1	4132	826.4	0	21.6
		4183	836.6	0	21.7
		4233	846.6	0	21.7
	Subtest 2	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 3	9262	1852.4	2	20.3
		9400	1880.0	2	20.3
		9538	1907.6	2	20.4
	Subtest 4	9262	1852.4	1	21.1
		9400	1880.0	1	21.3
		9538	1907.6	1	21.0
	Subtest 5	9262	1852.4	2	20.3
		9400	1880.0	2	20.3
		9538	1907.6	2	20.4
	Subtest 6	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 7	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3

DC-HSDPA

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108 v9.5.0. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.0

Table E.5.0: Levels for HSDPA connection setup

Parameter During Connection setup	Unit	Value
P-CPICH_Ec/Ior	dB	-10
P-CCPCH and SCH_Ec/Ior	dB	-12
PICH_Ec/Ior	dB	-15
HS-PDSCH	dB	off
HS-SCCH_1	dB	off
DPCH_Ec/Ior	dB	-5
OCNS_Ec/Ior	dB	-3.1

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

The configurations of the fixed reference channels for HSDPA RF tests are described in 3GPP TS 34.121, annex C for FDD and 3GPP TS 34.122.

Table C.8.1.12: Fixed Reference Channel H-Set 12

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK
Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table. Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.		

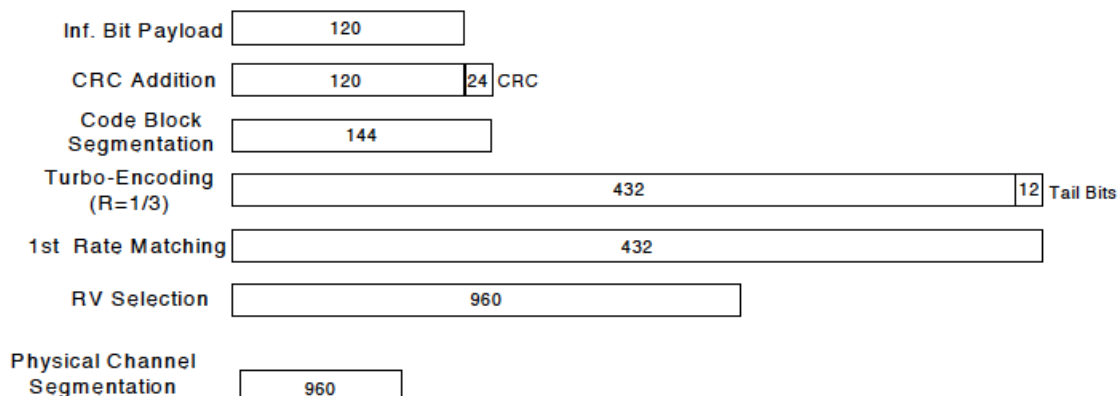


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

The following 4 Sub-tests for HSDPA were completed according to Release 8 procedures in section 5.2 of 3GPP TS34.121. A summary of subtest settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set 1			
	Power Control Algorithm	Algorithm2			
	β_c	2/15	11/15	15/15	15/15
	β_d	15/15	15/15	8/15	4/15
	β_d (SF)	64			
	β_c/β_d	2/15	11/15	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
	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack Repetition factor	3			
	CQI Feedback	4ms			
	CQI Repetition Factor	2			
	Ahs = β_{hs}/β_c	30/15			

Up commands are set continuously to set the UE to Max power.

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
WCDMA Band V	Subtest 1	4132	826.4	0	21.6
		4183	836.6	0	21.5
		4233	846.6	0	21.5
	Subtest 2	4132	826.4	0	21.6
		4183	836.6	0	21.6
		4233	846.6	0	21.6
	Subtest 3	4132	826.4	0.5	21.2
		4183	836.6	0.5	21.1
		4233	846.6	0.5	21.1
	Subtest 4	4132	826.4	0.5	21.2
		4183	836.6	0.5	21.2
		4233	846.6	0.5	21.1
WCDMA Band II	Subtest 1	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 2	9262	1852.4	0	22.3
		9400	1880.0	0	22.4
		9538	1907.6	0	22.3
	Subtest 3	9262	1852.4	0.5	21.8
		9400	1880.0	0.5	21.8
		9538	1907.6	0.5	21.8
	Subtest 4	9262	1852.4	0.5	21.8
		9400	1880.0	0.5	21.8
		9538	1907.6	0.5	21.8

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.

8.3. LTE Band 5

The following tests were conducted according to the test requirements outlined in section 6.2 of the 3GPP TS36.101 specification.

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

The allowed A-MPR values specified below in Table 6.2.4.-1 of 3GPP TS36.101 are in addition to the allowed MPR requirements. All the measurements below were performed with A-MPR disabled, by using Network Signaling Value of "NS_01".

Table 6.2.4-1: Additional Maximum Power Reduction (A-MPR)

Network Signalling value	Requirements (sub-clause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	NA
NS_03	6.6.2.2.1	2, 4, 10, 23, 25, 35, 36	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2	41	5	>6	≤ 1
			10, 15, 20	See Table 6.2.4-4	
NS_05	6.6.3.3.1	1	10,15,20	≥ 50	≤ 1
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	n/a
NS_07	6.6.2.2.3	13	10	Table 6.2.4-2	Table 6.2.4-2
	6.6.3.3.2				
NS_08	6.6.3.3.3	19	10, 15	> 44	≤ 3
NS_09	6.6.3.3.4	21	10, 15	> 40	≤ 1
				> 55	≤ 2
NS_10		20	15, 20	Table 6.2.4-3	Table 6.2.4-3
NS_11	6.6.2.2.1	23 ¹	1.4, 3, 5, 10	Table 6.2.4-5	Table 6.2.4-5
..					
NS_32	-	-	-	-	-

Note 1: Applies to the lower block of Band 23, i.e. a carrier placed in the 2000-2010 MHz region.

LTE Band 5 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							829 MHz	836.5 MHz	844 MHz
LTE Band 5	10	QPSK	1	0	0	0	22.9	22.9	22.8
			1	25	0	0	22.9	22.7	22.7
			1	49	0	0	22.6	22.8	22.6
			25	0	1	1	21.9	21.9	21.9
			25	12	1	1	21.8	21.8	21.7
			25	25	1	1	21.9	21.7	21.8
			50	0	1	1	21.8	21.8	21.7
		16QAM	1	0	1	1	21.8	21.8	21.7
			1	25	1	1	21.9	21.7	21.8
			1	49	1	1	21.8	21.8	21.7
			25	0	2	2	20.9	21.0	20.9
			25	12	2	2	20.9	20.9	20.8
			25	25	2	2	20.9	20.8	20.9
			50	0	2	2	20.9	20.9	20.8
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							826.5 MHz	836.5 MHz	846.5 MHz
LTE Band 5	5	QPSK	1	0	0	0	22.6	22.9	22.8
			1	12	0	0	22.8	23.0	22.9
			1	24	0	0	22.7	22.8	22.7
			12	0	1	1	21.9	21.8	21.9
			12	7	1	1	21.8	21.8	21.8
			12	13	1	1	21.9	21.7	21.7
			25	0	1	1	21.8	21.7	21.8
		16QAM	1	0	1	1	21.8	21.8	21.8
			1	12	1	1	21.9	21.7	21.7
			1	24	1	1	21.8	21.7	21.8
			12	0	2	2	20.8	20.9	20.9
			12	7	2	2	20.9	20.9	20.8
			12	13	2	2	20.8	20.9	20.8
			25	0	2	2	21.0	20.8	20.7
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							825.5 MHz	836.5 MHz	847.5 MHz
LTE Band 5	3	QPSK	1	0	0	0	22.8	22.9	22.7
			1	8	0	0	22.7	23.0	23.0
			1	14	0	0	22.7	22.6	22.5
			8	0	1	1	21.8	21.8	21.8
			8	4	1	1	21.8	21.8	21.7
			8	7	1	1	21.8	21.8	21.7
			15	0	1	1	21.8	21.8	21.7
		16QAM	1	0	1	1	21.8	21.8	21.5
			1	8	1	1	21.8	21.8	22.0
			1	14	1	1	21.8	21.8	21.7
			8	0	2	2	20.9	20.5	20.9
			8	4	2	2	20.9	20.7	20.9
			8	7	2	2	20.8	20.7	20.8
			15	0	2	2	20.9	20.9	20.7

LTE Band 5 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							824.7 MHz	836.5 MHz	848.3 MHz
LTE Band 5	1.4	QPSK	1	0	0	0	22.8	22.7	22.7
			1	3	0	0	22.9	22.8	22.7
			1	5	0	0	22.9	22.7	22.5
			3	0	0	0	22.8	22.7	22.7
			3	1	0	0	22.9	22.7	22.7
			3	3	0	0	22.8	22.8	22.7
			6	0	1	1	21.8	21.7	21.8
		16QAM	1	0	1	1	21.8	21.9	21.7
			1	3	1	1	21.8	21.9	21.8
			1	5	1	1	21.8	21.9	21.9
			3	0	1	1	21.8	21.8	21.6
			3	1	1	1	21.8	21.8	22.0
			3	3	1	1	22.0	21.8	21.9
			6	0	2	2	21.0	20.7	20.8

8.4. Wi-Fi (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	17.4	Yes
			6	2437	17.3	
			11	2462	17.5	
	802.11g	6 Mbps	1	2412	13.1	No
			6	2437	13.4	
			11	2462	13.5	
	802.11n (HT20)	MCS0	1	2412	12.2	No
			6	2437	12.1	
			11	2462	12.5	

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	17.0	No
			11 Mbps	17.0	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 a-b/g mode channel BW configuration.

8.5. Wi-Fi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
5.2 (U-NII-1)	802.11a	6 Mbps	36	5180	13.5	Yes
			40	5200	13.2	
			44	5220	13.4	
			48	5240	13.5	
	802.11n (HT20)	6.5 Mbps	36	5180	12.5	No
			40	5200	12.2	
			48	5240	12.0	
	802.11n (HT40)	13.5 Mbps	38	5190	11.0	No
			46	5230	11.1	
5.3 (U-NII-2A)	802.11a	6 Mbps	52	5260	13.5	Yes
			56	5280	13.1	
			60	5300	13.5	
			64	5320	13.2	
	802.11n (HT20)	6.5 Mbps	52	5260	12.4	No
			60	5300	12.5	
			64	5320	12.3	
	802.11n (HT40)	13.5 Mbps	54	5270	11.2	No
			62	5310	11.3	
5.5 (U-NII-2C)	802.11a	6 Mbps	100	5500	13.0	Yes
			104	5520	13.5	
			108	5540	13.3	
			112	5560	13.1	
			116	5580	12.8	
			120	5600	13.3	
			124	5620	13.0	
			128	5640	13.5	
			132	5660	13.3	
			136	5680	13.3	
			140	5700	13.4	
	802.11n (HT20)	6.5 Mbps	100	5500	12.3	No
			116	5580	11.8	
			140	5700	12.3	
	802.11n (HT40)	13.5 Mbps	102	5510	11.2	No
			110	5550	11.2	
			134	5670	11.1	
5.8 (U-NII-3)	802.11a	6 Mbps	149	5745	13.3	Yes
			153	5765	13.5	
			157	5785	13.3	
			161	5805	13.0	
			165	5825	13.4	
	802.11n (HT20)	6.5 Mbps	149	5745	12.0	No
			157	5785	12.3	
			161	5805	12.0	
	802.11n (HT40)	13.5 Mbps	151	5755	11.5	No
			159	5795	11.5	

Note(s):

Per KDB 248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than $\frac{1}{4}$ dB higher than that measured on the corresponding 802.11a channels.

Power measurements to determine worst-case data rates

Band	Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
5.2 GHz (U-NII-1)	802.11a	36	5180	6 Mbps	13.5	Yes
				9 Mbps	13.5	No
				12 Mbps	13.5	No
				18 Mbps	13.4	No
				24 Mbps	13.3	No
				36 Mbps	13.5	No
				48 Mbps	13.2	No
				54 Mbps	13.3	No
5.3 GHz (U-NII-2A)	802.11a	52	5260	6 Mbps	13.5	Yes
				9 Mbps	13.5	No
				12 Mbps	13.4	No
				18 Mbps	13.2	No
				24 Mbps	13.5	No
				36 Mbps	13.5	No
				48 Mbps	13.4	No
				54 Mbps	13.5	No
5.5 GHz (U-NII-2C)	802.11a	104	5520	6 Mbps	13.5	Yes
				9 Mbps	13.4	No
				12 Mbps	13.1	No
				18 Mbps	13.2	No
				24 Mbps	13.4	No
				36 Mbps	13.3	No
				48 Mbps	13.3	No
				54 Mbps	13.4	No
5.8 GHz (DTS)	802.11a	153	5765	6 Mbps	13.5	Yes
				9 Mbps	13.5	No
				12 Mbps	13.5	No
				18 Mbps	13.5	No
				24 Mbps	13.4	No
				36 Mbps	13.5	No
				48 Mbps	13.5	No
				54 Mbps	13.4	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 < ¼ dB higher than those measured at the lowest data rate.
 - Each channel should be tested at the lowest data rate in each a-b/g mode channel BW configuration.

8.6. Bluetooth

Maximum tune-up tolerance limit is 11.0 dBm. This power level qualifies for exclusion of SAR testing.

9. Dielectric Property Measurements

9.1. 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 Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

9.2. Dielectric Property Measurements Results

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.

SAR Lab 1

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11/19/2014	Head 2450	e'	39.3000	Relative Permittivity (ϵ_r):	39.30	39.20	0.26	5
		e"	13.8700	Conductivity (σ):	1.89	1.80	4.97	5
	Head 2410	e'	39.5100	Relative Permittivity (ϵ_r):	39.51	39.28	0.59	5
		e"	13.7700	Conductivity (σ):	1.85	1.76	4.82	5
	Head 2475	e'	39.2100	Relative Permittivity (ϵ_r):	39.21	39.17	0.11	5
		e"	13.8900	Conductivity (σ):	1.91	1.83	4.62	5
11/19/2014	Body 2450	e'	50.2200	Relative Permittivity (ϵ_r):	50.22	52.70	-4.71	5
		e"	14.2100	Conductivity (σ):	1.94	1.95	-0.73	5
	Body 2410	e'	50.4200	Relative Permittivity (ϵ_r):	50.42	52.76	-4.43	5
		e"	14.0600	Conductivity (σ):	1.88	1.91	-1.23	5
	Body 2475	e'	50.0900	Relative Permittivity (ϵ_r):	50.09	52.67	-4.90	5
		e"	14.2800	Conductivity (σ):	1.97	1.99	-1.01	5

SAR Lab 3

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11/17/2014	Head 835	e'	41.2800	Relative Permittivity (ϵ_r):	41.28	41.50	-0.53	5
		e''	19.7500	Conductivity (σ):	0.92	0.90	1.88	5
	Head 820	e'	41.4100	Relative Permittivity (ϵ_r):	41.41	41.60	-0.46	5
		e''	19.7500	Conductivity (σ):	0.90	0.90	0.23	5
	Head 850	e'	41.0400	Relative Permittivity (ϵ_r):	41.04	41.50	-1.11	5
		e''	19.6900	Conductivity (σ):	0.93	0.92	1.71	5
11/17/2014	Body 835	e'	53.0800	Relative Permittivity (ϵ_r):	53.08	55.20	-3.84	5
		e''	21.7500	Conductivity (σ):	1.01	0.97	4.11	5
	Body 820	e'	53.2100	Relative Permittivity (ϵ_r):	53.21	55.28	-3.74	5
		e''	21.8000	Conductivity (σ):	0.99	0.97	2.63	5
	Body 850	e'	52.9500	Relative Permittivity (ϵ_r):	52.95	55.16	-4.00	5
		e''	21.6700	Conductivity (σ):	1.02	0.99	3.75	5
11/24/2014	Head 835	e'	43.1300	Relative Permittivity (ϵ_r):	43.13	41.50	3.93	5
		e''	19.8200	Conductivity (σ):	0.92	0.90	2.25	5
	Head 820	e'	43.2800	Relative Permittivity (ϵ_r):	43.28	41.60	4.03	5
		e''	19.9600	Conductivity (σ):	0.91	0.90	1.29	5
	Head 850	e'	42.9200	Relative Permittivity (ϵ_r):	42.92	41.50	3.42	5
		e''	19.7700	Conductivity (σ):	0.93	0.92	2.12	5
11/24/2014	Body 835	e'	53.2800	Relative Permittivity (ϵ_r):	53.28	55.20	-3.48	5
		e''	21.5700	Conductivity (σ):	1.00	0.97	3.24	5
	Body 820	e'	53.4600	Relative Permittivity (ϵ_r):	53.46	55.28	-3.29	5
		e''	21.6800	Conductivity (σ):	0.99	0.97	2.07	5
	Body 850	e'	53.1900	Relative Permittivity (ϵ_r):	53.19	55.16	-3.57	5
		e''	21.4300	Conductivity (σ):	1.01	0.99	2.60	5

SAR Lab 4

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11/17/2017	Head 1900	e'	38.2300	Relative Permittivity (ϵ_r):	38.23	40.00	-4.43	5
		e"	13.1100	Conductivity (σ):	1.39	1.40	-1.07	5
	Head 1850	e'	38.4500	Relative Permittivity (ϵ_r):	38.45	40.00	-3.87	5
		e"	13.0100	Conductivity (σ):	1.34	1.40	-4.41	5
	Head 1910	e'	38.1800	Relative Permittivity (ϵ_r):	38.18	40.00	-4.55	5
		e"	13.2500	Conductivity (σ):	1.41	1.40	0.51	5
11/17/2014	Body 1900	e'	50.8100	Relative Permittivity (ϵ_r):	50.81	53.30	-4.67	5
		e"	14.3100	Conductivity (σ):	1.51	1.52	-0.54	5
	Body 1850	e'	51.0100	Relative Permittivity (ϵ_r):	51.01	53.30	-4.30	5
		e"	14.1800	Conductivity (σ):	1.46	1.52	-4.04	5
	Body 1910	e'	50.8000	Relative Permittivity (ϵ_r):	50.80	53.30	-4.69	5
		e"	14.4000	Conductivity (σ):	1.53	1.52	0.61	5
11/24/2014	Head 1900	e'	39.7200	Relative Permittivity (ϵ_r):	39.72	40.00	-0.70	5
		e"	13.2200	Conductivity (σ):	1.40	1.40	-0.24	5
	Head 1850	e'	39.9600	Relative Permittivity (ϵ_r):	39.96	40.00	-0.10	5
		e"	13.1500	Conductivity (σ):	1.35	1.40	-3.38	5
	Head 1910	e'	39.7100	Relative Permittivity (ϵ_r):	39.71	40.00	-0.72	5
		e"	13.2300	Conductivity (σ):	1.41	1.40	0.36	5
11/24/2014	Body 1900	e'	51.4300	Relative Permittivity (ϵ_r):	51.43	53.30	-3.51	5
		e"	14.2300	Conductivity (σ):	1.50	1.52	-1.10	5
	Body 1850	e'	51.6100	Relative Permittivity (ϵ_r):	51.61	53.30	-3.17	5
		e"	14.1500	Conductivity (σ):	1.46	1.52	-4.24	5
	Body 1910	e'	51.3900	Relative Permittivity (ϵ_r):	51.39	53.30	-3.58	5
		e"	14.2700	Conductivity (σ):	1.52	1.52	-0.30	5

SAR Lab 5

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11/19/2014	Head 5180	e'	37.1000	Relative Permittivity (ϵ_r):	37.10	36.01	3.02	5
		e"	15.3100	Conductivity (σ):	4.41	4.63	-4.77	5
	Head 5200	e'	37.0900	Relative Permittivity (ϵ_r):	37.09	35.99	3.06	5
		e"	15.3400	Conductivity (σ):	4.44	4.65	-4.64	5
	Head 5600	e'	36.6500	Relative Permittivity (ϵ_r):	36.65	35.53	3.14	5
		e"	15.5200	Conductivity (σ):	4.83	5.06	-4.50	5
	Head 5800	e'	36.3500	Relative Permittivity (ϵ_r):	36.35	35.30	2.97	5
		e"	15.8100	Conductivity (σ):	5.10	5.27	-3.25	5
	Head 5825	e'	36.4000	Relative Permittivity (ϵ_r):	36.40	35.30	3.12	5
		e"	15.6900	Conductivity (σ):	5.08	5.27	-3.57	5
11/19/2014	Body 5180	e'	48.3500	Relative Permittivity (ϵ_r):	48.35	49.05	-1.42	5
		e"	18.6400	Conductivity (σ):	5.37	5.27	1.85	5
	Body 5200	e'	48.3000	Relative Permittivity (ϵ_r):	48.30	49.02	-1.47	5
		e"	18.6900	Conductivity (σ):	5.40	5.29	2.06	5
	Body 5600	e'	47.8700	Relative Permittivity (ϵ_r):	47.87	48.48	-1.25	5
		e"	18.9900	Conductivity (σ):	5.91	5.76	2.64	5
	Body 5800	e'	47.4400	Relative Permittivity (ϵ_r):	47.44	48.20	-1.58	5
		e"	19.3400	Conductivity (σ):	6.24	6.00	3.95	5
	Body 5825	e'	47.4400	Relative Permittivity (ϵ_r):	47.44	48.20	-1.58	5
		e"	19.2200	Conductivity (σ):	6.23	6.00	3.75	5

10. 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.

10.1. System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 $\pm$ 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.

10.2. Reference Target SAR Values

The reference SAR values are obtained from the calibration certificate of system validation dipoles. The measured values are normalized to 1 Watt.

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	706	5/20/2014	2450	1g	53.0	50.2
				10g	24.5	23.4
D5GHzV2	1003	2/26/2014	5200	1g	77.7	73.5
				10g	22.2	20.5
			5600	1g	81.8	79.6
				10g	23.2	22.1
			5800	1g	78.3	73.8
				10g	22.1	20.4

10.3. 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			
11/19/2014	D2450V2	706	Head	1g	5.61	56.1	53.00	5.85
				10g	2.52	25.2	24.50	2.86
11/19/2014	D2450V2	706	Body	1g	5.12	51.2	50.20	1.99
				10g	2.34	23.4	23.40	0.00

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			
11/17/2014	D835V2	4d142	Head	1g	0.929	9.29	8.91	4.26
				10g	0.608	6.08	5.77	5.37
11/17/2014	D835V2	4d142	Body	1g	0.966	9.66	9.22	4.77
				10g	0.634	6.34	6.05	4.79
11/24/2014	D835V2	4d142	Head	1g	0.947	9.47	8.91	6.29
				10g	0.620	6.20	5.77	7.45
11/24/2014	D835V2	4d142	Body	1g	0.975	9.75	9.22	5.75
				10g	0.642	6.42	6.05	6.12

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			
11/17/2014	D1900V2	5d163	Head	1g	4.04	40.4	40.80	-0.98
				10g	2.08	20.8	21.20	-1.89
11/17/2014	D1900V2	5d163	Body	1g	3.76	37.6	40.60	-7.39
				10g	1.96	19.6	21.40	-8.41
11/24/2014	D1900V2	5d163	Head	1g	4.18	41.8	40.80	2.45
				10g	2.16	21.6	21.20	1.89
11/24/2014	D1900V2	5d163	Body	1g	3.91	39.1	40.60	-3.69
				10g	2.04	20.4	21.40	-4.67

SAR Lab 5

Date Tested	System Dipole		T.S. Liquid	Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #		Zoom Scan to 100 mW	Normalize to 1 W			
11/19/2014	D5GHzV2 (5.2 GHz)	1003	Head	1g	7.32	73.2	77.7	-5.79
				10g	2.13	21.3	22.2	-4.05
11/19/2014	D5GHzV2 (5.2 GHz)	1003	Body	1g	7.39	73.9	73.5	0.54
				10g	2.09	20.9	20.5	1.95
11/19/2014	D5GHzV2 (5.6 GHz)	1003	Head	1g	7.97	79.7	81.8	-2.57
				10g	2.27	22.7	23.2	-2.16
11/19/2014	D5GHzV2 (5.6 GHz)	1003	Body	1g	8.11	81.1	79.6	1.88
				10g	2.25	22.5	22.1	1.81
11/19/2014	D5GHzV2 (5.8 GHz)	1003	Head	1g	8.11	81.1	78.3	3.58
				10g	2.31	23.1	22.1	4.52
11/19/2014	D5GHzV2 (5.8 GHz)	1003	Body	1g	7.65	76.5	73.8	3.66
				10g	2.13	21.3	20.4	4.41

11. 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:

Body SAR is also measured for HSPA when the maximum average output of each RF channel with HSPA active is at least $\frac{1}{4}$ dB higher than that measured without HSPA using 12.2 kbps RMC or the maximum SAR for 12.2 kbps RMC is above 75% of the SAR limit. Body SAR for HSPA is measured with E-DCH Sub-test 5, using H-Set 1 and QPSK for FRC and a 12.2 kbps RMC configured in Test Loop Mode 1 with power control algorithm 2.

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.

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.

11.1. 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	32.5	0.124	0.156	1
			Left Tilt	190	836.6	33.5	32.5	0.100	0.125	
			Right Touch	190	836.6	33.5	32.5	0.135	0.170	
			Right Tilt	190	836.6	33.5	32.5	0.091	0.114	
Head VoIP	GPRS 3 Slots	0	Left Touch	190	836.6	29.5	29.5	0.153	0.153	2
			Left Tilt	190	836.6	29.5	29.5	0.126	0.126	
			Right Touch	190	836.6	29.5	29.5	0.178	0.178	
			Right Tilt	190	836.6	29.5	29.5	0.120	0.120	
Body-worn	Voice	10	Rear	190	836.6	33.5	32.5	0.317	0.399	3
			Front	190	836.6	33.5	32.5	0.256	0.322	
Body-worn(VoIP) & Hotspot	GPRS 3 Slots	10	Rear	190	836.6	29.5	29.5	0.415	0.415	4
Front			190	836.6	29.5	29.5	0.342	0.342		
Hotspot			Edge 2	190	836.6	29.5	29.5	0.287	0.287	
			Edge 3	190	836.6	29.5	29.5	0.211	0.211	
			Edge 4	190	836.6	29.5	29.5	0.093	0.093	

11.2. 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	30.5	29.8	0.197	0.231	5
			Left Tilt	661	1880.0	30.5	29.8	0.040	0.047	
			Right Touch	661	1880.0	30.5	29.8	0.189	0.222	
			Right Tilt	661	1880.0	30.5	29.8	0.045	0.053	
Head VoIP	GPRS 3 Slots	0	Left Touch	661	1880.0	26.5	26.4	0.307	0.314	6
			Left Tilt	661	1880.0	26.5	26.4	0.059	0.061	
			Right Touch	661	1880.0	26.5	26.4	0.271	0.277	
			Right Tilt	661	1880.0	26.5	26.4	0.052	0.053	
Body-worn	Voice	10	Rear	661	1880.0	30.5	29.8	0.338	0.397	
			Front	661	1880.0	30.5	29.8	0.381	0.448	7
Body-worn(VoIP) & Hotspot	GPRS 3 Slots	10	Rear	661	1880.0	26.5	26.4	0.394	0.403	
			Front	661	1880.0	26.5	26.4	0.488	0.499	8
Edge 2			661	1880.0	26.5	26.4	0.109	0.112		
Edge 3			512	1850.2	26.5	26.4	1.020	1.044	9	
			661	1880.0	26.5	26.4	0.866	0.886		
Hotspot			810	1909.8	26.5	26.4	0.691	0.707		
			Edge 4	661	1880.0	26.5	26.4	0.242	0.248	

11.3. WCDMA 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	23.0	22.6	0.111	0.122	10
			Left Tilt	4183	836.6	23.0	22.6	0.091	0.100	
			Right Touch	4183	836.6	23.0	22.6	0.161	0.177	
			Right Tilt	4183	836.6	23.0	22.6	0.090	0.099	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	4183	836.6	23.0	22.6	0.273	0.299	11
			Front	4183	836.6	23.0	22.6	0.216	0.237	
Hotspot	Rel 99 RMC	10	Edge 2	4183	836.6	23.0	22.6	0.209	0.229	
			Edge 3	4183	836.6	23.0	22.6	0.140	0.154	
			Edge 4	4183	836.6	23.0	22.6	0.090	0.099	

11.4. WCDMA 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	22.9	0.425	0.435	12
			Left Tilt	9400	1880.0	23.0	22.9	0.085	0.087	
			Right Touch	9400	1880.0	23.0	22.9	0.345	0.353	
			Right Tilt	9400	1880.0	23.0	22.9	0.075	0.077	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	9262	1852.4	23.0	22.9	0.720	0.737	
				9400	1880.0	23.0	22.9	0.820	0.839	
				9538	1907.6	23.0	22.9	0.855	0.875	
			Front	9262	1852.4	23.0	22.9	0.864	0.884	
				9400	1880.0	23.0	22.9	0.906	0.927	
				9538	1907.6	23.0	22.9	0.970	0.993	13
Hotspot	Rel 99 RMC	10	Edge 2	9400	1880.0	23.0	22.9	0.146	0.149	
				9262	1852.4	23.0	22.9	1.030	1.054	
			Edge 3	9400	1880.0	23.0	22.9	1.140	1.167	14
				9538	1907.6	23.0	22.9	1.080	1.105	
			Edge 4	9400	1880.0	23.0	22.9	0.342	0.350	

11.5. LTE Band 5 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB Offset	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Head	QPSK	0	Left Touch	20525	836.5	1	0	23.0	22.9	0.108	0.111	
						25	0	22.0	21.9	0.079	0.081	
			Left Tilt	20525	836.5	1	0	23.0	22.9	0.101	0.103	
						25	0	22.0	21.9	0.074	0.075	
			Right Touch	20525	836.5	1	0	23.0	22.9	0.144	0.147	15
						25	0	22.0	21.9	0.107	0.109	
			Right Tilt	20525	836.5	1	0	23.0	22.9	0.097	0.099	
						25	0	22.0	21.9	0.073	0.075	
Body-worn & Hotspot	QPSK	10	Rear	20525	836.5	1	0	23.0	22.9	0.325	0.333	16
						25	0	22.0	21.9	0.237	0.243	
			Front	20525	836.5	1	0	23.0	22.9	0.272	0.278	
						25	0	22.0	21.9	0.201	0.206	
Hotspot	QPSK	10	Edge 2	20525	836.5	1	0	23.0	22.9	0.221	0.226	
						25	0	22.0	21.9	0.169	0.173	
			Edge 3	20525	836.5	1	0	23.0	22.9	0.140	0.143	
						25	0	22.0	21.9	0.107	0.109	
			Edge 4	20525	836.5	1	0	23.0	22.9	0.129	0.132	
						25	0	22.0	21.9	0.073	0.075	

11.6. 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	0.342	0.342	17
				Left Tilt	11	2462.0	17.5	17.5	0.224	0.224	
				Right Touch	11	2462.0	17.5	17.5	0.133	0.133	
				Right Tilt	11	2462.0	17.5	17.5	0.087	0.087	
	Body-worn & Hotspot	802.11b 1 Mbps	10	Rear	11	2462.0	17.5	17.5	0.039	0.039	18
				Front	11	2462.0	17.5	17.5	0.029	0.029	
	Hotspot	802.11b 1 Mbps	10	Edge 1	11	2462.0	17.5	17.5	0.022	0.022	
				Edge 2	11	2462.0	17.5	17.5	0.007	0.007	
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	
5.8 GHz (DTS)	Head	802.11a 6 Mbps	0	Left Touch	153	5765.0	13.5	13.5	0.299	0.299	23
				Left Tilt	153	5765.0	13.5	13.5	0.204	0.204	
				Right Touch	153	5765.0	13.5	13.5	0.165	0.165	
				Right Tilt	153	5765.0	13.5	13.5	0.130	0.130	
	Body-worn & Hotspot	802.11a 6 Mbps	10	Rear	153	5765.0	13.5	13.5	0.044	0.044	24
				Front	153	5765.0	13.5	13.5	0.021	0.021	
	Hotspot	802.11a 6 Mbps	10	Edge 1	153	5765.0	13.5	13.5	0.015	0.015	
				Edge 2	153	5765.0	13.5	13.5	0.014	0.014	

11.7. Wi-Fi (UNII 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	
5.2 GHz (U-NII-1)	Head	802.11a 6 Mbps	0	Left Touch	36	5180.0	13.5	13.5	0.246	0.246	19
				Left Tilt	36	5180.0	13.5	13.5	0.169	0.169	
				Right Touch	36	5180.0	13.5	13.5	0.111	0.111	
				Right Tilt	36	5180.0	13.5	13.5	0.069	0.069	
	Body-worn	802.11a 6 Mbps	10	Rear	36	5180.0	13.5	13.5	0.000	0.000	
				Front	36	5180.0	13.5	13.5	0.000	0.000	
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	
5.3 GHz (U-NII-2A)	Head	802.11a 6 Mbps	0	Left Touch	52	5260.0	13.5	13.5	0.254	0.254	20
				Left Tilt	52	5260.0	13.5	13.5	0.181	0.181	
				Right Touch	52	5260.0	13.5	13.5	0.120	0.120	
				Right Tilt	52	5260.0	13.5	13.5	0.074	0.074	
	Body-worn	802.11a 6 Mbps	10	Rear	52	5260.0	13.5	13.5	0.000	0.000	
				Front	52	5260.0	13.5	13.5	0.000	0.000	
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	
5.5 GHz (U-NII-2C)	Head	802.11a 6 Mbps	0	Left Touch	104	5520.0	13.5	13.5	0.297	0.297	21
				Left Tilt	104	5520.0	13.5	13.5	0.217	0.217	
				Right Touch	104	5520.0	13.5	13.5	0.122	0.122	
				Right Tilt	104	5520.0	13.5	13.5	0.101	0.101	
	Body-worn	802.11a 6 Mbps	10	Rear	104	5520.0	13.5	13.5	0.038	0.038	22
				Front	104	5520.0	13.5	13.5	0.000	0.000	

11.8. Bluetooth

11.8.1. Standalone SAR Test Exclusion Considerations

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

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$, 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.

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
11.0	13	10	2.480	2.0

Conclusion:

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

11.8.2. Estimated SAR

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

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

Estimated SAR Result for Body-worn Accessory Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 1-g SAR (W/kg)
Rear/Front	13	10	2.480	0.273

12. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 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 < 0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), 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 3 (1-g or 10-g respectively) or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
- 4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 or 3 (1-g or 10-g respectively).

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 & Hotspot	Rear	No	0.415	N/A	N/A
	WCDMA Band V	Body & Hotspot	Rear	No	0.273	N/A	N/A
	LTE Band 5	Body & Hotspot	Rear	No	0.325	N/A	N/A
1900	GSM 1900	Hotspot	Edge 3	No	1.020	N/A	N/A
	WCDMA Band II	Hotspot	Edge 3	Yes	1.140	1.11	1.03
2400	Wi-Fi 802.11b	Head	Left Touch	No	0.342	N/A	N/A
5200	Wi-Fi 802.11a	Head	Left Touch	No	0.246	N/A	N/A
5300	Wi-Fi 802.11a	Head	Left Touch	No	0.254	N/A	N/A
5500	Wi-Fi 802.11a	Head	Left Touch	No	0.297	N/A	N/A
5800	Wi-Fi 802.11a	Head	Left Touch	No	0.299	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 .

13. Simultaneous Transmission SAR Analysis

13.1. 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 Wi-Fi(U-NII)	④ Bluetooth		
Head	Left Touch	① + ②	0.178	0.342			0.520	No
		① + ③	0.178		0.297		0.475	No
	Left Tilt	① + ②	0.126	0.224			0.350	No
		① + ③	0.126		0.217		0.343	No
	Right Touch	① + ②	0.178	0.165			0.343	No
		① + ③	0.178		0.122		0.300	No
	Right Tilt	① + ②	0.120	0.130			0.250	No
		① + ③	0.120		0.101		0.221	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.415	0.044			0.459	No
		① + ③	0.415		0.038		0.453	No
		① + ④	0.415			0.273	0.688	No
		① + ② + ④	0.415	0.044		0.273	0.732	No
		① + ② + ④	0.415		0.038	0.273	0.726	No
	Front	① + ②	0.342	0.029			0.371	No
		① + ③	0.342		0.000		0.342	No
		① + ④	0.342			0.273	0.615	No
		① + ③ + ④	0.342		0.000	0.273	0.615	No
Hotspot	Edge 1	① + ②		0.022			0.022	No
	Edge 2	① + ②	0.287	0.014			0.301	No
	Edge 3	① + ②	0.211				0.211	No
	Edge 4	① + ②	0.093				0.093	No

13.2. 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 Wi-Fi(U-NII)	④ Bluetooth		
Head	Left Touch	① + ②	0.314	0.342			0.656	No
		① + ③	0.314		0.297		0.611	No
	Left Tilt	① + ②	0.061	0.224			0.285	No
		① + ③	0.061		0.217		0.278	No
	Right Touch	① + ②	0.277	0.165			0.442	No
		① + ③	0.277		0.122		0.399	No
	Right Tilt	① + ②	0.053	0.130			0.183	No
		① + ③	0.053		0.101		0.154	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.403	0.044			0.447	No
		① + ③	0.403		0.038		0.441	No
		① + ④	0.403			0.273	0.676	No
		① + ② + ④	0.403	0.044		0.273	0.720	No
		① + ③ + ④	0.403		0.038	0.273	0.714	No
	Front	① + ②	0.499	0.029			0.528	No
		① + ③	0.499		0.000		0.499	No
		① + ④	0.499			0.273	0.772	No
		① + ③ + ④	0.499		0.000	0.273	0.772	No
Hotspot	Edge 1	① + ②		0.022			0.022	No
	Edge 2	① + ②	0.112	0.014			0.126	No
	Edge 3	① + ②	1.044				1.044	No
	Edge 4	① + ②	0.248				0.248	No

13.3. 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 Wi-Fi (U-NII)	④ Bluetooth		
Head	Left Touch	① + ②	0.122	0.342			0.464	No
		① + ③	0.122		0.297		0.419	No
	Left Tilt	① + ②	0.100	0.224			0.324	No
		① + ③	0.100		0.217		0.317	No
	Right Touch	① + ②	0.177	0.165			0.342	No
		① + ③	0.177		0.122		0.299	No
	Right Tilt	① + ②	0.099	0.130			0.229	No
		① + ③	0.099		0.101		0.200	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.299	0.044			0.343	No
		① + ③	0.299		0.038		0.337	No
		① + ④	0.299			0.273	0.572	No
		① + ② + ④	0.299	0.044		0.273	0.616	No
		① + ③ + ④	0.299		0.038	0.273	0.610	No
	Front	① + ②	0.237	0.029			0.266	No
		① + ③	0.237		0.000		0.237	No
		① + ④	0.237			0.273	0.510	No
		① + ③ + ④	0.237		0.000	0.273	0.510	No
Hotspot	Edge 1	① + ②		0.022			0.022	No
	Edge 2	① + ②	0.229	0.014			0.243	No
	Edge 3	① + ②	0.154				0.154	No
	Edge 4	① + ②	0.099				0.099	No

13.4. 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 Wi-Fi (U-NII)	④ Bluetooth		
Head	Left Touch	① + ②	0.435	0.342			0.777	No
		① + ③	0.435		0.297		0.732	No
	Left Tilt	① + ②	0.087	0.224			0.311	No
		① + ③	0.087		0.217		0.304	No
	Right Touch	① + ②	0.353	0.165			0.518	No
		① + ③	0.353		0.122		0.475	No
	Right Tilt	① + ②	0.077	0.130			0.207	No
		① + ③	0.077		0.101		0.178	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.875	0.044			0.919	No
		① + ③	0.875		0.038		0.913	No
		① + ④	0.875			0.273	1.148	No
		① + ② + ④	0.875	0.044		0.273	1.192	No
		① + ③ + ④	0.875		0.038	0.273	1.186	No
	Front	① + ②	0.993	0.029			1.022	No
		① + ③	0.993		0.000		0.993	No
		① + ④	0.993			0.273	1.266	No
		① + ③ + ④	0.993		0.000	0.273	1.266	No
Hotspot	Edge 1	① + ②		0.022			0.022	No
	Edge 2	① + ②	0.149	0.014			0.163	No
	Edge 3	① + ②	1.167				1.167	No
	Edge 4	① + ②	0.350				0.350	No

13.5. Sum of the SAR for LTE Band 5 & Wi-Fi & BT

RF Exposure conditions	Test Position	Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
		① LTE Band 5	② Wi-Fi (DTS)	③ Wi-Fi (U-NII)	④ Bluetooth		
Head	Left Touch	① + ②	0.111	0.342		0.453	No
		① + ③	0.111	0.297		0.408	No
	Left Tilt	① + ②	0.103	0.224		0.327	No
		① + ③	0.103	0.217		0.320	No
	Right Touch	① + ②	0.147	0.165		0.312	No
		① + ③	0.147	0.122		0.269	No
	Right Tilt	① + ②	0.099	0.130		0.229	No
		① + ③	0.099	0.101		0.200	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.333	0.044		0.377	No
		① + ③	0.333	0.038		0.371	No
		① + ④	0.333		0.273	0.606	No
		① + ② + ④	0.333	0.044	0.273	0.650	No
		① + ③ + ④	0.333	0.038	0.273	0.644	No
	Front	① + ②	0.278	0.029		0.307	No
		① + ③	0.278	0.000		0.278	No
		① + ④	0.278		0.273	0.551	No
		① + ③ + ④	0.278	0.000	0.273	0.551	No
Hotspot	Edge 1	① + ②		0.022		0.022	No
	Edge 2	① + ②	0.226	0.014		0.240	No
	Edge 3	① + ②	0.143			0.143	No
	Edge 4	① + ②	0.132			0.132	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.

14. Appendixes

Refer to separated files for the following appendixes.

- A. Photos and Antenna Locations**
- B. System Performance Check Plots**
- C. Highest SAR Test Plots**
- D. Tissue Material Ingredients**
- E. Calibration Certificates for E-Field Probes**
- F. Calibration Certificates for Dipoles**

END OF REPORT