



SAR EVALUATION REPORT

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

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

**FCC ID: A3LSMA800S
Model Name: SM-A800S**

**Report Number: 15I20931-S1A
Issue Date: 6/30/2015**

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
--	6/29/2015	Initial Issue	--
A	6/30/2015	Updated Section 6.2: Updated DUT Description Updated Section 6.3: Added 16-QAM Tune-Up Results	Mark Balauro

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1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO., LTD.			
FCC ID	A3LSMA800S			
Model Name	SM-A800S			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 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	0.151	1.040	0.531	N/A
Body-worn*	1.130	0.330	0.096	
Hotspot/Wi-Fi Direct	1.130	0.330	0.096	
Simultaneous Tx	Head	1.191	0.682	
	Body-worn*	1.460	1.226	
	Hotspot/ Wi-Fi Direct	1.460	1.226	
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.				
Date Tested	6/11/2015 to 6/26/2015			
Test Results	Pass			
UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report. Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.				
Approved & Released By:		Prepared By:		
				
Devin Chang Senior Engineer UL Verification Services Inc.		Mark Balauro 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:

- 248227 D01 802.11 Wi-Fi SAR v02
- 447498 D01 General RF Exposure Guidance v05r02
- 648474 D04 Handset SAR v01r02
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- 865664 D02 RF Exposure Reporting v01r01
- 941225 D01 3G SAR Procedures v03
- 941225 D05 SAR for LTE Devices v02r03
- 941225 D06 Hotspot Mode v02

3. Facilities and Accreditation

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

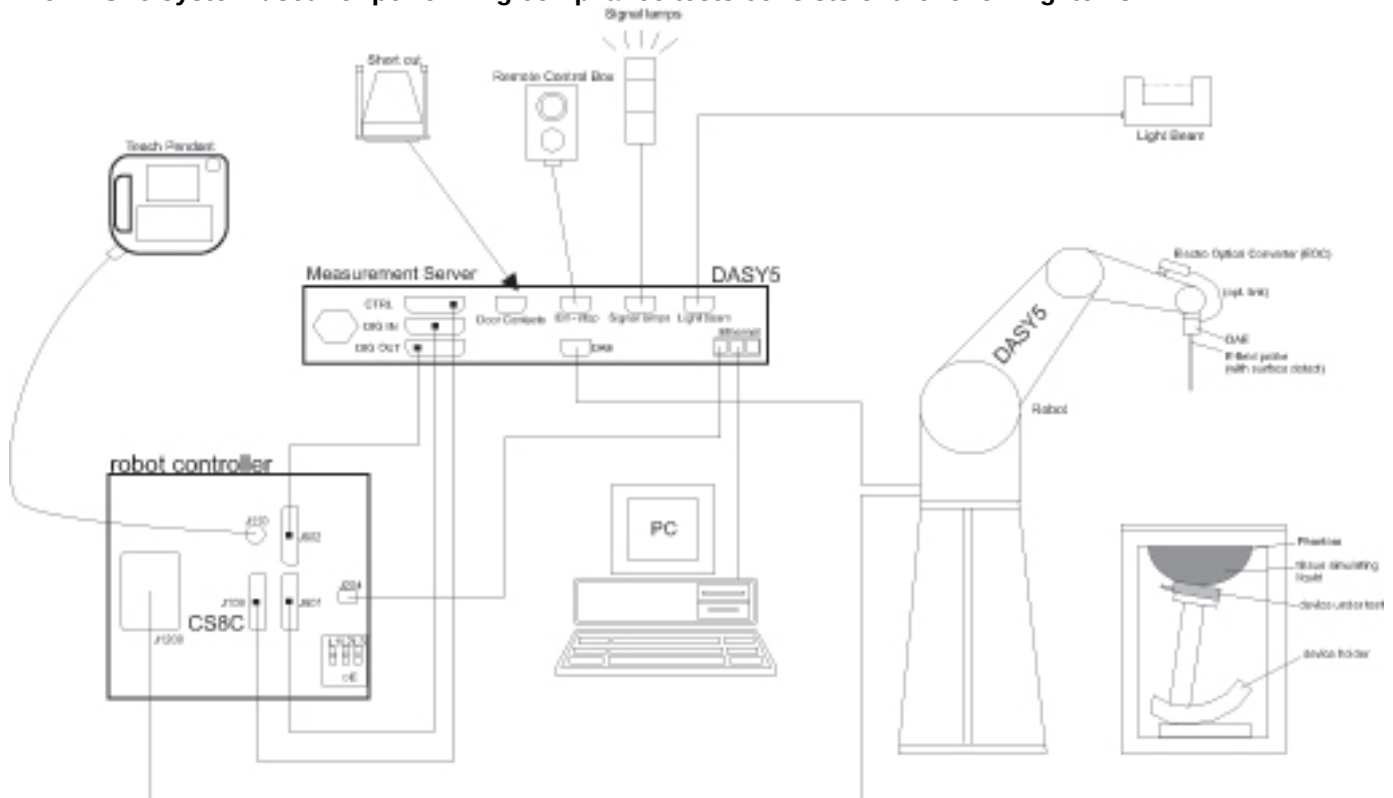
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

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

Step 4: Power drift measurement

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

Step 5: Z-Scan (FCC only)

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

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	4/17/2016
Dielectric Probe kit	SPEAG	DAK-3.5	1082	9/16/2015
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	Traceable	122529163	10/8/2015

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	8665B	3438A00633	7/10/2015
Power Meter	HP	437B	3125U09516	8/27/2015
Power Meter	HP	437B	3125U11347	10/6/2015
Power Sensor	HP	8481A	3318A95392	10/6/2015
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 Lab 1)	SPEAG	EX3DV4	3929	4/22/2016
E-Field Probe (SAR Lab 2)	SPEAG	EX3DV4	3990	3/18/2016
E-Field Probe (SAR Lab 3)	SPEAG	EX3DV4	3749	1/26/2016
E-Field Probe (SAR Lab 4)	SPEAG	EX3DV4	3989	3/17/2016
E-Field Probe (SAR Lab 5)	SPEAG	EX3DV4	3773	4/22/2016
Data Acquisition Electronics (SAR Lab 1)	SPEAG	DAE4	1352	11/7/2015
Data Acquisition Electronics (SAR Lab 2)	SPEAG	DAE4	1259	1/14/2016
Data Acquisition Electronics (SAR Lab 3)	SPEAG	DAE4	1380	7/23/2015
Data Acquisition Electronics (SAR Lab 4)	SPEAG	DAE4	1377	8/27/2015
Data Acquisition Electronics (SAR Lab 5)	SPEAG	DAE4	1239	4/16/2016
System Validation Dipole	SPEAG	D750V3	1071	11/13/2015
System Validation Dipole	SPEAG	D835V2	4d142	9/9/2015
System Validation Dipole	SPEAG	D1900V2	5d163	9/11/2015
System Validation Dipole	SPEAG	D2450V2	748	2/20/2016
System Validation Dipole	SPEAG	D2450V2	706	5/11/2016
System Validation Dipole	SPEAG	D5GHZV2	1168	12/4/2015
Thermometer (SAR Lab 1)	EXTECH	445703	CCS-205	3/20/2016
Thermometer (SAR Lab 2)	EXTECH	445703	CCS-203	3/19/2016
Thermometer (SAR Lab 3)	EXTECH	445703	CCS-237	6/5/2016
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/5/2016
Thermometer (SAR Lab 5)	EXTECH	445703	CCS-239	6/5/2016

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY53060002	4/7/2017
Power Sensor	Agilent	N1921A	MY52020011	6/1/2016
Base Station Simulator	R & S	CMW500	135387	4/20/2016

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

Device Dimension	Overall (Length x Width): 157.9 mm x 76.9 mm Overall Diagonal: 167.7 mm Display Diagonal: 144.3 mm		
Back Cover	The rechargeable battery is not user accessible.		
Battery Options	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 5.2, Group Client only, and 5.8 GHz, Group Owner)		
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 5.2, Group Client only, and 5.8 GHz, Group Owner)		
Test sample information	S/N	IMEI	Notes
	0000000000	0000000000000000	Radiated unit
	0000000000	0000000000000000	Radiated unit
	0000000000	0000000000000000	Radiated unit
	0000000000	0000000000000000	Radiated unit
	0000000000	0000000000000000	Radiated unit
	0000000000	0000000000000000	Radiated (Phone RF)
	0000000000	0000000000000000	Conducted
Hardware Version	REV0.0		
Software Version	A800S.000		

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode		Duty Cycle used for SAR testing
GSM	1900	Voice (GMSK) GPRS (GMSK)	GPRS Multi-Slot Class: ☐ Class 8 - 1 Up, 4 Down ☒ Class 10 - 2 Up, 4 Down ☐ Class 12 - 4 Up, 4 Down ☐ Class 33 - 4 Up, 5 Down	GSM Voice: 12.5% GPRS: 1 Slot: 12.5% 2 Slots: 25%
	☒ Class A = both simultaneously. ☐ Class B = GPRS connection interrupted during a GSM call, automatically resumed at end of call. ☐ Class C = manual GSM / GPRS mode switching. Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No			
W-CDMA (UMTS)	Band II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6)		100%
LTE	FDD Band 5 FDD Band 17	QPSK 16QAM ☐ Rel. 10 Does not support Carrier Aggregation (CA) ☒ Rel. 10 Carrier Aggregation (1 Uplink and 2 Downlinks) *FCC Bands do not support Carrier Aggregation ☐ Rel. 11 Carrier Aggregation (2 Uplink and 2 Downlinks)		100% (FDD)
	Does this device support 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) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		100%
	Does this device support frequencies 5.60 ~ 5.65 GHz? ☒ Yes ☐ No			
	Does this device support Band gap channel(s)? ☐ Yes ☒ No			
Bluetooth	2.4 GHz	Version 4.1 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		Max. RF Output Pow er (dBm)		
RF Air interface	Mode	Target	Max. tune-up tolerance limit	
			Burst	Frame
GSM1900	Voice (1 slot)	30.0	30.5	21.5
	GPRS 1 slot	30.0	30.5	21.5
	GPRS 2 slots	26.5	27.0	21.0
Upper limit (dB): -1.5 ~ 0.5		Max. RF Output Pow er (dBm)		
RF Air interface	Mode	Target	Max. tune-up tolerance limit	
W-CDMA Band V	R99	22.0	22.5	
	HSDPA	21.0	21.5	
	HSUPA	21.0	21.5	
W-CDMA Band II	R99	21.5	22.0	
	HSDPA	21.0	21.5	
	HSUPA	20.6	21.1	
LTE Band 5	QPSK	23.5	24.0	
	16-QAM	22.5	23.0	
LTE Band 17	QPSK	23.5	24.0	
	16-QAM	22.5	23.0	
Upper limit (dB): 0.5		Max. RF Output Pow er (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	12.0	12.5	
WiFi 5 GHz	802.11a	10.0	10.5	
	802.11n HT20	10.0	10.5	
	802.11n HT40	10.0	10.5	
	802.11ac VHT20	10.0	10.5	
	802.11ac VHT40	10.0	10.5	
	802.11ac VHT80	9.5	10.0	
	Bluetooth	9.0	9.5	
Bluetooth LE		7.0	7.5	

6.4. General LTE SAR Test and Reporting Considerations

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																																						
	Band 17	Frequency range: 704 - 716 MHz																																											
		Channel Bandwidth																																											
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz																																						
	Low				23755/ 706.5																																								
	Mid			23790/ 710	23790/ 710																																								
	High				23825/ 713.5																																								
LTE transmitter and antenna implementation	LTE has one (1) Tx/Rx antenna for LTE Bands 5 and 17 and one (1) Rx antenna for LTE Bands 5 and 17. Refer to Appendix A.																																												
Maximum power reduction (MPR)	Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3 <table border="1"> <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							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
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 “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	2
			Front	N/A	Yes	2
	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	2
			Front	N/A	Yes	2
	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.
- 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.

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 Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:**SAR Lab 1**

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/11/2015	Head 835	e'	40.1800	Relative Permittivity (ϵ_r):	40.18	41.50	-3.18	5
		e''	18.9200	Conductivity (σ):	0.88	0.90	-2.40	5
	Head 820	e'	40.3700	Relative Permittivity (ϵ_r):	40.37	41.60	-2.96	5
		e''	18.8900	Conductivity (σ):	0.86	0.90	-4.14	5
	Head 850	e'	39.9200	Relative Permittivity (ϵ_r):	39.92	41.50	-3.81	5
		e''	19.0100	Conductivity (σ):	0.90	0.92	-1.81	5
6/11/2015	Body 835	e'	54.8900	Relative Permittivity (ϵ_r):	54.89	55.20	-0.56	5
		e''	21.8000	Conductivity (σ):	1.01	0.97	4.34	5
	Body 820	e'	54.9200	Relative Permittivity (ϵ_r):	54.92	55.28	-0.65	5
		e''	22.0500	Conductivity (σ):	1.01	0.97	3.81	5
	Body 850	e'	54.7000	Relative Permittivity (ϵ_r):	54.70	55.16	-0.83	5
		e''	21.6900	Conductivity (σ):	1.03	0.99	3.85	5

SAR Lab 2

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/11/2015	Head 750	e'	40.8600	Relative Permittivity (ϵ_r):	40.86	41.96	-2.63	5
		e''	21.7100	Conductivity (σ):	0.91	0.89	1.38	5
	Head 700	e'	41.3500	Relative Permittivity (ϵ_r):	41.35	42.22	-2.06	5
		e''	22.2000	Conductivity (σ):	0.86	0.89	-2.83	5
	Head 725	e'	41.1600	Relative Permittivity (ϵ_r):	41.16	42.09	-2.21	5
		e''	22.0400	Conductivity (σ):	0.89	0.89	-0.30	5
6/11/2015	Body 750	e'	53.7500	Relative Permittivity (ϵ_r):	53.75	55.55	-3.23	5
		e''	23.1400	Conductivity (σ):	0.96	0.96	0.20	5
	Body 700	e'	54.3000	Relative Permittivity (ϵ_r):	54.30	55.74	-2.58	5
		e''	23.6500	Conductivity (σ):	0.92	0.96	-4.04	5
	Body 725	e'	54.2000	Relative Permittivity (ϵ_r):	54.20	55.64	-2.59	5
		e''	23.3600	Conductivity (σ):	0.94	0.96	-2.02	5

SAR Lab 3

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/12/2015	Head 1900	e'	38.9600	Relative Permittivity (ϵ_r):	38.96	40.00	-2.60	5
		e"	13.8300	Conductivity (σ):	1.46	1.40	4.36	5
	Head 1850	e'	39.3100	Relative Permittivity (ϵ_r):	39.31	40.00	-1.72	5
		e"	13.6900	Conductivity (σ):	1.41	1.40	0.59	5
	Head 1910	e'	38.9700	Relative Permittivity (ϵ_r):	38.97	40.00	-2.58	5
		e"	13.8000	Conductivity (σ):	1.47	1.40	4.68	5
6/12/2015	Body 1900	e'	51.4800	Relative Permittivity (ϵ_r):	51.48	53.30	-3.41	5
		e"	14.5800	Conductivity (σ):	1.54	1.52	1.34	5
	Body 1850	e'	51.8100	Relative Permittivity (ϵ_r):	51.81	53.30	-2.80	5
		e"	14.3500	Conductivity (σ):	1.48	1.52	-2.89	5
	Body 1910	e'	51.4600	Relative Permittivity (ϵ_r):	51.46	53.30	-3.45	5
		e"	14.5400	Conductivity (σ):	1.54	1.52	1.59	5

SAR Lab 4

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/19/2015	Body 2450	e'	51.3800	Relative Permittivity (ϵ_r):	51.38	52.70	-2.50	5
		e"	14.8100	Conductivity (σ):	2.02	1.95	3.46	5
	Body 2410	e'	51.6800	Relative Permittivity (ϵ_r):	51.68	52.76	-2.05	5
		e"	14.6900	Conductivity (σ):	1.97	1.91	3.20	5
	Body 2475	e'	51.3500	Relative Permittivity (ϵ_r):	51.35	52.67	-2.50	5
		e"	15.0300	Conductivity (σ):	2.07	1.99	4.19	5
6/22/2015	Head 2450	e'	39.3300	Relative Permittivity (ϵ_r):	39.33	39.20	0.33	5
		e"	13.8500	Conductivity (σ):	1.89	1.80	4.82	5
	Head 2410	e'	39.4400	Relative Permittivity (ϵ_r):	39.44	39.28	0.41	5
		e"	13.7800	Conductivity (σ):	1.85	1.76	4.89	5
	Head 2475	e'	39.2800	Relative Permittivity (ϵ_r):	39.28	39.17	0.28	5
		e"	13.8800	Conductivity (σ):	1.91	1.83	4.55	5
6/26/2015	Head 2450	e'	38.7300	Relative Permittivity (ϵ_r):	38.73	39.20	-1.20	5
		e"	13.5800	Conductivity (σ):	1.85	1.80	2.78	5
	Head 2410	e'	38.8600	Relative Permittivity (ϵ_r):	38.86	39.28	-1.07	5
		e"	13.4600	Conductivity (σ):	1.80	1.76	2.46	5
	Head 2475	e'	38.5900	Relative Permittivity (ϵ_r):	38.59	39.17	-1.48	5
		e"	13.6400	Conductivity (σ):	1.88	1.83	2.74	5

SAR Lab 5

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
6/22/2015	Head 5180	e'	36.8600	Relative Permittivity (ϵ_r):	36.86	36.01	2.35	5
		e''	15.9800	Conductivity (σ):	4.60	4.63	-0.60	5
	Head 5200	e'	36.9600	Relative Permittivity (ϵ_r):	36.96	35.99	2.69	5
		e''	16.1300	Conductivity (σ):	4.66	4.65	0.27	5
	Head 5600	e'	36.3300	Relative Permittivity (ϵ_r):	36.33	35.53	2.24	5
		e''	16.0700	Conductivity (σ):	5.00	5.06	-1.11	5
	Head 5800	e'	36.0600	Relative Permittivity (ϵ_r):	36.06	35.30	2.15	5
		e''	16.3600	Conductivity (σ):	5.28	5.27	0.12	5
	Head 5825	e'	36.0300	Relative Permittivity (ϵ_r):	36.03	35.30	2.07	5
		e''	16.3600	Conductivity (σ):	5.30	5.27	0.55	5
6/22/2015	Body 5180	e'	47.1500	Relative Permittivity (ϵ_r):	47.15	49.05	-3.87	5
		e''	18.5500	Conductivity (σ):	5.34	5.27	1.36	5
	Body 5200	e'	47.3800	Relative Permittivity (ϵ_r):	47.38	49.02	-3.34	5
		e''	18.5400	Conductivity (σ):	5.36	5.29	1.24	5
	Body 5600	e'	46.4500	Relative Permittivity (ϵ_r):	46.45	48.48	-4.18	5
		e''	18.8100	Conductivity (σ):	5.86	5.76	1.67	5
	Body 5800	e'	46.0800	Relative Permittivity (ϵ_r):	46.08	48.20	-4.40	5
		e''	19.2300	Conductivity (σ):	6.20	6.00	3.36	5
	Body 5825	e'	46.1000	Relative Permittivity (ϵ_r):	46.10	48.20	-4.36	5
		e''	19.2200	Conductivity (σ):	6.23	6.00	3.75	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 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 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
D750V3	1071	11/13/2014	750	1g	8.12	8.77
				10g	5.26	5.79
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	40.60
				10g	21.2	21.4
D2450V2	748	2/20/2015	2450	1g	52.7	50.3
				10g	24.6	23.5
D2450V2	706	5/11/2015	2450	1g	52.6	51.3
				10g	24.6	24.0
D5GHzV2	1168	12/4/2014	5200	1g	79.3	76.0
				10g	22.5	21.1
			5600	1g	85.3	80.6
				10g	24.3	22.3
			5800	1g	81.0	75.7
				10g	22.9	20.9

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			
6/11/2015	D835V2	4d142	Head	1g	0.96	9.6	8.91	1,2
				10g	0.63	6.3	5.77	
6/11/2015	D835V2	4d142	Body	1g	0.95	9.5	9.22	
				10g	0.63	6.3	6.05	

SAR Lab 2

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			
6/11/2015	D750V3	1071	Head	1g	0.83	8.3	8.22	
				10g	0.54	5.4	5.39	
6/11/2015	D750V3	1071	Body	1g	0.85	8.5	8.52	3,4
				10g	0.57	5.7	5.39	

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			
6/12/2015	D1900V2	5d163	Head	1g	4.09	40.9	40.80	
				10g	2.13	21.3	21.20	
6/12/2015	D1900V2	5d163	Body	1g	4.02	40.2	40.60	5,6
				10g	2.10	21.0	21.40	

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			
6/19/2015	D2450V2	748	Body	1g	5.32	53.2	50.3	7,8
				10g	2.44	24.4	23.5	
6/22/2015	D2450V2	706	Head	1g	5.44	54.4	52.60	9,10
				10g	2.46	24.6	24.60	
6/26/2015	D2450V2	748	Head	1g	5.16	51.60	52.70	
				10g	2.34	23.40	24.60	

SAR Lab 5

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			
6/22/2015	D5GHzV2 (5.2GHz)	1168	Head	1g	7.21	72.1	79.3	11,12
				10g	2.06	20.6	22.5	
6/22/2015	D5GHzV2 (5.6GHz)	1168	Head	1g	7.72	77.2	81.7	
				10g	2.17	21.7	23.2	
6/22/2015	D5GHzV2 (5.8GHz)	1168	Head	1g	7.19	71.9	78.0	
				10g	2.04	20.4	22.1	
6/22/2015	D5GHzV2 (5.2GHz)	1168	Body	1g	7.31	73.1	76.0	
				10g	2.06	20.6	21.1	
6/22/2015	D5GHzV2 (5.6GHz)	1168	Body	1g	7.93	79.3	82.0	
				10g	2.21	22.1	22.7	
6/22/2015	D5GHzV2 (5.8GHz)	1168	Body	1g	7.28	72.8	76.2	
				10g	2.04	20.4	21.0	

9. Conducted Output Power Measurements

9.1. GSM

Per KDB 941225 D01 3G SAR Procedures:

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested.

GSM1900 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Max. Pwr		Frame Pwr Maximum
						Burst (dBm)	Frame (dBm)	
1900	GSM (Voice)	CS1	1	512	1850.2	29.5	20.5	21.47
				661	1880.0	29.5	20.5	
				810	1909.8	29.5	20.5	
	GPRS (GMSK)	CS1	1	512	1850.2	29.5	20.5	21.47
				661	1880.0	29.5	20.5	
				810	1909.8	29.5	20.5	
			2	512	1850.2	26.4	20.4	20.98
				661	1880.0	26.2	20.2	
				810	1909.8	26.3	20.3	

Notes:

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

- Head & Body-worn: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 1 time slots based on the output power measurements above.
- SAR is not required for EGPRS (8PSK) mode because it's Receive Only

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 5 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	11/15	15/8	15/4
	β_{hs}	4/15	24/15	30/15	30/15
	MPR (dB)	0	0	0.5	0.5
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	$A_{hs}=\beta_{hs}/\beta_c$	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				
	$A_{hs} = \beta_{hs}/\beta_c$	30/15				
	E-DPDCCCH	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

W-CDMA Band II Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Max. Pwr (dBm)
W-CDMA Band II	Rel 99	RMC, 12.2 kbps	9262	1852.4	N/A	21.2
			9400	1880.0	N/A	21.4
			9538	1907.6	N/A	21.4
	HSDPA	Subtest 1	9262	1852.4	0	21.0
			9400	1880.0	0	21.0
			9538	1907.6	0	21.0
		Subtest 2	9262	1852.4	0	21.1
			9400	1880.0	0	20.4
			9538	1907.6	0	20.3
		Subtest 3	9262	1852.4	0.5	20.8
			9400	1880.0	0.5	20.4
			9538	1907.6	0.5	20.5
		Subtest 4	9262	1852.4	0.5	20.4
			9400	1880.0	0.5	20.5
			9538	1907.6	0.5	20.6
	HSUPA	Subtest 1	9262	1852.4	0	20.5
			9400	1880.0	0	20.8
			9538	1907.6	0	21.0
		Subtest 2	9262	1852.4	2	18.8
			9400	1880.0	2	18.9
			9538	1907.6	2	19.0
		Subtest 3	9262	1852.4	1	19.8
			9400	1880.0	1	19.9
			9538	1907.6	1	20.0
		Subtest 4	9262	1852.4	2	18.8
			9400	1880.0	2	18.8
			9538	1907.6	2	18.9
		Subtest 5	9262	1852.4	0	19.9
			9400	1880.0	0	20.0
			9538	1907.6	0	20.0

W-CDMA Band V Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Max. Pwr (dBm)
W-CDMA Band V	Rel 99	RMC, 12.2 kbps	4132	826.4	N/A	21.5
			4183	836.6	N/A	21.6
			4233	846.6	N/A	21.6
	HSDPA	Subtest 1	4132	826.4	0	21.1
			4183	836.6	0	21.2
			4233	846.6	0	21.3
		Subtest 2	4132	826.4	0	20.3
			4183	836.6	0	20.3
			4233	846.6	0	20.3
		Subtest 3	4132	826.4	0.5	20.5
			4183	836.6	0.5	20.5
			4233	846.6	0.5	20.7
		Subtest 4	4132	826.4	0.5	20.5
			4183	836.6	0.5	20.6
			4233	846.6	0.5	20.5
	HSUPA	Subtest 1	4132	826.4	0	20.5
			4183	836.6	0	20.8
			4233	846.6	0	21.0
		Subtest 2	4132	826.4	2	18.8
			4183	836.6	2	18.9
			4233	846.6	2	19.0
		Subtest 3	4132	826.4	1	19.8
			4183	836.6	1	19.9
			4233	846.6	1	20.0
		Subtest 4	4132	826.4	2	18.8
			4183	836.6	2	18.8
			4233	846.6	2	18.9
		Subtest 5	4132	826.4	0	20.9
			4183	836.6	0	20.0
			4233	846.6	0	20.0

9.4. LTE

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
64 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	Max. Avg Pwr (dBm)		
						829 MHz	836.5 MHz	844 MHz
LTE Band 5	10	QPSK	1	0	0	24.0	24.0	23.9
			1	25	0	24.0	24.0	23.9
			1	49	0	23.9	23.9	23.8
			25	0	1	22.6	22.6	22.6
			25	12	1	22.6	22.6	22.6
			25	25	1	22.6	22.6	22.5
		16QAM	50	0	1	22.6	22.5	22.5
			1	0	1	23.0	23.0	22.5
			1	25	1	22.9	23.0	22.6
			1	49	1	22.9	23.0	22.4
			25	0	2	21.4	21.3	21.3
			25	12	2	21.4	21.3	21.4
			25	25	2	21.4	21.3	21.3
			50	0	2	21.4	21.3	21.3
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)		
						826.5 MHz	836.5 MHz	846.5 MHz
LTE Band 5	5	QPSK	1	0	0	23.9	23.9	24.0
			1	12	0	23.8	23.9	24.0
			1	24	0	23.9	23.9	24.0
			12	0	1	22.6	22.6	22.6
			12	6	1	22.7	22.6	22.6
			12	11	1	22.6	22.5	22.5
			25	0	1	22.6	22.7	22.6
		16QAM	1	0	1	23.0	23.0	22.9
			1	12	1	23.0	22.9	22.9
			1	24	1	22.8	23.0	22.8
			12	0	2	21.4	21.4	21.4
			12	6	2	21.4	21.3	21.3
			12	11	2	21.4	21.3	21.4
			25	0	2	21.5	21.4	21.4
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)		
						825.5 MHz	836.5 MHz	847.5 MHz
LTE Band 5	3	QPSK	1	0	0	23.9	23.9	24.0
			1	7	0	23.9	24.0	23.9
			1	14	0	24.0	23.8	23.9
			8	0	1	22.7	22.6	22.5
			8	4	1	22.6	22.6	22.5
			8	7	1	22.6	22.6	22.5
			15	0	1	22.6	22.6	22.6
		16QAM	1	0	1	22.8	23.0	23.0
			1	7	1	22.9	23.0	22.8
			1	14	1	22.9	23.0	22.8
			8	0	2	21.5	21.5	22.0
			8	4	2	21.4	21.4	21.4
			8	7	2	21.5	21.4	21.3
			15	0	2	21.4	21.4	21.4

LTE Band 5 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)		
						824.7 MHz	836.5 MHz	848.3 MHz
LTE Band 5	1.4	QPSK	1	0	0	24.0	23.9	23.9
			1	2	0	23.9	23.9	23.9
			1	5	0	24.0	23.9	23.9
			3	0	0	23.9	23.9	23.8
			3	1	0	23.8	23.9	23.8
			3	2	0	23.9	23.9	23.9
			6	0	1	22.7	22.6	22.5
		16QAM	1	0	1	23.0	23.0	23.0
			1	2	1	22.7	23.0	23.0
			1	5	1	22.7	23.0	23.0
			3	0	1	22.8	22.8	22.7
			3	1	1	22.8	22.8	22.7
			3	2	1	22.8	22.8	22.7
			6	0	2	21.6	21.3	21.4

LTE Band 17 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)
						710 MHz
LTE Band 17	10	QPSK	1	0	0	23.5
			1	25	0	23.4
			1	49	0	23.5
			25	0	1	21.8
			25	12	1	21.7
			25	25	1	21.7
			50	0	1	21.7
		16QAM	1	0	1	22.5
			1	25	1	22.5
			1	49	1	22.5
			25	0	2	20.5
			25	12	2	20.4
			25	25	2	20.5
			50	0	2	20.6
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)
						710 MHz
LTE Band 17	5	QPSK	1	0	0	23.5
			1	12	0	23.5
			1	24	0	23.5
			12	0	1	21.7
			12	6	1	21.7
			12	11	1	21.7
			25	0	1	21.7
		16QAM	1	0	1	22.5
			1	12	1	22.5
			1	24	1	22.5
			12	0	2	20.6
			12	6	2	20.5
			12	11	2	20.5
			25	0	2	20.5

Note(s):

10/5 MHz Bandwidths does not support at least three non-overlapping channels in certain channel bandwidths. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing per KDB 941225 D05 SAR for LTE Devices

9.5. Wi-Fi 2.4GHz (DTS Band)

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Note(s)
2.4	802.11b	1 Mbps	1	2412	17.1	17.5	Yes	
			6	2437	16.8			
			11	2462	17.5			
	802.11g	6 Mbps	1	2412	Not Required	14.5	No	1
			6	2437				
			11	2462				
	802.11n (HT20)	6.5 Mbps	1	2412		12.5	No	1
			6	2437				
			11	2462				

Note(s):

- Output Power and SAR is not required for 802.11g/n HT20 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

9.6. Wi-Fi 5GHz (U-NII Bands)

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Note(s)
5.2 (U-NII 1)	802.11a	6 Mbps	36	5180	10.1	10.5	No	3
			40	5200	10.3			
			44	5220	10.1			
			48	5240	10.3			
	802.11n (HT20)	6.5 Mbps	36	5180	9.5	10.5	No	3
			40	5200	9.5			
			44	5220	9.6			
			48	5240	9.6			
	802.11n (HT40)	13.5 Mbps	38	5190	10.0	10.5	No	3
			46	5230	10.1			
	802.11ac (VHT20)	6.5 Mbps	36	5180	9.5	10.5	No	3
			40	5200	9.5			
			44	5220	9.6			
			48	5240	9.6			
	802.11ac (VHT40)	13.5 Mbps	38	5190	10.1	10.5	No	3
			46	5230	10.2			
	802.11ac (VHT80)	29.3 Mbps	42	5210	Not Required	10	No	1
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	10.5	10.5	No	2
			56	5280	10.5			
			60	5300	10.5			
			64	5320	10.5			
	802.11n (HT20)	6.5 Mbps	52	5260	10.2	10.5	No	2
			56	5280	10.4			
			60	5300	10.3			
			64	5320	10.4			
	802.11n (HT40)	13.5 Mbps	54	5270	10.4	10.5	Yes	
			62	5310	10.2			
	802.11ac (VHT20)	6.5 Mbps	52	5260	10.4	10.5	No	2
			56	5280	10.4			
			60	5300	10.3			
			64	5320	10.2			
	802.11ac (VHT40)	13.5 Mbps	54	5270	10.3	10.5	No	2
			62	5310	10.4			
	802.11ac (VHT80)	29.3 Mbps	58	5290	Not Required	10	No	1

Measured Results (Continued)

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Note(s)
5.5 (U-NII 2C)	802.11a	6 Mbps	100	5500	10.0	10.5	No	2
			116	5580	9.9			
			124	5620	9.7			
			140	5700	9.1			
	802.11n (HT20)	6.5 Mbps	100	5500	9.8	10.5	No	2
			116	5580	9.5			
			124	5620	9.2			
			140	5700	10.3			
	802.11n (HT40)	13.5 Mbps	102	5510	10.0	10.5	Yes	
			118	5590	10.2			
			134	5670	9.8			
	802.11ac (VHT20)	6.5 Mbps	100	5500	9.8	10.5	No	2
			116	5580	9.5			
			124	5620	9.0			
			140	5700	10.4			
	802.11ac (VHT40)	13.5 Mbps	102	5510	10.4	10.5	No	2
			118	5590	10.2			
			134	5670	9.7			
	802.11ac (VHT80)	29.3 Mbps	106	5530	Not Required	10	No	1
			122	5610	Not Required			
5.8 (U-NII 3)	802.11a	6 Mbps	149	5745	10.0	10.5	No	2
			157	5785	9.5			
			165	5825	10.5			
	802.11n (HT20)	6.5 Mbps	149	5745	9.6	10.5	No	2
			157	5785	10.5			
			165	5825	10.3			
	802.11n (HT40)	13.5 Mbps	151	5755	10.2	10.5	Yes	
			159	5795	9.8			
	802.11ac (VHT20)	6.5 Mbps	149	5745	9.7	10.5	No	2
			157	5785	10.5			
			165	5825	10.3			
	802.11ac (VHT40)	13.5 Mbps	151	5755	10.0	10.5	No	2
			159	5795	9.7			
	802.11ac (VHT80)	29.3 Mbps	155	5775	Not Required	10	No	1

Note(s):

- Output Power and SAR measurement is not required for 802.11ac VHT80 channels when the specified tune-up tolerances for 802.11ac VHT80 are lower than 802.11a by more than ½ dB and the measured SAR is ≤ 1.2 W/Kg.
- When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
- When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest reported SAR for UNII band 2A is
 - ≤ 1.2 W/kg, SAR is not required for UNII band I
 - > 1.2 W/kg, both bands should be tested independently for SAR.

9.7. Bluetooth

Maximum tune-up tolerance limit is 9.50 dBm. This power level qualifies for exclusion of SAR testing.

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.

Additional 1-g SAR testing at 5 mm is not required. For hotspot mode, 10-g extremity SAR is not required for the surfaces and edges since all 1-g reported SAR < 1.2 W/kg. **(for Phablet only)**

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 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 meas for 802.11 v02:

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the initial test position(s) by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The initial test position(s) is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the reported SAR for the initial test position is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the reported SAR is ≤ 0.8 W/kg or all required test positions are tested.
 - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
 - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required test channels are considered.
 - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the initial test position, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the initial test position.

10.1. 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 & GPRS 1 Slot	0	Left Touch	661	1880.0	30.5	29.5	0.093	0.117	1
			Left Tilt	661	1880.0	30.5	29.5	0.038	0.047	
			Right Touch	661	1880.0	30.5	29.5	0.070	0.088	
			Right Tilt	661	1880.0	30.5	29.5	0.043	0.054	
Body-worn(VoIP) & Hotspot	Voice & GPRS 1 Slot	10	Rear	661	1880.0	30.5	29.5	0.570	0.718	2
			Front	661	1880.0	30.5	29.5	0.526	0.662	
Hotspot	GPRS 1 Slots	10	Edge 2	661	1880.0	30.5	29.5	0.093	0.117	
			Edge 3	512	1850.2	30.5	29.5	0.693	0.872	
				661	1880.0	30.5	29.5	0.707	0.890	3
				810	1909.8	30.5	29.5	0.673	0.847	
			Edge 4	661	1880.0	30.5	29.5	0.047	0.060	

10.2. 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	9538	1907.6	22.0	21.4	0.064	0.073	4
			Left Tilt	9538	1907.6	22.0	21.4	0.028	0.032	
			Right Touch	9538	1907.6	22.0	21.4	0.051	0.059	
			Right Tilt	9538	1907.6	22.0	21.4	0.034	0.038	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	9538	1907.6	22.0	21.4	0.665	0.764	5
			Front	9538	1907.6	22.0	21.4	0.613	0.704	
Hotspot	Rel 99 RMC	10	Edge 2	9538	1907.6	22.0	21.4	0.119	0.137	
			Edge 3	9262	1852.4	22.0	21.2	0.739	0.888	
				9400	1880.0	22.0	21.4	0.753	0.865	
				9538	1907.6	22.0	21.4	0.840	0.964	6
			Edge 4	9538	1907.6	22.0	21.4	0.041	0.047	

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	4233	846.6	22.5	21.6	0.087	0.107	
			Left Tilt	4233	846.6	22.5	21.6	0.031	0.038	
			Right Touch	4233	846.6	22.5	21.6	0.107	0.132	7
			Right Tilt	4233	846.6	22.5	21.6	0.035	0.043	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	4132	826.4	22.5	21.5	0.665	0.837	
				4183	836.6	22.5	21.6	0.692	0.851	8
				4233	846.6	22.5	21.6	0.633	0.779	
			Front	4132	826.4	22.5	21.5	0.597	0.752	
				4183	836.6	22.5	21.6	0.622	0.765	
				4233	846.6	22.5	21.6	0.635	0.781	
Hotspot	Rel 99 RMC	10	Edge 2	4233	846.6	22.5	21.6	0.154	0.189	
			Edge 3	4233	846.6	22.5	21.6	0.298	0.367	
			Edge 4	4233	846.6	22.5	21.6	0.076	0.094	

10.4. 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	24.0	24.0	0.124	0.124	9
						25	0	23.0	22.6	0.082	0.082	
			Left Tilt	20525	836.5	1	0	24.0	24.0	0.056	0.056	
						25	0	23.0	22.6	0.036	0.036	
			Right Touch	20525	836.5	1	0	24.0	24.0	0.151	0.151	
						25	0	23.0	22.6	0.108	0.108	
Body-worn & Hotspot	QPSK	10	Rear	20450	829.0	1	0	24.0	24.0	1.060	1.065	10
						25	0	23.0	22.6	0.800	0.869	
						50	0	23.0	22.6	0.795	0.874	
				20525	836.6	1	0	24.0	24.0	1.130	1.130	
						25	0	23.0	22.6	0.797	0.874	
				20600	844.0	1	0	24.0	23.9	1.050	1.067	
						25	0	23.0	22.6	0.793	0.870	
			Front	20450	829.0	1	0	24.0	24.0	0.906	0.910	
						25	0	23.0	22.6	0.679	0.738	
				20525	836.6	1	0	24.0	24.0	0.892	0.892	
						25	0	23.0	22.6	0.665	0.729	
				20600	844.0	1	0	24.0	23.9	0.872	0.886	
						25	0	23.0	22.6	0.648	0.711	
Hotspot	QPSK	10	Edge 2	20525	836.5	1	0	24.0	24.0	0.254	0.254	
						25	0	23.0	22.6	0.184	0.202	
			Edge 3	20525	836.5	1	0	24.0	24.0	0.500	0.500	
						25	0	23.0	22.6	0.354	0.388	
			Edge 4	20525	836.5	1	0	24.0	24.0	0.140	0.140	
						25	0	23.0	22.6	0.097	0.106	

10.5. LTE Band 17 (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	23790	710.0	1	0.0	23.5	23.5	0.036	0.036	11
						25	0.0	22.5	21.8	0.021	0.025	
			Left Tilt	23790	710.0	1	0.0	23.5	23.5	0.024	0.024	
						25	0.0	22.5	21.8	0.014	0.016	
			Right Touch	23790	710.0	1	0.0	23.5	23.5	0.034	0.034	
						25	0.0	22.5	21.8	0.023	0.027	
			Right Tilt	23790	710.0	1	0.0	23.5	23.5	0.022	0.022	
						25	0.0	22.5	21.8	0.013	0.015	
Body-worn & Hotspot	QPSK	10	Rear	23790	710.0	1	0.0	23.5	23.5	0.172	0.172	12
						25	0.0	22.5	21.8	0.115	0.136	
			Front	23790	710.0	1	0.0	23.5	23.5	0.126	0.126	
						25	0.0	22.5	21.8	0.078	0.093	
Hotspot	QPSK	10	Edge 2	23790	710.0	1	0.0	23.5	23.5	0.107	0.107	
						25	0.0	22.5	21.8	0.067	0.079	
			Edge 3	23790	710.0	1	0.0	23.5	23.5	0.041	0.041	
						25	0.0	22.5	21.8	0.023	0.027	
			Edge 4	23790	710.0	1	0.0	23.5	23.5	0.089	0.089	
						25	0.0	22.5	21.8	0.053	0.063	

10.6. Wi-Fi (DTS Band)

Frequency Band	Mode	RF Exposure Conditions	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
								Tune-up limit	Meas.	Meas.	Scaled		
2.4GHz	802.11b 1 Mbps	Head	0	Left Touch	11	2462.0	1.010	17.5	17.5	0.788	0.788	2	
				Left Tilt	11	2462.0	1.260	17.5	17.5	0.955	0.955	2	
				Right Touch	1	2412.0	1.030	17.5	17.1	0.972	1.066	3	
					6	2437.0	0.723	17.5	16.8	0.705	0.828		
					11	2462.0	0.987	17.5	17.5	1.030	1.030		
				Right Tilt	1	2412.0	0.901	17.5	17.1	0.934	1.024	3	
					6	2437.0	0.780	17.5	16.8	0.825	0.969		
					11	2462.0	0.972	17.5	17.5	1.040	1.040		13
		Body-worn & Hotspot & Wi-Fi Direct	10	Rear	11	2462.0	0.156	17.5	17.5				
				Front	11	2462.0	0.202	17.5	17.5				
				Edge 1	11	2462.0	0.344	17.5	17.5	0.330	0.330	1	14
				Edge 4	11	2462.0	0.085	17.5	17.5				

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions in this exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.
- Testing for a second channel was required because the reported SAR for this test position was > 0.8 W/kg.

10.7. Wi-Fi (U-NII Band)

Frequency Band	Mode	RF Exposure Conditions	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Notes	Plot No.
								Tune-up limit	Meas.	Meas.	Scaled		
5.3 GHz U-NII 2A	802.11n (HT40)	Head	0	Left Touch	54	5270.0	0.219	10.5	10.4				
				Left Tilt	54	5270.0	0.151	10.5	10.4				
				Right Touch	54	5270.0	0.538	10.5	10.4	0.336	0.344	1	15
				Right Tilt	54	5270.0	0.337	10.5	10.4				
		Body-worn	10	Rear	54	5260.0	0.041	10.5	10.4	0.024	0.025	1	16
				Front	54	5260.0	0.039	10.5	10.4				
5.5 GHz U-NII 2C	802.11n (HT40)	Head	0	Left Touch	118	5590.0	0.384	10.5	10.2				
				Left Tilt	118	5590.0	0.279	10.5	10.2				
				Right Touch	118	5590.0	0.613	10.5	10.2	0.469	0.503		17
				Right Tilt	118	5590.0	0.515	10.5	10.2	0.352	0.377	2	
		Body-worn	10	Rear	118	5590.0	0.117	10.5	10.2	0.048	0.051	1	18
				Front	118	5590.0	0.081	10.5	10.2				
5.8 GHz U-NII 3	802.11n (HT40)	Head	0	Left Touch	151	5755.0	0.480	10.5	10.2	0.241	0.258	2	
				Left Tilt	151	5755.0	0.298	10.5	10.2				
				Right Touch	151	5755.0	0.673	10.5	10.2	0.496	0.531		19
				Right Tilt	151	5755.0	0.465	10.5	10.2				
		Body-worn & Hotspot & Wi-Fi Direct	10	Rear	151	5755.0	0.165	10.5	10.2	0.089	0.096	1	20
				Front	151	5755.0	0.085	10.5	10.2				
				Edge 1	151	5755.0	0.033	10.5	10.2				
				Edge 4	151	5755.0	0.024	10.5	10.2				

Note(s):

- Highest reported SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions in Head exposure condition were evaluated until a SAR ≤ 0.8 W/kg was reported.

10.8. 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:

- $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f_{(\text{GHz})}/x}]$ 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	0.189

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
700	LTE Band 17	Body & Hotspot	Rear	No	0.172	N/A	N/A
850	WCDMA Band V	Body & Hotspot	Rear	No	0.692	N/A	N/A
	LTE Band 5	Body & Hotspot	Rear	Yes	1.130	1.08	1.05
1900	GSM 1900	Hotspot	Edge 3	No	0.707	N/A	N/A
	WCDMA Band II	Hotspot	Edge 3	Yes	0.840	0.834	1.01
2400	Wi-Fi 802.11b/g/n	Head	Right Tilt	Yes	1.040	0.993	1.05
5300	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.336	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.503	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.531	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)	+	DTS		
	2	GSM(Voice)	+	U-NII		
	3	GSM(GPRS)	+	DTS		
	4	GSM(GPRS)	+	U-NII		
	5	W-CDMA	+	DTS		
	6	W-CDMA	+	U-NII		
	9	LTE	+	DTS		
	10	LTE	+	U-NII		
Body-worn	11	GSM(Voice)	+	DTS		
	12	GSM(Voice)	+	U-NII		
	13	GSM(Voice)	+	BT		
	14	GSM(Voice)	+	U-NII	+	BT
	15	GSM(GPRS)	+	DTS		
	16	GSM(GPRS)	+	U-NII		
	17	GSM(GPRS)	+	BT		
	18	GSM(GPRS)	+	U-NII	+	BT
	19	W-CDMA	+	DTS		
	20	W-CDMA	+	U-NII		
	21	W-CDMA	+	BT		
	22	W-CDMA	+	U-NII	+	BT
	27	LTE	+	DTS		
	28	LTE	+	U-NII		
	29	LTE	+	BT		
	30	LTE	+	U-NII	+	BT
Hotspot & Wi-Fi Direct	31	GSM(GPRS)	+	DTS		
	32	GSM(GPRS)	+	U-NII		
	33	W-CDMA	+	DTS		
	34	W-CDMA	+	U-NII		
	37	LTE	+	DTS		
	38	LTE	+	U-NII		
Notes:						
1. Wi-Fi 2.4GHz supports Hotspot and Wi-Fi Direct						
2. Wi-Fi 5.8GHz supports Hotspot and Wi-Fi Direct						
3. GPRS, W-CDMA and LTE support Hotspot.						
4. VoIP is supported in GPRS, W-CDMA and LTE.						
5. DTS Radio cannot transmit simultaneously with Bluetooth Radio.						
6. U-NII Radio can transmit simultaneously with Bluetooth Radio.						

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

RF Exposure conditions	① WWAN	② DTS	③ U-NII	④ BT	① + ② WWAN + DTS		① + ③ WWAN + U-NII		① + ③ + ④ WWAN + U-NII + BT	
					Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)	Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)	Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
Head	0.151	1.040	0.531		1.191	No	0.682	No		
Body-worn & Hotspot	1.130	0.330	0.096	0.189	1.460	No	1.226	No	1.415	No
Hotspot	1.130	0.330	0.096		1.460	No	1.226	No		

Conclusion:

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

Appendixes

Refer to separated files for the following appendixes.

A_15U120931v0 SAR Photos & Ant. Locations

B_15U120931v0 SAR System Check Plots

C_15U120931v0 SAR Highest Test Plots

D_15U120931v0 SAR Tissue Ingredients

E_15U120931v0 SAR Probe Cal. Certificates

F_15U120931v0 SAR Dipole Cal. Certificates

END OF REPORT