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, NFC and ANT+

FCC ID: A3LSMA510KOR
Model Name: SM-A510S, SM-A510K, SM-A510L

Report Number: 15K22092-S1V2
Issue Date: 12/3/2015

Prepared for
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ACCREDITED

TL-637

Revision History

Rev.	Date	Revisions	Revised By
V1	11/29/2015	Initial Issue	Justin Park
V2	12/3/2015	Revised Re-use SAR data of WCDMA Band II.	Justin Park

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1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.				
FCC ID	A3LSMA510KOR				
Model Name	SM-A510S, SM-A510K, SM-A510L				
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		0.169	0.880	1.053	N/A
Body-worn*		1.087	0.229	0.110	
Hotspot/Wi-Fi Direct		0.991			
Simultaneous TX	Head	1.222	1.049	1.222	
	Body-worn*	1.316		1.197	
	Hotspot/ Wi-Fi Direct	1.220		1.101	

Notes:

1) 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.

2) The WWAN (WCDMA Band 2,5 and LTE Band 5), WLAN (DTS, U-NII) SAR measurement results from the original filling can be found in SAR test report 15K22047-S1V2, FCC ID A3LSMA510F. The WWAN (WCDMA Band 2,5 and LTE Band 5) , WLAN (DTS, U-NII) antennas and surrounding circuitry is the same between these two units, and tune up power targets are identical for WWAN, WLAN operations. Therefore, SAR data for WWAN, WLAN from the original filling was used for this model. Spot checks for WWAN, WLAN were performed to ensure that the SAR measurements for both devices are the same.

Date Tested	10/30/2015 to 12/3/2015
Test Results	Pass

UL Korea, Ltd. 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 Korea, Ltd. 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 Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. 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 IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released By:	Prepared By:
	
JiHo Choi Operations Manager UL Korea, Ltd Suwon Laboratory	Justin Park Engineer UL Korea, Ltd Suwon Laboratory

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 v02r02
- 447498 D01 General RF Exposure Guidance v06
- 648474 D04 Handset SAR v01r03
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01
- 941225 D05 SAR for LTE Devices v02r04
- 941225 D06 Hotspot Mode v02r01

3. Facilities and Accreditation

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

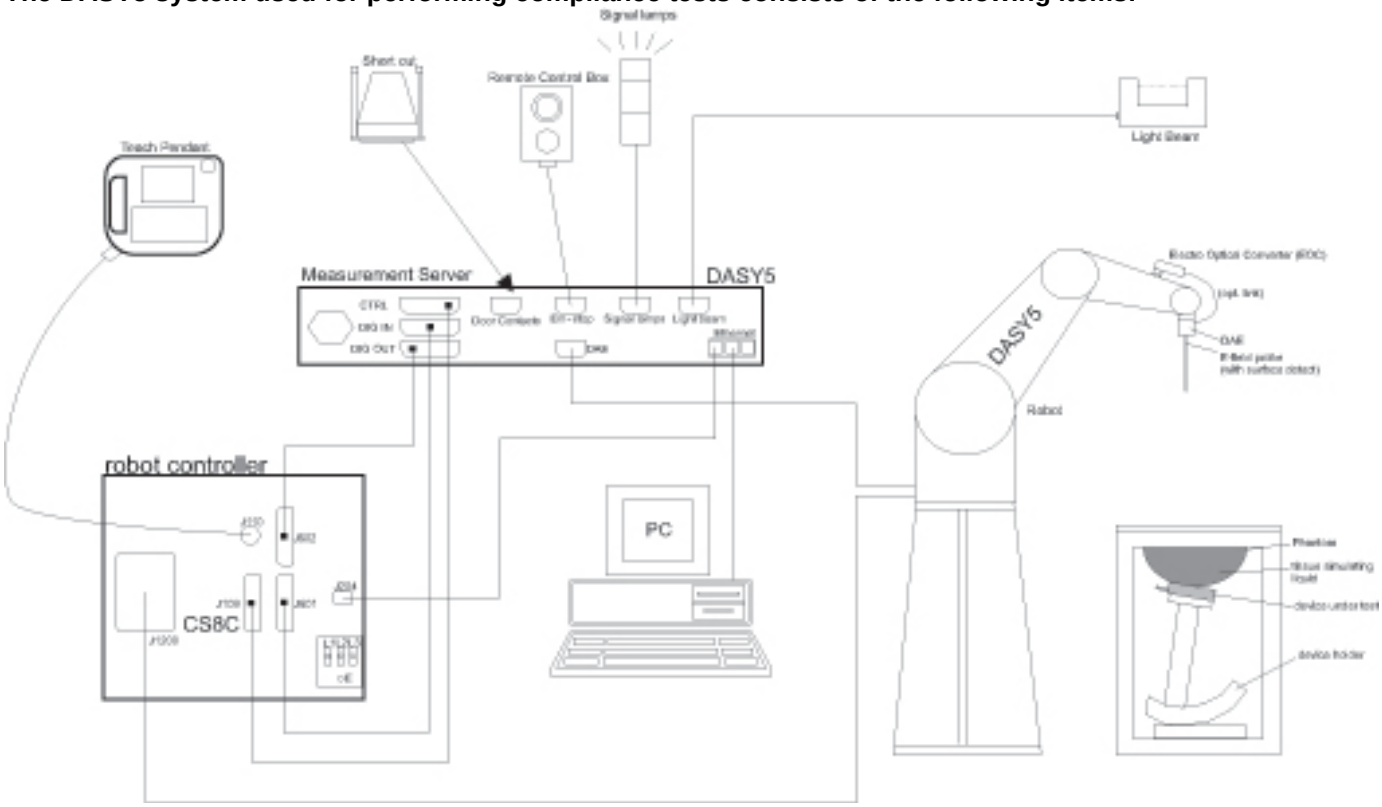
Suwon
SAR 1 Room
SAR 2 Room
SAR 3 Room

UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.
The full scope of accreditation can be viewed at http://www.iasonline.org/PDF/TL/TL-637.pdf.

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

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

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

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

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

Step 4: Power drift measurement

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

Step 5: Z-Scan (FCC only)

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

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	E5071C	MY46522054	8-18-2016
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	8-4-2016
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3424	8-19-2016
Thermometer	Lutron	MHB-382SD	AH.91478	8-12-2016

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8-18-2016
Power Sensor	Agilent	U2000A	MY54260010	8-18-2016
Power Sensor	Agilent	U2000A	MY54260007	8-18-2016
Power Amplifier	EXODUS	1410025-AMP2027-10003	10003	8-18-2016
Directional Coupler	Agilent	772D	MY52180193	8-18-2016
Directional Coupler	Agilent	778D	MY52180432	8-18-2016
Low Pass Filter	MICROLAB	LA-15N	03943	8-18-2016
Low Pass Filter	FILTRON	L14012FL	1410003S	8-18-2016
Low Pass Filter	MICROLAB	LA-60N	03942	8-18-2016
Attenuator	Agilent	8491B/003	MY39269292	8-18-2016
Attenuator	Agilent	8491B/010	MY39269315	8-18-2016
Attenuator	Agilent	8491B/020	MY39269298	8-18-2016
E-Field Probe (SAR1)	SPEAG	EX3DV4	7314	9-25-2016
E-Field Probe (SAR2)	SPEAG	EX3DV4	7376	9-2-2016
E-Field Probe (SAR3)	SPEAG	EX3DV4	7330	2-12-2016
Data Acquisition Electronics (SAR1)	SPEAG	DAE4	1447	9-23-2016
Data Acquisition Electronics (SAR2)	SPEAG	DAE4	1468	9-15-2016
Data Acquisition Electronics (SAR3)	SPEAG	DAE4	1446	8-17-2016
System Validation Dipole	SPEAG	D750V3	1122	8-17-2016
System Validation Dipole	SPEAG	D835V2	4d194	9-17-2016
System Validation Dipole	SPEAG	D1900V2	5d199	2-6-2016
System Validation Dipole	SPEAG	D2450V2	960	2-5-2016
System Validation Dipole	SPEAG	D5GHzV2	1184	8-26-2016
Thermometer (SAR1)	Lutron	MHB-382SD	AH.91463	8-12-2016
Thermometer (SAR2)	Lutron	MHB-382SD	AH.50215	8-19-2016
Thermometer (SAR3)	Lutron	MHB-382SD	AH.50213	8-24-2016

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	150313	8-18-2016
Base Station Simulator	R & S	CMW500	150314	8-18-2016

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): 145 mm x 71.2 mm Overall Diagonal: 153.24 mm Display Diagonal: 132.78 mm
Back Cover	☒ The rechargeable battery is not user accessible.
Battery Options	☒ The rechargeable battery is not user accessible.
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 5.8 GHz)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☒ Wi-Fi Direct (Wi-Fi 5.8 GHz)

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% (E)GPRS: 1 Slot: 12.5% 2 Slots: 25% 3 Slots: 37.5% 4 Slots: 50%
	Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No			
W-CDMA (UMTS)	Band V Band II	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6) HSPA+ (Rel. 7)		100%
LTE	FDD Band 5 FDD Band 17	QPSK 16QAM		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)		100%
	Does this device support bands 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		N/A

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 Power (dBm)		Reduce RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit	Target	Max. tune-up tolerance limit
GSM1900	Voice (1 slot)	29.5	**30.0**	N/A	
	GPRS 1 slot	29.5	**30.0**		
	GPRS 2 slots	28.0	**28.5**		
	GPRS 3 slots	26.0	**26.5**		
	GPRS 4 slots	25.0	**25.5**		
W-CDMA Band V	R99	22.5	**23.0**	N/A	
	HSDPA	22.5	**23.0**		
	HSUPA	22.5	**23.0**		
W-CDMA Band II	R99	22.5	**23.0**	20.5	**21.0**
	HSDPA	22.2	**22.7**	20.2	**20.7**
	HSUPA	21.5	**22.0**	20.5	**21.0**
LTE Band 5	QPSK, 16QAM	22.5	**23.0**	N/A	
LTE Band 17	QPSK, 16QAM	23.0	**23.5**	N/A	

Note(s):

The device utilizes power reduction under some portable hotspot conditions for SAR compliance.
There is power reduction for WCDMA Band II.
The reduced powers were confirmed via conducted power measurements the RF port.
Detailed description of the hotspot power reduction mechanism is included in the operational description.

Upper limit (dB):	0.5	Max. RF Output Power (dBm)		Reduce RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit	Target	Max. tune-up tolerance limit
WiFi 2.4 GHz	802.11b	17.0	**17.5**	16.0	**16.5**
	802.11g	14.0	**14.5**	14.0	**14.5**
	802.11n HT20	13.0	**13.5**	13.0	**13.5**
WiFi 2.4 GHz (Ch. 12&13)	802.11b	7.5	**8.0**	N/A	
	802.11g	7.5	**8.0**		
	802.11n HT20	7.5	**8.0**		
WiFi 5 GHz	802.11a	13.0	**13.5**	N/A	
	802.11n HT20	13.0	**13.5**		
	802.11n HT40	12.0	**12.5**		
Bluetooth		9.0	**9.5**	N/A	
Bluetooth LE		8.0	**8.5**	N/A	

Note(s):

This device utilizes independent power reduction mechanisms for SAR compliance for the licensed transmitter and the WLAN transmitter.

Additionally, the device uses an independent single-step fixed level power reduction mechanism for WLAN operations were evaluated at reduced power according to the head SAR positions described in IEEE 1528.

The reduced powers for the power reduction mechanisms were confirmed via conducted power measurements at the RF port.

6.4. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td>
<table>
<tr><td rowspan="3">Band 5</td><td colspan="6">Frequency range: 824 - 849 MHz</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td>20450/ 829</td><td>20425/ 826.5</td><td>20415/ 825.5</td><td>20407/ 824.7</td></tr>
<tr><td>Mid</td><td></td><td></td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td><td>20525/ 836.5</td></tr>
<tr><td>High</td><td></td><td></td><td>20600/ 844</td><td>20625/ 846.5</td><td>20635/ 847.5</td><td>20643/ 848.3</td></tr>
<tr><td rowspan="3">Band 17</td><td colspan="6">Frequency range: 704 - 716 MHz</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td></td><td></td><td></td><td>23755/ 706.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td></td><td></td><td>23790/ 710</td><td>23790/ 710</td><td></td><td></td></tr>
<tr><td>High</td><td></td><td></td><td></td><td>23825/ 713.5</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td>LTE has 1 Main TX/RX Ant and 2 Diversity RX Ant Refer to Appendix A...</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3
<table>
<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
</td></tr>
<tr><td>Power reduction</td><td>No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td>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.</td></tr>
</table>

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:

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.
2. 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 ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

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 1 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11-15-2015	Head 5180	e'	36.29	Relative Permittivity (εr):	36.29	36.01	0.77	5
		e"	15.45	Conductivity (σ):	4.45	4.63	-3.90	5
	Head 5200	e'	36.26	Relative Permittivity (εr):	36.26	35.99	0.75	5
		e"	15.46	Conductivity (σ):	4.47	4.65	-3.89	5
	Head 5600	e'	35.7	Relative Permittivity (εr):	35.70	35.53	0.47	5
		e"	15.61	Conductivity (σ):	4.86	5.06	-3.95	5
	Head 5800	e'	35.44	Relative Permittivity (εr):	35.44	35.30	0.40	5
		e"	15.71	Conductivity (σ):	5.07	5.27	-3.86	5
	Head 5825	e'	35.4	Relative Permittivity (εr):	35.40	35.30	0.28	5
		e"	15.74	Conductivity (σ):	5.10	5.27	-3.26	5
11-16-2015	Body 5180	e'	49.04	Relative Permittivity (εr):	49.04	49.05	-0.01	5
		e"	18.73	Conductivity (σ):	5.39	5.27	2.34	5
	Body 5200	e'	49.04	Relative Permittivity (εr):	49.04	49.02	0.04	5
		e"	18.77	Conductivity (σ):	5.43	5.29	2.50	5
	Body 5600	e'	48.33	Relative Permittivity (εr):	48.33	48.48	-0.30	5
		e"	18.98	Conductivity (σ):	5.91	5.76	2.59	5
	Body 5800	e'	48.16	Relative Permittivity (εr):	48.16	48.20	-0.08	5
		e"	19.27	Conductivity (σ):	6.21	6.00	3.58	5
	Body 5825	e'	48.02	Relative Permittivity (εr):	48.02	48.20	-0.37	5
		e"	19.22	Conductivity (σ):	6.23	6.00	3.75	5
11-18-2015	Head 2450	e'	37.7800	Relative Permittivity (εr):	37.78	39.20	-3.62	5
		e"	13.6500	Conductivity (σ):	1.86	1.80	3.31	5
	Head 2410	e'	37.9400	Relative Permittivity (εr):	37.94	39.28	-3.41	5
		e"	13.5400	Conductivity (σ):	1.81	1.76	3.07	5
	Head 2475	e'	37.6800	Relative Permittivity (εr):	37.68	39.17	-3.80	5
		e"	13.7300	Conductivity (σ):	1.89	1.83	3.42	5
11-18-2015	Body 2450	e'	50.9100	Relative Permittivity (εr):	50.91	52.70	-3.40	5
		e"	14.8000	Conductivity (σ):	2.02	1.95	3.39	5
	Body 2410	e'	51.0100	Relative Permittivity (εr):	51.01	52.76	-3.32	5
		e"	14.7200	Conductivity (σ):	1.97	1.91	3.41	5
	Body 2475	e'	50.8200	Relative Permittivity (εr):	50.82	52.67	-3.51	5
		e"	14.8500	Conductivity (σ):	2.04	1.99	2.95	5

SAR 2 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
11-13-2015	Body 835	e'	53.0800	Relative Permittivity (εr):	53.08	55.20	-3.84	5
		e"	21.1200	Conductivity (σ):	0.98	0.97	1.09	5
	Body 820	e'	53.2000	Relative Permittivity (εr):	53.20	55.28	-3.76	5
		e"	21.1700	Conductivity (σ):	0.97	0.97	-0.33	5
	Body 850	e'	52.9900	Relative Permittivity (εr):	52.99	55.16	-3.93	5
		e"	21.1200	Conductivity (σ):	1.00	0.99	1.12	5
11-15-2015	Head 835	e'	40.8000	Relative Permittivity (εr):	40.80	41.50	-1.69	5
		e"	19.0200	Conductivity (σ):	0.88	0.90	-1.88	5
	Head 820	e'	40.9900	Relative Permittivity (εr):	40.99	41.60	-1.47	5
		e"	19.0600	Conductivity (σ):	0.87	0.90	-3.28	5
	Head 850	e'	40.6500	Relative Permittivity (εr):	40.65	41.50	-2.05	5
		e"	18.9900	Conductivity (σ):	0.90	0.92	-1.91	5
11-17-2015	Body 835	e'	53.8200	Relative Permittivity (εr):	53.82	55.20	-2.50	5
		e"	21.1400	Conductivity (σ):	0.98	0.97	1.19	5
	Body 820	e'	53.9600	Relative Permittivity (εr):	53.96	55.28	-2.38	5
		e"	21.1700	Conductivity (σ):	0.97	0.97	-0.33	5
	Body 850	e'	53.7700	Relative Permittivity (εr):	53.77	55.16	-2.51	5
		e"	21.1400	Conductivity (σ):	1.00	0.99	1.21	5
11-20-2015	Head 835	e'	40.6600	Relative Permittivity (εr):	40.66	41.50	-2.02	5
		e"	19.4600	Conductivity (σ):	0.90	0.90	0.39	5
	Head 820	e'	40.8400	Relative Permittivity (εr):	40.84	41.60	-1.83	5
		e"	19.5100	Conductivity (σ):	0.89	0.90	-0.99	5
	Head 850	e'	40.4900	Relative Permittivity (εr):	40.49	41.50	-2.43	5
		e"	19.4200	Conductivity (σ):	0.92	0.92	0.31	5
11-24-2015	Body 1900	e'	51.5900	Relative Permittivity (εr):	51.59	53.30	-3.21	5
		e"	14.9400	Conductivity (σ):	1.58	1.52	3.84	5
	Body 1850	e'	51.6400	Relative Permittivity (εr):	51.64	53.30	-3.11	5
		e"	14.7400	Conductivity (σ):	1.52	1.52	-0.25	5
	Body 1910	e'	51.6100	Relative Permittivity (εr):	51.61	53.30	-3.17	5
		e"	14.9800	Conductivity (σ):	1.59	1.52	4.66	5

SAR 3 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
10-29-2015	Body 750	e'	54.0900	Relative Permittivity (εr):	54.09	55.55	-2.62	5
		e"	23.0000	Conductivity (σ):	0.96	0.96	-0.41	5
	Body 700	e'	54.6200	Relative Permittivity (εr):	54.62	55.74	-2.01	5
		e"	23.4400	Conductivity (σ):	0.91	0.96	-4.89	5
	Body 790	e'	53.6500	Relative Permittivity (εr):	53.65	55.39	-3.15	5
		e"	22.6700	Conductivity (σ):	1.00	0.97	3.07	5
11-3-2015	Head 750	e'	41.5800	Relative Permittivity (εr):	41.58	41.96	-0.91	5
		e"	21.4000	Conductivity (σ):	0.89	0.89	-0.07	5
	Head 700	e'	42.3200	Relative Permittivity (εr):	42.32	42.22	0.24	5
		e"	21.7300	Conductivity (σ):	0.85	0.89	-4.89	5
	Head 790	e'	41.0000	Relative Permittivity (εr):	41.00	41.76	-1.81	5
		e"	21.1300	Conductivity (σ):	0.93	0.90	3.57	5
11-3-2015	Body 750	e'	56.1700	Relative Permittivity (εr):	56.17	55.55	1.12	5
		e"	23.0700	Conductivity (σ):	0.96	0.96	-0.10	5
	Body 700	e'	56.6800	Relative Permittivity (εr):	56.68	55.74	1.69	5
		e"	23.4800	Conductivity (σ):	0.91	0.96	-4.73	5
	Body 790	e'	55.7300	Relative Permittivity (εr):	55.73	55.39	0.61	5
		e"	22.7800	Conductivity (σ):	1.00	0.97	3.57	5
11-10-2015	Body 1900	e'	51.1700	Relative Permittivity (εr):	51.17	53.30	-4.00	5
		e"	14.8600	Conductivity (σ):	1.57	1.52	3.28	5
	Body 1850	e'	51.3500	Relative Permittivity (εr):	51.35	53.30	-3.66	5
		e"	14.8900	Conductivity (σ):	1.53	1.52	0.77	5
	Body 1910	e'	51.1400	Relative Permittivity (εr):	51.14	53.30	-4.05	5
		e"	14.8600	Conductivity (σ):	1.58	1.52	3.83	5
11-11-2015	Head 1900	e'	39.3800	Relative Permittivity (εr):	39.38	40.00	-1.55	5
		e"	13.7200	Conductivity (σ):	1.45	1.40	3.53	5
	Head 1850	e'	39.5500	Relative Permittivity (εr):	39.55	40.00	-1.13	5
		e"	13.7200	Conductivity (σ):	1.41	1.40	0.81	5
	Head 1910	e'	39.3500	Relative Permittivity (εr):	39.35	40.00	-1.63	5
		e"	13.7400	Conductivity (σ):	1.46	1.40	4.23	5
11-18-2015	Body 1900	e'	52.2600	Relative Permittivity (εr):	52.26	53.30	-1.95	5
		e"	14.9600	Conductivity (σ):	1.58	1.52	3.98	5
	Body 1850	e'	52.4500	Relative Permittivity (εr):	52.45	53.30	-1.59	5
		e"	14.8900	Conductivity (σ):	1.53	1.52	0.77	5
	Body 1910	e'	52.2100	Relative Permittivity (εr):	52.21	53.30	-2.05	5
		e"	14.9900	Conductivity (σ):	1.59	1.52	4.73	5
11-21-2015	Head 1900	e'	38.9500	Relative Permittivity (εr):	38.95	40.00	-2.62	5
		e"	13.4900	Conductivity (σ):	1.43	1.40	1.80	5
	Head 1850	e'	39.1100	Relative Permittivity (εr):	39.11	40.00	-2.23	5
		e"	13.4400	Conductivity (σ):	1.38	1.40	-1.25	5
	Head 1910	e'	38.9100	Relative Permittivity (εr):	38.91	40.00	-2.73	5
		e"	13.5000	Conductivity (σ):	1.43	1.40	2.41	5
11-23-2015	Body 1900	e'	51.1100	Relative Permittivity (εr):	51.11	53.30	-4.11	5
		e"	14.8300	Conductivity (σ):	1.57	1.52	3.07	5
	Body 1850	e'	51.2000	Relative Permittivity (εr):	51.20	53.30	-3.94	5
		e"	14.7800	Conductivity (σ):	1.52	1.52	0.02	5
	Body 1910	e'	51.0900	Relative Permittivity (εr):	51.09	53.30	-4.15	5
		e"	14.8500	Conductivity (σ):	1.58	1.52	3.76	5
11-27-2015	Head 750	e'	43.3100	Relative Permittivity (εr):	43.31	41.96	3.21	5
		e"	21.5100	Conductivity (σ):	0.90	0.89	0.44	5
	Head 700	e'	43.9300	Relative Permittivity (εr):	43.93	42.22	4.06	5
		e"	21.7900	Conductivity (σ):	0.85	0.89	-4.62	5
	Head 790	e'	42.7400	Relative Permittivity (εr):	42.74	41.76	2.36	5
		e"	21.2200	Conductivity (σ):	0.93	0.90	4.01	5

SAR 3 Room(Continued)

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
12-3-2015	Body 1900	e'	51.2100	Relative Permittivity (εr):	51.21	53.30	-3.92	5
		e''	14.7400	Conductivity (σ):	1.56	1.52	2.45	5
	Body 1850	e'	51.7600	Relative Permittivity (εr):	51.76	53.30	-2.89	5
		e''	14.8800	Conductivity (σ):	1.53	1.52	0.70	5
	Body 1910	e'	50.8900	Relative Permittivity (εr):	50.89	53.30	-4.52	5
		e''	14.6500	Conductivity (σ):	1.56	1.52	2.36	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	1122	8-17-2015	750	1g	8.23	8.6
				10g	5.37	5.67
D835V2	4d194	9-17-2015	835	1g	9.38	9.49
				10g	6.09	6.18
D1900V2	5d199	2-6-2015	1900	1g	41.0	40.6
				10g	21.4	21.6
D2450V2	960	2-5-2015	2450	1g	53.3	50.8
				10g	24.8	23.6
D5GHzV2	1184	8-26-2015	5200	1g	79.6	76.1
				10g	22.7	21.2
			5600	1g	82.8	80.5
				10g	23.6	22.3
			5800	1g	80.3	78.7
				10g	22.8	21.7

System Check Results

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

SAR 1 Room

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			
11-15-2015	D5GHzV2 (5200)	1184	Head	1g	7.88	78.80	79.60	-1.01	
				10g	2.28	22.80	22.70	0.44	
11-15-2015	D5GHzV2 (5600)	1184	Head	1g	7.89	78.90	82.80	-4.71	
				10g	2.27	22.70	23.60	-3.81	
11-15-2015	D5GHzV2 (5800)	1184	Head	1g	7.48	74.80	80.30	-6.85	
				10g	2.14	21.40	22.80	-6.14	
11-16-2015	D5GHzV2 (5200)	1184	Body	1g	7.87	78.70	76.10	3.42	
				10g	2.24	22.40	21.20	5.66	
11-16-2015	D5GHzV2 (5600)	1184	Body	1g	8.63	86.30	80.50	7.20	1,2
				10g	2.40	24.00	22.30	7.62	
11-16-2015	D5GHzV2 (5800)	1184	Body	1g	7.61	76.10	78.70	-3.30	
				10g	2.10	21.00	21.70	-3.23	
11-18-2015	D2450V2	960	Head	1g	5.22	52.20	53.30	-2.06	3,4
				10g	2.41	24.10	24.80	-2.82	
11-18-2015	D2450V2	960	Body	1g	5.08	50.80	50.80	0.00	
				10g	2.37	23.70	23.60	0.42	

SAR 2 Room

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			
11-13-2015	D835V2	4d194	Body	1g	0.98	9.76	9.49	2.85	
				10g	0.64	6.43	6.18	4.05	
11-15-2015	D835V2	4d194	Head	1g	0.99	9.92	9.38	5.76	
				10g	0.66	6.56	6.09	7.72	
11-17-2015	D835V2	4d194	Body	1g	0.99	9.91	9.49	4.43	
				10g	0.65	6.52	6.18	5.50	
11-20-2015	D835V2	4d194	Head	1g	1.01	10.10	9.38	7.68	5,6
				10g	0.67	6.68	6.09	9.69	
11-24-2015	D1900V2	5d199	Body	1g	4.37	43.70	40.6	7.64	7,8
				10g	2.22	22.20	21.6	2.78	

SAR 3 Room

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			
10-29-2015	D750v3	1122	Body	1g	0.88	8.83	8.60	2.67	
				10g	0.59	5.88	5.67	3.70	
11-3-2015	D750v3	1122	Body	1g	0.91	9.12	8.60	6.05	9,10
				10g	0.61	6.08	5.67	7.23	
11-3-2015	D750v3	1122	Head	1g	0.82	8.15	8.23	-0.97	
				10g	0.54	5.40	5.37	0.56	
11-10-2015	D1900v2	5d199	Body	1g	3.96	39.60	40.60	-2.46	
				10g	2.01	20.10	21.60	-6.94	
11-11-2015	D1900v2	5d199	Head	1g	3.91	39.10	41.00	-4.63	
				10g	2.00	20.00	21.40	-6.54	
11-18-2015	D1900V2	5d199	Body	1g	3.98	39.80	40.60	-1.97	
				10g	2.03	20.30	21.60	-6.02	
11-21-2015	D1900V2	5d199	Head	1g	3.89	38.90	41	-5.12	11,12
				10g	1.98	19.80	21.40	-7.48	
11-23-2015	D1900V2	5d199	Body	1g	4.01	40.10	40.6	-1.23	
				10g	2.02	20.20	21.6	-6.48	
11-27-2015	D750v3	1122	Head	1g	0.77	7.71	8.23	-6.32	
				10g	0.52	5.16	5.37	-3.91	
12-3-2015	D1900v2	5d199	Body	1g	3.93	39.30	40.60	-3.20	13,14
				10g	1.99	19.90	21.60	-7.87	

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	
						Burst (dBm)	Frame (dBm)
1900	GSM (Voice)	CS1	1	512	1850.2	29.6	20.6
				661	1880.0	29.6	20.6
				810	1909.8	29.8	20.8
	GPRS (GMSK)	CS1	1	512	1850.2	29.6	20.6
				661	1880.0	29.6	20.6
				810	1909.8	29.8	20.8
			2	512	1850.2	27.9	21.8
				661	1880.0	27.6	21.6
				810	1909.8	28.1	22.0
			3	512	1850.2	26.4	22.1
				661	1880.0	26.0	21.7
				810	1909.8	26.5	22.2
			4	512	1850.2	25.0	22.0
				661	1880.0	24.2	21.2
				810	1909.8	24.9	21.9

Notes:

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

- Head & Body-worn: GMSK Voice Mode
- Head VoIP & Hotspot mode: GMSK (GPRS) mode with 2 time slots for Max power, based on the output power measurements above.

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
	βc/βd	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			
	βc	2/15	11/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	12/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	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			
	Ahs=βhs/βc	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
	βc	11/15	6/15	15/15	2/15	15/15
	βd	15/15	15/15	9/15	15/15	0
	βec	209/225	12/15	30/15	2/15	5/15
	βc/βd	11/15	6/15	15/9	2/15	15/1
	βhs	22/15	12/15	30/15	4/15	5/15
	βed	1309/225	94/75	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				
	Ahs = βhs/βc	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 Channelisation Codes	2xSF2				SF4

W-CDMA Band II Measured Results

Band	Mode		UL Ch No.	Freq. (MHz)	MPR (dB)	Max. Pwr (dBm)	MPR (dB)	Reduced Pwr (dBm)
W-CDMA Band II	Rel 99	RMC, 12.2 kbps	9262	1852.4	N/A	22.3	N/A	20.2
			9400	1880.0	N/A	22.1	N/A	20.1
			9538	1907.6	N/A	22.1	N/A	20.0
	HSDPA	Subtest 1	9262	1852.4	0	22.2	0	20.0
			9400	1880.0	0	22.0	0	20.0
			9538	1907.6	0	22.0	0	19.9
		Subtest 2	9262	1852.4	0	22.3	0	20.2
			9400	1880.0	0	22.2	0	20.1
			9538	1907.6	0	22.1	0	20.0
		Subtest 3	9262	1852.4	0.5	22.2	0	20.1
			9400	1880.0	0.5	22.2	0	20.1
			9538	1907.6	0.5	22.2	0	20.0
		Subtest 4	9262	1852.4	0.5	21.9	0	20.2
			9400	1880.0	0.5	21.8	0	20.1
			9538	1907.6	0.5	21.8	0	20.1
	HSUPA	Subtest 1	9262	1852.4	0	20.5	0	19.1
			9400	1880.0	0	20.5	0	19.0
			9538	1907.6	0	20.4	0	19.0
		Subtest 2	9262	1852.4	2	18.5	0	18.4
			9400	1880.0	2	18.3	0	18.3
			9538	1907.6	2	18.2	0	18.2
		Subtest 3	9262	1852.4	1	21.0	0	19.2
			9400	1880.0	1	21.0	0	19.1
			9538	1907.6	1	21.0	0	18.9
		Subtest 4	9262	1852.4	2	18.5	0	18.5
			9400	1880.0	2	18.3	0	18.3
			9538	1907.6	2	18.2	0	18.2
		Subtest 5	9262	1852.4	0	22.0	0	20.3
			9400	1880.0	0	22.0	0	20.1
			9538	1907.6	0	22.0	0	20.1

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	22.8
			4183	836.6	N/A	22.8
			4233	846.6	N/A	22.7
	HSDPA	Subtest 1	4132	826.4	0	22.7
			4183	836.6	0	22.7
			4233	846.6	0	22.6
		Subtest 2	4132	826.4	0	22.8
			4183	836.6	0	22.9
			4233	846.6	0	22.8
		Subtest 3	4132	826.4	0.5	22.4
			4183	836.6	0.5	22.4
			4233	846.6	0.5	22.3
		Subtest 4	4132	826.4	0.5	22.2
			4183	836.6	0.5	22.3
			4233	846.6	0.5	22.2
	HSUPA	Subtest 1	4132	826.4	0	21.3
			4183	836.6	0	21.3
			4233	846.6	0	21.3
		Subtest 2	4132	826.4	2	19.3
			4183	836.6	2	19.2
			4233	846.6	2	19.2
		Subtest 3	4132	826.4	1	21.8
			4183	836.6	1	21.7
			4233	846.6	1	21.7
		Subtest 4	4132	826.4	2	19.2
			4183	836.6	2	19.2
			4233	846.6	2	19.1
		Subtest 5	4132	826.4	0	22.8
			4183	836.6	0	22.8
			4233	846.6	0	22.7

9.3. 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
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 Signalling 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 6.6.3.3.2	13	10	Table 6.2.4-2	Table 6.2.4-2
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	22.4	22.5	22.5
			1	25	0	22.3	22.4	22.4
			1	49	0	22.5	22.5	22.5
			25	0	1	20.3	20.5	20.4
			25	12	1	20.4	20.4	20.4
			25	25	1	20.3	20.4	20.3
			50	0	1	20.3	20.5	20.3
		16QAM	1	0	1	21.2	21.4	21.3
			1	25	1	21.1	21.3	21.2
			1	49	1	21.2	21.3	21.2
			25	0	2	19.1	19.3	19.3
			25	12	2	19.4	19.3	19.3
			25	25	2	19.4	19.2	19.2
			50	0	2	19.2	19.3	19.2
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	22.5	22.7	22.5
			1	12	0	22.4	22.7	22.4
			1	24	0	22.4	22.7	22.5
			12	0	1	21.3	21.6	21.5
			12	6	1	21.3	21.5	21.4
			12	11	1	21.4	21.4	21.4
			25	0	1	21.3	21.5	21.4
		16QAM	1	0	1	21.1	21.4	20.9
			1	12	1	21.0	21.3	20.8
			1	24	1	21.1	21.4	20.8
			12	0	2	20.1	20.3	20.3
			12	6	2	20.1	20.2	20.3
			12	11	2	20.1	20.2	20.2
			25	0	2	20.3	20.3	20.3
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	22.7	22.7	22.6
			1	8	0	22.6	22.6	22.5
			1	14	0	22.6	22.7	22.5
			8	0	1	21.4	21.5	21.5
			8	4	1	21.3	21.5	21.4
			8	7	1	21.3	21.4	21.5
			15	0	1	21.4	21.5	21.5
		16QAM	1	0	1	21.5	21.6	21.6
			1	8	1	21.4	21.5	21.5
			1	14	1	21.5	21.5	21.6
			8	0	2	20.2	20.2	20.4
			8	4	2	20.3	20.2	20.3
			8	7	2	20.3	20.2	20.3
			15	0	2	20.2	20.4	20.2

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	22.4	22.6	22.5
			1	3	0	22.4	22.6	22.5
			1	5	0	22.5	22.6	22.5
			3	0	0	22.4	22.5	22.5
			3	1	0	22.5	22.5	22.5
			3	3	0	22.4	22.5	22.5
			6	0	1	21.4	21.5	21.5
		16QAM	1	0	1	21.1	21.4	21.0
			1	3	1	21.1	21.4	21.0
			1	5	1	21.1	21.4	21.1
			3	0	1	21.1	21.2	21.4
			3	1	1	21.1	21.1	21.4
			3	3	1	21.2	21.2	21.4
			6	0	2	20.3	20.2	20.4

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	23.0
			1	25	0	23.0
			1	49	0	23.0
			25	0	1	21.1
			25	12	1	21.0
			25	25	1	21.0
			50	0	1	21.0
		16QAM	1	0	1	21.8
			1	25	1	21.7
			1	49	1	21.7
			25	0	2	20.5
			25	12	2	20.5
			25	25	2	20.5
			50	0	2	20.5
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Max. Avg Pwr (dBm)
						710 MHz
LTE Band 17	5	QPSK	1	0	0	23.2
			1	12	0	23.0
			1	24	0	23.1
			12	0	1	21.0
			12	6	1	21.0
			12	11	1	20.9
			25	0	1	21.0
		16QAM	1	0	1	21.4
			1	12	1	21.3
			1	24	1	21.4
			12	0	2	20.4
			12	6	2	20.4
			12	11	2	20.3
			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

9.4. Wi-Fi 2.4GHz (DTS Band)

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Max Power			Reduce Power		
					Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)	Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
2.4	802.11b	1 Mbps	1	2412	16.7	17.5	Yes	16.0	16.5	Yes
			6	2437	16.5			15.6		
			11	2462	16.6			15.8		
			12	2467	7.8	8.0	No	7.8	8.0	No
			13	2472	7.7			7.7		
	802.11g	6 Mbps	1	2412	Not Require	14.5	No	Not Require	14.5	No
			6	2437						
			11	2462						
	802.11n (HT20)	6.5 Mbps	1	2412	Not Require	13.5	No	Not Require	13.5	No
			6	2437						
			11	2462						

Note(s):

1. 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.
2. Additionally, SAR is not required for Channels 12 and 13 because the tune-up limit and the measured output power for these two channels are no greater than those for the default test channels.

9.5. 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	12.8	13.5	No	3
			40	5200	12.6			
			44	5220	12.6			
			48	5240	12.5			
	802.11n (HT20)	6.5 Mbps	36	5180	Not Required	13.5	No	2
			40	5200				
			44	5220				
			48	5240				
	802.11n (HT40)	13.5 Mbps	38	5190	Not Required	13	No	1
			46	5230				
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260	12.7	13.5	Yes	
			56	5280	12.6			
			60	5300	12.7			
			64	5320	12.6			
	802.11n (HT20)	6.5 Mbps	52	5260	Not Required	13.5	No	2
			56	5280				
			60	5300				
			64	5320				
	802.11n (HT40)	13.5 Mbps	54	5270	Not Required	13	No	1
			62	5310				
5.5 (U-NII 2C <5.65GHz)	802.11a	6 Mbps	100	5500	12.8	13.5	Yes	
			112	5560	12.8			
			116	5580	12.8			
			128	5640	12.8			
	802.11n (HT20)	6.5 Mbps	100	5500	Not Required	13.5	No	2
			112	5560				
			116	5580				
			128	5640				
	802.11n (HT40)	13.5 Mbps	102	5510	Not Required	13	No	1
			110	5550				
			118	5590				
			126	5630				
5.5 (U-NII 2C >5.65GHz) & 5.8 (U-NII 3)	802.11a	6 Mbps	132	5660	13.0	13.5	Yes	
			149	5745	12.7			
			165	5825	12.7			
	802.11n (HT20)	6.5 Mbps	132	5660	Not Required	13.5	No	2
			149	5745				
			165	5825				
	802.11n (HT40)	13.5 Mbps	134	5670	Not Required	13	No	1
			142	5710				
			151	5755				
			159	5795				

Note(s):

1. Output Power and SAR measurement is not required for 802.11n HT20/HT40 channels when the specified tune-up tolerances for 802.11n HT20/HT40 are lower than 802.11a by more than ½ dB and the measured SAR is ≤ 1.2 W/Kg.
2. 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.
3. 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.

9.6. Bluetooth

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

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 ≤ ¼ 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:

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	0	Left Touch	661	1880.0	30.0	29.6	0.040	0.044	
			Left Tilt	661	1880.0	30.0	29.6	0.011	0.012	
			Right Touch	661	1880.0	30.0	29.6	0.063	0.070	
			Right Tilt	661	1880.0	30.0	29.6	0.012	0.013	
Head VoIP	GPRS 3 Slots	0	Left Touch	661	1880.0	26.5	26.0	0.041	0.046	
			Left Tilt	661	1880.0	26.5	26.0	0.009	0.010	
			Right Touch	661	1880.0	26.5	26.0	0.064	0.072	1
			Right Tilt	661	1880.0	26.5	26.0	0.014	0.015	
Body-worn	Voice	10	Rear	661	1880.0	30.0	29.6	0.483	0.532	
			Front	661	1880.0	30.0	29.6	0.391	0.430	
Body-worn(VoIP) & Hotspot	GPRS 3 Slots	10	Rear	661	1880.0	26.5	26.0	0.520	0.584	2
			Front	661	1880.0	26.5	26.0	0.377	0.424	
Hotspot			Edge 2	661	1880.0	26.5	26.0	0.156	0.175	
			Edge 3	661	1880.0	26.5	26.0	0.380	0.427	
			Edge 4	661	1880.0	26.5	26.0	0.032	0.036	

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	9400	1880.0	23.0	22.1	0.080	0.098	
			Left Tilt	9400	1880.0	23.0	22.1	0.038	0.046	
			Right Touch	9400	1880.0	23.0	22.1	0.119	0.146	3
			Rightt Tilt	9400	1880.0	23.0	22.1	0.060	0.073	
Body-worn	Rel 99 RMC	10	Rear	9262	1852.4	23.0	22.3	0.860	1.016	
				9400	1880.0	23.0	22.1	0.860	1.055	
				9538	1907.6	23.0	22.1	0.894	1.087	4
			Front	9262	1852.4	23.0	22.3	0.756	0.893	
				9400	1880.0	23.0	22.1	0.745	0.914	
				9538	1907.6	23.0	22.1	0.814	0.990	
Hotspot	Rel 99 RMC	10	Rear	9400	1880.0	21.0	20.1	0.528	0.645	
			Front	9400	1880.0	21.0	20.1	0.445	0.544	
			Edge 2	9400	1880.0	21.0	20.1	0.096	0.117	
			Edge 3	9262	1852.4	21.0	20.2	0.816	0.991	
				9400	1880.0	21.0	20.1	0.755	0.922	
				9538	1907.6	21.0	20.0	0.776	0.973	
			Edge 4	9400	1880.0	21.0	20.1	0.046	0.056	

Note(s):

All WCDMA Band II SAR data- used in this report were taken from SAR report 15K22047-S1V2, submitted under FCC ID A3LSMA510F. Both models share identical antennas and output power. Spot checks were performed on model SM-A510S to ensure SAR values were the same between both models.

10.3. W-CDMA Band V

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	4183	836.6	23.0	22.8	0.108	0.112	
			Left Tilt	4183	836.6	23.0	22.8	0.064	0.066	
			Right Touch	4183	836.6	23.0	22.8	0.147	0.153	5
			Right Tilt	4183	836.6	23.0	22.8	0.053	0.055	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	4183	836.6	23.0	22.8	0.628	0.653	6
			Front	4183	836.6	23.0	22.8	0.546	0.568	
Hotspot	Rel 99 RMC	10	Edge 2	4183	836.6	23.0	22.8	0.243	0.253	
			Edge 3	4183	836.6	23.0	22.8	0.278	0.289	
			Edge 4	4183	836.6	23.0	22.8	0.089	0.092	

Note(s):

All WCDMA Band V SAR data- used in this report were taken from SAR report 15K22047-S1V2, submitted under FCC ID A3LSMA510F. Both models share identical antennas and output power. Spot checks were performed on model SM-A510S to ensure SAR values were the same between both models.

10.4. LTE Band 5 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Head	QPSK	0	Left Touch	20525	836.5	1	49	23.0	22.5	0.098	0.109	
						25	0	22.0	20.5	0.054	0.076	
			Left Tilt	20525	836.5	1	49	23.0	22.5	0.052	0.058	
						25	0	22.0	20.5	0.031	0.044	
			Right Touch	20525	836.5	1	49	23.0	22.5	0.152	0.169	7
						25	0	22.0	20.5	0.092	0.129	
			Right Tilt	20525	836.5	1	49	23.0	22.5	0.063	0.071	
						25	0	22.0	20.5	0.037	0.052	
Body-worn & Hotspot	QPSK	10	Rear	20525	836.5	1	49	23.0	22.5	0.522	0.582	8
						25	0	22.0	20.5	0.283	0.399	
			Front	20525	836.5	1	49	23.0	22.5	0.486	0.542	
						25	0	22.0	20.5	0.284	0.400	
Hotspot	QPSK	10	Edge 2	20525	836.5	1	49	23.0	22.5	0.294	0.328	
						25	0	22.0	20.5	0.200	0.282	
			Edge 3	20525	836.5	1	49	23.0	22.5	0.260	0.290	
						25	0	22.0	20.5	0.160	0.226	
			Edge 4	20525	836.5	1	49	23.0	22.5	0.073	0.081	
						25	0	22.0	20.5	0.043	0.060	

Note(s):

All LTE Band 5 SAR data- used in this report were taken from SAR report 15K22047-S1V2, submitted under FCC ID A3LSMA510F. Both models share identical antennas and output power. Spot checks were performed on model SM-A510S to ensure SAR values were the same between both models.

10.5. LTE Band 17 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	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	23.0	0.066	0.074	9
						25	0.0	22.5	21.1	0.041	0.057	
			Left Tilt	23790	710.0	1	0.0	23.5	23.0	0.041	0.045	
						25	0.0	22.5	21.1	0.023	0.032	
			Right Touch	23790	710.0	1	0.0	23.5	23.0	0.056	0.062	
						25	0.0	22.5	21.1	0.036	0.051	
			Right Tilt	23790	710.0	1	0.0	23.5	23.0	0.036	0.041	
						25	0.0	22.5	21.1	0.021	0.029	
Body-worn & Hotspot	QPSK	10	Rear	23790	710.0	1	0.0	23.5	23.0	0.298	0.332	10
						25	0.0	22.5	21.1	0.182	0.254	
			Front	23790	710.0	1	0.0	23.5	23.0	0.245	0.273	
						25	0.0	22.5	21.1	0.159	0.222	
Hotspot	QPSK	10	Edge 2	23790	710.0	1	0.0	23.5	23.0	0.108	0.120	
						25	0.0	22.5	21.1	0.055	0.077	
			Edge 3	23790	710.0	1	0.0	23.5	23.0	0.108	0.120	
						25	0.0	22.5	21.1	0.083	0.116	
			Edge 4	23790	710.0	1	0.0	23.5	23.0	0.082	0.092	
						25	0.0	22.5	21.1	0.062	0.086	

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)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
2.4GHz	802.11b 1 Mbps	Head	0	Left Touch	1	2412	0.766	16.5	16.0	0.540	0.609	
				Left Tilt	1	2412	0.664	16.5	16.0			
				Right Touch	1	2412	1.031	16.5	16.0	0.745	0.840	
					11	2462	1.077	16.5	15.8	0.751	0.880	11
				Rightt Tilt	1	2412	1.019	16.5	16.0	0.764	0.861	
					11	2462	0.963	16.5	15.8	0.706	0.828	
		Body-worn & Hotspot & Wi-Fi Direct	10	Rear	1	2412	0.219	17.5	16.7			
				Front	1	2412	0.259	17.5	16.7	0.190	0.229	12
				Edge 1	1	2412	0.231	17.5	16.7			
				Edge 4	1	2412	0.075	17.5	16.7			

Note(s):

1. Highest *reported* SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
2. 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*.
3. Testing for a second channel was required because the *reported* SAR for this test position was >0.8 W/kg.
4. Additional testing required in order satisfying FCC simultaneous transmission limit criteria.
5. All DTS Band SAR data- used in this report were taken from SAR report 15K22047-S1V2, submitted under FCC ID A3LSMA510F. Both models share identical antennas and output power. Spot checks were performed on model SM-A510S to ensure SAR values were the same between both models.

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)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
5.3 GHz U-NII 2A	802.11a 6 Mbps	Head	0	Left Touch	60	5300.0	0.552	13.5	12.7	0.387	0.471	
				Left Tilt	60	5300.0	0.520	13.5	12.7			
				Right Touch	52	5260.0	1.246	13.5	12.7	0.866	1.053	13
					60	5300.0	1.069	13.5	12.7	0.842	1.024	
				Right Tilt	52	5260.0	1.504	13.5	12.7	0.732	0.890	
					60	5300.0	1.453	13.5	12.7	0.720	0.876	
		Body-worn	10	Rear	60	5300.0	0.199	13.5	12.7	0.079	0.096	14
				Front	60	5300.0	0.158	13.5	12.7			
5.5 GHz U-NII 2C	802.11a 6 Mbps	Head	0	Left Touch	116	5580.0	0.698	13.5	12.8			
				Left Tilt	116	5580.0	0.798	13.5	12.8			
				Right Touch	116	5580.0	0.902	13.5	12.8	0.525	0.611	
				Right Tilt	116	5580.0	1.163	13.5	12.8	0.657	0.765	15
		Body-worn	10	Rear	116	5580.0	0.242	13.5	12.8	0.095	0.110	16
				Front	116	5580.0	0.205	13.5	12.8			
5.8 GHz U-NII 3	802.11a 6 Mbps	Head	0	Left Touch	149	5745.0	0.677	13.5	13.0			
				Left Tilt	149	5745.0	0.746	13.5	13.0			
				Right Touch	149	5745.0	0.631	13.5	13.0	0.448	0.508	
				Right Tilt	149	5745.0	0.922	13.5	13.0	0.496	0.566	17
		Body-worn & Hotspot & Wi-Fi Direct	10	Rear	149	5745.0	0.148	13.5	13.0	0.061	0.069	
				Front	149	5745.0	0.180	13.5	13.0	0.076	0.086	18
				Edge 1	149	5745.0	0.119	13.5	13.0			
				Edge 4	159	5795.0	0.059	13.5	13.0			

Note(s):

1. Highest *reported* SAR is ≤ 0.4 W/kg. Therefore, further SAR measurements within this exposure condition are not required.
2. 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*.
3. Testing for a second channel was required because the *reported* SAR for this test position was >0.8 W/kg.
4. Additional testing required in order satisfying FCC simultaneous transmission limit criteria.
5. All U-NII Band SAR data- used in this report were taken from SAR report 15K22047-S1V2, submitted under FCC ID A3LSMA510F. Both models share identical antennas and output power. Spot checks were performed on model SM-A510S to ensure SAR values were the same between both models.

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:

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

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

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

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

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

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 or 2.0 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.80 or 2.0 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 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.

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	0.298	N/A	N/A
850	WCDMA Band V	Body & Hotspot	Rear	No	0.628	N/A	N/A
	LTE Band 5	Body & Hotspot	Rear	No	0.522	N/A	N/A
1900	GSM 1900	Body & Hotspot	Rear	No	0.520	N/A	N/A
	WCDMA Band II	Body	Rear	Yes	0.894	0.864	1.03
2400	Wi-Fi 802.11b/g/n	Head	Right Touch	No	0.764	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	Head	Right Touch	Yes	0.866	0.843	1.03
5500	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.657	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.496	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

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

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

Where:

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

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

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

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

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

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
	7	LTE	+	DTS
	8	LTE	+	U-NII
Body-worn	9	GSM(Voice)	+	DTS
	10	GSM(Voice)	+	U-NII
	11	GSM(Voice)	+	BT
	12	GSM(GPRS)	+	DTS
	13	GSM(GPRS)	+	U-NII
	14	GSM(GPRS)	+	BT
	15	W-CDMA	+	DTS
	16	W-CDMA	+	U-NII
	17	W-CDMA	+	BT
	18	LTE	+	DTS
	19	LTE	+	U-NII
	20	LTE	+	BT
Hotspot & Wi-Fi Direct	21	GSM(GPRS)	+	DTS
	22	GSM(GPRS)	+	U-NII
	23	W-CDMA	+	DTS
	24	W-CDMA	+	U-NII
	25	LTE	+	DTS
	26	LTE	+	U-NII

Notes:

1. DTS, U-NII 3 supports Hotspot and Wi-Fi Direct.
2. GPRS, W-CDMA and LTE support Hotspot.
3. VoIP is supported in GPRS, W-CDMA and LTE.
4. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
5. U-NII Radio cannot 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 + ④ WWAN + BT	
					∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)	∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)	∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)
Head	0.169	0.880	1.053		1.049	No	1.222	No		
Body-worn	1.087	0.229	0.110	0.189	1.316	No	1.197	No	1.276	No
Hotspot	0.991	0.229	0.110	0.189	1.220	No	1.101	No	1.180	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.

15K22092-S1V2 FCC Report SAR_App A_Photos & Ant. Locations

15K22092-S1V2 FCC Report SAR_App B_Highest SAR Test Plots

15K22092-S1V2 FCC Report SAR_App C_System Check Plots

15K22092-S1V2 FCC Report SAR_App D_SAR Tissue Ingredients

15K22092-S1V2 FCC Report SAR_App E_Probe Cal. Certificates

15K22092-S1V2 FCC Report SAR_App F_Dipole Cal. Certificates

END OF REPORT