



**FCC 47 CFR Parts 1 & 2
Published RF Exposure KDB Procedures
IEEE Std 1528-2013**

The model FCC ID: A3LSMC115 shares the same enclosure and circuit board as model FCC ID: A3LSMC115L. The WLAN/Bluetooth circuitry and layout, including antenna, are almost identical between the two units. The WLAN/Bluetooth antenna and surrounding circuitry is the same between these two units, and tune up power targets are identical for WLAN and Bluetooth operations. For this reason the SAR data for the WLAN and Bluetooth operations for FCC ID: A3LSMC115 is considered representative for FCC ID: A3LSMC115L.

SAR EVALUATION REPORT

For
GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII abgn & NFC

**Model: SM-C115L
FCC ID: A3LSMC115L**

**Report Number: 14U17495-S8A
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1. Attestation of Test Results

Applicant	Samsung Electronics Co., Ltd.			
DUT description	GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII abgn & NFC			
Model	SM-C115L			
Test device is	An identical prototype			
Device category	Portable			
Exposure category	General Population/Uncontrolled Exposure			
Date tested	3/17/2014 – 3/20/2014; 4/09/2014 – 4/14/2014			
The highest reported SAR values	RF exposure condition	Licensed	DTS	UNII
	Head	0.363 W/kg	0.159 W/kg	0.060 W/kg
	Body-worn Accessory	0.581 W/kg	0.500 W/kg	0.477 W/kg
	Wireless Router (Hotspot)	0.581 W/kg	0.195 W/kg	N/A
	Simultaneous Transmission	0.971 W/kg	0.971 W/kg	0.948 W/kg
Applicable Standards	FCC 47 CFR Parts 1 & 2 Published RF Exposure KDB Procedures, and TCB workshop updates IEEE Std 1528-2013			
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.

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2. Test Methodology

The tests documented in this report were performed in accordance with FCC 47 CFR Parts 1 & 2, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures, and TCB workshop updates:

- 447498 D01 General RF Exposure Guidance v05r02
- 648474 D04 Handset SAR v01r02
- 941225 D01 SAR test for 3G devices v02
- 941225 D02 HSPA and 1x Advanced v02r02
- 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- 941225 D04 SAR for GSM E GPRS Dual Xfer Mode v01
- 941225 D05 SAR for LTE Devices v02r03
- 941225 D06 Hotspot Mode SAR v01r01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r03

3. Facilities and Accreditation

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

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 F	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. Calibration and Uncertainty

4.1. Measuring Instrument Calibration

The measuring equipment used to perform the tests documented in this report has been calibrated in accordance with the manufacturers' recommendations, and is traceable to recognized national standards.

Tissue Dielectric Properties

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
PNA Network Analyzer	Agilent	E8363C	MY49030443	12/3/2014
Dielectronic Probe kit	SPEAG	DAK-3.5	1082	9/10/2014
Dielectronic Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529163	9/19/2014
Network Analyzer	Agilent	8753ES	MY40001647	7/11/2014
Dielectronic Probe kit	SPEAG	DAK-3.5	1082	9/10/2014
Dielectronic Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529162	9/19/2014

System Performance Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	HP	8665B	3744A01084	5/7/2014
Power Meter	HP	437B	3125U12345	7/29/2014
Power Meter	HP	437B	3125U11364	8/26/2014
Power Sensor	HP	8481A	2702A76223	9/17/2014
Power Sensor	HP	8481A	1926A27048	7/29/2014
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	BK Precision	1611	215-02292	N/A
Synthesized Signal Generator	Agilent	8665B	3438A00633	6/13/2014
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808939	N/A
Directional coupler	Werlatone	C8060-102	2710	N/A
DC Power Supply	Sorensen Ametek	XT15-4	1319A02778	N/A
Power Meter	HP	438A	2822A05684	10/10/2014
Power Sensor	Agilent	8481A	2237A31744	10/2/2014
Power Sensor	Aglient	8481A	2349A36506	9/30/2014
E-Field Probe	SPEAG	EX3DV4	3902	7/12/2014
E-Field Probe	SPEAG	EX3DV4	3772	2/26/2015
E-Field Probe	SPEAG	EX3DV4	3749	1/29/2015
E-Field Probe	SPEAG	EX3DV4	3751	11/21/2014
Data Acquisition Electronics	SPEAG	DAE4	1377	7/15/2014
Data Acquisition Electronics	SPEAG	DAE4	1259	1/23/2015
Data Acquisition Electronics	SPEAG	DAE4	1352	9/11/2014
Data Acquisition Electronics	SPEAG	DAE3	500	5/28/2014
System Validation Dipole	SPEAG	D2450V2	706	5/29/2014
System Validation Dipole	SPEAG	D5GHzV2	1138	11/19/2014
System Validation Dipole	SPEAG	D750V3	1019	3/17/2015
System Validation Dipole	SPEAG	D835V2	4d117	5/28/2014
System Validation Dipole	SPEAG	D1900V2	5d043	11/12/2014

Others

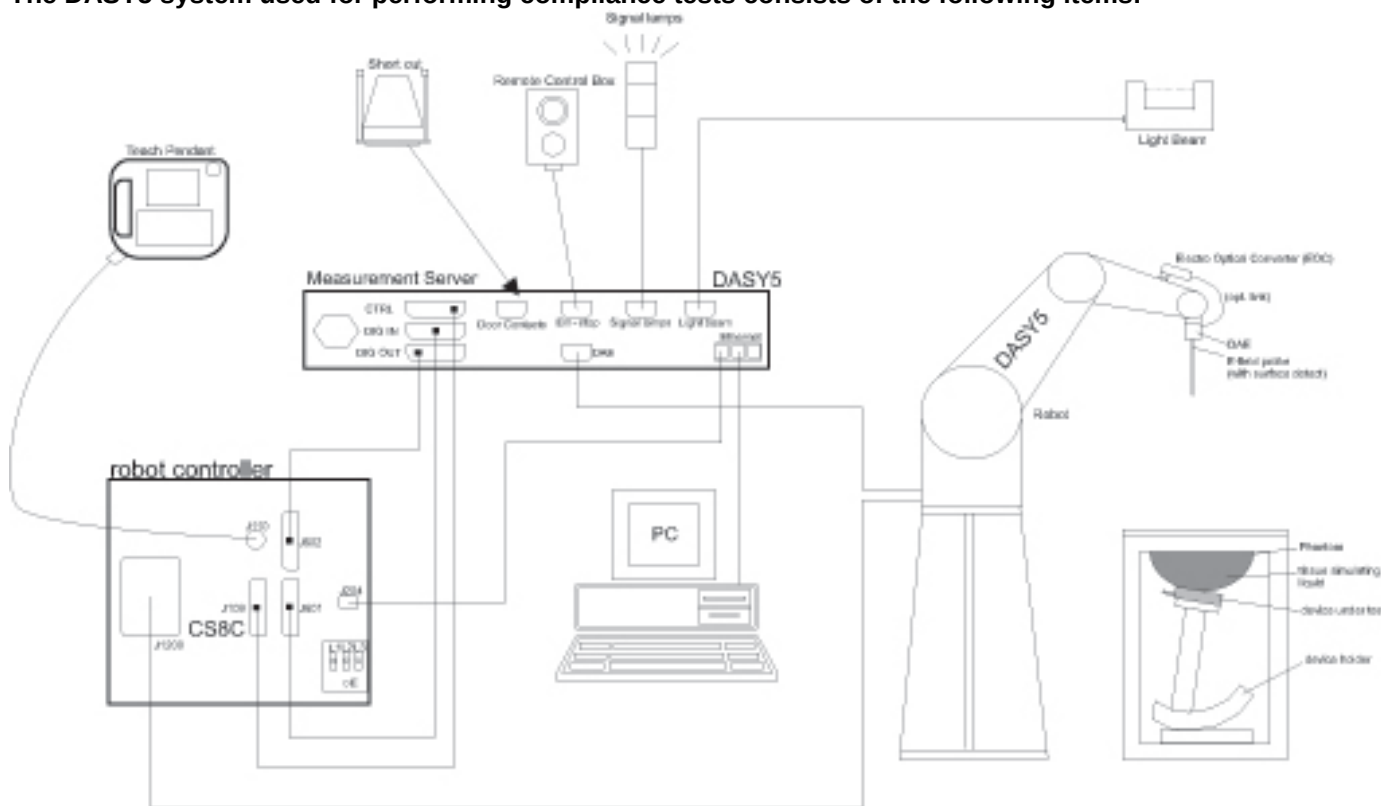
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMU200	106301	7/3/2014
Base Station Simulator	R & S	CMW500	124595-SS	7/25/2014
Power Meter	Agilent	N1912A	MY50001018	8/23/2014
Power Sensor	Agilent	N1921A	MY52020011	5/13/2014
Power Sensor	Agilent	N1921A	MY52200012	9/25/2014

4.2. 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.

5. Measurement System Description and Setup

The DASY5 system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6. SAR Measurement Procedure

6.1. Normal SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

	≤ 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: Δx_{Area} , Δy_{Area}	≤ 2 GHz: ≤ 15 mm $2 - 3$ GHz: ≤ 12 mm	$3 - 4$ GHz: ≤ 12 mm $4 - 6$ GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.				
* When zoom scan is required and the <u>reported</u> SAR from the area scan based <i>1-g SAR estimation</i> procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

Step 4: Power drift measurement

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

Step 5: Z-Scan (FCC only)

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

6.2. Volume Scan Procedures

Step 1: Repeat Step 1-4 in Section 6.1

Step 2: Volume Scan

Volume Scans are used to assess peak SAR and averaged SAR measurements in largely extended 3-dimensional volumes within any phantom. This measurement does not need any previous area scan. The grid can be anchored to a user specific point or to the current probe location.

Step 3: Power drift measurement

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

7. Device Under Test

7.1. General Information

Operating Configuration(s)	Held to head, Body-worn (Voice call)
Mobile Hotspot	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi -enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5 GHz)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☐ Wi-Fi Direct (Wi-Fi 5 GHz)
Device dimension	Overall (Length x Width): 137 mm x 70.8mm Overall Diagonal: 139mm Display Diagonal: 121.8mm
Back Cover	☐ Normal Battery Cover ☐ Wireless Charger Battery Cover ☒ Normal Battery Cover with NFC
Accessory	☒ Headset
Battery Options	☒ Standard – Lithium-ion battery, Rating 3.8Vdc, 9.23Wh ☐ Extended (large capacity)

7.2. Wireless Technologies

Wireless Technology and Frequency Bands	GSM: 1900 W-CDMA Band: V / II LTE Band 5 / 17 Wi-Fi : 2.4 / 5 GHz Bluetooth: 2.4 GHz.
Mode	GSM ☒ Voice (GMSK) ☒ GPRS (GMSK) W-CDMA ☒ UMTS Rel. 99 (Voice & Data) ☒ HSDPA (Rel. 5) ☒ HSUPA (Rel. 6) LTE ☒ QPSK ☒ 16QAM Wi-Fi 2.4GHz (802.11b/g/n) ☒ 802.11b ☒ 802.11g ☒ 802.11n (HT20) Wi-Fi 5GHz ☒ 802.11a ☒ 802.11n (HT20) ☒ 802.11n (HT40) Bluetooth Ver. 4.0 (LE)
Duty Cycle	GSM Voice: 12.5%; GPRS 1 Slot: 12.5%; 2 Slots: 25% W-CDMA: 100% LTE: 100% Wi-Fi 802.11a/b/g/n: 100%
GPRS Multi-Slot Class	☐ Class 8 - One Up ☒ Class 10 - Two Up ☐ Class 12 - Four Up ☐ Class 33 - Four Up
DTM (Dual Transfer Mode)	☐ Supported
VoIP (GPRS)	☒ Supported
SV-LTE & SV-DO	☐ Supported

7.3. RF Output Power Tolerance

Upper limit (dB): 0.5 ~ -1.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
GSM1900	Voice	30.0	30.5
	GPRS 1 slot	30.0	30.5
	GPRS 2 slots	27.0	27.5
W-CDMA Band V	R99	23.0	23.5
	HSDPA	22.0	22.5
	HSUPA	22.0	22.5
W-CDMA Band II	R99	23.0	23.5
	HSDPA	22.0	22.5
	HSUPA	22.0	22.5
LTE Band 5	QPSK	23.0	23.5
LTE Band 17	QPSK	22.0	22.5

Upper limit (dB): 0.5 ~ 1.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
WiFi 2.4 GHz	802.11b	17.0	17.5
	802.11g	13.0	13.5
	802.11n HT20	12.0	12.5
WiFi 5 GHz	802.11a	13.0	13.5
	802.11n HT20	12.0	12.5
	802.11n HT40	11.0	11.5
Bluetooth		10.0	10.5
Bluetooth LE		8.5	9.0

7.4. Simultaneous Transmission Condition

RF Exposure Condition	Capable Transmit Configurations
Head	1. GSM 1900 Voice + Wi-Fi 2.4/5GHz 2. GSM 1900 (GPRS) + Wi-Fi 2.4/5GHz (VoIP) 3. WCDMA Band V/II + Wi-Fi 2.4/5GHz 4. LTE B5/B17 + Wi-Fi 2.4/5GHz
Body-worn Accessory	5. GSM 1900 Voice + Wi-Fi 2.4/5GHz 6. GSM 1900 Voice + BT 7. GSM 1900 (GPRS) + Wi-Fi 2.4/5GHz (VoIP) 8. GSM 1900 (GPRS) + BT (VoIP) 9. WCDMA Band V/II + Wi-Fi 2.4/5GHz 10. WCDMA Band V/II + BT 11. LTE B5/B17 + Wi-Fi 2.4/5GHz 12. LTE B5/B17 + BT
Wireless Router (Hotspot) & Wi-Fi Direct	13. GSM 1900 (GPRS) + Wi-Fi 2.4GHz 14. WCDMA Band V/II + Wi-Fi 2.4GHz 15. LTE B5/B17 + Wi-Fi 2.4GHz
Notes: 1. Wi-Fi 2.4GHz supports Hotspot and Wi-Fi Direct. 2. GPRS, WCDMA, and LTE support Hotspot. 3. VoIP is support in GPRS, WCDMA, and LTE. 4. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio. 5. Wi-Fi 5 GHz Radio can transmit simultaneously with Bluetooth Radio.	

7.5. General LTE SAR Test and Reporting Considerations

Item	Description																																												
Frequency range, Channel Bandwidth, Numbers and Frequencies	Band 5	Frequency range: 824 - 849 MHz																																											
		Channel Bandwidth																																											
		20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz																																						
	Low			20450/ 829	20425/ 826.5	20415/ 825.5	20407/ 824.7																																						
	Mid			20525/ 836.5	20525/ 836.5	20525/ 836.5	20525/ 836.5																																						
	High			20600/ 844	20625/ 846.5	20635/ 847.5	20643/ 848.3																																						
	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 TX/RX antennas. Please refer to Appendix Photos and Antenna Locations for more information																																												
Maximum power reduction (MPR)	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							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.																																												

8. RF Exposure Conditions

Refer to Appendix "Antenna Locations and Separation Distances" for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

8.1. Head Exposure Conditions

For WWAN, LTE and Wi-Fi

Test Configurations	SAR Required	Note
Left Touch	Yes	
Left Tilt (15°)	Yes	
Right Touch	Yes	
Right Tilt (15°)	Yes	

8.2. Body-worn Accessory Exposure Conditions

For WWAN and LTE

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	<25 mm	Yes	
Front	<25 mm	Yes	

For Wi-Fi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	<25 mm	Yes	
Front	<25 mm	Yes	

8.3. Hotspot Exposure Conditions and Wi-Fi Direct (2.4GHz only)

For WWAN and LTE

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	1.2 mm	Yes	
Front	4.2 mm	Yes	
Edge 1 (Top)	126 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR
Edge 2 (Right)	5.2 mm	Yes	
Edge 3 (Bottom)	3 mm	Yes	
Edge 4 (Left)	22.1 mm	Yes	

For Wi-Fi (2.4 GHz only)

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	1.2 mm	Yes	
Front	9.9 mm	Yes	
Edge 1 (Top)	66 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 648474 D04 Handset SAR
Edge 2 (Right)	61 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 648474 D04 Handset SAR
Edge 3 (Bottom)	34.2 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 648474 D04 Handset SAR
Edge 4 (Left)	2.6 mm	Yes	

9. RF Output Power Measurement

9.1. GSM

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
1900	GSM (Voice)	CS1	1	512	1850.2	29.5	20.5
				661	1880.0	29.5	20.5
				810	1909.8	29.6	20.6
	GPRS (GMSK)	CS1	1	512	1850.2	29.5	20.5
				661	1880.0	29.5	20.5
				810	1909.8	29.6	20.6
			2	512	1850.2	26.3	20.3
				661	1880.0	26.1	20.1
				810	1909.8	26.5	20.5

Notes:

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

- Head & Body-worn Accessory: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 1 time slots, based on the output power measurements above

9.2. W-CDMA

Release 99

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

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 1
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	β_c/β_d	8/15

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Rel 99 (RMC, 12.2 kbps)	4132	826.4	22.9
		4183	836.6	23.0
		4233	846.6	23.0
W-CDMA Band II	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	23.0
		9400	1880.0	22.9
		9538	1907.6	23.0

HSDPA

The following 4 Sub-tests were completed according to Release 5 procedures in section 5.2 of 3GPP TS34.121-1. 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-Set1			
	Power Control Algorithm	Algorithm 2			
	β_c	2/15	12/15	15/15	15/15
	β_d	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	β_c/β_d	2/15	12/15	15/8	15/4
	β_{hs}	4/15	24/15	30/15	30/15
	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			

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	22.5
		4183	836.6	22.5
		4233	846.6	22.5
	Subtest 2	4132	826.4	22.5
		4183	836.6	22.5
		4233	846.6	22.5
	Subtest 3	4132	826.4	22.5
		4183	836.6	22.5
		4233	846.6	22.5
	Subtest 4	4132	826.4	21.9
		4183	836.6	22.2
		4233	846.6	21.8
W-CDMA Band II	Subtest 1	9262	1852.4	22.5
		9400	1880.0	22.5
		9538	1907.6	22.5
	Subtest 2	9262	1852.4	22.5
		9400	1880.0	22.5
		9538	1907.6	22.5
	Subtest 3	9262	1852.4	22.0
		9400	1880.0	22.2
		9538	1907.6	22.2
	Subtest 4	9262	1852.4	21.2
		9400	1880.0	20.8
		9538	1907.6	20.7

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

HSPA (HSDPA & HSUPA)

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

	Mode	HSPA				
	Subtest	1	2	3	4	5
WCDMA General Settings	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set 1				
	HSUPA Test	HSPA				
	Power Control Algorithm	Algorithm 2				Algorithm 1
	β_c	11/15	6/15	15/15	2/15	15/15
	β_d	15/15	15/15	9/15	15/15	0
	β_{ec}	209/225	12/15	30/15	2/15	5/15
	β_c/β_d	11/15	11/15	15/9	2/15	15/0
	β_{hs}	22/15	12/15	30/15	4/15	5/15
	β_{ed}	1309/225	94/75	47/15 47/15	56/75	47/15
	CM (dB)	1	3	2	3	1
HSDPA Specific Settings	DACK	8				0
	DNAK	8				0
	DCQI	8				0
	Ack-Nack repetition factor	3				
	CQI Feedback (Table 5.2B.4)	4ms				
	CQI Repetition Factor (Table 5.2B.4)	2				
	$A_{hs} = \beta_{hs}/\beta_c$	30/15				
HSUPA Specific Settings	E-DPDCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E-TFCIs	5	5	2	5	1
	Reference E-TFCI	11	11	11	11	67
	Reference E-TFCI PO	4	4	4	4	18
	Reference E-TFCI	67	67	92	67	67
	Reference E-TFCI PO	18	18	18	18	18
	Reference E-TFCI	71	71	71	71	71
	Reference E-TFCI PO	23	23	23	23	23
	Reference E-TFCI	75	75	75	75	75
	Reference E-TFCI PO	26	26	26	26	26
	Reference E-TFCI	81	81	81	81	81
	Reference E-TFCI PO	27	27	27	27	27
	Maximum Channelisation Codes	2xSF2				SF4

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	22.1
		4183	836.6	22.3
		4233	846.6	22.3
	Subtest 2	4132	826.4	20.2
		4183	836.6	20.3
		4233	846.6	20.3
	Subtest 3	4132	826.4	21.2
		4183	836.6	21.3
		4233	846.6	21.3
	Subtest 4	4132	826.4	20.1
		4183	836.6	20.1
		4233	846.6	20.2
	Subtest 5	4132	826.4	22.9
		4183	836.6	23.0
		4233	846.6	23.0
W-CDMA Band II	Subtest 1	9262	1852.4	21.6
		9400	1880.0	21.5
		9538	1907.6	21.7
	Subtest 2	9262	1852.4	19.5
		9400	1880.0	19.6
		9538	1907.6	19.8
	Subtest 3	9262	1852.4	20.7
		9400	1880.0	20.6
		9538	1907.6	20.8
	Subtest 4	9262	1852.4	19.7
		9400	1880.0	19.5
		9538	1907.6	19.7
	Subtest 5	9262	1852.4	23.0
		9400	1880.0	22.9
		9538	1907.6	23.0

9.3. LTE Band

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	13	10	Table 6.2.4-2	Table 6.2.4-2
	6.6.3.3.2				
NS_08	6.6.3.3.3	19	10, 15	> 44	≤ 3
NS_09	6.6.3.3.4	21	10, 15	> 40	≤ 1
				> 55	≤ 2
NS_10		20	15, 20	Table 6.2.4-3	Table 6.2.4-3
NS_11	6.6.2.2.1	23 ¹	1.4, 3, 5, 10	Table 6.2.4-5	Table 6.2.4-5
..					
NS_32	-	-	-	-	-

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

LTE Band 5 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							829 MHz	836.5 MHz	844 MHz
LTE Band 5	10	QPSK	1	0	0	0	23.5	23.5	23.5
			1	25	0	0	23.4	23.5	23.5
			1	49	0	0	23.3	23.5	23.0
			25	0	1	1	21.9	22.1	22.1
			25	12	1	1	21.9	22.1	22.1
			25	25	1	1	21.9	22.1	22.0
			50	0	1	1	22.0	22.2	22.0
		16QAM	1	0	1	1	22.4	22.5	22.4
			1	25	1	1	22.5	22.5	22.5
			1	49	1	1	22.2	22.5	21.9
			25	0	2	2	21.1	21.1	21.1
			25	12	2	2	20.9	21.1	21.1
			25	25	2	2	21.0	21.1	20.9
			50	0	2	2	21.0	21.1	21.0
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							826.5 MHz	836.5 MHz	846.5 MHz
LTE Band 5	5	QPSK	1	0	0	0	23.4	23.5	23.5
			1	12	0	0	23.4	23.3	23.5
			1	24	0	0	23.5	23.3	23.2
			12	0	1	1	22.2	22.3	22.4
			12	6	1	1	22.1	22.1	22.2
			12	11	1	1	22.0	22.2	22.1
			25	0	1	1	22.0	22.2	22.3
		16QAM	1	0	1	1	22.5	22.5	22.5
			1	12	1	1	22.5	22.5	22.5
			1	24	1	1	22.5	22.5	22.5
			12	0	2	2	21.0	21.2	21.4
			12	6	2	2	21.1	21.1	21.2
			12	11	2	2	21.0	21.0	21.1
			25	0	2	2	20.9	21.2	21.3
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							825.5 MHz	836.5 MHz	847.5 MHz
LTE Band 5	3	QPSK	1	0	0	0	23.5	23.4	23.5
			1	7	0	0	23.5	23.4	23.5
			1	14	0	0	23.5	23.3	23.5
			8	0	1	1	22.4	22.5	22.5
			8	4	1	1	22.2	22.4	22.5
			8	7	1	1	22.3	22.3	22.4
			15	0	1	1	22.3	22.3	22.4
		16QAM	1	0	1	1	22.5	22.5	22.5
			1	7	1	1	22.5	22.5	22.5
			1	14	1	1	22.5	22.5	22.5
			8	0	2	2	21.2	21.5	21.4
			8	4	2	2	21.2	21.4	21.4
			8	7	2	2	21.2	21.4	21.3
			15	0	2	2	21.1	21.4	21.5

LTE Band 5 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							824.7 MHz	836.5 MHz	848.3 MHz
LTE Band 5	1.4	QPSK	1	0	0	0	23.5	23.5	23.5
			1	2	0	0	23.5	23.5	23.5
			1	5	0	0	23.5	23.4	23.5
			3	0	0	0	23.4	23.5	23.5
			3	1	0	0	23.4	23.5	23.5
			3	2	0	0	23.4	23.5	23.5
			6	0	1	1	22.3	22.5	22.5
		16QAM	1	0	1	1	22.3	22.5	22.5
			1	2	1	1	22.5	22.5	22.5
			1	5	1	1	22.5	22.5	22.5
			3	0	2	1	22.5	22.5	22.5
			3	1	2	1	22.5	22.4	22.5
			3	2	2	1	22.4	22.4	22.5
			6	0	2	2	21.1	21.2	21.4

LTE Band 17 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)
							710 MHz
LTE Band 17	10	QPSK	1	0	0	0	22.5
			1	25	0	0	22.5
			1	49	0	0	22.5
			25	0	1	1	21.5
			25	12	1	1	21.5
			25	25	1	1	21.5
			50	0	1	1	21.5
		16QAM	1	0	1	1	21.5
			1	25	1	1	21.5
			1	49	1	1	21.5
			25	0	2	2	20.5
			25	12	2	2	20.5
			25	25	2	2	20.5
			50	0	2	2	20.5
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)
							710 MHz
LTE Band 17	5	QPSK	1	0	0	0	22.5
			1	12	0	0	22.5
			1	24	0	0	22.5
			12	0	1	1	21.5
			12	6	1	1	21.5
			12	11	1	1	21.5
			25	0	1	1	21.5
		16QAM	1	0	1	1	21.5
			1	12	1	1	21.5
			1	24	1	1	21.5
			12	0	2	2	20.5
			12	6	2	2	20.5
			12	11	2	2	20.5
			25	0	2	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 (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

Mode	Band	GHz	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	2.412	1 [#]	√	▽
		2.437	6	√	▽
		2.462	11 [#]	√	▽

Notes:

√ = "default test channels"

▽ = possible 802.11g channels with maximum average output ¼ dB ≥ the "default test channels"

[#] = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
2.4 (DTS)	802.11b	1 Mbps	1	2412	17.0	Yes
			6	2437	17.1	
			11	2462	17.0	
	802.11g	6 Mbps	1	2412	13.0	No
			6	2437	13.0	
			11	2462	13.0	
	802.11n (HT20)	MCS0	1	2412	12.0	No
			6	2437	12.0	
			11	2462	12.0	

Note(s):

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

Power measurements to determine worst-case data rates

Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
802.11b	6	2437	1 Mbps	17.1	Yes
			2 Mbps	17.1	No
			5.5 Mbps	17.0	No
			11 Mbps	17.1	No

9.5. Wi-Fi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

Mode		Band	GHz	Channel	“Default Test Channels”	
					802.11a	
802.11a	UNII (15.407)	5.2 GHz	5.180	36	√	
			5.200	40		*
			2.220	44		*
			5.240	48	√	
		5.3 GHz	5.260	52	√	
			5.280	56		*
			5.300	60		*
			5.320	64	√	
		5.5 GHz	5.500	100		
			5.520	104	√	
			5.540	108		*
			5.560	112		*
			5.580	116	√	
			5.600	120		*
			5.620	124	√	
			5.640	128		*
			5.660	132		*
			5.680	136	√	
			5.700	140		*
	DTS (15.247)	5.8 GHz	5.745	149	√	
			5.765	153		*
			5.785	157	√	
			5.805	161		*
			5.825	165	√	

√ = "default test channels"

* = possible 802.11a channels with maximum average output > the "default test channels"

= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
5.2 (UNII)	802.11a	6 Mbps	36	5180	13.5	Yes
			40	5200	13.4	
			44	5220	13.5	
			48	5240	13.4	
	802.11n (HT20)	MCS0	36	5180	12.5	No
			40	5200	12.5	
			48	5240	12.5	
	802.11n (HT40)	MCS0	38	5190	11.0	No
			46	5230	11.0	
5.3 (UNII)	802.11a	6 Mbps	52	5260	13.0	Yes
			56	5280	13.0	
			60	5300	13.1	
			64	5320	13.5	
	802.11n (HT20)	MCS0	52	5260	12.4	No
			60	5300	12.5	
			64	5320	12.4	
	802.11n (HT40)	MCS0	54	5270	11.2	No
			62	5310	11.3	
5.5 (UNII)	802.11a	6 Mbps	100	5500	12.8	Yes
			104	5520	13.1	
			108	5540	13.4	
			112	5560	13.5	
			116	5580	13.5	
			120	5600	13.5	
			124	5620	13.5	
			128	5640	13.4	
			132	5660	13.3	
			136	5680	13.5	
			140	5700	13.4	
	802.11n (HT20)	MCS0	100	5500	11.9	No
			116	5580	11.8	
			140	5700	11.9	
	802.11n (HT40)	MCS0	102	5510	11.3	No
			110	5550	11.3	
			134	5670	11.2	
5.8 (DTS)	802.11a	6 Mbps	149	5745	13.1	Yes
			153	5765	13.0	
			157	5785	13.1	
			161	5805	13.0	
			165	5825	12.9	
	802.11n (HT20)	MCS0	149	5745	12.4	No
			157	5785	12.4	
			161	5805	12.3	
	802.11n (HT40)	MCS0	151	5755	11.3	No
			159	5795	11.2	

Note(s):

Per KDB 248227, SAR is not required for 802.11n HT20/HT40 and 802.11ac VHT40/VHT80 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.

Power measurements to determine worst-case data rates

Band	Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
5.2 GHz (UNII)	802.11a	36	5180	6 Mbps	13.5	Yes
				9 Mbps	13.4	No
				12 Mbps	13.3	No
				18 Mbps	13.4	No
				24 Mbps	13.3	No
				36 Mbps	13.4	No
				48 Mbps	13.5	No
				54 Mbps	13.5	No
5.3 GHz (UNII)	802.11a	64	5320	6 Mbps	13.5	Yes
				9 Mbps	13.5	No
				12 Mbps	13.5	No
				18 Mbps	13.4	No
				24 Mbps	13.4	No
				36 Mbps	13.5	No
				48 Mbps	13.3	No
				54 Mbps	13.3	No
5.5 GHz (UNII)	802.11a	116	5580	6 Mbps	13.5	Yes
				9 Mbps	13.4	No
				12 Mbps	13.5	No
				18 Mbps	13.4	No
				24 Mbps	13.3	No
				36 Mbps	13.4	No
				48 Mbps	13.5	No
				54 Mbps	13.4	No
5.8 GHz (DTS)	802.11a	157	5785	6 Mbps	13.1	Yes
				9 Mbps	13.1	No
				12 Mbps	13.1	No
				18 Mbps	13.0	No
				24 Mbps	13.0	No
				36 Mbps	12.9	No
				48 Mbps	12.9	No
				54 Mbps	13.0	No

9.6. Bluetooth

Maximum tune-up tolerance limit is 10.5 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

Refer to Standalone SAR Test Exclusion Considerations Section.

10. Tissue Dielectric Properties

IEEE Std 1528-2013

Target Frequency (MHz)	Head	
	ϵ_r	σ (S/m)
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1500	40.4	1.23
1640	40.2	1.31
1750	40.1	1.37
1800	40.0	1.40
1900	40.0	1.40
2000	40.0	1.40
2100	39.8	1.49
2300	39.5	1.67
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
3500	37.9	2.91
4000	37.4	3.43
4500	36.8	3.94
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.5	5.07
5800	35.3	5.27
6000	35.1	5.48

NOTE—For convenience, permittivity and conductivity values at some frequencies that are not part of the original data from Drossos et al. [B60] or the extension to 5800 MHz are provided (i.e., the values shown in italics). These values were linearly interpolated between the values in this table that are immediately above and below these values, except the values at 6000 MHz that were linearly extrapolated from the values at 3000 MHz and 5800 MHz.

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

10.1. Composition of Ingredients for the Tissue Material Used in the SAR Tests

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16 MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

MSL/HSL750 (Body and Head liquids for 700 – 800 MHz)

Item	Head Tissue Simulation Liquids HSL750 Muscle (body) Tissue Simulation Liquids MSL750
Type No	SL AAH 075
Manufacturer	SPEAG
The item is composed of the following ingredients:	
H ₂ O	Water, 35 – 58%
Sucrose	Sugar, white, refined, 40-60%
NaCl	Sodium Chloride, 0-6%
Hydroxyethyl-cellulose	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyl-3(2H)-isothiazolone, 0.1-0.7%

MSL/HSL1750 (Body and Head liquids for 1700 – 1800 MHz)

Item	Head Tissue Simulation Liquids HSL1750 Muscle (body) Tissue Simulation Liquids MSL1750
Type No	SL AAM 175
Manufacturer	SPEAG
-The item is composed of the following ingredients:	
H ₂ O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25-48%
NaCl	Sodium Chloride, <1.0%

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

10.2. Tissue Dielectric Parameter Check Results

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

The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.

Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.

SAR Lab 3

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
3/17/2014	Body 2450	e'	51.2800	Relative Permittivity (ϵ_r):	51.28	52.70	-2.69	5
		e"	13.8100	Conductivity (σ):	1.88	1.95	-3.52	5
	Body 2410	e'	51.4200	Relative Permittivity (ϵ_r):	51.42	52.76	-2.54	5
		e"	13.6900	Conductivity (σ):	1.83	1.91	-3.83	5
	Body 2475	e'	51.2100	Relative Permittivity (ϵ_r):	51.21	52.67	-2.77	5
		e"	13.9000	Conductivity (σ):	1.91	1.99	-3.64	5
3/17/2014	Head 5180	e'	37.7500	Relative Permittivity (ϵ_r):	37.75	36.01	4.82	5
		e"	15.4700	Conductivity (σ):	4.46	4.63	-3.77	5
	Head 5200	e'	37.7100	Relative Permittivity (ϵ_r):	37.71	35.99	4.78	5
		e"	15.4500	Conductivity (σ):	4.47	4.65	-3.95	5
	Head 5600	e'	37.1600	Relative Permittivity (ϵ_r):	37.16	35.53	4.58	5
		e"	15.6800	Conductivity (σ):	4.88	5.06	-3.51	5
	Head 5800	e'	36.8700	Relative Permittivity (ϵ_r):	36.87	35.30	4.45	5
		e"	15.8200	Conductivity (σ):	5.10	5.27	-3.19	5
	Head 5825	e'	36.8100	Relative Permittivity (ϵ_r):	36.81	35.30	4.28	5
		e"	15.8100	Conductivity (σ):	5.12	5.27	-2.83	5
3/19/2014	Head 2450	e'	38.1600	Relative Permittivity (ϵ_r):	38.16	39.20	-2.65	5
		e"	13.7900	Conductivity (σ):	1.88	1.80	4.37	5
	Head 2410	e'	38.3400	Relative Permittivity (ϵ_r):	38.34	39.28	-2.39	5
		e"	13.6800	Conductivity (σ):	1.83	1.76	4.13	5
	Head 2475	e'	38.0500	Relative Permittivity (ϵ_r):	38.05	39.17	-2.86	5
		e"	13.8700	Conductivity (σ):	1.91	1.83	4.47	5
3/20/2014	Body 5180	e'	47.0400	Relative Permittivity (ϵ_r):	47.04	49.05	-4.09	5
		e"	18.8600	Conductivity (σ):	5.43	5.27	3.05	5
	Body 5200	e'	47.0900	Relative Permittivity (ϵ_r):	47.09	49.02	-3.94	5
		e"	18.7600	Conductivity (σ):	5.42	5.29	2.45	5
	Body 5600	e'	46.2700	Relative Permittivity (ϵ_r):	46.27	48.48	-4.55	5
		e"	19.2500	Conductivity (σ):	5.99	5.76	4.04	5
	Body 5800	e'	45.8300	Relative Permittivity (ϵ_r):	45.83	48.20	-4.92	5
		e"	19.4700	Conductivity (σ):	6.28	6.00	4.65	5
	Body 5825	e'	46.1400	Relative Permittivity (ϵ_r):	46.14	48.20	-4.27	5
		e"	19.4000	Conductivity (σ):	6.28	6.00	4.72	5

Tissue Dielectric Parameter Check Results (continued)

SAR Lab A

Date Tested	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
4/10/2014	Body 835	e'	54.9400	Relative Permittivity (ε _r):	54.94	55.20	-0.47	5
		e"	21.9200	Conductivity (σ):	1.02	0.97	4.92	5
	Body 820	e'	55.0400	Relative Permittivity (ε _r):	55.04	55.28	-0.43	5
		e"	22.0200	Conductivity (σ):	1.00	0.97	3.67	5
	Body 850	e'	54.8300	Relative Permittivity (ε _r):	54.83	55.16	-0.59	5
		e"	21.8200	Conductivity (σ):	1.03	0.99	4.47	5
4/10/2014	Body 1900	e'	51.0600	Relative Permittivity (ε _r):	51.06	53.30	-4.20	5
		e"	14.6500	Conductivity (σ):	1.55	1.52	1.82	5
	Body 1850	e'	51.1700	Relative Permittivity (ε _r):	51.17	53.30	-4.00	5
		e"	14.6300	Conductivity (σ):	1.50	1.52	-0.99	5
	Body 1910	e'	51.0200	Relative Permittivity (ε _r):	51.02	53.30	-4.28	5
		e"	14.6500	Conductivity (σ):	1.56	1.52	2.36	5
4/11/2014	Head 835	e'	41.4000	Relative Permittivity (ε _r):	41.40	41.50	-0.24	5
		e"	19.6400	Conductivity (σ):	0.91	0.90	1.32	5
	Head 820	e'	41.5800	Relative Permittivity (ε _r):	41.58	41.60	-0.05	5
		e"	19.6800	Conductivity (σ):	0.90	0.90	-0.13	5
	Head 850	e'	41.2400	Relative Permittivity (ε _r):	41.24	41.50	-0.63	5
		e"	19.6100	Conductivity (σ):	0.93	0.92	1.29	5

SAR Lab B

Date Tested	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit $\pm$ (%)
4/9/2014	Body 835	e'	53.6700	Relative Permittivity (ϵ_r):	53.67	55.20	-2.77	5
		e"	21.6800	Conductivity (σ):	1.01	0.97	3.77	5
	Body 820	e'	53.8300	Relative Permittivity (ϵ_r):	53.83	55.28	-2.62	5
		e"	21.6800	Conductivity (σ):	0.99	0.97	2.07	5
	Body 850	e'	53.4900	Relative Permittivity (ϵ_r):	53.49	55.16	-3.02	5
		e"	21.6200	Conductivity (σ):	1.02	0.99	3.51	5
4/11/2014	Head 835	e'	41.1100	Relative Permittivity (ϵ_r):	41.11	41.50	-0.94	5
		e"	19.6000	Conductivity (σ):	0.91	0.90	1.11	5
	Head 820	e'	41.2800	Relative Permittivity (ϵ_r):	41.28	41.60	-0.78	5
		e"	19.6300	Conductivity (σ):	0.90	0.90	-0.38	5
	Head 850	e'	40.9200	Relative Permittivity (ϵ_r):	40.92	41.50	-1.40	5
		e"	19.5600	Conductivity (σ):	0.92	0.92	1.03	5
4/14/2014	Body 750	e'	53.4300	Relative Permittivity (ϵ_r):	53.43	55.55	-3.81	5
		e"	23.1500	Conductivity (σ):	0.97	0.96	0.24	5
	Body 700	e'	53.9400	Relative Permittivity (ϵ_r):	53.94	55.74	-3.23	5
		e"	23.5800	Conductivity (σ):	0.92	0.96	-4.32	5
	Body 790	e'	52.9000	Relative Permittivity (ϵ_r):	52.90	55.39	-4.50	5
		e"	22.8600	Conductivity (σ):	1.00	0.97	3.93	5

Tissue Dielectric Parameter Check Results (continued)

SAR Lab C

Date Tested	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit $\pm$ (%)
4/11/2014	Head 1900	e'	41.3200	Relative Permittivity (ϵ_r):	41.32	40.00	3.30	5
		e"	13.1400	Conductivity (σ):	1.39	1.40	-0.84	5
	Head 1850	e'	41.4500	Relative Permittivity (ϵ_r):	41.45	40.00	3.63	5
		e"	12.9900	Conductivity (σ):	1.34	1.40	-4.56	5
	Head 1910	e'	41.2600	Relative Permittivity (ϵ_r):	41.26	40.00	3.15	5
		e"	13.1400	Conductivity (σ):	1.40	1.40	-0.32	5
4/14/2014	Head 750	e'	40.2400	Relative Permittivity (ϵ_r):	40.24	41.96	-4.10	5
		e"	21.6800	Conductivity (σ):	0.90	0.89	1.24	5
	Head 700	e'	40.8800	Relative Permittivity (ϵ_r):	40.88	42.22	-3.17	5
		e"	22.0100	Conductivity (σ):	0.86	0.89	-3.66	5
	Head 790	e'	39.7100	Relative Permittivity (ϵ_r):	39.71	41.76	-4.90	5
		e"	21.3500	Conductivity (σ):	0.94	0.90	4.65	5

11. System Performance Check

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

11.1. System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ± 0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm ± 0.5 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm ± 0.5 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 3 mm.
For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

11.2. Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (mW/g)		
				1g/10g	Head	Body
D750V3	1019	3/17/2014	750	1g	8.21	8.64
				10g	5.38	5.69
D835V2	4d117	5/28/2013	835	1g	9.54	9.40
				10g	6.21	6.16
D1900V2	5d043	11/12/2013	1900	1g	40.1	39.0
				10g	21.1	20.8
D2450V2	706	5/29/2013	2450	1g	53.7	49.9
				10g	25.0	23.3
D5GHzV2	1138	11/19/2013	5200	1g	78.5	72.9
				10g	22.5	20.4
			5600	1g	82.7	78.3
				10g	23.5	21.7
			5800	1g	78.3	72.8
				10g	22.4	20.1

11.3. System Performance Check Results

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

SAR Lab 3

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W				
3/17/2014	D2450V2	706	Body	1g	5.19	5.16	51.6	49.9	3.41	0.58	1, 2
				10g	2.25	2.39	23.9	23.3	2.58		
3/17/2014	D5GHzV2 (5.2 GHz)	1138	Head	1g	7.04	7.81	78.1	78.5	-0.51	-10.94	
				10g	1.95	2.23	22.3	22.5	-0.89		
3/17/2014	D5GHzV2 (5.6 GHz)	1138	Head	1g	6.94	8.01	80.1	82.7	-3.14	-15.42	
				10g	1.89	2.26	22.6	23.5	-3.83		
3/17/2014	D5GHzV2 (5.8 GHz)	1138	Head	1g	7.29	7.90	79.0	78.3	0.89	-8.37	
				10g	2.00	2.20	22.0	22.4	-1.79		
3/19/2014	D2450V2	706	Head	1g	5.53	5.42	54.2	53.7	0.93	1.99	
				10g	2.42	2.45	24.5	25.0	-2.00		
3/20/2014	D5GHzV2 (5.2 GHz)	1138	Body	1g	7.10	7.31	73.1	72.9	0.27	-2.96	
				10g	2.04	2.06	20.6	20.4	0.98		
3/20/2014	D5GHzV2 (5.6 GHz)	1138	Body	1g	7.83	8.19	81.9	78.3	4.60	-4.60	3,4
				10g	2.19	2.27	22.7	21.7	4.61		
3/20/2014	D5GHzV2 (5.8 GHz)	1138	Body	1g	6.77	7.39	73.9	72.8	1.51	-9.16	
				10g	1.83	2.04	20.4	20.1	1.49		

SAR Lab A

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W				
4/10/2014	D835V2	4d117	Body	1g	1.00	0.956	9.6	9.40	1.70	3.92	5,6
				10g	0.665	0.631	6.3	6.16	2.44		
4/10/2014	D1900V2	5d043	Body	1g	4.08	4.04	40.4	39.0	3.59	0.98	7,8
				10g	2.05	2.10	21.0	20.8	0.96		
4/11/2014	D835V2	4d117	Head	1g	0.968	0.945	9.5	9.54	-0.94	2.38	
				10g	0.655	0.622	6.2	6.21	0.16		

SAR Lab B

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W				
4/9/2014	D835V2	4d117	Body	1g	0.986	0.981	9.8	9.40	4.36	0.51	
				10g	0.663	0.649	6.5	6.16	5.36		
4/11/2014	D835V2	4d117	Head	1g	0.926	0.894	8.9	9.54	-6.29	3.46	9,10
				10g	0.623	0.588	5.9	6.21	-5.31		
4/14/2014	D750V3	1019	Body	1g	0.935	0.917	9.2	8.64	6.13	1.93	11,12
				10g	0.635	0.611	6.1	5.69	7.38		

SAR Lab C

Date Tested	System Dipole		T.S. Liquid		Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #			Area Scan	Zoom Scan	Normalize to 1 W				
4/11/2014	D1900V2	5d043	Head	1g	3.98	3.98	39.8	40.10	-0.75	0.00	13,14
				10g	2.07	2.09	20.9	21.10	-0.95		
4/14/2014	D750V3	1019	Head	1g	0.831	0.816	8.2	8.21	-0.61	1.81	15,16
				10g	0.566	0.534	5.3	5.38	-0.74		

12. SAR Test Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 648474 D04 Handset SAR:

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

KDB 941225 D01 SAR test for 3G devices:

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

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

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

12.1. 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	30.5	29.5	0.079	0.099	1
			Left Tilt	661	1880.0	30.5	29.5	0.063	0.079	
			Right Touch	661	1880.0	30.5	29.5	0.117	0.147	
			Righttt Tilt	661	1880.0	30.5	29.5	0.049	0.062	
Head VoIP	GPRS 1 Slot	0	Left Touch	661	1880.0	30.5	29.5	0.073	0.092	
			Left Tilt	661	1880.0	30.5	29.5	0.060	0.076	
			Right Touch	661	1880.0	30.5	29.5	0.113	0.142	
			Righttt Tilt	661	1880.0	30.5	29.5	0.045	0.057	
Body-worn	Voice	10	Rear	661	1880.0	30.5	29.5	0.108	0.136	2
			Front	661	1880.0	30.5	29.5	0.175	0.220	
Body-worn(VoIP) & Hotspot	GPRS 1 Slot	10	Rear	661	1880.0	30.5	29.5	0.104	0.131	
Front			661	1880.0	30.5	29.5	0.116	0.146		
Hotspot		10	Edge 2	661	1880.0	30.5	29.5	0.074	0.093	3
			Edge 3	661	1880.0	30.5	29.5	0.153	0.193	
			Edge 4	661	1880.0	30.5	29.5	0.022	0.028	

12.2. W-CDMA Band V

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	4183	836.6	23.5	23.0	0.169	0.190	4
			Left Tilt	4183	836.6	23.5	23.0	0.135	0.151	
			Right Touch	4183	836.6	23.5	23.0	0.233	0.261	
			Right Tilt	4183	836.6	23.5	23.0	0.132	0.148	
Body-worn & Hptspot	Rel 99 RMC	10	Rear	4183	836.6	23.5	23.0	0.313	0.351	5
			Front	4183	836.6	23.5	23.0	0.336	0.377	
Hotspot	Rel 99 RMC	10	Edge 2	4183	836.6	23.5	23.0	0.270	0.303	
			Edge 3	4183	836.6	23.5	23.0	0.197	0.221	
			Edge 4	4183	836.6	23.5	23.0	0.100	0.112	

12.3. 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	23.5	22.9	0.202	0.232	6
			Left Tilt	9400	1880.0	23.5	22.9	0.169	0.194	
			Right Touch	9400	1880.0	23.5	22.9	0.315	0.362	
			Right Tilt	9400	1880.0	23.5	22.9	0.131	0.150	
Body-worn & Hptspot	Rel 99 RMC	10	Rear	9400	1880.0	23.5	22.9	0.283	0.325	7
			Front	9400	1880.0	23.5	22.9	0.491	0.564	
Hotspot	Rel 99 RMC	10	Edge 2	9400	1880.0	23.5	22.9	0.201	0.231	
			Edge 3	9400	1880.0	23.5	22.9	0.454	0.521	
			Edge 4	9400	1880.0	23.5	22.9	0.107	0.123	

12.4. 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	836.6	1	0	23.5	23.5	0.277	0.277	8
						25	0	22.5	22.1	0.193	0.212	
			Left Tilt	20525	836.6	1	0	23.5	23.5	0.196	0.196	
						50	0	22.5	22.1	0.135	0.148	
			Right Touch	20525	836.6	1	0	23.5	23.5	0.363	0.363	
						50	0	22.5	22.1	0.254	0.279	
			Rightt Tilt	20525	836.6	1	0	23.5	23.5	0.206	0.206	
						50	0	22.5	22.1	0.146	0.160	
Body-worn & Hptspot	QPSK	10	Rear	20525	836.6	1	0	23.5	23.5	0.471	0.471	9
						50	0	22.5	22.1	0.329	0.361	
			Front	20525	836.6	1	0	23.5	23.5	0.581	0.581	
						50	0	22.5	22.1	0.406	0.445	
Hotspot	QPSK	10	Edge 2	20525	836.6	1	0	23.5	23.5	0.398	0.398	
						50	0	22.5	22.1	0.280	0.307	
			Edge 3	20525	836.6	1	0	23.5	23.5	0.287	0.287	
						50	0	22.5	22.1	0.207	0.227	
			Edge 4	20525	836.6	1	0	23.5	23.5	0.142	0.142	
						50	0	22.5	22.1	0.100	0.110	

12.5. 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	22.5	22.5	0.022	0.022	10
						25	0	21.5	21.5	0.015	0.015	
			Left Tilt	23790	710.0	1	0	22.5	22.5	0.019	0.019	
						50	0	21.5	21.5	0.013	0.013	
			Right Touch	23790	710.0	1	0	22.5	22.5	0.029	0.029	
						50	0	21.5	21.5	0.019	0.019	
			Rightt Tilt	23790	710.0	1	0	22.5	22.5	0.017	0.017	
						50	0	21.5	21.5	0.011	0.011	
Body-worn & Hptspot	QPSK	10	Rear	23790	710.0	1	0	22.5	22.5	0.055	0.055	11
						50	0	21.5	21.5	0.039	0.039	
			Front	23790	710.0	1	0	22.5	22.5	0.074	0.074	
						50	0	21.5	21.5	0.052	0.052	
Hotspot	QPSK	10	Edge 2	23790	710.0	1	0	22.5	22.5	0.040	0.040	
						50	0	21.5	21.5	0.030	0.030	
			Edge 3	23790	710.0	1	0	22.5	22.5	0.028	0.028	
						50	0	21.5	21.5	0.019	0.019	
			Edge 4	23790	710.0	1	0	22.5	22.5	0.025	0.025	
						50	0	21.5	21.5	0.017	0.017	

12.6. Wi-Fi (DTS Band)

12.6.1. Wi-Fi 2.4 GHz

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	802.11b 1 Mbps	0	Left Touch	6	2437.0	17.5	17.1	0.145	0.159	12
			Left Tilt	6	2437.0	17.5	17.1	0.040	0.044	
			Right Touch	6	2437.0	17.5	17.1	0.051	0.056	
			Right Tilt	6	2437.0	17.5	17.1	0.049	0.054	
Body-worn & Hotspot	802.11b 1 Mbps	10	Rear	6	2437.0	17.5	17.1	0.126	0.138	
			Front	6	2437.0	17.5	17.1	0.060	0.066	
Hotspot	802.11b 1 Mbps	10	Edge 4	6	2437.0	17.5	17.1	0.178	0.195	13

12.6.2. Wi-Fi 5.8 GHz

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	802.11a 6 Mbps	0	Left Touch	157	5785.0	13.5	13.1	0.045	0.049	14
			Left Tilt	157	5785.0	13.5	13.1	0.000	0.000	
			Right Touch	157	5785.0	13.5	13.1	0.000	0.000	
			Right Tilt	157	5785.0	13.5	13.1	0.000	0.000	
Body-worn	802.11a 6 Mbps	10	Rear	157	5785.0	13.5	13.1	0.456	0.500	15
			Front	157	5785.0	13.5	13.1	0.049	0.054	

12.7. Wi-Fi (UNII Band)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	802.11a 6 Mbps	0	Left Touch	36	5180.0	13.5	13.5	0.057	0.057	16
				64	5320.0	13.5	13.5	0.060	0.060	17
				136	5680.0	13.5	13.5	0.047	0.047	18
			Left Tilt	36	5180.0	13.5	13.5	0.000	0.000	
				64	5320.0	13.5	13.5	0.000	0.000	
				136	5680.0	13.5	13.5	0.000	0.000	
			Right Touch	36	5180.0	13.5	13.5	0.000	0.000	
				64	5320.0	13.5	13.5	0.000	0.000	
				136	5680.0	13.5	13.5	0.000	0.000	
			Right Tilt	36	5180.0	13.5	13.5	0.000	0.000	
				64	5320.0	13.5	13.5	0.000	0.000	
				136	5680.0	13.5	13.5	0.000	0.000	
Body-worn	802.11a 6 Mbps	10	Rear	36	5180.0	13.5	13.5	0.314	0.314	19
				64	5320.0	13.5	13.5	0.281	0.281	20
				104	5520.0	13.5	13.4	0.391	0.400	
				116	5580.0	13.5	13.5	0.411	0.411	
				124	5620.0	13.5	13.5	0.443	0.443	
				136	5680.0	13.5	13.5	0.477	0.477	21
			Front	36	5180.0	13.5	13.5	0.033	0.033	
				64	5320.0	13.5	13.5	0.004	0.004	
				136	5680.0	13.5	13.5	0.024	0.024	

12.8. Bluetooth

12.8.1. Standalone SAR Test Exclusion Considerations

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

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

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

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

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
10.5	11	10	2.480	1.8

Conclusion:

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

12.8.2. Estimated SAR

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

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

Estimated SAR Result for Body-worn Accessory Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 1-g SAR (W/kg)
Rear/Front	11	10	2.480	0.231

13. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 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 .

13.1. The Highest Measured SAR Configuration in Each Frequency Band

Not Applicable.

13.2. Repeated Measurement Results

Head Exposure Condition

Not Applicable.

Body-worn Accessory Exposure Condition

Not Applicable.

Hotspot Mode Exposure Conditions

Not Applicable.

Note(s):

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not > 1.20 .

14. 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:

SAR₁ is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR₂ is the highest reported 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:

$$[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$$

A new threshold of 0.04 is also introduced in the KDB 447498. Thus, in order for a pair of simultaneously transmitting antennas, with the sum of 1-g SAR > 1.6 W/kg, to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

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

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

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			GSM 1900	Wi-Fi DTS Bands	Wi-Fi UNII Bands	Bluetooth		
Head	Left Touch	WWAN + Wi-Fi(DTS)	0.099	0.159			0.258	No
		WWAN + Wi-Fi(UNII)	0.099		0.060		0.159	No
	Left Tilt	WWAN + Wi-Fi(DTS)	0.079	0.044			0.123	No
		WWAN + Wi-Fi(UNII)	0.079		0.000		0.079	No
	Right Touch	WWAN + Wi-Fi(DTS)	0.147	0.056			0.203	No
		WWAN + Wi-Fi(UNII)	0.147		0.000		0.147	No
	Right Tilt	WWAN + Wi-Fi(DTS)	0.062	0.054			0.116	No
		WWAN + Wi-Fi(UNII)	0.062		0.000		0.062	No
Body-worn Accessory & Hotspot	Rear	WWAN + Wi-Fi(DTS)	0.136	0.500			0.636	No
		WWAN + Wi-Fi(UNII)	0.135		0.477		0.612	No
		WWAN + BT	0.136			0.231	0.367	No
	Front	WWAN + Wi-Fi(DTS)	0.220	0.066			0.286	No
		WWAN + Wi-Fi(UNII)	0.220		0.033		0.253	No
		WWAN + BT	0.220			0.231	0.451	No
Hotspot	Edge 2	WWAN + Wi-Fi(DTS)	0.093				0.093	No
	Edge 3	WWAN + Wi-Fi(DTS)	0.193				0.193	No
	Edge 4	WWAN + Wi-Fi(DTS)	0.028	0.195			0.223	No

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

14.2. Sum of the SAR for W-CDMA Band V & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			W-CDMA Band V	Wi-Fi DTS Bands	Wi-Fi UNII Bands	Bluetooth		
Head	Left Touch	WWAN + Wi-Fi(DTS)	0.190	0.159			0.349	No
		WWAN + Wi-Fi(UNII)	0.190		0.060		0.250	No
	Left Tilt	WWAN + Wi-Fi(DTS)	0.151	0.044			0.195	No
		WWAN + Wi-Fi(UNII)	0.151		0.000		0.151	No
	Right Touch	WWAN + Wi-Fi(DTS)	0.261	0.056			0.317	No
		WWAN + Wi-Fi(UNII)	0.261		0.000		0.261	No
	Right Tilt	WWAN + Wi-Fi(DTS)	0.148	0.054			0.202	No
		WWAN + Wi-Fi(UNII)	0.148		0.000		0.148	No
Body-worn Accessory & Hotspot	Rear	WWAN + Wi-Fi(DTS)	0.351	0.500			0.851	No
		WWAN + Wi-Fi(UNII)	0.351		0.477		0.828	No
		WWAN + BT	0.351			0.231	0.582	No
	Front	WWAN + Wi-Fi(DTS)	0.377	0.066			0.443	No
		WWAN + Wi-Fi(UNII)	0.377		0.033		0.410	No
		WWAN + BT	0.377			0.231	0.608	No
Hotspot	Edge 2	WWAN + Wi-Fi(DTS)	0.303				0.303	No
	Edge 3	WWAN + Wi-Fi(DTS)	0.221				0.221	No
	Edge 4	WWAN + Wi-Fi(DTS)	0.112	0.195			0.307	No

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

14.3. Sum of the SAR for W-CDMA Band II & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			W-CDMA Band II	Wi-Fi DTS Bands	Wi-Fi UNII Bands	Bluetooth		
Head	Left Touch	WWAN + Wi-Fi(DTS)	0.232	0.159			0.391	No
		WWAN + Wi-Fi(UNII)	0.232		0.060		0.292	No
	Left Tilt	WWAN + Wi-Fi(DTS)	0.194	0.044			0.238	No
		WWAN + Wi-Fi(UNII)	0.194		0.000		0.194	No
	Right Touch	WWAN + Wi-Fi(DTS)	0.362	0.056			0.418	No
		WWAN + Wi-Fi(UNII)	0.362		0.000		0.362	No
Body-worn Accessory & Hotspot	Rear	WWAN + Wi-Fi(DTS)	0.325	0.500			0.825	No
		WWAN + Wi-Fi(UNII)	0.325		0.477		0.802	No
		WWAN + BT	0.325			0.231	0.556	No
	Front	WWAN + Wi-Fi(DTS)	0.564	0.066			0.630	No
		WWAN + Wi-Fi(UNII)	0.564		0.033		0.597	No
		WWAN + BT	0.564			0.231	0.795	No
Hotspot	Edge 2	WWAN + Wi-Fi(DTS)	0.231				0.231	No
	Edge 3	WWAN + Wi-Fi(DTS)	0.521				0.521	No
	Edge 4	WWAN + Wi-Fi(DTS)	0.123	0.195			0.318	No

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

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

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			LTE Band 5	Wi-Fi DTS Bands	Wi-Fi UNII Bands	Bluetooth		
Head	Left Touch	WWAN + Wi-Fi(DTS)	0.277	0.159			0.436	No
		WWAN + Wi-Fi(UNII)	0.277		0.060		0.337	No
	Left Tilt	WWAN + Wi-Fi(DTS)	0.196	0.044			0.240	No
		WWAN + Wi-Fi(UNII)	0.196		0.000		0.196	No
	Right Touch	WWAN + Wi-Fi(DTS)	0.363	0.056			0.419	No
		WWAN + Wi-Fi(UNII)	0.363		0.000		0.363	No
Body-worn Accessory & Hotspot	Rear	WWAN + Wi-Fi(DTS)	0.206	0.054			0.260	No
		WWAN + Wi-Fi(UNII)	0.206		0.000		0.206	No
		WWAN + BT	0.471	0.500			0.971	No
	Front	WWAN + Wi-Fi(DTS)	0.471		0.477		0.948	No
		WWAN + BT	0.471			0.231	0.702	No
		WWAN + Wi-Fi(DTS)	0.581	0.066			0.647	No
Hotspot	Edge 2	WWAN + Wi-Fi(DTS)	0.581		0.033		0.614	No
	Edge 3	WWAN + Wi-Fi(DTS)	0.581			0.231	0.812	No
	Edge 4	WWAN + Wi-Fi(DTS)	0.142	0.195			0.337	No

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

14.5. Sum of the SAR for LTE Band 17 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			LTE Band 17	Wi-Fi DTS Bands	Wi-Fi UNII Bands	Bluetooth		
Head	Left Touch	WWAN + Wi-Fi(DTS)	0.022	0.159			0.181	No
		WWAN + Wi-Fi(UNII)	0.022		0.060		0.082	No
	Left Tilt	WWAN + Wi-Fi(DTS)	0.019	0.044			0.063	No
		WWAN + Wi-Fi(UNII)	0.019		0.000		0.019	No
	Right Touch	WWAN + Wi-Fi(DTS)	0.029	0.056			0.085	No
		WWAN + Wi-Fi(UNII)	0.029		0.000		0.029	No
	Right Tilt	WWAN + Wi-Fi(DTS)	0.017	0.054			0.071	No
		WWAN + Wi-Fi(UNII)	0.017		0.000		0.017	No
Body-worn Accessory & Hotspot	Rear	WWAN + Wi-Fi(DTS)	0.055	0.500			0.555	No
		WWAN + Wi-Fi(UNII)	0.055		0.477		0.532	No
		WWAN + BT	0.055			0.231	0.286	No
	Front	WWAN + Wi-Fi(DTS)	0.074	0.066			0.140	No
		WWAN + Wi-Fi(UNII)	0.074		0.033		0.107	No
		WWAN + BT	0.074			0.231	0.305	No
Hotspot	Edge 2	WWAN + Wi-Fi(DTS)	0.040				0.040	No
	Edge 3	WWAN + Wi-Fi(DTS)	0.028				0.028	No
	Edge 4	WWAN + Wi-Fi(DTS)	0.025	0.195			0.220	No

SAR to Peak Location Separation Ratio (SPLSR)

As the Sum of the SAR is not greater than 1.6 W/kg SPLSR assessment is not required.

Conclusion:

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

15. Appendixes

Refer to separated files for the following appendixes.

- 15.1. Photos and Antenna Locations**
- 15.2. System Performance Check Plots**
- 15.3. Highest SAR Test Plots**
- 15.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3902**
- 15.5. Calibration Certificate for E-Field Probe EX3DV4 - SN 3772**
- 15.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3749**
- 15.7. Calibration Certificate for E-Field Probe EX3DV3 - SN 3751**
- 15.8. Calibration Certificate for D750V3 - SN 1019**
- 15.9. Calibration Certificate for D835V2 - SN 4d117**
- 15.10. Calibration Certificate for D1900V2 - SN 5d043**
- 15.11. Calibration Certificate for D2450V2 - SN 706**
- 15.12. Calibration Certificate for D5GHzV2 - SN 1138**

END OF REPORT