SAR EVALUATION REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

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

FCC ID: A3LSMA750F
Model Name: SM-A750F/DS, SM-A750F

Report Number: 12440922-S1V3
Issue Date: 9/12/2018

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	9/7/2018	Initial Issue	--
V2	9/11/2018	Added Section 6.6	Coltyce Sanders
V3	9/12/2018	Section 10.10: Removed Product Specific 10g Bluetooth Exclusion	AJ Newcomer

Table of Contents

1. Attestation of Test Results

Applicant Name		Samsung Electronics Co., Ltd.			
FCC ID		A3LSMA750F			
Model Name		SM-A750F/DS, SM-A750F			
Applicable Standards		FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
Exposure Category		SAR Limits (W/Kg)			
		Peak spatial-average (1g of tissue)		Extremities (hands, wrists, ankles, etc.) (10g of tissue)	
General population / Uncontrolled exposure		1.6		4	
RF Exposure Conditions		Equipment Class - Highest Reported SAR (W/kg)			
		PCE	DTS	NII	DSS
Head		0.435	0.474	0.582	0.232
Body-worn		0.390	0.207	0.291	N/A
Hotspot/Wi-Fi Direct/BT Tethering		1.045	0.426	0.751	N/A
Product specific 10g SAR		N/A	N/A	0.648	N/A
Simultaneous TX	Head	0.989	0.890	0.989	0.667
	Body-worn	0.681	0.597	0.681	0.530
	Hotspot/ Wi-Fi Direct/ BT Tethering	1.471	1.471	1.456	1.255
Date Tested		8/27/2018 to 9/6/2018			
Test Results		Pass			

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released By:	Prepared By:
	
Devin Chang Senior Test Engineer UL Verification Services Inc.	Florencio Pesigan Laboratory Technician UL Verification Services Inc.

2. Test Specification, Methods and Procedures

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

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR 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 v02r05
- 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
- 941225 D06 Hotspot Mode v02r01

In addition to the above, the following information was used:

- TCB workshop April 2015; Page 33, RF Exposure Procedures Update (Overlapping LTE Bands)
- TCB workshop October 2014; Page 37, RF Exposure Procedures Update (Other LTE Considerations)
- TCB workshop October 2015; Page 6, RF Exposure Procedures (KDB 941225 D05A)
- TCB workshop April 2016; Page 13, RF Exposure Procedures (LTE Carrier Aggregation for DL)
- TCB workshop April 2016; Page 22, RF Exposure Procedures (Phablet Procedures)
- TCB workshop October 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)
- TCB workshop October 2016; Page 18, RF Exposure Procedures (DUT Holder Perturbations)
- TCB workshop May 2017; Page 9, Broadband Liquid Above 3 GHz
- TCB workshop May 2017; Page 16, Bluetooth Tethering

3. Facilities and Accreditation

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

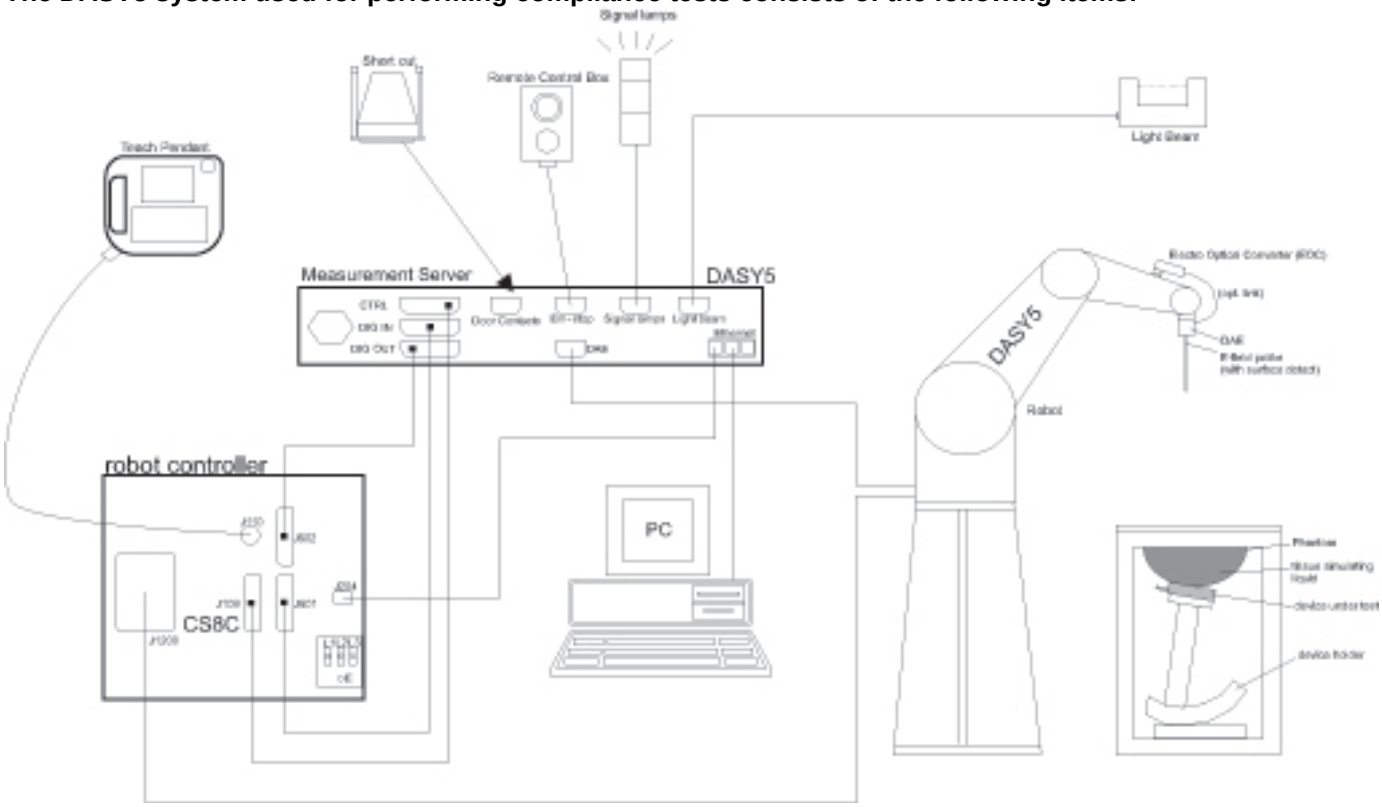
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	SAR Lab 6
SAR Lab G	SAR Lab 7
SAR Lab H	SAR Lab 8

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

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



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

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

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

Step 2: Area Scan

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

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

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
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 ≤ 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: 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.

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Rohde & Schwarz	ZNLE6	1323.0012K56-101273-VA	7/16/2019
Dielectric Probe kit	SPEAG	DAK-3.5	1087	11/14/2018
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	2/6/2019
Thermometer	Traceable Calibration Control Co.	4242	140493798	12/8/2018

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Rohde & Schwarz	SMB 100A	1406.6000K03-180968-gX	7/4/2019
Power Sensor	Rohde & Schwarz	NRP 18A	1424.6815K02-100994-RE	6/19/2019
Synthesized Signal Generator	Rohde & Schwarz	SMB 100A	1406.6000K03-180969-yC	6/27/2019
Power Meter	Rohde & Schwarz	NRP 18A	1424.6815K02-10092-iU	6/19/2019

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab B)	SPEAG	EX3DV4	3772	2/13/2019
E-Field Probe (SAR Lab C)	SPEAG	EX3DV4	3773	4/23/2019
E-Field Probe (SAR Lab F)	SPEAG	EX3DV4	3902	5/24/2019
E-Field Probe (SAR Lab G)	SPEAG	EX3DV4	7463	7/20/2019
Data Acquisition Electronics (SAR Lab B)	SPEAG	DAE4	1352	11/8/2018
Data Acquisition Electronics (SAR Lab C)	SPEAG	DAE4	1472	3/8/2019
Data Acquisition Electronics (SAR Lab F)	SPEAG	DAE4	1377	10/11/2018
Data Acquisition Electronics (SAR Lab G)	SPEAG	DAE4	1359	2/9/2019
System Validation Dipole	SPEAG	D835V2	4d002	11/21/2018
System Validation Dipole	SPEAG	D1900V2	5d140	4/11/2019
System Validation Dipole	SPEAG	D2450V2	748	2/14/2019
System Validation Dipole	SPEAG	D2600V2	1006	10/5/2018
System Validation Dipole	SPEAG	D5GHzV2	1168	8/10/2019

Other

Name of Equipment	Manufacturer	Type/Model	T Number	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	T 733	MY50001018	10/17/2019
Power Sensor	Agilent	N1921A	T 308	MY52260009	1/8/2019
Base Station Simulator	R & S	CMW500	T1871	165411-Ci	2/19/2019
Base Station Simulator	R & S	CMW500	T 259	124594-HX	2/21/2019

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 and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, 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	This is a Phablet Device (display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm) Refer to Appendix A
Back Cover	The Back Cover is not removable
Battery Options	The rechargeable battery is not user accessible.
Accessory	Headset
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☒ Mobile Hotspot (Wi-Fi 5.8 GHz Channel 149 only)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☒ Wi-Fi Direct (Wi-Fi 5.2 GHz) ☒ Wi-Fi Direct (Wi-Fi 5.8 GHz)
Bluetooth Tethering	BT Tethering mode permits the device to share its cellular data connection with other devices. ☒ BT Tethering (Bluetooth 2.4 GHz)
Test sample information	**S/N** / **IMEI** / **Notes** R38K70KBTSH / 351580100020037 351581100020035 / WWAN Conducted R38K70KBTTV / 351580100020045 351581100020043 / WWAN Conducted R38K70KQGDH / 359979090076524 359980090076522 / WLAN Conducted R38K70MFHHP / 359949090044343 359950090044341 / SAR Radiated R38K70MFLFT / 359949090045316 359950090045314 / SAR Radiated R38K70MFL6K / 359949090045225 359950090045223 / SAR Radiated R38K70MFLJR / 359949090045340 359950090045348 / SAR Radiated
Hardware Version	REV1.0
Software Version	A750F.001

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating Mode		Duty Cycle used for SAR testing
GSM	850 1900	Voice (GMSK) GPRS (GMSK) EDGE (8PSK)	Multi-Slot Class: 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 II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 9) HSUPA (Rel. 9) HSPA+ (Rel. 9)[5] DC-HSDPA (Rel. 9)		100%
LTE	FDD Band 5 TDD Band 41	QPSK 16QAM Rel. 10 Carrier Aggregation (1 Uplink and 2 Downlinks)[4]		100% (FDD) 63.3% (TDD)[3] Refer to §6.4
	Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No			
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)		802.11b[1]: 99.65% 802.11g[1]: 95.00% 802.11n HT20[1]: 94.68%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		802.11a[1]: 98.35% 802.11n/ac HT20[1]: 98.24% 802.11n/ac HT40[1]: 96.23% 802.11ac VHT80[1]: 92.74%
	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 5.0 LE		GFSK[2]: 76.5%

Notes:

1. Duty Cycles for Wi-Fi are referenced from the DTS report 12440922-E4 and U-NII report 12440922-E5.
2. Duty Cycle for Bluetooth GFSK mode is referenced from the BT report 12440922-E2.
3. This device supports uplink-downlink configuration 0-6. The configuration with the highest duty cycle was used (Subframe Number 0 at 63.3%).
4. For supported Carrier Aggregation combinations, refer to §6.5.
5. Uplink 16QAM is not supported for HSPA+. Only downlink is supported.

6.3. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th colspan="7">Description</th></tr>
<tr><td rowspan="11">Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td rowspan="3">Band 5</td><td colspan="6">Frequency range: 824 - 849 MHz (BW = 25 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz [2]</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 41[1]</td><td colspan="6">Frequency range: 2496 - 2690 MHz (BW = 194 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 colspan="4">39750 / 2506.0</td><td></td><td></td></tr>
<tr><td>Low-Mid</td><td colspan="4">40185 / 2549.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td colspan="4">40620 / 2593.0</td><td></td><td></td></tr>
<tr><td>Mid-High</td><td colspan="4">41055 / 2636.5</td><td></td><td></td></tr>
<tr><td>High</td><td colspan="4">41490 / 2680.0</td><td></td><td></td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td colspan="7">Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td colspan="7">
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{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>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
MPR Built-in by design
The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.
A-MPR (additional MPR) was disabled during SAR testing
</td></tr>
<tr><td>Power reduction</td><td colspan="7">No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td colspan="7">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>

Notes:

1. LTE band 41 test channels in accordance with October 2014 TCB workshop for all channels bandwidths. This band was tested using Uplink-Downlink Configuration 0 at 63.3% duty cycle and Special Subframe 7.
2. Maximum bandwidth 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.
3. SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

6.4. LTE (TDD) Considerations

According to KDB 941225 D05 SAR for LTE Devices, for Time-Division Duplex (TDD) systems, SAR must be tested using a fixed periodic duty factor according to the highest transmission duty factor implemented for the device and supported by the defined 3GPP LTE TDD configurations.

LTE TDD Bands support 3GPP TS 36.211 section 4.2 for Type 2 Frame Structure and Table 4.2-2 for uplink-downlink configurations and Table 4.2-1 for Special subframe configurations.

Table 4.2-1: Configuration of special subframe (lengths of DwPTS/GP/UpPTS)

Special subframe configuration	Normal cyclic prefix in downlink			Extended cyclic prefix in downlink		
	DwPTS	UpPTS		DwPTS	UpPTS	
		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink		Normal cyclic prefix in uplink	Extended cyclic prefix in uplink
0	$6592 \cdot T_s$	$(1+X) \cdot 2192 \cdot T_s$	$(1+X) \cdot 2560 \cdot T_s$	$7680 \cdot T_s$	$(1+X) \cdot 2192 \cdot T_s$	$(1+X) \cdot 2560 \cdot T_s$
1	$19760 \cdot T_s$			$20480 \cdot T_s$		
2	$21952 \cdot T_s$			$23040 \cdot T_s$		
3	$24144 \cdot T_s$			$25600 \cdot T_s$		
4	$26336 \cdot T_s$			$7680 \cdot T_s$	$(2+X) \cdot 2192 \cdot T_s$	$(2+X) \cdot 2560 \cdot T_s$
5	$6592 \cdot T_s$	$(2+X) \cdot 2192 \cdot T_s$	$(2+X) \cdot 2560 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-	-	-
9	$13168 \cdot T_s$			-	-	-
10	$13168 \cdot T_s$	$13152 \cdot T_s$	$12800 \cdot T_s$	-	-	-

Table 4.2-2: Uplink-downlink configurations & Calculated Duty Cycle

Uplink-Downlink Configuration	Downlink-to-Uplink Switch-point Periodicity	Subframe Number										Calculated Duty Cycle (%)
		0	1	2	3	4	5	6	7	8	9	
0	5 ms	D	S	U	U	U	D	S	U	U	U	63.3%
1	5 ms	D	S	U	U	D	D	S	U	U	D	43.3%
2	5 ms	D	S	U	D	D	D	S	U	D	D	23.3%
3	10 ms	D	S	U	U	U	D	D	D	D	D	31.7%
4	10 ms	D	S	U	U	D	D	D	D	D	D	21.7%
5	10 ms	D	S	U	D	D	D	D	D	D	D	11.7%
6	5 ms	D	S	U	U	U	D	S	U	U	D	53.3%

Calculated Duty Cycle = Extended cyclic prefix in uplink * (T_s) * # of S + # of U / period

Note(s):

This device supports uplink-downlink configurations 0-6. The configuration with highest duty cycle was used for SAR Testing: configuration 0 at 63.3%duty cycle and Special Subframe 7.

6.5. LTE Carrier Aggregation

Combination	CA configuration	Bandwidth (MHz)											
		PCC						SCC					
		20	15	10	5	3	1.4	20	15	10	5	3	1.4
Intra-Band non-contiguous	41A	✓	✓	✓	✓			✓	✓	✓	✓		
Intra-Band contiguous	41C	✓	✓	✓	✓			✓	✓	✓	✓		

Note(s):

For supported channels, please refer to §6.3.

6.6. WLAN Proximity Sensor Test Rationale

When a user makes or receives a voice or VOIP call, the audio of the call is sent through the earpiece at the top of the device so that the device can be used next to the ear. The IR Sensor located at the top of the device is used to detect when the device is in proximity of the user's head in order to optimize the user's device experience, for example, to dim or turn off the screen to save battery life. For this model, an auxiliary function of the IR sensor is for the purpose of RF Safety (i.e. reducing output power for Head SAR compliance).

A reduced power level of the device is called when the IR sensor is activated while in a held-to-ear voice/ VOIP call and the active audio receiver. Therefore, when the IR proximity sensor is active in a held-to-ear user scenario, the output power level is reduced.

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A 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 (Main Ant. 1)	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	< 25 mm	Yes	
			Edge 4 (Left)	< 25 mm	Yes	
	Product Specifc 10g	0 mm	Rear	< 25 mm	No	2
			Front	< 25 mm	No	2
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	< 25 mm	No	2
			Edge 4 (Left)	< 25 mm	No	2
WWAN (Main Ant. 2)	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	< 25 mm	Yes	
			Edge 3 (Bottom)	< 25 mm	Yes	
			Edge 4 (Left)	> 25 mm	No	1
	Product Specifc 10g	0 mm	Rear	< 25 mm	No	2
			Front	< 25 mm	No	2
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	< 25 mm	No	2
			Edge 3 (Bottom)	< 25 mm	No	2
			Edge 4 (Left)	> 25 mm	No	1

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. For Phablet devices: when hotspot mode applies, Product Specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.
3. WWAN Main Ant. 2 supports LTE Band 41 only.
4. Cellular Sub Antenna is Rx only.

RF Exposure Conditions (Test Configurations) (continued):

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required	Note
WLAN & BT	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot / Wi-Fi Direct (2.4/5.2/5.8 GHz Bands)	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	
	Product Specifc 10g (2.4 GHz)	0 mm	Rear	< 25 mm	No	3
			Front	< 25 mm	No	3
			Edge 1 (Top)	< 25 mm	No	3
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	> 25 mm	No	1
			Edge 4 (Left)	< 25 mm	No	3
	Product Specifc 10g (5.3/5.5 GHz Bands)	0 mm	Rear	< 25 mm	Yes	2
			Front	< 25 mm	Yes	2
			Edge 1 (Top)	< 25 mm	Yes	2
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	> 25 mm	No	1
			Edge 4 (Left)	< 25 mm	Yes	2

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. For Phablet devices: when Hotspot Mode is not supported, Product Specific 10-g SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.
3. For Phablet devices: when hotspot mode applies, Product Specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.

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.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

Target Frequency (MHz)	Head		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta	Measured	Target	Delta
B	8/27/2018	2600	Head	2600	37.33	39.01	-4.31	1.99	1.96	1.42
				2495	37.48	39.14	-4.25	1.90	1.85	2.94
				2690	37.12	38.90	-4.57	2.07	2.06	0.41
B	8/28/2018	835	Head	835	42.78	41.50	3.08	0.95	0.90	5.00
				805	42.80	41.68	2.69	0.94	0.90	4.27
				905	42.57	41.50	2.58	0.97	0.97	-0.37
B	8/31/2018	5250	Head	5250	35.72	35.93	-0.59	4.63	4.70	-1.58
				5150	35.91	36.05	-0.38	4.52	4.60	-1.65
				5350	35.54	35.82	-0.78	4.73	4.80	-1.47
B	8/31/2018	5600	Head	5600	35.12	35.53	-1.16	4.97	5.06	-1.80
				5500	35.30	35.65	-0.98	4.86	4.96	-2.02
				5725	34.84	35.39	-1.56	5.12	5.19	-1.31
B	8/31/2018	5750	Head	5750	34.84	35.36	-1.48	5.14	5.21	-1.43
				5700	34.93	35.42	-1.38	5.08	5.16	-1.54
				5850	34.67	35.30	-1.78	5.23	5.27	-0.70

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta	Measured	Target	Delta
C	8/29/2018	1900	Head	1900	38.07	40.00	-4.83	1.45	1.40	3.86
				1850	38.14	40.00	-4.65	1.43	1.40	1.86
				1920	38.07	40.00	-4.83	1.47	1.40	4.79
C	8/30/2018	2450	Head	2450	38.27	39.20	-2.37	1.86	1.80	3.28
				2400	38.33	39.30	-2.46	1.82	1.75	4.02
				2480	38.22	39.16	-2.41	1.87	1.83	2.21
C	9/6/2018	2450	Head	2450	37.53	39.20	-4.26	1.85	1.80	2.78
				2400	37.59	39.30	-4.34	1.81	1.75	3.33
				2480	37.46	39.16	-4.35	1.87	1.83	1.83

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta	Measured	Target	Delta
F	8/30/2018	2450	Body	2450	51.04	52.70	-3.15	2.03	1.95	4.00
				2400	51.24	52.77	-2.90	1.96	1.90	3.42
				2480	50.94	52.66	-3.27	2.06	1.99	3.46

Dielectric Property Measurements Results (continued):

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta	Measured	Target	Delta
G	8/27/2018	835	Body	835	52.65	55.20	-4.62	1.00	0.97	3.30
				805	52.70	55.33	-4.76	0.99	0.97	2.56
				905	52.53	55.00	-4.49	1.03	1.05	-1.95
G	8/28/2018	1900	Body	1900	54.29	53.30	1.86	1.57	1.52	3.09
				1850	54.38	53.30	2.03	1.53	1.52	0.72
				1920	54.29	53.30	1.86	1.58	1.52	4.08
G	8/29/2018	2600	Body	2600	52.37	52.51	-0.27	2.17	2.16	0.43
				2495	52.51	52.64	-0.25	2.07	2.01	2.77
				2690	52.18	52.40	-0.41	2.26	2.29	-1.02
G	8/30/2018	5250	Body	5250	47.68	48.95	-2.60	5.34	5.35	-0.30
				5150	47.88	49.09	-2.46	5.19	5.24	-0.89
				5350	47.49	48.82	-2.72	5.49	5.47	0.28
G	8/30/2018	5600	Body	5600	47.09	48.48	-2.86	5.83	5.76	1.25
				5500	47.25	48.61	-2.80	5.68	5.64	0.56
				5725	46.82	48.31	-3.08	6.05	5.91	2.43
G	8/30/2018	5750	Body	5750	46.82	48.27	-3.01	6.08	5.94	2.39
				5700	46.90	48.34	-2.98	6.00	5.88	2.12
				5850	46.66	48.20	-3.20	6.23	6.00	3.90
G	8/31/2018	5750	Head	5750	34.58	35.36	-2.21	5.12	5.21	-1.87
				5700	34.65	35.42	-2.17	5.06	5.16	-2.08
				5850	34.38	35.30	-2.61	5.21	5.27	-1.23

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.

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. Refer to Appendix B for the SAR System Check Plots.

SAR Lab	Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
B	8/27/2018	Head	D2600V2 SN:1006	10/5/2018	5.400	54.00	55.73	-3.10	2.430	24.30	25.08	-3.11	1,2
B	8/28/2018	Head	D835V2 SN:4d002	11/21/2018	0.988	9.88	10.27	-3.80	0.643	6.43	6.76	-4.88	3,4
B	8/31/2018	Head	D5GHzV2 SN:1168 (5.25 GHz)	8/10/2019	8.330	83.30	79.80	4.39	2.390	23.90	22.90	4.37	5,6
B	8/31/2018	Head	D5GHzV2 SN:1168 (5.60 GHz)	8/10/2019	8.620	86.20	85.00	1.41	2.440	24.40	24.40	0.00	
B	8/31/2018	Head	D5GHzV2 SN:1168 (5.75 GHz)	8/10/2019	8.300	83.00	80.60	2.98	2.370	23.70	23.40	1.28	
C	8/29/2018	Head	D1900V2 SN:5d140	4/11/2019	4.190	41.90	38.93	7.63	2.160	21.60	20.14	7.25	7,8
C	8/30/2018	Head	D2450V2 SN:748	2/14/2019	5.200	52.00	52.94	-1.78	2.400	24.00	24.60	-2.44	9,10
C	9/6/2018	Head	D2450V2 SN:748	2/14/2019	5.200	52.00	52.94	-1.78	2.400	24.00	24.60	-2.44	
F	8/30/2018	Body	D2450V2 SN:748	2/14/2019	5.360	53.60	50.95	5.20	2.440	24.40	23.80	2.52	11,12
G	8/27/2018	Body	D835V2 SN:4d002	11/21/2018	1.020	10.20	10.23	-0.29	0.663	6.63	6.80	-2.50	13,14
G	8/28/2018	Body	D1900V2 SN:5d140	4/11/2019	4.410	44.10	41.00	7.56	2.270	22.70	21.05	7.84	15,16
G	8/29/2018	Body	D2600V2 SN:1006	10/5/2018	5.980	59.80	56.13	6.54	2.640	26.40	25.00	5.60	17,18
G	8/30/2018	Body	D5GHzV2 SN:1168 (5.25 GHz)	8/10/2019	7.840	78.40	74.90	4.67	2.210	22.10	21.20	4.25	
G	8/30/2018	Body	D5GHzV2 SN:1168 (5.60 GHz)	8/10/2019	8.730	87.30	79.50	9.81	2.450	24.50	22.40	9.38	19,20
G	8/30/2018	Body	D5GHzV2 SN:1168 (5.75 GHz)	8/10/2019	7.880	78.80	72.80	8.24	2.210	22.10	20.70	6.76	
G	8/31/2018	Head	D5GHzV2 SN:1168 (5.75 GHz)	8/10/2019	8.520	85.20	80.60	5.71	2.460	24.60	23.40	5.13	

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.
When different maximum output power applies to GSM voice or GPRS/EDGE time slots, GSM voice and GPRS/EDGE time slots should be tested separately to determine compliance by summing the corresponding reported SAR.
The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance.

Per October 2013 TCB Workshop:
When the maximum frame-averaged powers levels are within 0.25 dB of each other, test the configuration with the most number of time slots.

GSM850 Measured Results

Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Maximum Average Power (dBm)			
					Measured		Tune-up Limit	
					Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr
GPRS/EDGE (GMSK)	CS1	1	128	824.2	32.9	23.9	34.0	25.0
			190	836.6	33.0	24.0		
			251	848.8	33.0	24.0		
		2	128	824.2	30.2	24.2	32.0	**26.0**
			190	836.6	30.5	24.5		
			251	848.8	30.4	24.4		
		3	128	824.2	28.6	19.5	29.0	24.7
			190	836.6	28.8	19.8		
			251	848.8	28.7	19.6		
		4	128	824.2	27.2	21.1	28.0	25.0
			190	836.6	27.4	21.4		
			251	848.8	27.4	21.4		
EDGE (8PSK)	MCS5	1	128	824.2	26.6	17.5	27.0	18.0
			190	836.6	26.9	17.8		
			251	848.8	26.7	17.7		
		2	128	824.2	23.9	17.9	25.0	19.0
			190	836.6	24.2	18.2		
			251	848.8	24.2	18.2		
		3	128	824.2	22.5	13.4	24.0	19.7
			190	836.6	22.5	13.4		
			251	848.8	22.5	13.5		
		4	128	824.2	20.7	14.6	23.0	20.0
			190	836.6	20.7	14.7		
			251	848.8	20.7	14.7		

Notes:
The worst-case configuration and mode for SAR testing is determined to be as follows:
- GPRS/EDGE (GMSK) mode with 2 time slots for Max power, based on the Tune-up Procedure.
- SAR is not required for EDGE (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GPRS/EDGE (GMSK) or the adjusted SAR of the highest reported SAR of GPRS/EDGE (GMSK) is ≤ 1.2W/kg.

GSM1900 Measured Results

Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Maximum Average Power (dBm)			
					Measured		Tune-up Limit	
					Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr
GPRS/EDGE (GMSK)	CS1	1	512	1850.2	29.4	20.3	31.0	22.0
			661	1880.0	29.7	20.7		
			810	1909.8	29.7	20.6		
		2	512	1850.2	26.8	20.8	28.5	**22.5**
			661	1880.0	27.2	21.1		
			810	1909.8	27.1	21.1		
		3	512	1850.2	25.7	16.7	26.5	22.2
			661	1880.0	26.2	17.2		
			810	1909.8	26.2	17.1		
		4	512	1850.2	24.6	18.6	25.0	22.0
			661	1880.0	25.0	18.9		
			810	1909.8	24.9	18.9		
EDGE (8PSK)	MCS5	1	512	1850.2	25.1	16.1	26.0	17.0
			661	1880.0	25.4	16.4		
			810	1909.8	25.4	16.3		
		2	512	1850.2	23.1	17.1	24.0	18.0
			661	1880.0	23.2	17.2		
			810	1909.8	23.3	17.3		
		3	512	1850.2	21.7	12.6	23.5	19.2
			661	1880.0	22.0	12.9		
			810	1909.8	21.8	12.8		
		4	512	1850.2	20.2	14.1	22.0	19.0
			661	1880.0	20.5	14.4		
			810	1909.8	20.3	14.2		

Notes:

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

- GPRS/EDGE (GMSK) mode with 2 time slots for Max power, based on the Tune-up Procedure.
- SAR is not required for EDGE (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GPRS/EDGE (GMSK) or the adjusted SAR of the highest reported SAR of GPRS/EDGE (GMSK) is ≤ 1.2W/kg.

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 9 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

Table C.10.2.4: β values for transmitter characteristics tests with HS-DPCCH

	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	11/15	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 9 procedures in table C,11.1.3 of 3GPP TS 34.121-1
A summary of these settings are illustrated below:

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

	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	-
	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	0
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	12
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	67
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E-TFCIs	5	5	2	5	1
	Reference E-TFCI	11	11	11	11	67
	Reference E-TFCI PO	4	4	4	4	18
	Reference E-TFCI	67	67	92	67	67
	Reference E-TFCI PO	18	18	18	18	18
	Reference E-TFCI	71	71	71	71	71
	Reference E-TFCI PO	23	23	23	23	23
	Reference E-TFCI	75	75	75	75	75
	Reference E-TFCI PO	26	26	26	26	26
	Reference E-TFCI	81	81	81	81	81
	Reference E-TFCI PO	27	27	27	27	27
	Maximum Channelization Codes	2xSF2				SF4

DC-HSDPA Setup Procedures used to establish the test signals

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

Downlink Physical Channels are set as per 3GPP TS34.121-1

Table E.5.0: Levels for HSDPA connection setup

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

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

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

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

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

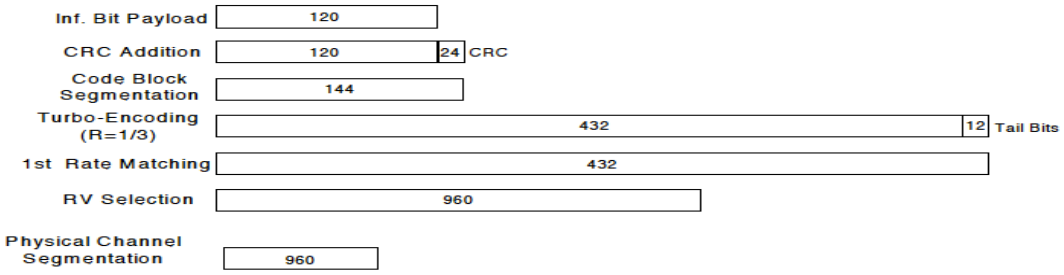


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

The following 4 Sub-tests for HSDPA were completed according to Release 9 procedures in section 5.2 of 3GPP TS34.121.
A summary of subtest settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set 1			
	Power Control Algorithm	Algorithm2			
	βc	2/15	11/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	βd (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	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack Repetition factor	3			
	CQI Feedback	4ms			
	CQI Repetition Factor	2			
	Ahs = βhs/ βc	30/15			

HSPA+ Release 9

Since 16QAM is not used for uplink, RF conducted power measurements are not required for HSPA+.

W-CDMA Band II Measured Results

Mode		UL Ch No.	Freq. (MHz)	Maximum Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	23.1	N/A	24.5
		9400	1880.0	23.3		
		9538	1907.6	23.4		
HSDPA	Subtest 1	9262	1852.4	22.2	0	23.0
		9400	1880.0	22.3		
		9538	1907.6	22.4		
	Subtest 2	9262	1852.4	22.2	0	23.0
		9400	1880.0	22.3		
		9538	1907.6	22.4		
	Subtest 3	9262	1852.4	21.3	0.5	22.5
		9400	1880.0	21.5		
		9538	1907.6	21.6		
	Subtest 4	9262	1852.4	21.2	0.5	22.5
		9400	1880.0	21.3		
		9538	1907.6	21.4		
HSUPA	Subtest 1	9262	1852.4	21.1	0	23.0
		9400	1880.0	21.3		
		9538	1907.6	21.4		
	Subtest 2	9262	1852.4	19.2	2	21.0
		9400	1880.0	19.5		
		9538	1907.6	19.6		
	Subtest 3	9262	1852.4	20.3	1	22.0
		9400	1880.0	20.5		
		9538	1907.6	20.5		
	Subtest 4	9262	1852.4	19.2	2	21.0
		9400	1880.0	19.5		
		9538	1907.6	19.6		
	Subtest 5	9262	1852.4	22.1	0	23.0
		9400	1880.0	22.3		
		9538	1907.6	22.4		
DC-HSDPA	Subtest 1	9262	1852.4	22.2	0	23.0
		9400	1880.0	22.3		
		9538	1907.6	22.4		
	Subtest 2	9262	1852.4	22.2	0	23.0
		9400	1880.0	22.3		
		9538	1907.6	22.4		
	Subtest 3	9262	1852.4	21.3	0.5	22.5
		9400	1880.0	21.5		
		9538	1907.6	21.6		
	Subtest 4	9262	1852.4	21.2	0.5	22.5
		9400	1880.0	21.3		
		9538	1907.6	21.4		

Notes:

Refer to W-CDMA MPR Attestation Letter for HSUPA MPR Explanation.

W-CDMA Band V Measured Results

Mode		UL Ch No.	Freq. (MHz)	Maximum Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	4132	826.4	24.0	N/A	25.0
		4183	836.6	24.2		
		4233	846.6	24.2		
HSDPA	Subtest 1	4132	826.4	22.9	0	23.5
		4183	836.6	23.1		
		4233	846.6	23.1		
	Subtest 2	4132	826.4	22.0	0	23.5
		4183	836.6	22.3		
		4233	846.6	22.3		
	Subtest 3	4132	826.4	20.9	0.5	23.0
		4183	836.6	21.2		
		4233	846.6	21.1		
	Subtest 4	4132	826.4	20.9	0.5	23.0
		4183	836.6	21.2		
		4233	846.6	21.1		
HSUPA	Subtest 1	4132	826.4	20.1	2	21.5
		4183	836.6	20.2		
		4233	846.6	20.2		
	Subtest 2	4132	826.4	18.1	4	19.5
		4183	836.6	18.1		
		4233	846.6	18.3		
	Subtest 3	4132	826.4	21.0	1	22.5
		4183	836.6	21.3		
		4233	846.6	21.2		
	Subtest 4	4132	826.4	18.1	4	19.5
		4183	836.6	18.2		
		4233	846.6	18.2		
	Subtest 5	4132	826.4	23.0	0	23.5
		4183	836.6	23.2		
		4233	846.6	23.2		
DC-HSDPA	Subtest 1	4132	826.4	22.9	0	23.5
		4183	836.6	23.1		
		4233	846.6	23.1		
	Subtest 2	4132	826.4	22.0	0	23.5
		4183	836.6	22.3		
		4233	846.6	22.3		
	Subtest 3	4132	826.4	20.9	0.5	23.0
		4183	836.6	21.2		
		4233	846.6	21.1		
	Subtest 4	4132	826.4	20.9	0.5	23.0
		4183	836.6	21.2		
		4233	846.6	21.1		

Notes:

Refer to W-CDMA MPR Attestation Letter for HSUPA MPR Explanation.

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 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{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
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3
256 QAM	≥ 1						≤ 5

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

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

Network Signalling value	Requirements (subclause)	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	N/A
NS_03	6.6.2.2.1	2, 4,10, 23, 25, 35, 36, 66, 70	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2, 6.6.3.3.19	41	5, 10, 15, 20	Table 6.2.4-4, Table 6.2.4-4a	
NS_05	6.6.3.3.1	1	10,15,20	≥ 50 (NOTE1)	≤ 1 (NOTE1)
			15, 20	Table 6.2.4-18 (NOTE2)	
		65 (NOTE 3)	10,15,20	≥ 50	≤ 1 (NOTE 1)
			15,20	Table 6.2.4-18 (NOTE 2)	
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	
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	
NS_11	6.6.2.2.1 6.6.3.3.13	23	1.4, 3, 5, 10, 15, 20	Table 6.2.4-5	
NS_12	6.6.3.3.5	26	1.4, 3, 5, 10, 15	Table 6.2.4-6	
NS_13	6.6.3.3.6	26	5	Table 6.2.4-7	
NS_14	6.6.3.3.7	26	10, 15	Table 6.2.4-8	
NS_15	6.6.3.3.8	26	1.4, 3, 5, 10, 15	Table 6.2.4-9 Table 6.2.4-10	
NS_16	6.6.3.3.9	27	3, 5, 10	Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13	
NS_17	6.6.3.3.10	28	5, 10	Table 5.6-1	N/A
NS_18	6.6.3.3.11	28	5	≥ 2	≤ 1
			10, 15, 20	≥ 1	≤ 4
NS_19	6.6.3.3.12	44	10, 15, 20	Table 6.2.4-14	
NS_20	6.2.2 6.6.2.2.1 6.6.3.3.14	23	5, 10, 15, 20	Table 6.2.4-15	
NS_21	6.6.2.2.1 6.6.3.3.15	30	5, 10	Table 6.2.4-16	
NS_22	6.6.3.3.16	42, 43	5, 10, 15, 20	Table 6.2.4-17	
NS_23	6.6.3.3.17	42, 43	5, 10, 15, 20	N/A	
NS_24	6.6.3.3.20	65 (NOTE 4)	5, 10, 15, 20	Table 6.2.4-19	
NS_25	6.6.3.3.21	65 (NOTE 4)	5, 10, 15, 20	Table 6.2.4-20	
NS_26	6.6.3.3.22	68	10, 15	Table 6.2.4-21	
NS_27	6.6.2.2.5, 6.6.3.3.23	48	5, 10, 15, 20	Table 6.2.4-22	
NS_28	6.2.2A, 6.6.3.3.24	46 (NOTE 5)	20	Table 6.2.4-23	
NS_29	6.2.2A, 6.6.2.3.1a, 6.6.3.3.25	46 (NOTE 5)	20	Table 6.2.4-24	
NS_30	6.2.2A, 6.6.3.3.26	46 (NOTE 5)	20	Table 6.2.4-25	
NS_31	6.2.2A, 6.6.3.3.27	46 (NOTE 5)	20	Table 6.2.4-26	
NS_32	-	-	-	-	-

NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. A-MPR for

LTE Band 5 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20450	20525	20600		
				829 MHz	836.5 MHz	844 MHz		
10 MHz	QPSK	1	0		23.1		0	25
		1	25		23.1		0	25
		1	49		23.1		0	25
		25	0		22.0		1	24
		25	12		22.0		1	24
		25	25		22.0		1	24
		50	0		22.1		1	24
	16QAM	1	0		22.0		1	24
		1	25		21.9		1	24
		1	49		22.0		1	24
		25	0		21.0		2	23
		25	12		21.0		2	23
		25	25		21.0		2	23
		50	0		21.0		2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20425	20525	20625		
				826.5 MHz	836.5 MHz	846.5 MHz		
5 MHz	QPSK	1	0	23.0	23.1	23.1	0	25
		1	12	22.9	23.1	23.0	0	25
		1	24	23.0	23.1	23.0	0	25
		12	0	22.0	22.0	22.1	1	24
		12	7	21.9	22.0	22.1	1	24
		12	13	21.9	22.0	22.0	1	24
		25	0	21.9	22.1	22.1	1	24
	16QAM	1	0	21.8	21.9	21.9	1	24
		1	12	21.7	21.8	21.8	1	24
		1	24	21.7	21.9	21.8	1	24
		12	0	20.8	20.9	21.0	2	23
		12	7	20.8	20.9	20.9	2	23
		12	13	20.8	20.9	20.9	2	23
		25	0	20.8	20.9	20.9	2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20415	20525	20635		
				825.5 MHz	836.5 MHz	847.5 MHz		
3 MHz	QPSK	1	0	23.0	23.2	23.3	0	25
		1	8	23.0	23.2	23.2	0	25
		1	14	23.0	23.2	23.2	0	25
		8	0	21.9	22.0	22.1	1	24
		8	4	21.9	22.0	22.1	1	24
		8	7	21.9	22.0	22.0	1	24
		15	0	22.0	22.1	22.1	1	24
	16QAM	1	0	21.9	22.1	22.0	1	24
		1	8	21.9	21.9	22.1	1	24
		1	14	22.0	22.0	22.0	1	24
		8	0	20.8	20.9	20.9	2	23
		8	4	20.8	20.9	20.9	2	23
		8	7	20.7	20.9	20.9	2	23
		15	0	20.8	20.9	20.9	2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20407	20525	20643		
				824.7 MHz	836.5 MHz	848.3 MHz		
1.4 MHz	QPSK	1	0	23.0	23.2	23.2	0	25
		1	3	23.1	23.2	23.2	0	25
		1	5	23.1	23.1	23.2	0	25
		3	0	23.0	23.1	23.2	0	25
		3	1	23.0	23.1	23.2	0	25
		3	3	23.0	23.1	23.1	0	25
		6	0	21.9	22.0	22.0	1	24
	16QAM	1	0	21.5	21.8	21.8	1	24
		1	3	21.5	21.8	21.8	1	24
		1	5	21.5	21.9	21.8	1	24
		3	0	22.0	22.1	22.1	1	24
		3	1	22.0	21.9	22.1	1	24
		3	3	22.0	22.0	22.1	1	24
		6	0	20.8	20.8	21.0	2	23

LTE Band 41 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
20 MHz	QPSK	1	0	22.6	22.8	23.1	23.6	23.7	0	24.5
		1	49	22.7	22.8	23.1	23.6	23.8	0	24.5
		1	99	22.7	22.8	23.1	23.6	23.8	0	24.5
		50	0	21.6	21.9	22.1	22.5	22.8	1	23.5
		50	24	21.6	21.9	22.2	22.5	22.8	1	23.5
		50	50	21.6	21.9	22.2	22.5	22.8	1	23.5
		100	0	21.6	21.9	22.2	22.5	22.8	1	23.5
	16QAM	1	0	21.3	21.7	21.7	22.6	22.6	1	23.5
		1	49	21.3	21.8	22.0	22.4	22.7	1	23.5
		1	99	21.5	21.6	21.7	22.4	22.7	1	23.5
		50	0	20.6	20.9	21.2	21.4	21.8	2	22.5
		50	24	20.6	20.9	21.2	21.5	21.8	2	22.5
		50	50	20.6	20.9	21.2	21.5	21.9	2	22.5
		100	0	20.6	20.9	21.2	21.5	21.8	2	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
15 MHz	QPSK	1	0	22.5	22.8	23.2	23.4	23.8	0	24.5
		1	37	22.5	22.8	23.2	23.4	23.8	0	24.5
		1	74	22.5	22.9	23.2	23.4	23.8	0	24.5
		36	0	21.6	21.9	22.2	22.5	22.8	1	23.5
		36	20	21.6	21.9	22.2	22.5	22.8	1	23.5
		36	39	21.7	21.9	22.2	22.5	22.8	1	23.5
		75	0	21.7	21.9	22.2	22.5	22.8	1	23.5
	16QAM	1	0	21.1	21.8	21.9	22.2	22.6	1	23.5
		1	37	21.2	22.1	21.9	22.2	22.7	1	23.5
		1	74	21.3	22.1	21.9	22.3	23.2	1	23.5
		36	0	20.7	20.9	21.3	21.5	21.8	2	22.5
		36	20	20.6	21.0	21.2	21.5	21.8	2	22.5
		36	39	20.7	21.0	21.2	21.5	21.9	2	22.5
		75	0	20.7	20.9	21.2	21.5	21.8	2	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
10 MHz	QPSK	1	0	22.5	22.8	23.2	23.4	23.7	0	24.5
		1	25	22.6	22.8	23.2	23.4	23.7	0	24.5
		1	49	22.6	22.8	23.2	23.4	23.8	0	24.5
		25	0	21.6	21.9	22.2	22.4	22.8	1	23.5
		25	12	21.6	21.9	22.2	22.4	22.8	1	23.5
		25	25	21.6	21.9	22.2	22.4	22.8	1	23.5
		50	0	21.6	21.9	22.2	22.4	22.8	1	23.5
	16QAM	1	0	21.3	21.8	21.7	22.3	22.8	1	23.5
		1	25	21.3	21.7	21.7	22.3	22.8	1	23.5
		1	49	21.3	21.7	21.7	22.3	22.8	1	23.5
		25	0	20.7	20.9	21.1	21.4	21.8	2	22.5
		25	12	20.7	20.9	21.2	21.5	21.8	2	22.5
		25	25	20.7	20.9	21.2	21.5	21.8	2	22.5
		50	0	20.7	20.9	21.2	21.5	21.8	2	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
5 MHz	QPSK	1	0	22.6	22.9	23.1	23.5	23.8	0	24.5
		1	12	22.6	22.9	23.1	23.5	23.8	0	24.5
		1	24	22.6	22.9	23.2	23.5	23.8	0	24.5
		12	0	21.6	21.9	22.2	22.4	22.7	1	23.5
		12	7	21.6	21.9	22.2	22.4	22.7	1	23.5
		12	13	21.7	21.8	22.2	22.4	22.7	1	23.5
		25	0	21.6	21.8	22.2	22.5	22.7	1	23.5
	16QAM	1	0	21.4	21.6	21.7	22.3	22.6	1	23.5
		1	12	21.4	21.6	21.7	22.2	22.6	1	23.5
		1	24	21.4	21.6	21.7	22.3	22.6	1	23.5
		12	0	20.7	20.8	21.1	21.5	21.7	2	22.5
		12	7	20.7	20.8	21.1	21.5	21.7	2	22.5
		12	13	20.7	20.8	21.1	21.5	21.7	2	22.5
		25	0	20.7	20.9	21.2	21.5	21.8	2	22.5

9.4. LTE Carrier Aggregation

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

For inter-band carrier aggregation with uplink assigned to one E-UTRA band (Table 5.6A-1), the requirements in subclause 6.2.3 apply.

For inter-band carrier aggregation with one component carrier per operating band and the uplink active in two E-UTRA bands, the requirements in subclause 6.2.3 apply for each uplink component carrier.

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power applicable to the DUT in table below. In case the modulation format is different on different component carriers then the MPR is determined by the rules applied to higher order of those modulations.

Modulation	CA bandwidth Class B and C / Smallest Component Carrier Transmission Bandwidth Configuration				MPR (dB)
	25 RB	50 RB	75 RB	100 RB	
QPSK	> 8 and ≤ 25	> 12 and ≤ 50	> 16 and ≤ 75	> 18 and ≤ 100	≤ 1
QPSK	> 25	> 50	> 75	> 100	≤ 2
16 QAM	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 8 and ≤ 25	> 12 and ≤ 50	> 16 and ≤ 75	> 18 and ≤ 100	≤ 2
16 QAM	> 25	> 50	> 75	> 100	≤ 3
64 QAM	≤ 8 and allocation wholly contained within a single CC	≤ 12 and allocation wholly contained within a single CC	≤ 16 and allocation wholly contained within a single CC	≤ 18 and allocation wholly contained within a single CC	≤ 2
64 QAM	> 8 or allocation extends across two CC's	> 12 or allocation extends across two CC's	> 16 or allocation extends across two CC's	> 18 or allocation extends across two CC's	≤ 3

For PUCCH and SRS transmissions, the allowed MPR is according to that specified for PUSCH WPDK modulation for the corresponding transmission bandwidth.

For intra-band contiguous carrier aggregation bandwidth class C with non-contiguous resource allocation, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2.2A-1 is specified as follows

$$MPR = CEIL\ \{\min(M_A, M_{IM5}), 0.5\}$$

Where M_A is defined as follows

$$M_A = \begin{cases} 8.2 & ;0 \le A < 0.025 \\ 9.2 - 40A & ;0.025 \le A < 0.05 \\ 8 - 16A & ;0.05 \le A < 0.25 \\ 4.83 - 3.33A & ;0.25 \le A \le 0.4 \\ 3.83 - 0.83A & ;0.4 \le A \le 1 \end{cases}$$

and M_{IM5} is defined as follows

$$M_{IM5} = \begin{cases} 4.5 & ; \Delta_{IM5} < 1.5 * BW_{Channel\_CA} \\ 6.0 & ; 1.5 * BW_{Channel\_CA} \le \Delta_{IM5} < BW_{Channel\_CA}/2 + \Delta f_{ooB} \\ M_A & ; \Delta_{IM5} \ge BW_{Channel\_CA}/2 + \Delta f_{ooB} \end{cases}$$

Where

$A = N_{RB\_alloc} / N_{RB\_agg}$

$\Delta_{IM5} = \max(\left| F_{C\_agg} - (3*F_{agg\_alloc\_low} - 2*F_{agg\_alloc\_high}) \right|, \left| F_{C\_agg} - (3*F_{agg\_alloc\_high} - 2*F_{agg\_alloc\_low}) \right|)$

CEIL{M_A, 0.5} means rounding upwards to closest 0.5dB, i.e. MPR ∈ [3.0, 3.5, 4.0, 4.5, 5.0, 5.5, 6.0, 6.5, 7.0, 7.5, 8.0, 8.5]

For intra-band carrier aggregation, the MPR is evaluated per slot and given by the maximum value taken over the transmission(s) on all component carriers within the slot; the maximum MPR over the two slots is then applied for the entire subframe.

For intra-band non-contiguous carrier aggregation with one uplink carrier on the PCC, the requirements in the subclause 6.2.3 apply. For intra-band non-contiguous aggregation with two uplink carriers the MPR is defined tfor those E-UTRA bands where maximum possible $W_{GAP} \le 42.2$ MHz as follows

$$MPR = CEIL\{M_A, 0.5\}$$

Where M_N is defined as follows

$$M_N = \begin{cases} -0.125N + 18.25 & ; 2 \le N \le 50 \\ -0.0333\ N + 13.67 & ; 50 < N \le 200 \end{cases}$$

Where $N = N_{RB\_alloc}$ is the number of allocated resource blocks.

For the UE maximum output power modified by MPR, the power limits specified in subclause 6.2.5A apply.

LTE Carrier Aggregation Measured Results

The following power measurements were performed with a single carrier uplink; CA for this particular project is only supported in the downlinks. The CA combinations supported by this device is one (1) Uplink and two (2) Downlinks.

Type	LTE CA combinations	PCC (UL)					SCC (DL)			LTE Rel 8 Tx. Power [dBm]	LTE Rel 10 Tx. Power [dBm]	Delta (dBm)
	PCC + SCC	Mode	BW (MHz)	Channel	Freq. (MHz)	RB/Offset	BW (MHz)	Channel	Freq. (MHz)			
Intra-Band non-contiguous	41A	QPSK	20	39750	2506.0	1/99	20	41490	2680.0	22.7	22.7	0.0
Intra-Band Contiguous	41C	QPSK	20	39750	2506.0	1/99	20	39948	2525.8	22.7	22.7	0.0

Note:

Per KDB 941225 D05A LTE Rel. 10 KDB Inquiry Sheet: SAR is excluded for Carrier Aggregation when measured power does not exceed LTE Release 8 by more than a $^1/_4$ dBm

9.5. Wi-Fi 2.4GHz (DTS Band)

When the proximity sensor is active in a held-to-ear user scenario, the output power level is reduced. The maximum allowed output powers in all conditions are included in the maximum power document.

Refer to Operational Description for WLAN explanation.

Wi-Fi 2.4GHz Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up	SAR Test (Yes/No)	Meas Pwr	Tune-up	SAR Test (Yes/No)
DSSS 2.4 GHz	802.11b	1 Mbps	1	2412	14.0	15.0	Yes	12.8	13.0	Yes
			2	2417	18.6	19.0		12.3	13.0	
			6	2437	18.6	19.0		12.3	13.0	
			10	2457	18.5	19.0		12.3	13.0	
			11	2462	16.0	16.0		12.5	13.0	
OFDM 2.4 GHz	802.11g	6 Mbps	1	2412	Not Required	17.0	No	Not Required	13.0	No
			6	2437		17.0			13.0	
			11	2462		17.0			13.0	
	802.11n (HT20)	6.5 Mbps	1	2412	Not Required	17.0	No	Not Required	13.0	No
			6	2437		17.0			13.0	
			11	2462		17.0			13.0	

Note(s):

1. SAR testing is not required for OFDM modes 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. For “Not required”, SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1).
3. Channels 2, 6 and 10 for Maximum average power, were chosen for SAR evaluation due to these channels having highest Tune-up power.

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

When the proximity sensor is active in a held-to-ear user scenario, the output power level is reduced. The maximum allowed output powers in all conditions are included in the maximum power document.

Refer to Operational Description for WLAN explanation.

Wi-Fi 5 GHz Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up	SAR Test (Yes/No)	Meas Pwr	Tune-up	SAR Test (Yes/No)
UNII-1 5.2 GHz	802.11a	6 Mbps	36	5180	16.1	16.5	Yes	Not Required	11.0	No
			40	5200	16.0	16.5			11.0	
			44	5220	16.0	16.5			11.0	
			48	5240	16.2	16.5			11.0	
	802.11n (HT20)	6.5 Mbps	36	5180	Not Required	16.5	No	Not Required	11.0	No
			40	5200		16.5			11.0	
			44	5220		16.5			11.0	
			48	5240		16.5			11.0	
	802.11ac (VHT20)	6.5 Mbps	36	5180	Not Required	16.5	No	Not Required	11.0	No
			40	5200		16.5			11.0	
			44	5220		16.5			11.0	
			48	5240		16.5			11.0	
	802.11n (HT40)	13.5 Mbps	38	5190	Not Required	15.0	No	Not Required	11.0	No
			46	5230		15.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	38	5190	Not Required	15.0	No	Not Required	11.0	No
			46	5230		15.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	42	5210	Not Required	11.0	No	10.8	11.0	Yes
Band	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up	SAR Test (Yes/No)	Meas Pwr	Tune-up	SAR Test (Yes/No)
UNII-2A 5.3 GHz	802.11a	6 Mbps	52	5260	15.9	16.5	Yes	Not Required	11.0	No
			56	5280	16.2	16.5			11.0	
			60	5300	15.7	16.5			11.0	
			64	5320	16.4	16.5			11.0	
	802.11n (HT20)	6.5 Mbps	52	5260	Not Required	16.5	No	Not Required	11.0	No
			56	5280		16.5			11.0	
			60	5300		16.5			11.0	
			64	5320		16.5			11.0	
	802.11ac (VHT20)	6.5 Mbps	52	5260	Not Required	16.5	No	Not Required	11.0	No
			56	5280		16.5			11.0	
			60	5300		16.5			11.0	
			64	5320		16.5			11.0	
	802.11n (HT40)	13.5 Mbps	54	5270	Not Required	15.0	No	Not Required	11.0	No
			62	5310		15.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	54	5270	Not Required	15.0	No	Not Required	11.0	No
			62	5310		15.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	58	5290	Not Required	14.0	No	10.8	11.0	Yes

Note(s):

1. For "Not required", SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1). When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
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 U-NII band 1 and U-NII band 2A, begin SAR measurement in U-NII band 2A; and if the highest *reported* SAR for U-NII band 2A is
   - o ≤ 1.2 W/kg, SAR is not required for U-NII band 1
   - o > 1.2 W/kg, both bands should be tested independently for SAR.
4. Wi-Fi Direct is supported in U-NII Band 1. Therefore, Wi-Fi Direct was tested separately for SAR for U-NII Band 1.

Wi-Fi 5 GHz Measured Results (continued)

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up	SAR Test (Yes/No)	Meas Pwr	Tune-up	SAR Test (Yes/No)
UNII-2C 5.5 GHz	802.11a	6 Mbps	100	5500	16.0	16.5	Yes	Not Required	11.0	No
			116	5580	15.6	16.5			11.0	
			124	5620	15.6	16.5			11.0	
			140	5700	15.6	16.5			11.0	
			144	5720	15.5	16.5			11.0	
	802.11n (HT20)	6.5 Mbps	100	5500	Not Required	16.5	No	Not Required	11.0	No
			116	5580		16.5			11.0	
			124	5620		16.5			11.0	
			140	5700		16.5			11.0	
			144	5720		16.5			11.0	
	802.11ac (VHT20)	6.5 Mbps	100	5500	Not Required	16.5	No	Not Required	11.0	No
			116	5580		16.5			11.0	
			124	5620		16.5			11.0	
			140	5700		16.5			11.0	
			144	5720		16.5			11.0	
	802.11n (HT40)	13.5 Mbps	102	5510	Not Required	15.0	No	Not Required	11.0	No
			118	5590		15.0			11.0	
			126	5630		15.0			11.0	
			134	5670		15.0			11.0	
			142	5710		15.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	102	5510	Not Required	15.0	No	Not Required	11.0	No
			118	5590		15.0			11.0	
			126	5630		15.0			11.0	
			134	5670		15.0			11.0	
			142	5710		15.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	106	5530	Not Required	14.0	No	10.4	11.0	Yes
			122	5610		14.0		10.5	11.0	
			138	5690		14.0		10.4	11.0	

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up	SAR Test (Yes/No)	Meas Pwr	Tune-up	SAR Test (Yes/No)
UNII-3 5.8 GHz	802.11a	6 Mbps	149	5745	14.9	16.5	Yes	Not Required	11.0	No
			157	5785	15.0	16.5			11.0	
			165	5825	15.1	16.5			11.0	
	802.11n (HT20)	6.5 Mbps	149	5745	Not Required	16.5	No	Not Required	11.0	No
			157	5785		16.5			11.0	
			165	5825		16.5			11.0	
	802.11ac (VHT20)	6.5 Mbps	149	5745	Not Required	16.5	No	Not Required	11.0	No
			157	5785		16.5			11.0	
			165	5825		16.5			11.0	
	802.11n (HT40)	13.5 Mbps	151	5755	Not Required	15.0	No	Not Required	11.0	No
			159	5795		15.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	151	5755	Not Required	15.0	No	Not Required	11.0	No
			159	5795		15.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	155	5775	Not Required	14.0	No	10.5	11.0	Yes

Note(s):

1. For “Not required”, SAR Test reduction was applied in accordance with KDB 248227 §2.1, b), 1). When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
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.

9.7. Bluetooth

Bluetooth Measured Results

Band	Mode	Ch #	Freq. (MHz)	Maximum Average Power (dBm)		
				Meas Pwr	Tune-up	SAR Test (Yes/No)
2.4	GFSK	0	2402	8.1	10.00	Yes
		39	2441	8.3	10.00	
		78	2480	7.6	10.00	
	EDR, π/4 DQPSK	0	2402	7.4	10.00	No
		39	2441	7.8	10.00	
		78	2480	7.1	10.00	
	EDR, 8-DPSK	0	2402	6.7	10.00	No
		39	2441	7.2	10.00	
		78	2480	6.5	10.00	
	LE, GFSK	0	2402	4.2	5.00	No
		19	2440	4.9	5.00	
		39	2480	4.4	5.00	

Note(s):

Body-worn and BT Tethering Mode qualify for SAR Test Exclusion. Refer to §10.10.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for WWAN = Measured SAR *Tune-up Scaling Factor
- Reported SAR(W/kg) for Wi-Fi and Bluetooth = Measured SAR * Tune-up scaling factor * Duty Cycle scaling factor
- Duty Cycle scaling factor = 1 / Duty cycle (%)

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 648474 D04 Handset SAR (Phablet Only):

When hotspot mode does not apply, 10-g Extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.
When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg .
Per TCB workshop April 2016; Page 22, RF Exposure Procedures (Phablet Procedures): phablet 10-g SAR should not be identified as hand or extremity SAR; this should be reported as product specific 10-g SAR in reports and grants.

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.
- For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. 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; therefore, the requirement for H, M and L channels may not fully apply.

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). Initial Test Position SAR Test Reduction Procedure is outlined in KDB 248227 D01 §5.1.1. 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. GSM850

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	GPRS 2 Slots	OFF	0	Left Touch	190	836.6	32.0	30.5	0.169	0.239	
				Left Tilt	190	836.6	32.0	30.5	0.106	0.150	
				Right Touch	190	836.6	32.0	30.5	0.200	0.283	1
				Right Tilt	190	836.6	32.0	30.5	0.096	0.136	
Body-worn	GPRS 2 Slots	OFF	15	Rear	190	836.6	32.0	30.5	0.276	0.390	2
				Front	190	836.6	32.0	30.5	0.135	0.191	
Hotspot	GPRS 2 Slots	OFF	10	Rear	128	824.2	32.0	30.2	0.464	0.702	
					190	836.6	32.0	30.5	0.626	0.884	
					251	848.8	32.0	30.4	0.723	1.045	3
				Front	190	836.6	32.0	30.5	0.204	0.288	
				Edge 3	190	836.6	32.0	30.5	0.276	0.390	
				Edge 4	190	836.6	32.0	30.5	0.042	0.059	

10.2. GSM1900

RF Exposure Conditions	Mode	Pwr Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	GPRS 2 Slots	OFF	0	Left Touch	661	1880.0	28.50	27.20	0.027	0.036	4
				Left Tilt	661	1880.0	28.50	27.20	0.010	0.013	
				Right Touch	661	1880.0	28.50	27.20	0.018	0.024	
				Right Tilt	661	1880.0	28.50	27.20	0.009	0.013	
Body-worn	GPRS 2 Slots	OFF	15	Rear	661	1880.0	28.50	27.20	0.036	0.048	5
				Front	661	1880.0	28.50	27.20	0.024	0.032	
Hotsopt	GPRS 2 Slots	OFF	10	Rear	661	1880.0	28.50	27.20	0.089	0.120	6
				Front	661	1880.0	28.50	27.20	0.053	0.071	
				Edge 3	661	1880.0	28.50	27.20	0.040	0.054	
				Edge 4	661	1880.0	28.50	27.20	0.024	0.032	

10.3. W-CDMA Band II

RF Exposure Conditions	Mode	Power Back-off	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 12.2 kbps	OFF	0	Left Touch	9400	1880.0	24.5	23.3	0.031	0.041	7
				Left Tilt	9400	1880.0	24.5	23.3	0.011	0.014	
				Right Touch	9400	1880.0	24.5	23.3	0.021	0.028	
				Right Tilt	9400	1880.0	24.5	23.3	0.012	0.016	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	9400	1880.0	24.5	23.3	0.072	0.094	8
				Front	9400	1880.0	24.5	23.3	0.044	0.057	
Hotspot	Rel 99 RMC 12.2 kbps	OFF	10	Rear	9400	1880.0	24.5	23.3	0.187	0.245	9
				Front	9400	1880.0	24.5	23.3	0.096	0.126	
				Edge 3	9400	1880.0	24.5	23.3	0.078	0.102	
				Edge 4	9400	1880.0	24.5	23.3	0.050	0.066	

10.4. W-CDMA Band V

RF Exposure Conditions	Mode	Power Back-off	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 12.2 kbps	OFF	0	Left Touch	4183	836.6	25.0	24.2	0.135	0.163	
				Left Tilt	4183	836.6	25.0	24.2	0.097	0.117	
				Right Touch	4183	836.6	25.0	24.2	0.185	0.224	10
				Right Tilt	4183	836.6	25.0	24.2	0.093	0.113	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	4183	836.6	25.0	24.2	0.229	0.277	11
				Front	4183	836.6	25.0	24.2	0.116	0.140	
Hotspot	Rel 99 RMC 12.2 kbps	OFF	10	Rear	4183	836.6	25.0	24.2	0.496	0.600	12
				Front	4183	836.6	25.0	24.2	0.159	0.192	
				Edge 3	4183	836.6	25.0	24.2	0.231	0.280	
				Edge 4	4183	836.6	25.0	24.2	0.035	0.042	

10.5. LTE Band 5 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Pwr Back-off	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	OFF	0	Left Touch	20525	836.5	1	49	25.0	23.1	0.109	0.169	
							25	0	24.0	22.0	0.106	0.166	
				Left Tilt (15°)	20525	836.5	1	49	25.0	23.1	0.073	0.113	
							25	0	24.0	22.0	0.070	0.110	
				Right Touch	20525	836.5	1	49	25.0	23.1	0.146	0.227	13
							25	0	24.0	22.0	0.133	0.209	
				Right Tilt (15°)	20525	836.5	1	49	25.0	23.1	0.077	0.120	
							25	0	24.0	22.0	0.072	0.113	
Body-worn	QPSK	OFF	15	Rear	20525	836.5	1	49	25.0	23.1	0.187	0.291	14
							25	0	24.0	22.0	0.157	0.246	
				Front	20525	836.5	1	49	25.0	23.1	0.085	0.132	
							25	0	24.0	22.0	0.087	0.137	
Hotspot	QPSK	OFF	10	Rear	20525	836.5	1	49	25.0	23.1	0.398	0.619	15
							25	0	24.0	22.0	0.337	0.529	
				Front	20525	836.5	1	49	25.0	23.1	0.131	0.204	
							25	0	24.0	22.0	0.114	0.179	
				Edge 3	20525	836.5	1	49	25.0	23.1	0.216	0.336	
							25	0	24.0	22.0	0.184	0.289	
				Edge 4	20525	836.5	1	49	25.0	23.1	0.031	0.048	
							25	0	24.0	22.0	0.033	0.052	

10.6. LTE Band 41 (20MHz Bandwidth)

RF Exposure Conditions	Mode	Pwr Back-off	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	OFF	0	Left Touch	40620	2593.0	1	99	24.5	23.1	0.146	0.200	
							50	24	23.5	22.2	0.108	0.146	
				Left Tilt (15°)	40620	2593.0	1	99	24.5	23.1	0.162	0.222	
							50	24	23.5	22.2	0.122	0.165	
				Right Touch	40620	2593.0	1	99	24.5	23.1	0.318	0.435	16
							50	24	23.5	22.2	0.234	0.317	
				Right Tilt (15°)	40620	2593.0	1	99	24.5	23.1	0.092	0.126	
							50	24	23.5	22.2	0.068	0.092	
Body-worn	QPSK	OFF	15	Rear	40620	2593.0	1	99	24.5	23.1	0.229	0.313	17
							50	24	23.5	22.2	0.174	0.236	
				Front	40620	2593.0	1	99	24.5	23.1	0.215	0.294	
							50	24	23.5	22.2	0.158	0.214	
Hotspot	QPSK	OFF	10	Rear	40620	2593.0	1	99	24.5	23.1	0.435	0.595	18
							50	24	23.5	22.2	0.330	0.447	
				Front	40620	2593.0	1	99	24.5	23.1	0.387	0.529	
							50	24	23.5	22.2	0.280	0.379	
				Edge 2	40620	2593.0	1	99	24.5	23.1	0.309	0.423	
							50	24	23.5	22.2	0.234	0.317	
				Edge 3	40620	2593.0	1	99	24.5	23.1	0.088	0.120	
							50	24	23.5	22.2	0.063	0.085	

10.7. Wi-Fi (DTS Band)

When the 802.11b reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, no further SAR testing is required. If SAR is > 0.8 W/kg and ≤ 1.2 W/kg, SAR is required for the next highest measured output power channel. Finally, if SAR is > 1.2 W/kg, SAR is required for the third channel.
SAR testing is not required for OFDM mode(s) 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.

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Head	802.11b 1 Mbps	ON	0	Left Touch	1	2412.0	99.65%	0.355	13.0	12.8			
				Left Tilt	1	2412.0	99.65%	0.367	13.0	12.8			
				Right Touch	1	2412.0	99.65%	0.626	13.0	12.8	0.433	0.455	
				Right Tilt	1	2412.0	99.65%	0.706	13.0	12.8	0.451	0.474	19
Body-worn	802.11b 1 Mbps	OFF	15	Rear	6	2437.0	99.65%	0.320	19.0	18.6	0.188	0.207	20
				Front	6	2437.0	99.65%	0.188	19.0	18.6			
Hotspot & Wi-Fi Direct	802.11b 1 Mbps	OFF	10	Rear	6	2437.0	99.65%	0.569	19.0	18.6	0.387	0.426	21
				Front	6	2437.0	99.65%	0.473	19.0	18.6	0.318	0.350	
				Edge 1	6	2437.0	99.65%	0.424	19.0	18.6			
				Edge 4	6	2437.0	99.65%	0.075	19.0	18.6			

10.8. Wi-Fi (U-NII Band)

UNII-1 &2A

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

- o ≤ 1.2 or 3 W/kg (1g and 10g respectively), SAR is not required for UNII band I
- o > 1.2 or 3 W/kg (1g and 10g respectively), both bands should be tested independently for SAR.

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	ON	0	Left Touch	58	5290.0	92.74%	0.360	11.0	10.8			
				Left Tilt	58	5290.0	92.74%	0.445	11.0	10.8			
				Right Touch	58	5290.0	92.74%	0.317	11.0	10.8			
				Right Tilt	58	5290.0	92.74%	0.493	11.0	10.8	0.266	0.300	22
Body-worn	802.11a 6 Mbps	OFF	15	Rear	64	5320.0	98.35%	0.317	16.5	16.4	0.155	0.161	23
				Front	64	5320.0	98.35%	0.286	16.5	16.4			
RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Wi-Fi Direct	802.11a 6 Mbps	OFF	10	Rear	48	5240.0	98.35%	0.205	16.5	16.2			
				Front	48	5240.0	98.35%	0.134	16.5	16.2			
				Edge 1	48	5240.0	98.35%	0.239	16.5	16.2	0.133	0.145	24
				Edge 4	48	5240.0	98.35%	0.028	16.5	16.2			
RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		10-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Product Specific 10g	802.11a 6 Mbps	OFF	0	Rear	64	5320.0	98.35%	7.620	16.5	16.4	0.623	0.648	25
				Front	64	5320.0	98.35%	4.140	16.5	16.4			
				Edge 1	64	5320.0	98.35%	5.690	16.5	16.4			
				Edge 4	64	5320.0	98.35%	0.115	16.5	16.4			

Note(s):

1. For Head and Body-worn RF Exposure Conditions, The Highest Reported 1-g SAR for U-NII 2A mode is < 1.2 W/kg, therefore SAR testing is not required for U-NII 1 mode.
2. For Product Specific 10g RF Exposure Condition, The Highest Reported 10-g SAR for U-NII 2A mode is < 3.0 W/kg, therefor SAR testing is not required for U-NII 1 mode.
3. Wi-Fi Direct is supported in U-NII Band 1, therefore it was evaluated separately.

U-NII 2C

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	ON	0	Left Touch	122	5610.0	72.27%	0.548	11.0	10.5			
				Left Tilt	122	5610.0	72.27%	0.866	11.0	10.5	0.357	0.554	
				Right Touch	122	5610.0	72.27%	0.556	11.0	10.5			
				Right Tilt	122	5610.0	72.27%	1.080	11.0	10.5	0.375	0.582	26
Body-worn	802.11a 6 Mbps	OFF	15	Rear	100	5500.0	98.35%	0.441	16.5	16.0	0.190	0.217	27
				Front	100	5500.0	98.35%	0.320	16.5	16.0			
RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		10-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Product Specific 10g	802.11a 6 Mbps	OFF	0	Rear	100	5500.0	98.35%	6.700	16.5	16.0	0.543	0.619	28
				Front	100	5500.0	98.35%	4.210	16.5	16.0			
				Edge 1	100	5500.0	98.35%	3.630	16.5	16.0			
				Edge 4	100	5500.0	98.35%	0.147	16.5	16.0			

U-NII 3

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Area Scan Max. SAR (W/kg)	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	ON	0	Left Touch	155	5775	92.74%	0.783	11.0	10.5			
				Left Tilt	155	5775	92.74%	0.912	11.0	10.5	0.429	0.519	
				Right Touch	155	5775	92.74%	0.735	11.0	10.5			
				Right Tilt	155	5775	92.74%	1.180	11.0	10.5	0.461	0.558	29
Body-worn	802.11a 6 Mbps	OFF	15	Rear	165	5825	98.35%	0.505	16.5	15.1	0.207	0.291	30
				Front	165	5825	98.35%	0.331	16.5	15.1			
Hotspot & Wi-Fi Direct	802.11a 6 Mbps	OFF	10	Rear	165	5825	98.35%	0.662	16.5	15.1	0.293	0.411	
				Front	165	5825	98.35%	0.529	16.5	15.1			
				Edge 1	165	5825	98.35%	1.260	16.5	15.1	0.535	0.751	31
				Edge 4	165	5825	98.35%	0.086	16.5	15.1			

10.9. Bluetooth

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Head	GFSK DH5	OFF	0	Left Touch	39	2441	76.50%	10.0	8.3	0.067	0.129	
				Left Tilt	39	2441	76.50%	10.0	8.3	0.064	0.123	
				Right Touch	39	2441	76.50%	10.0	8.3	0.121	0.232	32
				Right Tilt	39	2441	76.50%	10.0	8.3	0.118	0.227	

Note(s):

Body-worn, BT Tethering Mode and Product Specific 10g qualify for SAR Test Exclusion. Refer to §10.10.

10.10. 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 and BT Tethering:

RF Air interface	RF Exposure Conditions	Frequency (GHz)	Max. tune-up tolerance Power		Min. test separation distance (mm)	SAR test exclusion Result*	Estimated 1-g SAR (W/kg)
			(dBm)	(mW)			
Bluetooth	Body-worn	2.480	10.0	10	15	1.0	0.140
Bluetooth	Tethering	2.480	10.0	10	10	1.6	0.210

Conclusion:

*: The computed value is ≤ 3; therefore, this 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 <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or 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)
850	GSM 850	Hotspot	Rear	No	0.723
	WCDMA Band V	Hotspot	Rear	No	0.496
1900	GSM 1900	Hotspot	Rear	No	0.089
	WCDMA Band II	Hotspot	Rear	No	0.187
2400	Wi-Fi 802.11b	Head	Right Tilt	No	0.451
	BT	Head	Right Touch	No	0.121
2600	LTE Band 41	Hotspot	Rear	No	0.435
5200	Wi-Fi 802.11a	Wi-Fi Direct	Edge 1	No	0.133
5300	Wi-Fi 802.11ac	Head	Right Tilt	No	0.266
5500	Wi-Fi 802.11ac	Head	Right Tilt	No	0.375
5800	Wi-Fi 802.11ac	Hotspot & Wi-Fi Direct	Edge 1	No	0.535

Note(s):
Repeated Measurement is not required since measured SAR is < 0.8 W/kg.

Product Specific 10g SAR:

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)
5300	Wi-Fi 802.11a	Product Specific 10g	Rear	No	0.648
5500	Wi-Fi 802.11a	Product Specific 10g	Rear	No	0.543

Note(s):
Repeated Measurement is not required since measured SAR is < 2.0 W/kg.

12. Simultaneous Transmission Conditions

Simultaneous transmission SAR test exclusion considerations

KDB 447498 D01 General RF Exposure Guidance provides two procedures for determining simultaneous transmission SAR test exclusion: Sum of SAR and SAR to Peak Location Ratio (SPLSR)

Sum of SAR

To qualify for simultaneous transmission SAR test exclusion based upon Sum of SAR the sum of the reported standalone SARs for all simultaneously transmitting antennas shall be below the applicable standalone SAR limit. If the sum of the SARs is above the applicable limit then simultaneous transmission SAR test exclusion may still apply if the requirements of the SAR to Peak Location Ratio (SPLSR) evaluation are met.

Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Body-Worn Accessory	Wireless Router	Notes
1	GSM voice + 2.4 GHz WI-FI	Yes	Yes	N/A	
2	GSM voice + 5 GHz WI-FI	Yes	Yes	N/A	
3	GSM voice + 2.4 GHz Bluetooth	Yes^	Yes	N/A	^Bluetooth Tethering is considered
4	UMTS + 2.4 GHz WI-FI	Yes	Yes	Yes	
5	UMTS + 5 GHz WI-FI	Yes	Yes	Yes	
6	UMTS + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	^Bluetooth Tethering is considered
7	LTE + 2.4 GHz WI-FI	Yes	Yes	Yes	
8	LTE + 5 GHz WI-FI	Yes	Yes	Yes	
9	LTE + 2.4 GHz Bluetooth	Yes^	Yes	Yes^	^Bluetooth Tethering is considered
10	GPRS/EDGE + 2.4 GHz WI-FI	N/A	N/A	Yes	
11	GPRS/EDGE + 5 GHz WI-FI	N/A	N/A	Yes	
12	GPRS/EDGE + 2.4 GHz Bluetooth	N/A	N/A	Yes^	

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

RF Exposure conditions	Test Position	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)		
		WWAN ①	DTS ②	U-NII ③	BT	WWAN + DTS +	WWAN + U-NII +	WWAN + BT +
Head	Left Touch	0.239	0.455	0.554	0.129	0.694	0.793	0.368
	Left Tilt	0.222	0.455	0.554	0.123	0.677	0.776	0.345
	Right Touch	0.435	0.455	0.554	0.232	0.890	0.989	0.667
	Right Tilt	0.136	0.474	0.582	0.227	0.610	0.718	0.363
Body-worn	Rear	0.390	0.207	0.291	0.140	0.597	0.681	0.530
	Front	0.294	0.207	0.291	0.140	0.501	0.585	0.434
Hotspot, Wi-Fi Direct & BT Tethering	Rear	1.045	0.426	0.411	0.210	1.471	1.456	1.255
	Front	0.529	0.350	0.411	0.210	0.879	0.940	0.739
	Edge 1		0.350	0.751	0.210			
	Edge 2	0.423						
	Edge 3	0.390						
	Edge 4	0.493	0.350	0.411	0.210	0.843	0.904	0.703

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because the sum of the 1-g SAR is < 1.6 W/kg.

Appendixes

Refer to separated files for the following appendixes.

12440922-S1V1 Appendix A: SAR Setup Photos

12440922-S1V1 Appendix B: SAR System Check Plots

12440922-S1V1 Appendix C: Highest SAR Test Plots

12440922-S1V1 Appendix D: SAR Liquid Tissue Ingredients

12440922-S1V1 Appendix E: SAR Probe Calibration Certificates

12440922-S1V1 Appendix F: SAR Dipole Calibration Certificates

END OF REPORT