SAR EVALUATION REPORT

IEEE Std 1528-2013

For

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

FCC ID: A3LSMA7050
Model Name: SM-A7050

Report Number: 12737383-S1V3
Issue Date: 4/3/2019

Prepared for

Samsung Electronics Co. Ltd
129 Samsung-Ro, Yeongtong-Gu,
Suwon-Si, Gyeonggi-Do, 16677, Korea

Prepared by

UL VERIFICATION SERVICES INC.
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	3/22/2019	Initial Issue	--
V2	4/1/2019	Updated EUT Description	Coltyce Sanders
V3	4/3/2019	Section 6.5: Update Power Back-off description	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name		Samsung Electronics Co. Ltd			
FCC ID		A3LSMA7050			
Model Name		SM-A7050			
Applicable Standards		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		0.447	0.066	0.186	0.017
Body-worn		0.250	0.094	0.580	0.001
Hotspot		0.561	0.239	0.545	0.012
Product specific 10g SAR		N/A	N/A	2.967	N/A
Simultaneous TX	Head	0.633	0.513	0.633	0.464
	Body-worn	0.830	0.344	0.830	0.251
	Hotspot	1.106	0.800	1.106	0.573
Date Tested		2/26/2019 to 3/15/2019 and 3/20/2019 to 3/21/2019			
Test Results		Pass			

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.
The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.
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 the U.S. government.

Approved & Released By:	Prepared By:
Devin Chang Senior Test Engineer UL Verification Services Inc.	Coltyce Sanders Senior Test Engineer UL Verification Services Inc.

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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 October 2015; RF Exposure Procedures (KDB 941225 D05A)
- TCB workshop April 2016; RF Exposure Procedures (LTE Carrier Aggregation for DL)
- TCB workshop October 2016; RF Exposure Procedures (Bluetooth Duty Factor)
- TCB workshop October 2016; RF Exposure Procedures (DUT Holder Perturbations)
- TCB workshop May 2017; RF Exposure Procedures (Broadband Liquid Above 3 GHz)
- TCB workshop November 2017; RF Exposure Procedures (Uplink CA SAR Test Guidance)
- TCB workshop April 2018; RF Exposure Procedures (LTE DL CA SAR Test Exclusion)

3. Facilities and Accreditation

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

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

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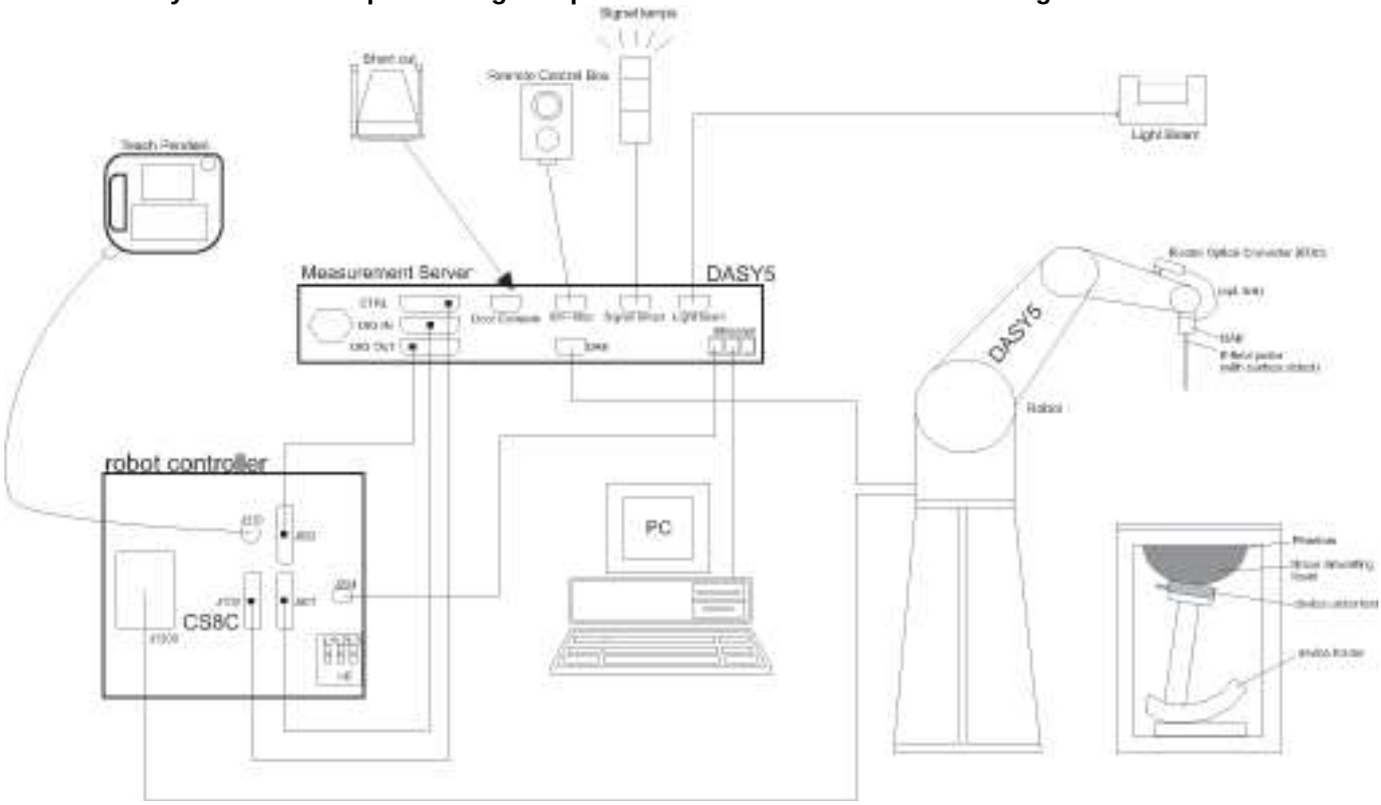
4. SAR Measurement System & Test Equipment

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.

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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.	

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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	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
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.

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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.

Equipment used during Test Dates 2/26/2019 to 3/15/2019:

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	R&S	ZNLE6	101273-VA	7/16/2019
Dielectric Probe kit	SPEAG	DAK-3.5	1082	9/11/2019
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	9/11/2019
Thermometer	Fisher Scientific	Traceable	170064398	3/31/2019

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Signal Generator	Rhode & Schwarz	SMB100A	180970	2/13/2020
Power Sensor	Rhode & Schwarz	NRP18A	100994	2/15/2020
Synthesized Signal Generator	Agilent	N5181A	MY50140610	1/31/2020
Power Meter	Keysight	N1912A	MY50001018	1/30/2020
Power Sensor	Agilent	N1921A	MY53020038	4/23/2019
Power Sensor	Agilent	N1921A	MY52260009	2/5/2020
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2149	N/A
DC Power Supply	Sorensen	XT 15-4	1817A02680	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab E)	SPEAG	EX3DV4	3990	8/17/2019
E-Field Probe (SAR Lab F)	SPEAG	EX3DV4	3902	5/24/2019
E-Field Probe (SAR Lab G)	SPEAG	EX3DV4	7463	7/20/2019
E-Field Probe (SAR Lab H)	SPEAG	EX3DV4	7482	7/23/2019
Data Acquisition Electronics (SAR Lab E)	SPEAG	DAE4	1548	5/3/2019
Data Acquisition Electronics (SAR Lab F)	SPEAG	DAE4	1439	7/10/2019
Data Acquisition Electronics (SAR Lab G)	SPEAG	DAE4	1257	9/14/2019
Data Acquisition Electronics (SAR Lab H)	SPEAG	DAE4	1239	7/11/2019
System Validation Dipole	SPEAG	D835V2	4d142	8/23/2019
System Validation Dipole	SPEAG	D835V2	4d117	5/16/2019
System Validation Dipole	SPEAG	D1900V2	5d140	4/11/2019
System Validation Dipole	SPEAG	D2450V2	889	3/16/2019
System Validation Dipole	SPEAG	D2600V2	1006	10/16/2019
System Validation Dipole	SPEAG	D5GHzV2	1138	8/21/2019

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY55196004	1/30/2020
Power Sensor	Agilent	N1921A	MY52270022	2/6/2020
Base Station Simulator	R & S	CMW500	135384	2/16/2020
Base Station Simulator	R & S	CBT Bluetooth Tester	100987	2/14/2020
PXA Spectrum Analyzer	Agilent	N9030A	MY53310968	1/23/2020

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Equipment used during Test Dates 3/20/2019 to 3/21/2019:

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	R&S	ZNLE6	101273-VA	7/16/2019
Dielectric Probe kit	SPEAG	DAK-3.5	1082	9/11/2019
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	9/11/2019
Thermometer	Fisher Scientific	Traceable	170064398	3/31/2019

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Signal Generator	Rhode & Schwarz	SMB100A	180970	2/13/2020
Power Sensor	Rhode & Schwarz	NRP18A	100994	2/15/2020

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab 4)	SPEAG	EX3DV4	7356	4/24/2019
Data Acquisition Electronics (SAR Lab 4)	SPEAG	DAE4	1547	5/3/2019
System Validation Dipole	SPEAG	D2600V2	1006	10/16/2019

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	135384	2/16/2020

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. Therefore, the measurement uncertainty is not required.

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6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Refer to Appendix A This is a Phablet Device (display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm)
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)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other. Wi-Fi Direct is only available in hand use configurations. ☒ Wi-Fi Direct (Wi-Fi 2.4 GH z) ☒ Wi-Fi Direct (Wi-Fi 5.2/5.8 GHz)
Bluetooth Tethering (Hotspot)	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** R38M2074QKF / 355912100202131 / WWAN Conducted R38M20759DP / 355911100208015 / WWAN Conducted R38M2075HAA / 355911100210623 / WLAN Conducted R38M2075V4R / 355911100214195 / WLAN Conducted R38M207597E / 355911100207959 / WLAN Conducted R38M207598Z / 355912100207965 / WWAN/WLAN Radiated R38M2074Q7T / 355912100202016 / WWAN Radiated R38M20759CH / 355912100208005 / WWAN Radiated R38M207599M / 355912100207973 / WWAN/WLAN Radiated R38020759FF / 355912100208039 / WWAN/WLAN Radiated R38020759EL / 355912100208021 / WWAN/WLAN Radiated
Hardware Version	REV0.4
Software Version	A7050.001

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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)	GSM Class : B 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			
	Does this device support SV-DO (1xRTT-1xEVDO)? ☐ Yes ☒ No			
CDMA (CDMA2000)	BC0	1xRTT (Voice & Data) 1xAdvanced 1xEV-DO Rel. 0 1xEV-DO Rev. A		100%
W-CDMA (UMTS)	Band II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6) HSPA+ (Rel. 7) DL only DC-HSDPA (Rel. 8)		100%
LTE	FDD Band 5 TDD Band 41	QPSK 16QAM 64AQM Rel. 12 Carrier Aggregation		100% (FDD) 63.3% (TDD) 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)		98.47% (802.11b) [1]
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		97.39% (802.11n HT20) [2] 90.14% (802.11ac VHT80) [2]
	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	BR, EDR, LE		77.01%[3]

Notes:

1. Refer to §9.6 for measured Duty Cycle.
2. Refer to §9.7 for measured Duty Cycle.
3. Refer to §9.8 for measured Duty Cycle.

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6.3. General LTE SAR Test and Reporting Considerations

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td rowspan="13">Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td>
<table>
<tr><td rowspan="3">Band 5[1]</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 [1]</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</td><td colspan="6">Frequency range: 2555 - 2655 MHz (BW = 100 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>40340/ 2565</td><td>40315/ 2562.5</td><td>40290/ 2560</td><td>40625/ 2557.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td>40740/ 2605</td><td>40740/ 2605</td><td>40740/ 2605</td><td>40740/ 2605</td><td></td><td></td></tr>
<tr><td>High</td><td>41140/ 2645</td><td>41165/ 2647.5</td><td>41190/ 2650</td><td>41215/ 2652.5</td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td>Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td>
Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 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>No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td>A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

Notes:

1. 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.
2. SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

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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.

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6.5. Power Back-off Operation

This device supports multiple power back-off modes: WWAN (Hotspot), WWAN (Grip Sensor), and WLAN (RCV+IR Sensor). Each of the power back-off modes operate within specific exposure conditions for certain technologies.

WWAN (Hotspot) and WWAN (Grip Sensor) operate separately. Also, in a situation where both WWAN power back-off modes could be active, WWAN (Grip Sensor) power back-off takes priority.

WLAN back-off power supports a RCV+IR Sensor. This sensor activates in a held to ear exposure condition. When the sensor activates in this exposure condition, the output power level is reduced.

For full details on how each power back-off mode operates, refer to the Operational Description.

Power Back-off mode	Technologies Supported	Exposure Conditions Active			
		Head	Body-worn	Hotspot	Product Specific 10g
WWAN (Hotspot)	GSM 1900 W-CDMA B2	N/A	N/A	✓	N/A
WWAN (Grip Sensor)	GSM 1900 W-CDMA B2 LTE B41	N/A	N/A	N/A	✓
WLAN (Head)	Wi-Fi 2.4GHz Wi-Fi 5GHz	✓	N/A	N/A	N/A

Note(s):

Tune-Up Limits for WWAN (Hotspot) and WWAN (Grip Sensor) are both Reduced Average Powers. Please refer to §9 for all power measurements.

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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	Yes	
			Edge 3 (Bottom)	< 25 mm	Yes	
			Edge 4 (Left)	< 25 mm	Yes	
	Product Specifc 10g	0 mm	Rear	Refer to notes 2 & 3		
			Front			
			Edge 1 (Top)			
			Edge 2 (Right)			
			Edge 3 (Bottom)			
			Edge 4 (Left)			
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	Yes	
			Edge 2 (Right)	> 25 mm	No	1
			Edge 3 (Bottom)	> 25 mm	No	1
			Edge 4 (Left)	< 25 mm	Yes	
	Product Specifc 10g	0 mm	Rear	Refer to notes 2 & 3		
			Front			
			Edge 1 (Top)			
			Edge 2 (Right)			
			Edge 3 (Bottom)			
			Edge 4 (Left)			

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. For Phablet devices: when hotspot mode applies and power reduction applies to hotspot mode, Product Specific 10-g SAR is required for each test position that has an adjusted SAR to maximum power that is > 1.2 W/kg.
4. WWAN Main Antenna #2 supports LTE B41.

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

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.
4. Wi-Fi Direct is only available in Hand use configuration.

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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

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Dielectric Property Measurements Results for Test Dates 2/26/2019 to 3/15/2019:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
E	3/11/2019	5600	Head	5600	35.09	35.53	-1.25	5.00	5.06	-1.25
				5500	35.27	35.65	-1.06	4.88	4.96	-1.59
				5725	34.81	35.39	-1.64	5.16	5.19	-0.60
E	3/11/2019	5600	Body	5600	48.09	48.48	-0.80	5.72	5.76	-0.71
				5500	48.25	48.61	-0.75	5.58	5.64	-1.18
				5725	47.82	48.31	-1.01	5.91	5.91	0.02
F	2/26/2019	835	Head	835	40.06	41.50	-3.47	0.88	0.90	-2.02
				805	40.02	41.68	-3.98	0.87	0.90	-2.76
				850	39.99	41.50	-3.64	0.89	0.92	-2.97
F	2/26/2019	835	Body	835	53.51	55.20	-3.06	0.95	0.97	-1.66
				805	53.48	55.33	-3.35	0.94	0.97	-2.39
				850	53.43	55.16	-3.13	0.96	0.99	-2.69
F	3/4/2019	835	Head	835	40.10	41.50	-3.37	0.89	0.90	-0.61
				805	40.10	41.68	-3.79	0.89	0.90	-1.08
				850	40.02	41.50	-3.57	0.90	0.92	-1.70
F	3/4/2019	835	Body	835	54.65	55.20	-1.00	0.97	0.97	-0.32
				805	54.65	55.33	-1.24	0.96	0.97	-0.88
				850	54.57	55.16	-1.06	0.97	0.99	-1.50
F	3/11/2019	835	Body	835	53.63	55.20	-2.84	0.98	0.97	0.52
				805	53.68	55.33	-2.99	0.96	0.97	-0.40
				850	53.60	55.16	-2.82	0.98	0.99	-0.57
G	2/26/2019	2450	Head	2450	37.50	39.20	-4.34	1.80	1.80	-0.11
				2400	37.55	39.30	-4.44	1.75	1.75	0.13
				2480	37.48	39.16	-4.30	1.82	1.83	-0.90
G	2/26/2019	2450	Body	2450	50.56	52.70	-4.06	2.04	1.95	4.36
				2400	50.60	52.77	-4.12	1.99	1.90	4.64
				2480	50.53	52.66	-4.05	2.06	1.99	3.30
G	3/4/2019	2600	Head	2600	40.22	39.01	3.10	1.98	1.96	0.76
				2495	40.37	39.14	3.13	1.88	1.85	1.80
				2690	40.01	38.90	2.86	2.06	2.06	-0.17
G	3/4/2019	2600	Body	2600	52.81	52.51	0.57	2.09	2.16	-3.32
				2495	52.94	52.64	0.56	2.00	2.01	-0.66
				2690	52.62	52.40	0.43	2.17	2.29	-4.95

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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	3/13/2019	5250	Head	5250	36.15	35.93	0.60	4.64	4.70	-1.28
				5150	36.34	36.05	0.81	4.53	4.60	-1.52
				5350	35.95	35.82	0.37	4.77	4.80	-0.82
G	3/13/2019	5250	Body	5250	48.48	48.95	-0.96	5.36	5.35	0.17
				5150	48.67	49.09	-0.85	5.22	5.24	-0.37
				5350	48.28	48.82	-1.10	5.51	5.47	0.81
G	3/13/2019	5600	Head	5600	35.53	35.53	-0.01	5.03	5.06	-0.58
				5500	35.70	35.65	0.15	4.91	4.96	-0.97
				5725	35.26	35.39	-0.37	5.20	5.19	0.13
G	3/13/2019	5600	Body	5600	47.86	48.48	-1.27	5.86	5.76	1.70
				5500	48.04	48.61	-1.18	5.71	5.64	1.09
				5725	47.59	48.31	-1.49	6.06	5.91	2.58
G	3/13/2019	5750	Head	5750	35.22	35.36	-0.40	5.23	5.21	0.39
				5700	35.34	35.42	-0.23	5.16	5.16	-0.05
				5850	35.06	35.30	-0.68	5.34	5.27	1.29
G	3/13/2019	5750	Body	5750	47.56	48.27	-1.48	6.10	5.94	2.83
				5700	47.66	48.34	-1.41	6.02	5.88	2.34
				5850	47.38	48.20	-1.70	6.24	6.00	4.03
H	2/26/2019	1900	Head	1900	38.04	40.00	-4.90	1.39	1.40	-0.71
				1850	38.09	40.00	-4.77	1.36	1.40	-2.64
				1920	38.04	40.00	-4.90	1.40	1.40	0.07
H	2/26/2019	1900	Body	1900	51.72	53.30	-2.96	1.53	1.52	0.79
				1850	51.77	53.30	-2.87	1.50	1.52	-1.18
				1920	51.72	53.30	-2.96	1.55	1.52	1.64
H	3/11/2019	1900	Head	1900	41.00	40.00	2.50	1.45	1.40	3.50
				1850	41.07	40.00	2.68	1.42	1.40	1.36
				1920	40.99	40.00	2.48	1.47	1.40	4.64
H	3/11/2019	1900	Body	1900	55.78	53.30	4.65	1.51	1.52	-0.99
				1850	55.80	53.30	4.69	1.47	1.52	-3.09
				1920	55.76	53.30	4.62	1.52	1.52	0.00

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Dielectric Property Measurements Results for Test Dates 3/20/2019 to 3/21/2019:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
4	3/20/2019	2600	Body	2600	50.59	52.51	-3.66	2.17	2.16	0.38
				2495	50.79	52.64	-3.52	2.07	2.01	2.97
				2690	50.46	52.40	-3.70	2.25	2.29	-1.50
4	3/21/2019	2600	Head	2600	40.76	39.01	4.48	1.94	1.96	-1.33
				2495	40.87	39.14	4.41	1.84	1.85	-0.36
				2690	40.58	38.90	4.33	2.01	2.06	-2.30

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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.

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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 for Test Dates 2/26/2019 to 3/15/2019:

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 %	
E	3/11/2019	Head	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	8.690	86.90	86.00	1.05	2.480	24.80	24.60	0.81	
E	3/11/2019	Body	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	8.390	83.90	79.50	**5.53**	2.340	23.40	22.20	5.41	1,2
F	2/26/2018	Head	D835V2 SN:4d142	8/23/2019	0.926	9.26	9.48	-2.32	0.607	6.07	6.10	-0.49	
F	2/26/2018	Body	D835V2 SN:4d142	8/23/2019	0.911	9.11	9.68	**-5.89**	0.599	5.99	6.36	-5.82	3,4
F	3/4/2019	Head	D835V2 SN:4d117	5/16/2019	0.924	9.24	9.87	-6.38	0.604	6.04	6.40	-5.63	
F	3/4/2019	Body	D835V2 SN:4d117	5/16/2019	0.965	9.65	10.31	**-6.40**	0.632	6.32	6.84	-7.60	5,6
F	3/11/2019	Body	D835V2 SN:4d142	8/23/2019	0.934	9.34	9.68	-3.51	0.615	6.15	6.36	-3.30	
G	2/26/2018	Head	D2450V2 SN:899	3/16/2019	5.130	51.30	51.75	-0.87	2.380	23.80	24.20	-1.65	
G	2/26/2018	Body	D2450V2 SN:899	3/16/2019	4.730	47.30	50.55	**-6.43**	2.170	21.70	23.20	-6.47	7,8
G	3/4/2019	Head	D2600V2 SN:1006	10/16/2019	5.500	55.00	59.31	**-7.27**	2.470	24.70	26.43	-6.55	9,10
G	3/4/2019	Body	D2600V2 SN:1006	10/16/2019	5.480	54.80	58.52	-6.36	2.470	24.70	26.15	-5.54	
G	3/13/2019	Head	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	7.490	74.90	82.60	**-9.32**	2.160	21.60	23.80	-9.24	11,12
G	3/13/2019	Body	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	7.050	70.50	76.60	-7.96	1.980	19.80	21.40	-7.48	
G	3/13/2019	Head	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	8.250	82.50	86.00	**-4.07**	2.350	23.50	24.60	-4.47	13,14
G	3/13/2019	Body	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	7.830	78.30	79.50	-1.51	2.190	21.90	22.20	-1.35	
G	3/13/2019	Head	D5GHzV2 SN:1138 (5.75 GHz)	8/21/2019	7.770	77.70	82.40	**-5.70**	2.250	22.50	23.60	-4.66	15,16
G	3/13/2019	Body	D5GHzV2 SN:1138 (5.75 GHz)	8/21/2019	7.210	72.10	74.10	-2.70	2.020	20.20	20.60	-1.94	
H	2/26/2018	Head	D1900V2 SN:5d140	4/11/2019	3.650	36.50	38.93	-6.24	1.880	18.80	20.14	-6.65	
H	2/26/2018	Body	D1900V2 SN:5d140	4/11/2019	3.790	37.90	41.00	**-7.56**	1.970	19.70	21.05	-6.41	17,18
H	3/11/2019	Head	D1900V2 SN:5d140	4/11/2019	4.060	40.60	38.93	4.29	2.090	20.90	20.14	3.77	
H	3/11/2019	Body	D1900V2 SN:5d140	4/11/2019	4.180	41.80	41.00	1.95	2.180	21.80	21.05	3.56	

System Check Plots for Test Dates 3/20/2019 to 3/21/2019:

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 %	
4	3/20/2019	Body	D2600V2 SN:1006	10/16/2019	5.580	55.80	58.52	**-4.65**	2.460	24.60	26.15	-5.93	19,20
4	3/21/2019	Head	D2600V2 SN:1006	10/16/2019	5.840	58.40	59.31	-1.53	2.600	26.00	26.43	-1.63	

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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.

Maximum Output Power (Tune-up Limit) for GSM

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.

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	34.0	25.0	34.0	25.0
			190	836.6	34.0	25.0		
			251	848.8	34.0	25.0		
		2	128	824.2	30.7	24.7	31.0	25.0
			190	836.6	30.2	24.2		
			251	848.8	30.3	24.3		
		3	128	824.2	28.5	24.2	29.0	24.7
			190	836.6	28.5	24.3		
			251	848.8	28.6	24.3		
		4	128	824.2	27.5	24.5	28.0	**25.0**
			190	836.6	27.3	24.3		
			251	848.8	26.6	23.6		
EDGE (8PSK)	MCS5	1	128	824.2	26.4	17.4	27.5	18.5
			190	836.6	26.3	17.2		
			251	848.8	26.0	17.0		
		2	128	824.2	24.0	18.0	25.0	19.0
			190	836.6	23.9	17.9		
			251	848.8	23.8	17.7		
		3	128	824.2	22.7	18.5	23.5	19.2
			190	836.6	22.5	18.2		
			251	848.8	22.3	18.0		
		4	128	824.2	21.2	18.2	22.0	19.0
			190	836.6	21.0	18.0		
			251	848.8	20.8	17.8		

Notes:

GPRS/EDGE (GMSK) mode with 4 time slots for Max power, based on the Tune-up Procedure.

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GSM1900 Measured Results

Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Maximum Average Power (dBm)				Hotspot Reduced Average Power (dBm)				Grip Sensor Reduced Average Power (dBm)			
					Measured		Tune-up Limit		Measured		Tune-up Limit		Measured		Tune-up Limit	
					Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr
GPRS/EDGE (GMSK)	CS1	1	512	1850.2	29.6	20.6	31.0	22.0	27.4	18.4	29.0	20.0	26.5	17.5	28.0	19.0
			661	1880.0	29.3	20.3			27.4	18.3			26.4	17.4		
			810	1909.8	29.7	20.6			27.7	18.6			26.7	17.7		
		2	512	1850.2	27.7	21.7	28.0	22.0	25.7	19.7	26.0	20.0	24.8	18.8	25.0	19.0
			661	1880.0	27.4	21.4			25.6	19.6			24.6	18.6		
			810	1909.8	27.8	21.7			25.9	19.9			24.9	18.9		
		3	512	1850.2	25.6	21.4	26.0	21.7	23.5	19.3	24.0	19.7	22.5	18.2	23.0	18.7
			661	1880.0	25.1	20.9			23.4	19.1			22.5	18.2		
			810	1909.8	25.5	21.2			23.7	19.4			22.8	18.5		
		4	512	1850.2	24.7	21.7	25.0	**22.0**	22.8	19.8	23.0	**20.0**	22.0	19.0	22.0	**19.0**
			661	1880.0	24.4	21.4			23.0	20.0			21.8	18.8		
			810	1909.8	24.7	21.7			23.0	20.0			22.0	19.0		
EDGE (8PSK)	MCS5	1	512	1850.2	25.3	16.2	26.0	17.0	23.2	14.2	24.0	15.0	22.5	13.5	23.0	14.0
			661	1880.0	24.9	15.8			23.1	14.0			22.2	13.2		
			810	1909.8	25.2	16.2			23.5	14.4			22.6	13.6		
		2	512	1850.2	23.1	17.1	23.5	17.5	21.1	15.0	21.5	15.5	20.2	14.2	20.5	14.5
			661	1880.0	22.7	16.7			21.0	14.9			20.0	14.0		
			810	1909.8	23.2	17.2			21.4	15.4			20.4	14.4		
		3	512	1850.2	22.5	18.2	23.0	18.7	20.4	16.2	21.0	16.7	19.5	15.2	20.0	15.7
			661	1880.0	22.1	17.8			20.0	15.8			19.4	15.1		
			810	1909.8	22.5	18.2			20.8	16.5			19.9	15.6		
		4	512	1850.2	20.7	17.6	21.0	18.0	18.7	15.6	19.0	16.0	17.8	14.8	18.0	15.0
			661	1880.0	20.4	17.3			18.6	15.6			17.7	14.7		
			810	1909.8	20.9	17.8			19.0	16.0			18.0	15.0		

Notes:

- GPRS/EDGE (GMSK) mode with 4 time slots for Max power, 4 time slots for Hotspot Reduced Power, and 4 time slots for Grip Sensor Reduced power, based on the Tune-up Procedure.

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9.2. W-CDMA

Per KDB 941225 D01 3G SAR Procedures for W-CDMA:

Maximum output power is verified on the high, middle and low channels and using the appropriate 12.2 kbps RMC with TPC (transmit power control) set to all “1’s”

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. A summary of these settings is illustrated below:

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 procedures in table C.10.1.4 of 3GPP TS 34.121-1
A summary of these settings is illustrated below:

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with β_{hs} = 30/15 * β_c, and Δ_{CQI} = 24/15 with β_{hs} = 24/15 * β_c.

Note 3: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

HSUPA Setup Procedures used to establish the test signals

The following 5 Sub-tests were completed according to procedures in table C.11.1.3 of 3GPP TS 34.121-1. A summary of these settings is illustrated below:

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

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{hs} (Note 1)	β_{ec}	β_{ed} (Note 4) (Note 5)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2) (Note 6)	AG Index (Note 5)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed}1$: 47/15 $\beta_{ed}2$: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15	0	-	-	5/15	5/15	47/15	4	1	1.0	0.0	12	67

Note 1: For sub-test 1 to 4, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c. For sub-test 5, Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 5/15 with β_{hs} = 5/15 * β_c.

Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.

Note 4: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 5: β_{ed} can not be set directly; it is set by Absolute Grant Value.

Note 6: For subtests 2, 3 and 4, UE may perform E-DPDCH power scaling at max power which could results in slightly smaller MPR values.

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DC-HSDPA Setup Procedures used to establish the test signals

The following 4 Sub-tests for DC-HSDPA were completed according to procedures in table C08.1.12 of 3GPP TS 34.121-1. A summary of subtest settings is illustrated below:

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.

HSPA+

DUT supports HSPA+ DL only. Therefore, conducted power measurements is not required.

SAR measurement is not required for the HSDPA, HSUPA and HSPA+. When primary mode and the adjusted SAR is ≤ 1.2 W/kg and secondary mode is ≤ ¼ dB higher than the primary mode

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W-CDMA Band II Measured Results

Mode		UL Ch No.	Freq. (MHz)	Maximum Average Power (dBm)			Hotspot Reduced Average Power (dBm)			Grip Sensor Reduced Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit	Measured Pwr	MPR	Tune-up Limit	Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	24.8	N/A	25.0	22.2	N/A	23.0	21.4	N/A	22.0
		9400	1880.0	24.3			22.1			21.2		
		9538	1907.6	24.4			22.3			21.3		
HSDPA	Subtest 1	9262	1852.4	23.8	0.0	24.0	21.2	0.0	22.0	19.8	0.0	21.0
		9400	1880.0	23.4			21.0			19.5		
		9538	1907.6	23.3			21.2			19.7		
	Subtest 2	9262	1852.4	23.9	0.0	24.0	21.3	0.0	22.0	19.3	0.0	21.0
		9400	1880.0	23.4			21.0			19.1		
		9538	1907.6	23.4			21.1			19.2		
	Subtest 3	9262	1852.4	23.3	0.5	23.5	20.7	0.5	21.5	18.6	0.5	20.5
		9400	1880.0	22.9			20.7			18.5		
		9538	1907.6	22.9			20.7			18.6		
	Subtest 4	9262	1852.4	23.1	0.5	23.5	20.7	0.5	21.5	18.6	0.5	20.5
		9400	1880.0	23.0			20.9			18.2		
		9538	1907.6	22.9			20.7			18.4		
HSUPA	Subtest 1	9262	1852.4	23.9	0.0	24.0	21.2	0.0	22.0	19.8	0.0	21.0
		9400	1880.0	23.4			21.0			19.7		
		9538	1907.6	23.4			21.3			19.8		
	Subtest 2	9262	1852.4	21.9	2.0	22.0	19.3	2.0	20.0	17.9	2.0	19.0
		9400	1880.0	21.4			19.2			17.6		
		9538	1907.6	21.5			19.3			17.8		
	Subtest 3	9262	1852.4	22.9	1.0	23.0	20.3	1.0	21.0	18.9	1.0	20.0
		9400	1880.0	22.3			20.1			18.6		
		9538	1907.6	22.5			20.2			18.8		
	Subtest 4	9262	1852.4	21.8	2.0	22.0	19.3	2.0	20.0	17.8	2.0	19.0
		9400	1880.0	21.4			19.1			17.6		
		9538	1907.6	21.4			19.1			17.8		
	Subtest 5	9262	1852.4	23.8	0.0	24.0	21.3	0.0	22.0	19.9	0.0	21.0
		9400	1880.0	23.3			21.1			19.7		
		9538	1907.6	23.3			21.3			19.8		
DC-HSDPA	Subtest 1	9262	1852.4	22.9	0.0	24.0	20.9	0.0	22.0	19.9	0.0	21.0
		9400	1880.0	22.7			20.7			19.7		
		9538	1907.6	22.8			20.8			19.8		
	Subtest 2	9262	1852.4	22.9	0.0	24.0	20.9	0.0	22.0	19.9	0.0	21.0
		9400	1880.0	22.6			20.7			19.7		
		9538	1907.6	22.9			20.9			19.9		
	Subtest 3	9262	1852.4	22.4	0.5	23.5	20.4	0.5	21.5	19.4	0.5	20.5
		9400	1880.0	22.2			20.2			19.2		
		9538	1907.6	22.3			20.3			19.4		
	Subtest 4	9262	1852.4	22.4	0.5	23.5	20.4	0.5	21.5	19.4	0.5	20.5
		9400	1880.0	22.2			20.2			19.2		
		9538	1907.6	22.3			20.4			19.4		

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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	23.4	N/A	25.0
		4183	836.6	23.2		
		4233	846.6	23.1		
HSDPA	Subtest 1	4132	826.4	22.3	0.0	24.0
		4183	836.6	22.2		
		4233	846.6	22.1		
	Subtest 2	4132	826.4	22.3	0.0	24.0
		4183	836.6	22.3		
		4233	846.6	22.1		
	Subtest 3	4132	826.4	22.4	0.5	23.5
		4183	836.6	22.2		
		4233	846.6	22.1		
	Subtest 4	4132	826.4	22.4	0.5	23.5
		4183	836.6	22.1		
		4233	846.6	22.0		
HSUPA	Subtest 1	4132	826.4	22.4	0.0	24.0
		4183	836.6	22.2		
		4233	846.6	22.1		
	Subtest 2	4132	826.4	20.9	2.0	22.0
		4183	836.6	20.7		
		4233	846.6	20.5		
	Subtest 3	4132	826.4	21.4	1.0	23.0
		4183	836.6	21.1		
		4233	846.6	21.1		
	Subtest 4	4132	826.4	21.7	2.0	22.0
		4183	836.6	21.6		
		4233	846.6	21.7		
	Subtest 5	4132	826.4	22.4	0.0	24.0
		4183	836.6	22.2		
		4233	846.6	22.0		
DC-HSDPA	Subtest 1	4132	826.4	23.7	0.0	24.0
		4183	836.6	23.5		
		4233	846.6	23.3		
	Subtest 2	4132	826.4	23.7	0.0	24.0
		4183	836.6	23.5		
		4233	846.6	23.3		
	Subtest 3	4132	826.4	23.2	0.5	23.5
		4183	836.6	23.0		
		4233	846.6	22.8		
	Subtest 4	4132	826.4	23.2	0.5	23.5
		4183	836.6	22.6		
		4233	846.6	22.6		

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9.3. CDMA

1x Advanced Setup Procedures used to establish the test signals

Call box setup procedure

- Protocol Rev > 6 (IS-2000-0)
- System ID: 331; NID: 65535, Reg. Ch. #.:
- Radio Config (RC) > Fwd11, Rvs8
- Service Option (SO) Setup > SO75 (Loopback)
- Traffic Data Rate > Full
- Rvs Power Ctrl > All Up bits (Maximum Tx Pout)
- Reverse Power Control Mode: 00-200 to 400 bps
- Smart blanking was disabled.

Maximum Output Power (Tune-up Limit) for CDMA

SAR for next to the ear head exposure is measured in RC3 with the handset configured to transmit at full rate in SO55. The 3G SAR test reduction procedure is applied to RC1 with RC3 as the primary mode

Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 D01 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCHn), with FCH only as the primary mode.

When VOIP is supported by Ev-Do devices for next to the ear use, head exposure SAR is required.

SAR measurement is not required for the 1xEVDO Rev. A and 1x-Advanced. When primary mode and the adjusted SAR is ≤ 1.2 W/kg and secondary mode is ≤ ¼ dB higher than the primary mode

CDMA BC0 Measured Results

Mode		Channel	Freq. (MHz)	Maximum Average Power (dBm)	
				Measured Pwr	Tune-up Limit
1xRTT	RC1, SO55 (Loopback)	1013	824.70	25.3	26.0
		384	836.52	25.1	
		777	848.31	24.8	
	RC3, SO55 (Loopback)	1013	824.70	25.3	
		384	836.52	25.2	
		777	848.31	24.8	
	RC3, SO32 (+F-SCH)	1013	824.70	25.3	
		384	836.52	25.1	
		777	848.31	24.8	
1xAdvanced	Fwd11/Rvs8 SO75 (Loopback)	1013	824.70	25.3	26.0
		384	836.52	25.1	
		777	848.31	24.8	
1xEv-Do Rel. 0	307.2 kbps (2 slot, QPSK)	1013	824.70	25.3	26.0
		384	836.52	25.2	
		777	848.31	24.9	
1xEv-Do Rev. A	307.2k, QPSK/ ACK channel is transmitted at all the slots	1013	824.70	25.3	26.0
		384	836.52	25.1	
		777	848.31	24.7	

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9.4. LTE

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

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

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

LTE QPSK configuration has the highest maximum average output power per 3GPP standard.

SAR measurement is not required for the 16QAM and 64QAM. When the highest maximum output power for 16QAM and 64QAM is ≤ ½ dB higher than the QPSK or when the reported SAR for the QPSK configuration is ≤ 1.45 W/kg.

Please refer to section 6.3. for LTE detail test channels.

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LTE Band 5 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				[redacted]	20525	[redacted]		
					836.5 MHz			
10 MHz	QPSK	1	0		23.7		0.0	25.0
		1	25		23.6		0.0	25.0
		1	49		23.6		0.0	25.0
		25	0		22.8		1.0	24.0
		25	12		22.8		1.0	24.0
		25	25		22.7		1.0	24.0
		50	0		22.7		1.0	24.0
	16QAM	1	0		22.6		1.0	24.0
		1	25		22.6		1.0	24.0
		1	49		22.5		1.0	24.0
		25	0		21.8		2.0	23.0
		25	12		21.8		2.0	23.0
		25	25		21.8		2.0	23.0
		50	0		21.8		2.0	23.0
	64QAM	1	0		22.0		2.0	23.0
		1	25		22.0		2.0	23.0
		1	49		22.0		2.0	23.0
		25	0		20.8		3.0	22.0
		25	12		20.9		3.0	22.0
		25	25		20.9		3.0	22.0
		50	0		20.8		3.0	22.0

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20425.0	20525.0	20625.0		
				826.5 MHz	836.5 MHz	846.5 MHz		
5 MHz	QPSK	1	0	23.8	23.7	23.8	0.0	25.0
		1	12	23.8	23.6	23.7	0.0	25.0
		1	24	23.7	23.7	23.6	0.0	25.0
		12	0	22.8	22.7	22.7	1.0	24.0
		12	7	22.8	22.7	22.6	1.0	24.0
		12	13	22.8	22.7	22.6	1.0	24.0
		25	0	22.8	22.8	22.7	1.0	24.0
	16QAM	1	0	22.9	23.2	22.8	1.0	24.0
		1	12	22.8	23.1	22.7	1.0	24.0
		1	24	22.8	23.2	22.7	1.0	24.0
		12	0	21.9	21.9	21.8	2.0	23.0
		12	7	21.9	21.9	21.7	2.0	23.0
		12	13	21.9	21.9	21.7	2.0	23.0
		25	0	21.8	21.8	21.7	2.0	23.0
	64QAM	1	0	22.1	21.7	21.9	2.0	23.0
		1	12	22.0	21.6	21.8	2.0	23.0
		1	24	22.0	21.6	21.8	2.0	23.0
		12	0	20.9	20.8	20.8	3.0	22.0
		12	7	20.8	20.8	20.8	3.0	22.0
		12	13	20.8	20.8	20.8	3.0	22.0
		25	0	20.8	20.8	20.7	3.0	22.0

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20415.0	20525.0	20635.0		
				825.5 MHz	836.5 MHz	847.5 MHz		
3 MHz	QPSK	1	0	23.8	23.6	23.6	0.0	25.0
		1	8	23.8	23.7	23.7	0.0	25.0
		1	14	23.7	23.6	23.5	0.0	25.0
		8	0	22.8	22.7	22.6	1.0	24.0
		8	4	22.8	22.7	22.6	1.0	24.0
		8	7	22.8	22.7	22.6	1.0	24.0
		15	0	22.8	22.7	22.6	1.0	24.0
	16QAM	1	0	22.7	22.7	22.9	1.0	24.0
		1	8	22.7	22.8	22.9	1.0	24.0
		1	14	22.6	22.7	22.9	1.0	24.0
		8	0	21.9	21.8	21.7	2.0	23.0
		8	4	22.0	21.8	21.7	2.0	23.0
		8	7	22.0	21.8	21.7	2.0	23.0
		15	0	21.9	21.7	21.7	2.0	23.0
	64QAM	1	0	21.9	22.0	21.8	2.0	23.0
		1	8	22.0	22.1	21.8	2.0	23.0
		1	14	21.9	22.0	21.7	2.0	23.0
		8	0	20.9	20.8	20.6	3.0	22.0
		8	4	20.9	20.9	20.6	3.0	22.0
		8	7	20.9	20.9	20.6	3.0	22.0
		15	0	20.9	20.8	20.7	3.0	22.0

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LTE Band 5 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20407.0	20525.0	20643.0		
				824.7 MHz	836.5 MHz	848.3 MHz		
1.4 MHz	QPSK	1	0	23.6	23.6	23.5	0.0	25.0
		1	3	23.7	23.6	23.5	0.0	25.0
		1	5	23.6	23.6	23.5	0.0	25.0
		3	0	23.6	23.6	23.4	0.0	25.0
		3	1	23.7	23.6	23.4	0.0	25.0
		3	3	23.7	23.6	23.4	0.0	25.0
		6	0	22.8	22.6	22.6	1.0	24.0
	16QAM	1	0	22.7	22.9	22.5	1.0	24.0
		1	3	22.7	23.0	22.6	1.0	24.0
		1	5	22.7	23.0	22.5	1.0	24.0
		3	0	22.8	22.8	22.5	1.0	24.0
		3	1	22.9	22.8	22.5	1.0	24.0
		3	3	22.9	22.8	22.5	1.0	24.0
		6	0	21.9	21.6	21.7	2.0	23.0
	64QAM	1	0	21.9	21.8	21.9	2.0	23.0
		1	3	21.9	21.9	22.0	2.0	23.0
		1	5	21.9	21.7	21.8	2.0	23.0
		3	0	21.7	21.7	21.8	2.0	23.0
		3	1	21.7	21.8	21.8	2.0	23.0
		3	3	21.7	21.8	21.8	2.0	23.0
		6	0	20.9	21.0	20.6	3.0	22.0

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LTE Band 41 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					Grip Sensor Reduced Average Power (dBm)				
				40340	40740	41140	MPR	Tune-up Limit	40340	40740	41140	MPR	Tune-up Limit
				2565 MHz	2605 MHz	2645 MHz			2565 MHz	2605 MHz	2645 MHz		
20 MHz	QPSK	1	0	23.8	23.9	23.8	0.0	24.5	21.3	21.5	21.2	0.0	22.5
		1	49	23.8	23.9	23.8	0.0	24.5	21.3	21.5	21.1	0.0	22.5
		1	99	23.8	23.8	23.6	0.0	24.5	21.3	21.3	21.0	0.0	22.5
		50	0	22.8	22.9	22.8	1.0	23.5	21.4	21.5	21.2	0.0	22.5
		50	24	22.9	22.9	22.8	1.0	23.5	21.4	21.5	21.3	0.0	22.5
		50	50	22.8	22.9	22.8	1.0	23.5	21.4	21.4	21.1	0.0	22.5
		100	0	22.8	22.9	22.7	1.0	23.5	21.4	21.5	21.2	0.0	22.5
	16QAM	1	0	22.8	22.8	22.9	1.0	23.5	21.4	21.5	21.2	0.0	22.5
		1	49	22.9	22.8	22.9	1.0	23.5	21.5	21.5	21.1	0.0	22.5
		1	99	22.8	22.7	22.8	1.0	23.5	21.5	21.4	21.0	0.0	22.5
		50	0	21.8	22.0	21.9	2.0	22.5	21.3	21.6	21.3	0.0	22.5
		50	24	21.9	22.0	21.9	2.0	22.5	21.4	21.6	21.4	0.0	22.5
		50	50	21.9	22.0	21.8	2.0	22.5	21.3	21.6	21.2	0.0	22.5
		100	0	21.9	22.0	21.8	2.0	22.5	21.4	21.6	21.3	0.0	22.5
	64QAM	1	0	21.7	22.3	21.9	2.0	22.5	21.0	21.5	21.3	0.0	22.5
		1	49	21.9	22.4	21.9	2.0	22.5	21.1	21.6	21.3	0.0	22.5
		1	99	21.8	22.3	21.7	2.0	22.5	21.1	21.5	21.1	0.0	22.5
		50	0	20.9	21.0	20.9	3.0	21.5	21.4	21.5	20.8	0.0	22.5
		50	24	21.0	21.0	20.9	3.0	21.5	21.5	21.6	20.8	0.0	22.5
		50	50	20.9	21.0	20.8	3.0	21.5	21.5	21.5	20.6	0.0	22.5
		100	0	20.9	20.9	20.9	3.0	21.5	21.4	21.6	20.8	0.0	22.5

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					Grip Sensor Reduced Average Power (dBm)				
				40315	40740	41165	MPR	Tune-up Limit	40315	40740	41165	MPR	Tune-up Limit
				2562.5 MHz	2605 MHz	2647.5 MHz			2562.5 MHz	2605 MHz	2647.5 MHz		
15 MHz	QPSK	1	0	23.7	23.9	23.8	0.0	24.5	21.3	21.3	21.2	0.0	22.5
		1	37	23.7	23.9	23.8	0.0	24.5	21.4	21.3	21.1	0.0	22.5
		1	74	23.8	23.8	23.7	0.0	24.5	21.3	21.2	21.0	0.0	22.5
		36	0	22.8	22.9	22.7	1.0	23.5	21.3	21.4	21.1	0.0	22.5
		36	20	22.8	22.9	22.8	1.0	23.5	21.3	21.4	21.1	0.0	22.5
		36	39	22.8	22.9	22.7	1.0	23.5	21.3	21.3	21.0	0.0	22.5
		75	0	22.8	22.8	22.7	1.0	23.5	21.3	21.3	21.1	0.0	22.5
	16QAM	1	0	22.8	22.9	22.9	1.0	23.5	21.3	21.4	21.2	0.0	22.5
		1	37	22.8	23.0	22.9	1.0	23.5	21.4	21.4	21.1	0.0	22.5
		1	74	22.8	22.9	22.8	1.0	23.5	21.4	21.3	21.0	0.0	22.5
		36	0	21.8	21.9	21.8	2.0	22.5	21.4	21.4	21.2	0.0	22.5
		36	20	21.9	22.0	21.9	2.0	22.5	21.4	21.5	21.1	0.0	22.5
		36	39	21.9	21.9	21.8	2.0	22.5	21.4	21.4	21.1	0.0	22.5
		75	0	21.9	21.9	21.8	2.0	22.5	21.4	21.4	21.2	0.0	22.5
	64QAM	1	0	22.1	21.5	21.7	2.0	22.5	21.9	22.2	21.9	0.0	22.5
		1	37	22.2	21.5	21.7	2.0	22.5	21.9	22.2	21.8	0.0	22.5
		1	74	22.2	21.4	21.6	2.0	22.5	21.9	22.1	21.7	0.0	22.5
		36	0	21.0	21.0	20.8	3.0	21.5	21.4	21.3	20.7	0.0	22.5
		36	20	21.0	21.0	20.8	3.0	21.5	21.4	21.3	20.6	0.0	22.5
		36	39	20.9	21.0	20.8	3.0	21.5	21.5	21.3	20.6	0.0	22.5
		75	0	20.9	20.9	20.8	3.0	21.5	21.3	21.3	20.6	0.0	22.5

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LTE Band 41 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					Grip Sensor Reduced Average Power (dBm)				
				40290	40740	41190	MPR	Tune-up Limit	40290	40740	41190	MPR	Tune-up Limit
				2560 MHz	2605 MHz	2650 MHz			2560 MHz	2605 MHz	2650 MHz		
10 MHz	QPSK	1	0	23.8	23.7	23.7	0.0	24.5	21.2	21.4	21.1	0.0	22.5
		1	25	23.8	23.7	23.7	0.0	24.5	21.2	21.4	21.0	0.0	22.5
		1	49	23.8	23.7	23.7	0.0	24.5	21.2	21.3	21.0	0.0	22.5
		25	0	22.3	22.4	22.2	1.0	23.5	21.3	21.4	21.1	0.0	22.5
		25	12	22.3	22.4	22.2	1.0	23.5	21.3	21.4	21.1	0.0	22.5
		25	25	22.3	22.4	22.2	1.0	23.5	21.3	21.4	21.1	0.0	22.5
		50	0	22.3	22.3	22.2	1.0	23.5	21.3	21.4	21.1	0.0	22.5
	16QAM	1	0	22.9	22.8	22.8	1.0	23.5	21.2	21.4	21.2	0.0	22.5
		1	25	23.0	22.8	22.7	1.0	23.5	21.3	21.4	21.2	0.0	22.5
		1	49	23.0	22.8	22.7	1.0	23.5	21.3	21.4	21.2	0.0	22.5
		25	0	21.9	21.9	21.8	2.0	22.5	21.3	21.5	21.2	0.0	22.5
		25	12	21.9	22.0	21.8	2.0	22.5	21.4	21.5	21.2	0.0	22.5
		25	25	21.9	21.9	21.8	2.0	22.5	21.4	21.5	21.2	0.0	22.5
		50	0	21.9	21.9	21.8	2.0	22.5	21.4	21.5	21.2	0.0	22.5
	64QAM	1	0	22.1	21.5	21.8	2.0	22.5	22.5	21.9	21.6	0.0	22.5
		1	25	22.2	21.5	21.8	2.0	22.5	22.5	21.9	21.6	0.0	22.5
		1	49	22.2	21.5	21.8	2.0	22.5	22.5	21.9	21.6	0.0	22.5
		25	0	20.8	21.0	20.7	3.0	21.5	21.3	21.4	20.5	0.0	22.5
		25	12	20.9	21.0	20.8	3.0	21.5	21.3	21.4	20.5	0.0	22.5
		25	25	20.8	21.0	20.7	3.0	21.5	21.3	21.5	20.5	0.0	22.5
		50	0	20.8	20.9	20.8	3.0	21.5	21.3	21.4	20.5	0.0	22.5

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					Grip Sensor Reduced Average Power (dBm)				
				40265	40740	41215	MPR	Tune-up Limit	40265	40740	41215	MPR	Tune-up Limit
				2557.5 MHz	2605 MHz	2652.5 MHz			2557.5 MHz	2605 MHz	2652.5 MHz		
5 MHz	QPSK	1	0	23.7	23.8	23.7	0.0	24.5	21.2	21.2	20.9	0.0	22.5
		1	12	23.7	23.8	23.7	0.0	24.5	21.1	21.2	20.9	0.0	22.5
		1	24	23.7	23.8	23.7	0.0	24.5	21.1	21.2	20.9	0.0	22.5
		12	0	22.8	22.9	22.8	1.0	23.5	21.2	21.2	20.9	0.0	22.5
		12	7	22.8	22.9	22.8	1.0	23.5	21.2	21.3	21.0	0.0	22.5
		12	13	22.8	22.9	22.7	1.0	23.5	21.2	21.3	20.9	0.0	22.5
		25	0	22.8	22.9	22.7	1.0	23.5	21.2	21.3	20.9	0.0	22.5
	16QAM	1	0	22.7	22.8	22.9	1.0	23.5	21.2	21.2	21.1	0.0	22.5
		1	12	22.7	22.9	22.9	1.0	23.5	21.2	21.2	21.1	0.0	22.5
		1	24	22.7	22.9	22.8	1.0	23.5	21.1	21.2	21.1	0.0	22.5
		12	0	21.8	21.9	21.8	2.0	22.5	21.2	21.3	21.1	0.0	22.5
		12	7	21.8	21.9	21.9	2.0	22.5	21.3	21.3	21.1	0.0	22.5
		12	13	21.9	21.9	21.8	2.0	22.5	21.3	21.3	21.1	0.0	22.5
		25	0	21.8	22.0	21.8	2.0	22.5	21.2	21.3	21.0	0.0	22.5
	64QAM	1	0	22.0	22.3	21.5	2.0	22.5	22.4	22.5	21.2	0.0	22.5
		1	12	22.0	22.3	21.5	2.0	22.5	22.4	22.5	21.2	0.0	22.5
		1	24	22.0	22.3	21.5	2.0	22.5	22.4	22.5	21.2	0.0	22.5
		12	0	20.7	21.1	20.8	3.0	21.5	21.2	21.5	20.5	0.0	22.5
		12	7	20.8	21.1	20.8	3.0	21.5	21.2	21.5	20.5	0.0	22.5
		12	13	20.8	21.0	20.8	3.0	21.5	21.2	21.5	20.5	0.0	22.5
		25	0	20.8	20.9	20.8	3.0	21.5	21.2	21.3	20.5	0.0	22.5

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9.5. 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

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

Where M_A is defined as follows

$M_A =$	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	;$0.4 \le A \le 1$

and M_{IM5} is defined as follows

$M_{IM5} =$	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	; $\Delta_{IM5} \ge BW_{Channel_CA}/2 + \Delta f_{ooB}$

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 $\in$ [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

$M_N =$	-0.125N + 18.25	; $2 \le N \le 50$
	-0.0333 N + 13.67	; $50 < N \le 200$

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.

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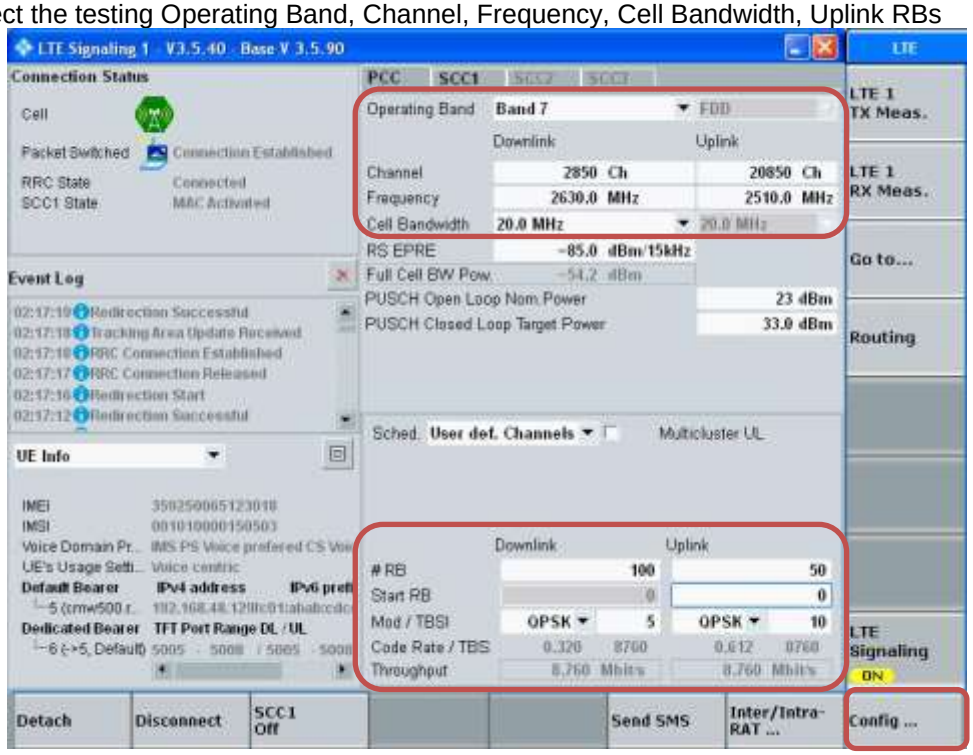
LTE Carrier Aggregation Test Signal Set-up Procedure
(Use normal LTE set-up procedure in addition with the following steps)

Set to CMW-500 with following parameters:

- PCC tab:
  - Select the testing Operating Band, Channel, Frequency, Cell Bandwidth, Uplink RBs
- 

- Go to “Config….”

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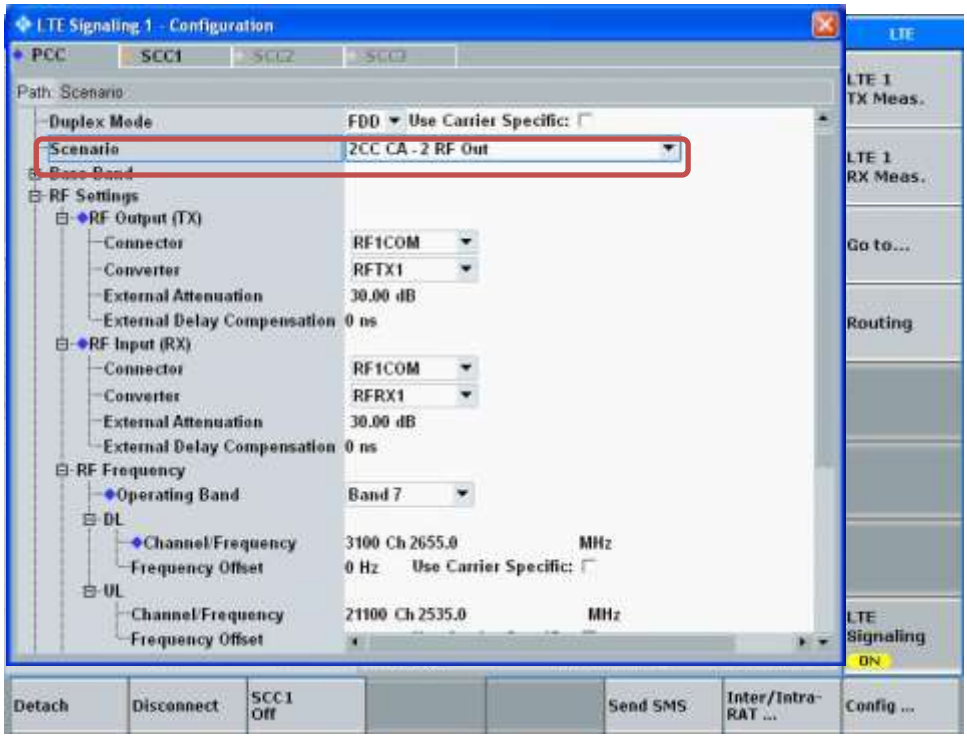
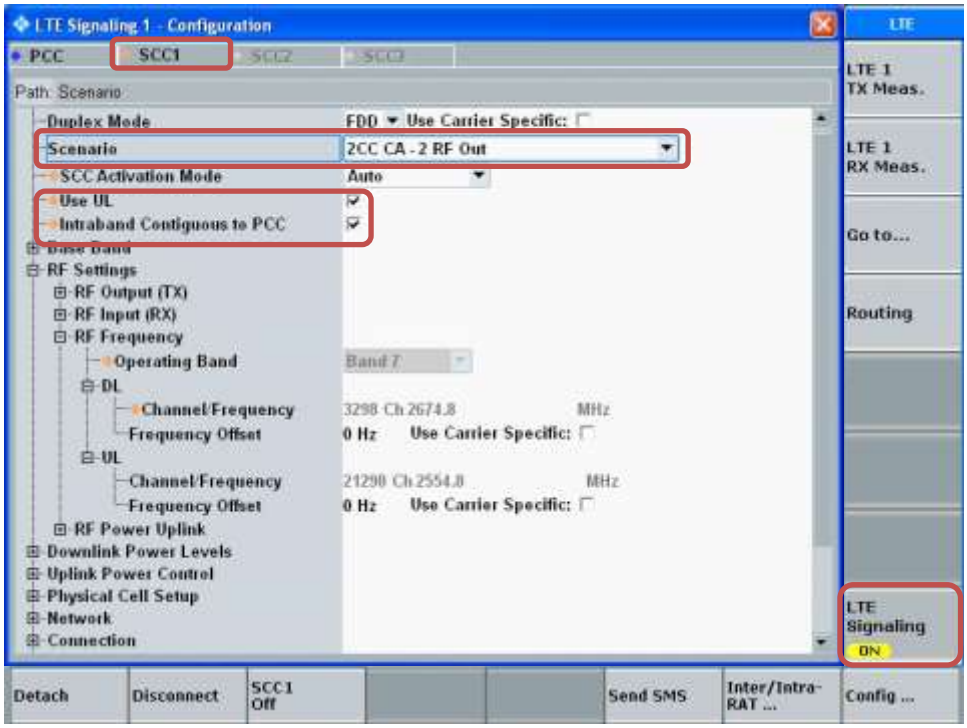
- Go to “Scenario”
- Set to “2CC CA – 2 RF Out”



- Select “SCC1” tab
- Go to “Scenario”
- Set to “2CC CA – 2 RF Out”
- Enable “Use UL”
- Enable “Intraband Contiguous to PCC”
- Select “LTE Signaling” button



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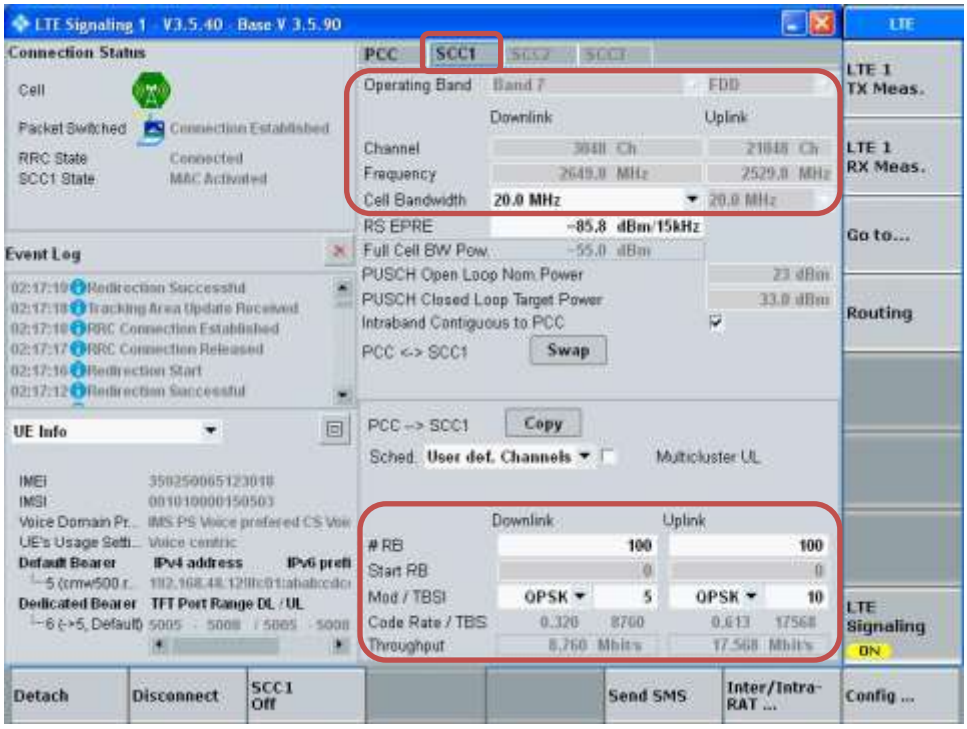
- Select “SCC1” tab
  - Select the testing Cell Bandwidth, Uplink RBs



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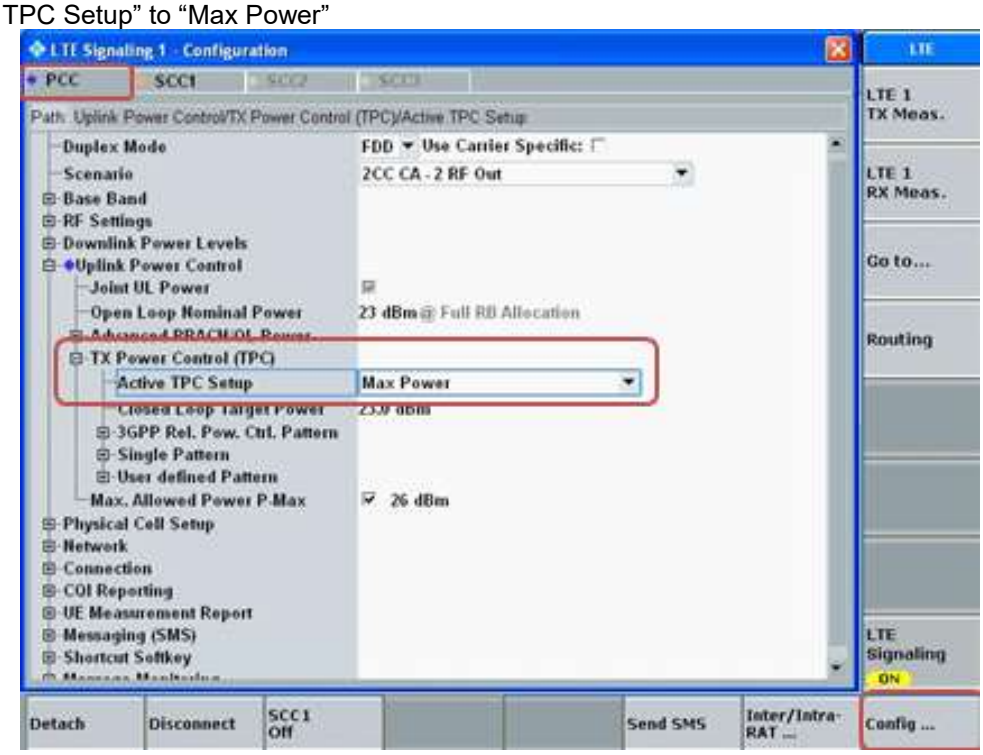
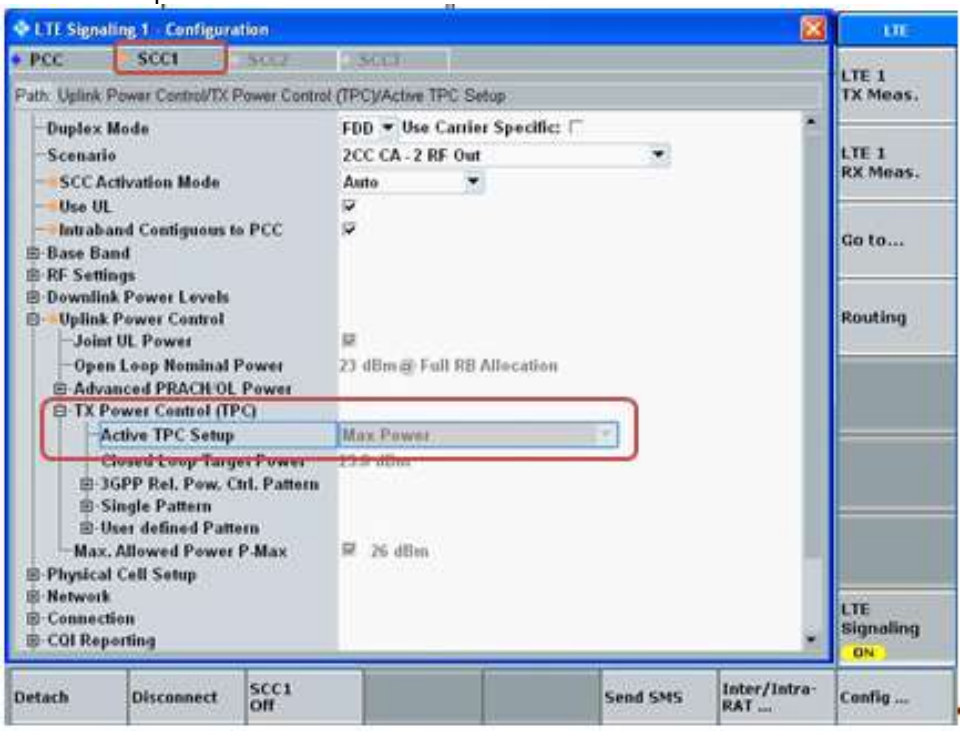
Max Power Setting

- Select “Config …” button
- Select PCC tab
- Set “Active TPC Setup” to “Max Power”



- Select SCC1 tab
- Verify that “Active TPC Setup” is set to “Max Power”



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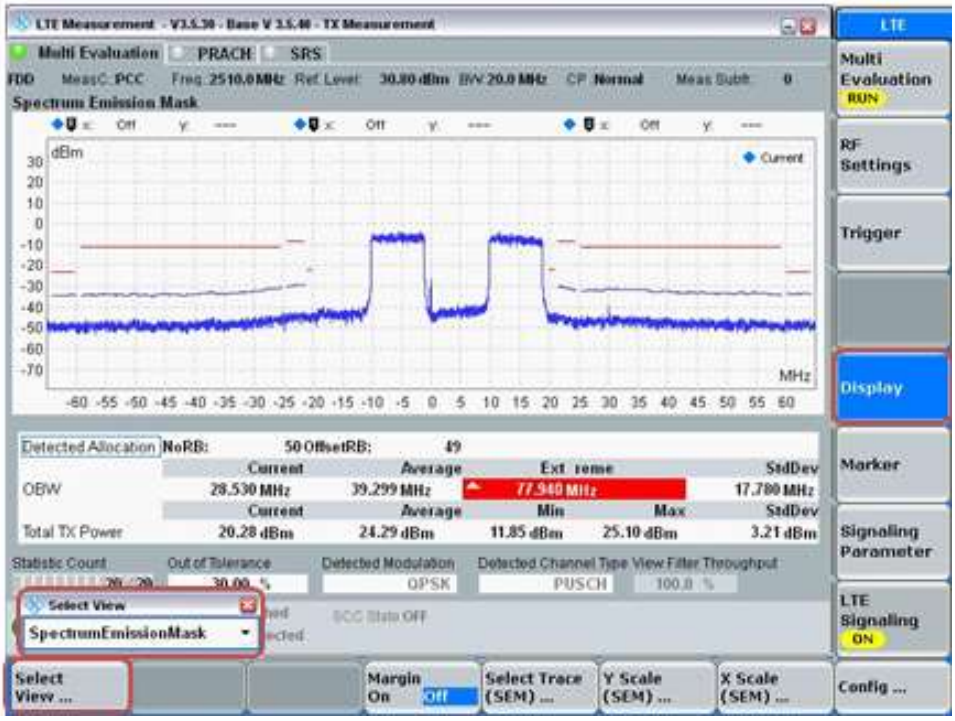
View TX Power

- Go to “Display”
- Select “Select View…”
- Select “Spectrum Emission Mask”



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LTE Up-Link Carrier Aggregation

Maximum Output Power (Tune-up Limit) for LTE UL Carrier Aggregation

UL CA shall be tested based on the worst-case SAR configuration determined from non-CA SAR testing result. The channel BW, channel number, RB allocation, etc. would be selected to allow contiguous CA of PCC and SCC. Uplink output power for UL CA is the total power measured across the PCC and SCC.

The UL CA mode power measurements represent the total power across both carriers. Measurements were made for all supported PCC bandwidths using the channel/RB combination resulting in the highest standalone output power at the least MPR (0 dB). SCCs were set to use configurations similar to the PCC to establish conservative or worst case equivalent SAR test conditions (highest maximum power with MPR of 0 dB).

The standalone power measurement is the power for the PCC in the non-CA mode (i.e. single carrier power). In all cases the UL CA power is less than or equal to the standalone power, which is in accordance with the tune-up limits in table below.

According to November 2017 TCB workshop, Uplink CA SAR Test Guidance as follows:

a) When the maximum output for UL CA is ≤ standalone LTE mode (without CA)
   - PCC is configured according to the highest standalone SAR configuration tested
   - SCC and subsequent CCs are configured according to procedures used for power measurement and parameters (BW, RB etc.) similar to that used for the PCC
b) When the Reported SAR for UL CA configuration, described above, is > 1.2 W/kg, UL CA SAR is also required for all required test channels(PCC based)
c) UL CA SAR is also required for standalone SAR configurations > 1.2 W/kg when they are scaled to the UL CA power level

SAR measurement is not required for the 16QAM and 64QAM. When primary mode and the adjusted SAR is ≤ 1.2 W/kg and secondary mode is ≤ ¼ dB higher than the primary mode.

UL Intra-Band Contiguous Measured Results

RF Exposure Conditions	E-UTRA CA configuration (BCS)	Modulation	Bands		UL											
			PCC	SCC	PCC				SCC				Standalone (dBm)	PCC+SCC		
			1st	2nd	BW	RB	Offset	Freq	BW	RB	Offset	Freq		Tune-Up Limit	CA Power (Total PCC+SCC)	Delta (dBm)
Head, Body & Hotspot	CA_41C	QPSK	41C	41C	20	1	99	2583.1	20	1	0	2602.9	24.4	24.5	24.4	0.0
Grip Sensor (Product Specific)	CA_41C	QPSK	41C	41C	20	1	99	2583.1	20	1	0	2602.9	21.5	22.5	21.4	-0.1

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LTE Down-Link Carrier Aggregation

The tables below show the supported frequency bands of the device for DL Intra-band combinations.

Power measurements were performed on the channel with the highest maximum output power from Tune-up Procedure.

When carrier aggregation is limited to downlink only, uplink maximum output power (single carrier) is measured for the supported combinations of downlink carrier aggregation listed in the table below. In applying the power measurement procedures of KDB 941225 D05A for DL CA to qualify for UL SAR test exclusion, power measurement is required only for the subset in each row with the largest combination of frequency bands and CCs (far right most configuration highlighted in the table below).

Index	2CC	Restriction	Completely Covered by Measurement Superset
Intra-Band Contiguous			
2CC# 1	CA_41C	N/A	No

In applying the power measurement procedures of KDB 941225 D05A for DL CA to qualify for UL SAR test exclusion, power measurement is required only for the CA configuration with the largest aggregated DL CA BW in each frequency band, independently for contiguous and non-contiguous CA; however, if the same frequency band is used for both contiguous and non-contiguous CA, power measurement was performed using the configuration with the largest aggregated BW and maximum output power among contiguous and non-contiguous CA.

DL Intra-Band Contiguous Measured Results

E-UTRA CA configuration (BCS)	3GPP Rel. #	CC1 (UL)					CC2 (DL)			Aggregated BW	MPR	CA Inactive (dBm)	CA Active (dBm)	Delta (dBm)
		Mode	BW (MHz)	Channel	Freq (MHz)	RB,Offset	BW (MHz)	Channel	Freq (MHz)					
CA_41C	13	QPSK	20	40521	2583.1	1,49	20	40719	2602.9	40	0	23.93	23.89	-0.04

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9.6. Wi-Fi 2.4GHz (DTS Band)

Wi-Fi 2.4GHz Measured Results

The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.
For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 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 802.11b/g/n 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.
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.

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	18.9	19.0	Yes	14.0	14.0	Yes
			6	2437	19.0	19.0		14.0	14.0	
			11	2462	18.7	19.0		14.0	14.0	
OFDM 2.4 GHz	802.11g	6 Mbps	1	2412	Not Required	16.0	No	14.0	14.0	No
			6	2437		18.0		14.0	14.0	
			11	2462		18.0		14.0	14.0	
	802.11n (HT20)	6.5 Mbps	1	2412	Not Required	16.0	No	13.9	14.0	No
			6	2437		18.0		14.0	14.0	
			11	2462		18.0		14.0	14.0	

Note(s):
SAR is not required for channels 12 and 13 because the tune-up limit and the measured output power for these two channels are not greater than those for the default test channels.

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
802.11b	1 Mbps	8.621	8.755	98.47%	1.02

Note(s):
Duty Cycle = (T on / period) * 100%

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Duty Cycle plots

802.11b

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

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. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.

Wi-Fi 5 GHz Measured Results

When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.

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		18.0	No		11.0	No
			40	5200		18.0			11.0	
			44	5220		18.0			11.0	
			48	5240		18.0			11.0	
	802.11n (HT20)	6.5 Mbps	36	5180	19.0	19.0	Yes		11.0	No
			40	5200	19.0	19.0			11.0	
			44	5220	19.0	19.0			11.0	
			48	5240	19.0	19.0			11.0	
	802.11ac (VHT20)	6.5 Mbps	36	5180	18.9	19.0	No		11.0	No
			40	5200	19.0	19.0			11.0	
			44	5220	19.0	19.0			11.0	
			48	5240	19.0	19.0			11.0	
	802.11n (HT40)	13.5 Mbps	38	5190		17.0	No		11.0	No
			46	5230		18.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	38	5190		18.0	No		11.0	No
			46	5230		18.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	42	5210		16.0	No	11.0	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		18.0	No		11.0	No
			56	5280		18.0			11.0	
			60	5300		18.0			11.0	
			64	5320		18.0			11.0	
	802.11n (HT20)	6.5 Mbps	52	5260	18.9	19.0	Yes		11.0	No
			56	5280	19.0	19.0			11.0	
			60	5300	19.0	19.0			11.0	
			64	5320	19.0	19.0			11.0	
	802.11ac (VHT20)	6.5 Mbps	52	5260	19.0	19.0	No		11.0	No
			56	5280	19.0	19.0			11.0	
			60	5300	19.0	19.0			11.0	
			64	5320	19.0	19.0			11.0	
	802.11n (HT40)	13.5 Mbps	54	5270		18.0	No		11.0	No
			62	5310		18.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	54	5270		18.0	No		11.0	No
			62	5310		18.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	58	5290		16.0	No	11.0	11.0	Yes

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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	No		11.0	No
			116	5580		18.0			11.0	
			124	5620		18.0			11.0	
			140	5700		18.0			11.0	
			144	5720		18.0			11.0	
	802.11n (HT20)	6.5 Mbps	100	5500	19.0	19.0	Yes		11.0	No
			116	5580	19.0	19.0			11.0	
			124	5620	18.9	19.0			11.0	
			140	5700	18.8	19.0			11.0	
			144	5720	18.9	19.0			11.0	
	802.11ac (VHT20)	6.5 Mbps	100	5500	19.0	19.0	No		11.0	No
			116	5580	19.0	19.0			11.0	
			124	5620	18.9	19.0			11.0	
			140	5700	18.8	19.0			11.0	
			144	5700	18.9	19.0			11.0	
	802.11n (HT40)	13.5 Mbps	102	5510		17.0	No		11.0	No
			118	5590		18.0			11.0	
			126	5630		18.0			11.0	
			134	5670		18.0			11.0	
			142	5710		18.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	102	5510		18.0	No		11.0	No
			118	5590		18.0			11.0	
			126	5630		18.0			11.0	
			134	5670		18.0			11.0	
			142	5710		18.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	106	5530		16.0	No	11.0	11.0	Yes
			122	5610		16.0		11.0	11.0	
			138	5690		16.0		11.0	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		18.0	No		11.0	No
			157	5785		18.0			11.0	
			165	5825		18.0			11.0	
	802.11n (HT20)	6.5 Mbps	149	5745	19.0	19.0	Yes		11.0	No
			157	5785	19.0	19.0			11.0	
			165	5825	19.0	19.0			11.0	
	802.11ac (VHT20)	6.5 Mbps	149	5745	19.0	19.0	No		11.0	No
			157	5785	19.0	19.0			11.0	
			165	5825	19.0	19.0			11.0	
	802.11n (HT40)	13.5 Mbps	151	5755		18.0	No		11.0	No
			159	5795		18.0			11.0	
	802.11ac (VHT40)	13.5 Mbps	151	5755		18.0	No		11.0	No
			159	5795		18.0			11.0	
	802.11ac (VHT80)	29.3 Mbps	155	5775		16.0	No	11.0	11.0	Yes

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
802.11n	HT20	1.341	1.377	97.39%	1.03
802.11ac	VHT80	0.3318	0.3681	90.14%	1.11

Note(s):

Duty Cycle = (T on / period) * 100%

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Duty Cycle plots

802.11n HT20

802.11ac VHT80

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9.8. Bluetooth

Bluetooth Measured Results

SAR measurement is not required for the QPSK, 8PSK, and BLE. When the secondary mode is ≤ ¼ dB higher than the primary mode.

Band	Mode	Ch #	Freq. (MHz)	Maximum Average Power (dBm)		
				Meas Pwr	Tune-up	SAR Test (Yes/No)
Bluetooth	BR GFSK	0	2402	12.0	12.0	Yes
		39	2441	12.0	12.0	
		78	2480	11.1	12.0	
	EDR, π/4 DQPSK	0	2402	10.0	12.0	No
		39	2441	9.3	12.0	
		78	2480	9.1	12.0	
	EDR, 8-DPSK	0	2402	10.0	12.0	No
		39	2441	9.3	12.0	
		78	2480	9.2	12.0	
	LE, GFSK	0	2402	0.5	2.0	No
		19	2440	0.5	2.0	
		39	2480	0.5	2.0	

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	2.887	3.749	77.01%	1.30

Note(s):

Duty Cycle = (T on / period) * 100%

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Duty Cycle plots

GFSK

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10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

- Reported SAR(W/kg) for WWAN and Bluetooth = Measured SAR *Tune-up Scaling Factor
- Reported SAR(W/kg) for Wi-Fi= 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):

For smart phones, with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm.
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; however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold.

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.

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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.

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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 4 Slots	OFF	0	Left Touch	190	836.6	28.0	27.3	0.037	0.043	
				Left Tilt	190	836.6	28.0	27.3	0.017	0.020	
				Right Touch	190	836.6	28.0	27.3	0.047	**0.055**	1
				Right Tilt	190	836.6	28.0	27.3	0.019	0.022	
Body-worn	GPRS 4 Slots	OFF	15	Rear	190	836.6	28.0	27.3	0.081	**0.095**	2
				Front	190	836.6	28.0	27.3	0.027	0.032	
Hotspot	GPRS 4 Slots	OFF	10	Rear	190	836.6	28.0	27.3	0.175	**0.206**	3
				Front	190	836.6	28.0	27.3	0.028	0.033	
				Edge 2	190	836.6	28.0	27.3	0.040	0.047	
				Edge 3	190	836.6	28.0	27.3	0.042	0.049	
				Edge 4	190	836.6	28.0	27.3	0.015	0.018	

10.2. GSM1900

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 4 Slots	OFF	0	Left Touch	661	1880.0	25.0	24.4	0.058	0.067	
				Left Tilt	661	1880.0	25.0	24.4	0.043	0.049	
				Right Touch	661	1880.0	25.0	24.4	0.083	**0.095**	4
				Right Tilt	661	1880.0	25.0	24.4	0.036	0.041	
Body-worn	GPRS 4 Slots	OFF	15	Rear	661	1880.0	25.0	24.4	0.056	**0.064**	5
				Front	661	1880.0	25.0	24.4	0.048	0.055	
Hotspot	GPRS 4 Slots	ON	10	Rear	661	1880.0	23.0	23.0	0.101	0.101	
				Front	661	1880.0	23.0	23.0	0.132	**0.132**	6
				Edge 2	661	1880.0	23.0	23.0	0.106	0.106	
				Edge 3	661	1880.0	23.0	23.0	0.091	0.091	
				Edge 4	661	1880.0	23.0	23.0	0.039	0.039	

Note(s):

Hotspot mode supports power reduction. When the measured SAR is scaled to the maximum tune-up limit, the adjusted SAR is < 1.2 W/kg. Therefore, Product Specific 10g SAR testing is not required for this band in accordance with KDB 648474 §2.5 b.

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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	9262	1852.4	25.0	24.8	0.157	0.164	
				Left Tilt	9262	1852.4	25.0	24.8	0.140	0.147	
				Right Touch	9262	1852.4	25.0	24.8	0.220	**0.230**	7
				Right Tilt	9262	1852.4	25.0	24.8	0.134	0.140	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	9262	1852.4	25.0	24.8	0.239	**0.250**	8
				Front	9262	1852.4	25.0	24.8	0.200	0.209	
Hotspot	Rel 99 RMC 12.2 kbps	ON	10	Rear	9400	1880.0	23.0	22.1	0.410	**0.509**	9
				Front	9400	1880.0	23.0	22.1	0.264	0.328	
				Edge 2	9400	1880.0	23.0	22.1	0.262	0.325	
				Edge 3	9400	1880.0	23.0	22.1	0.217	0.269	
				Edge 4	9400	1880.0	23.0	22.1	0.105	0.130	

Note(s):

Hotspot mode supports power reduction. When the measured SAR is scaled to the maximum tune-up limit, the adjusted SAR is < 1.2 W/kg. Therefore, Product Specific 10g SAR testing is not required for this band in accordance with KDB 648474 §2.5 b.

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	23.2	0.068	0.103	
				Left Tilt	4183	836.6	25.0	23.2	0.035	0.053	
				Right Touch	4183	836.6	25.0	23.2	0.083	**0.126**	10
				Rightt Tilt	4183	836.6	25.0	23.2	0.033	0.050	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	4183	836.6	25.0	23.2	0.114	**0.173**	11
				Front	4183	836.6	25.0	23.2	0.055	0.083	
Hotspot	Rel 99 RMC 12.2 kbps	OFF	10	Rear	4183	836.6	25.0	23.2	0.265	**0.401**	12
				Front	4183	836.6	25.0	23.2	0.059	0.089	
				Edge 2	4183	836.6	25.0	23.2	0.079	0.120	
				Edge 3	4183	836.6	25.0	23.2	0.079	0.120	
				Edge 4	4183	836.6	25.0	23.2	0.029	0.044	

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10.5. CDMA BC0

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	1xRTT RC3 SO55	OFF	0	Left Touch	384	836.5	26.0	25.2	0.104	0.126	
				Left Tilt	384	836.5	26.0	25.2	0.050	0.061	
				Right Touch	384	836.5	26.0	25.2	0.124	**0.151**	13
				Rightt Tilt	384	836.5	26.0	25.2	0.050	0.061	
Head	1xEVDO Rel.0	OFF	0	Left Touch	384	836.5	26.0	25.2	0.112	0.136	
				Left Tilt	384	836.5	26.0	25.2	0.055	0.067	
				Right Touch	384	836.5	26.0	25.2	0.133	**0.162**	14
				Right Tilt	384	836.5	26.0	25.2	0.055	0.067	
Body-worn	1xRTT RC3 SO32	OFF	15	Rear	384	836.5	26.0	25.1	0.150	**0.183**	15
				Front	384	836.5	26.0	25.1	0.076	0.093	
Hotspot	1xRTT RC3 SO32	OFF	10	Rear	384	836.5	26.0	25.1	0.459	**0.561**	16
				Front	384	836.5	26.0	25.1	0.091	0.111	
				Edge 2	384	836.5	26.0	25.1	0.134	0.164	
				Edge 3	384	836.5	26.0	25.1	0.136	0.166	
				Edge 4	384	836.5	26.0	25.1	0.044	0.054	

10.6. LTE Band 5 (10MHz Bandwidth)

RF Exposure Conditions	Mode	Power 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	0	25.0	23.7	0.060	0.081	
							25	0	24.0	22.8	0.050	0.066	
				Left Tilt (15°)	20525	836.5	1	0	25.0	23.7	0.033	0.045	
							25	0	24.0	22.8	0.025	0.033	
				Right Touch	20525	836.5	1	0	25.0	23.7	0.075	**0.101**	17
							25	0	24.0	22.8	0.062	0.082	
				Right Tilt (15°)	20525	836.5	1	0	25.0	23.7	0.031	0.042	
							25	0	24.0	22.8	0.025	0.033	
Body-worn	QPSK	OFF	15	Rear	20525	836.5	1	0	25.0	23.7	0.126	**0.170**	18
							25	0	24.0	22.8	0.103	0.136	
				Front	20525	836.5	1	0	25.0	23.7	0.053	0.071	
							25	0	24.0	22.8	0.042	0.055	
Hotspot	QPSK	OFF	10	Rear	20525	836.5	1	0	25.0	23.7	0.288	**0.389**	19
							25	0	24.0	22.8	0.236	0.311	
				Front	20525	836.5	1	0	25.0	23.7	0.052	0.070	
							25	0	24.0	22.8	0.042	0.055	
				Edge 2	20525	836.5	1	0	25.0	23.7	0.082	0.111	
							25	0	24.0	22.8	0.065	0.086	
				Edge 3	20525	836.5	1	0	25.0	23.7	0.074	0.100	
							25	0	24.0	22.8	0.062	0.082	
				Edge 4	20525	836.5	1	0	25.0	23.7	0.033	0.045	
							25	0	24.0	22.8	0.027	0.036	

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10.7. LTE Band 41 (20MHz Bandwidth)

RF Exposure Conditions	Mode	Power 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	40740	2605.0	1	0	24.5	23.9	0.103	0.118	
							50	0	23.5	22.9	0.088	0.101	
				Left Tilt	40740	2605.0	1	0	24.5	23.9	0.038	0.044	
							50	0	23.5	22.9	0.030	0.034	
				Right Touch	40740	2605.0	1	0	24.5	23.9	0.251	**0.288**	20
							50	0	23.5	22.9	0.211	0.242	
				Right Tilt	40740	2605.0	1	0	24.5	23.9	0.079	0.091	
							50	0	23.5	22.9	0.066	0.076	
Body-worn	QPSK	OFF	15	Rear	40740	2605.0	1	0	24.5	23.9	0.200	**0.230**	21
							50	0	23.5	22.9	0.162	0.186	
				Front	40740	2605.0	1	0	24.5	23.9	0.047	0.054	
							50	0	23.5	22.9	0.038	0.044	
Hotspot	QPSK	OFF	10	Rear	40740	2605.0	1	0	24.5	23.9	0.421	**0.483**	22
							50	0	23.5	22.9	0.348	0.400	
				Front	40740	2605.0	1	0	24.5	23.9	0.094	0.108	
							50	0	23.5	22.9	0.075	0.086	
				Edge 1	40740	2605.0	1	0	24.5	23.9	0.031	0.036	
							50	0	23.5	22.9	0.023	0.026	
				Edge 2	40740	2605.0	1	0	24.5	23.9	0.013	0.015	
							50	0	23.5	22.9	0.008	0.010	
				Edge 4	40740	2605.0	1	0	24.5	23.9	0.196	0.225	
							50	0	23.5	22.9	0.164	0.188	

LTE UL CA_41C Measured Results

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	PCC UL				SCC UL				Power (dBm)		1-g SAR (W/kg)		Plot No.
					Ch #.	Freq. (MHz)	RB Allocation	RB offest	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Tune-up limit	Meas.	Meas.	Scaled	
Head	QPSK	OFF	0	Right Touch	40521	2583.1	1	99	40719	2602.9	1	0	24.5	24.4	0.437	**0.447**	23
Body-worn	QPSK	OFF	15	Rear	40521	2583.1	1	99	40719	2602.9	1	0	24.5	24.4	0.123	**0.126**	24
Hotspot	QPSK	OFF	10	Rear	40521	2583.1	1	99	40719	2602.9	1	0	24.5	24.4	0.280	**0.287**	25

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10.8. 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	6	2437	98.47%	0.076	14.0	14.0			
				Left Tilt	6	2437	98.47%	**0.100**	14.0	14.0	0.065	**0.066**	26
				Right Touch	6	2437	98.47%	0.076	14.0	14.0			
				Right Tilt	6	2437	98.47%	0.090	14.0	14.0			
Body-worn	802.11b 1 Mbps	OFF	15	Rear	6	2437	98.47%	**0.134**	19.0	19.0	0.093	**0.094**	27
				Front	6	2437	98.47%	0.026	19.0	19.0			
Hotspot	802.11b 1 Mbps	OFF	10	Rear	6	2437	98.47%	**0.313**	19.0	19.0	0.235	**0.239**	28
				Front	6	2437	98.47%	0.051	19.0	19.0			
				Edge 1	6	2437	98.47%	0.113	19.0	19.0			
				Edge 2	6	2437	98.47%	0.039	19.0	19.0			

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10.9. 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

- ≤ 1.2 W/kg, SAR is not required for UNII band I
- > 1.2 W/kg, 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	90.14%	0.301	11.0	11.0			
				Left Tilt	58	5290	90.14%	**0.382**	11.0	11.0	0.168	**0.186**	29
				Right Touch	58	5290	90.14%	0.209	11.0	11.0			
				Right Tilt	58	5290	90.14%	0.276	11.0	11.0			
Body-worn	802.11n HT20	OFF	15	Rear	60	5300	97.39%	**1.140**	19.0	19.0	0.557	**0.572**	30
				Front	60	5300	97.39%	0.244	19.0	19.0	0.102	0.105	
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	802.11n HT20	OFF	0	Rear	56	5280	97.39%	28.300	19.0	19.0	2.460	2.526	
					60	5300	97.39%	**31.200**	19.0	19.0	2.890	**2.967**	31
				Front	60	5300	97.39%	1.910	19.0	19.0			
				Edge 1	60	5300	97.39%	14.500	19.0	19.0	1.300	1.335	
				Edge 2	60	5300	97.39%	0.804	19.0	19.0			

Note(s):

Reported SAR for UNII-2A is < 1.2 W/kg and 3.0 W/kg (Product Specific 10g), therefore SAR is not required for UNII-1.

UNII-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	90.14%	0.159	11.0	11.0			
				Left Tilt	122	5610	90.14%	**0.221**	11.0	11.0	0.120	**0.133**	32
				Right Touch	122	5610	90.14%	0.153	11.0	11.0			
				Right Tilt	122	5610	90.14%	0.185	11.0	11.0			
Body-worn	802.11n HT20	OFF	15	Rear	116	5580	97.39%	**1.120**	19.0	19.0	0.565	**0.580**	33
				Front	116	5580	97.39%	0.211	19.0	19.0	0.105	0.108	
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	802.11n HT20	OFF	0	Rear	100	5500	97.39%	14.800	19.0	19.0	2.080	2.136	
					116	5580	97.39%	**16.100**	19.0	19.0	2.260	**2.321**	34
				Front	116	5580	97.39%	1.460	19.0	19.0			
				Edge 1	100	5500	97.39%	9.480	19.0	19.0	0.932	0.957	
					116	5580	97.39%	10.500	19.0	19.0	0.994	1.021	
				Edge 2	116	5580	97.39%	0.480	19.0	19.0			

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UNII-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	90.14%	0.143	11.0	11.0			
				Left Tilt	155	5775	90.14%	0.181	11.0	11.0	0.092	**0.102**	35
				Right Touch	155	5775	90.14%	0.159	11.0	11.0			
				Right Tilt	155	5775	90.14%	**0.213**	11.0	11.0	0.085	0.094	
Body-worn	802.11n HT20	OFF	15	Rear	157	5785	97.39%	**0.830**	19.0	19.0	0.370	**0.380**	36
				Front	157	5785	97.39%	0.135	19.0	19.0			
Hotspot	802.11n HT20	OFF	10	Rear	157	5785	97.39%	**1.080**	19.0	19.0	0.531	**0.545**	37
				Front	157	5785	97.39%	0.238	19.0	19.0			
				Edge 1	157	5785	97.39%	0.871	19.0	19.0	0.400	0.411	
				Edge 2	157	5785	97.39%	0.124	19.0	19.0			

10.10. Bluetooth

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	GFSK	OFF	0	Left Touch	39	2441	12.0	12.0	0.014	0.014	
				Left Tilt	39	2441	12.0	12.0	0.016	0.016	
				Right Touch	39	2441	12.0	12.0	0.011	0.011	
				Right Tilt	39	2441	12.0	12.0	0.017	**0.017**	38
Body-worn	GFSK	OFF	15	Rear	39	2441	12.0	12.0	0.001	**0.001**	39
				Front	39	2441	12.0	12.0	-	-	
Hotspot	GFSK	OFF	10	Rear	39	2441	12.0	12.0	0.012	**0.012**	40
				Front	39	2441	12.0	12.0	0.004	0.004	
				Edge 1	39	2441	12.0	12.0	0.008	0.008	
				Edge 2	39	2441	12.0	12.0	0.002	0.002	

Notes:

1. For results listed with "-", the SAR result is less than 0.01 W/kg.

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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.

Conclusion for 1-g SAR:

Repeated measurements are not required since the original highest measured SAR is <0.8 W/kg(1-g).

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated	
						Measured SAR (W/kg)	Largest to Smallest SAR Ratio
5300	Wi-Fi 802.11a/n/ac	Product Specific 10g	Rear	Yes	2.890	2.89	1.00
5500	Wi-Fi 802.11a/n/ac	Product Specific 10g	Rear	Yes	2.260	2.13	1.06

Note(s):

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

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12. Simultaneous Transmission Conditions

RF Exposure Condition	Item	Capable Transmit Configurations		
Head Body-w orn Hotspot	1	GSM(Voice)	+	DTS
	2	GSM(Voice)	+	U-NII
	3	GSM(Voice)	+	BT
	4	GSM(GPRS/EDGE)	+	DTS
	5	GSM(GPRS/EDGE)	+	U-NII
	6	GSM(GPRS/EDGE)	+	BT
	7	W-CDMA	+	DTS
	8	W-CDMA	+	U-NII
	9	CDMA	+	DTS
	10	CDMA	+	U-NII
	11	CDMA	+	BT
	12	W-CDMA	+	BT
	13	LTE	+	DTS
	14	LTE	+	U-NII
	15	LTE	+	BT

Notes:
1. DTS & UNII supports Hotspot.
2. GPRS/EDGE, W-CDMA, and LTE support Hotspot.
3. VoIP is supported in GPRS/EDGE, W-CDMA, and LTE.
4. DTS Radio cannot transmit simultaneously w ith Bluetooth Radio.
5. U-NII Radio cannot transmit simultaneously w ith Bluetooth Radio.

Note(s):
Product Specific 10g SAR does not require simultaneous transmission analysis.

12.1. 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)

12.1.1. 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.

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

RF Exposure conditions	Standalone SAR (W/kg)				∑ 1-g SAR (W/kg)		
	1	2	3	4	1+2	1+3	1+4
	WWAN	Wi-Fi 2.4G	Wi-Fi 5G	BT			
Head	0.447	0.066	0.186	0.017	**0.513**	**0.633**	**0.464**
Body-worn	0.250	0.094	0.580	0.001	**0.344**	**0.830**	**0.251**
Hotspot	0.561	0.239	0.545	0.012	**0.800**	**1.106**	**0.573**

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

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Appendixes

Refer to separated files for the following appendixes.

Appendix A: SAR Setup Photos

Appendix B: SAR System Check Plots

Appendix C: SAR Highest Test Plots

Appendix D: SAR Tissue Ingredients

Appendix E: SAR Probe Certificates

Appendix F: SAR Dipole Certificates

END OF REPORT

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