SAR EVALUATION REPORT

IEEE Std 1528-2013

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

FCC ID: A3LSMA305F
Model Name: SM-A305F/DS and SM-A305F

Report Number: 12678282-S1V3
Issue Date: 2/20/2019

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	2/1/2019	Initial Issue Final	--
V2	2/8/2019	Updated in accordance to TCB Feedback	Miguel Llamas
V3	2/20/2019	Section 9.6: Updated Ch 102 Tune-up	Coltyce Sanders

Table of Contents

1. Attestation of Test Results

Applicant Name		Samsung Electronics Co. Ltd			
FCC ID		A3LSMA305F			
Model Name		SM-A305F/DS and SM-A305F (Used model SM-A305F/DS for final testing).			
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		0.315	0.106	0.142	0.051
Body-worn		0.522	0.117	0.167	0.004
Hotspot		1.148	0.280	0.153	0.018
Product specific 10g SAR		N/A	N/A	0.583	N/A
Simultaneous TX	Head	0.457	0.421	0.457	0.366
	Body-worn	0.689	0.639	0.689	0.526
	Hotspot	1.428	1.428	1.301	1.166
Date Tested		1/14/2019 to 2/1/2019			
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.	Miguel Llamas Laboratory Technician UL Verification Services Inc.

2. Test Specification, Methods and Procedures

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

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01
- 941225 D05 SAR for LTE Devices v02r05
- 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
- 941225 D06 Hotspot Mode v02r01

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

- TCB workshop October 2014; RF Exposure Procedures (Other LTE Considerations)
- 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 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

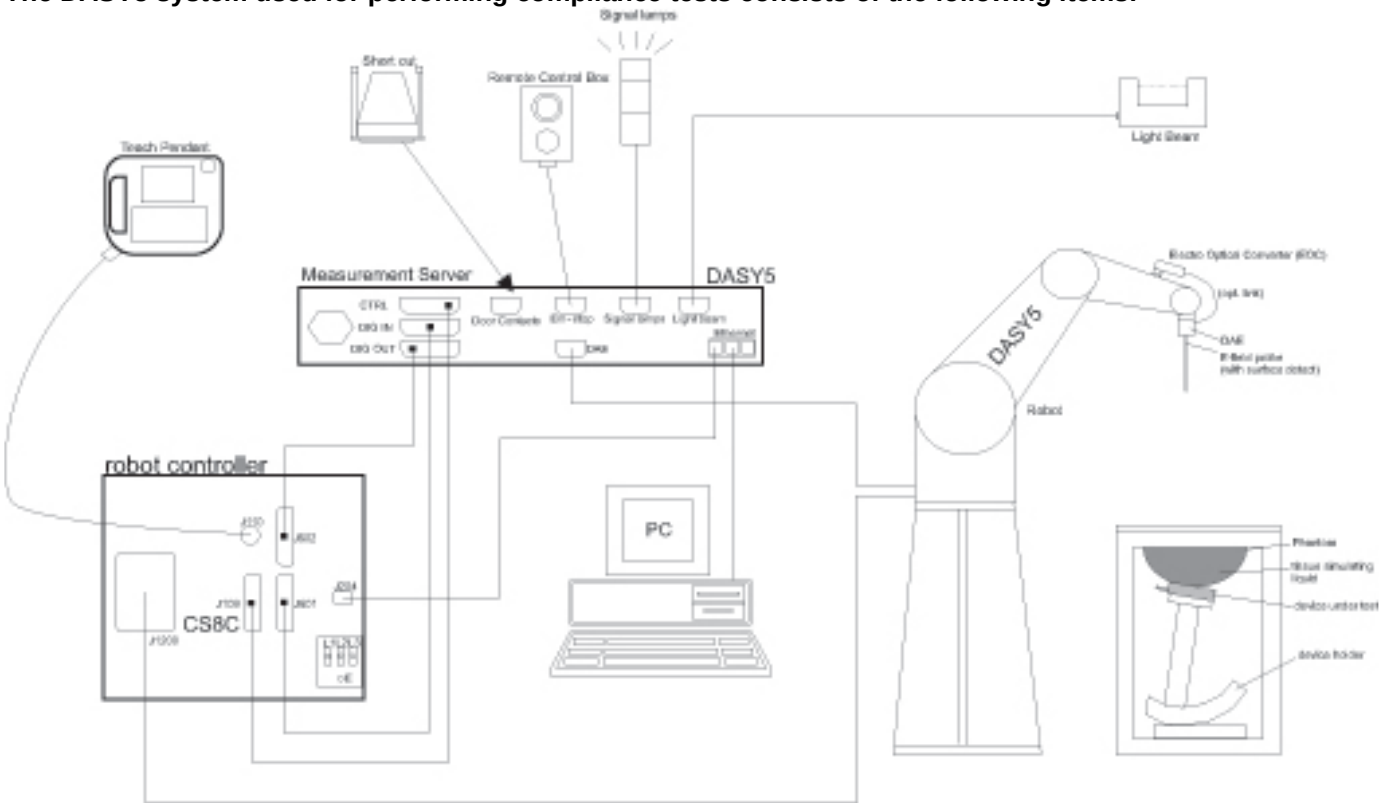
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

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

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



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

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

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

Step 2: Area Scan

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

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

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

Step 3: Zoom Scan

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

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

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

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

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

Step 4: Power drift measurement

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

4.3. Test Equipment

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

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	ZNLE6	1323	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	Traceable Calibration Control Co.	4242	122529162	12/8/2019

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	N5181A	MY50140610	6/7/2019
Power Meter	Keysight	N1912A	MY55196007	7/23/2019
Power Sensor	Agilent	N1921A	MY53020038	4/23/2019
Power Sensor	Agilent	N1921A	MY53260010	10/17/2019
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795093	N/A
Directional coupler	Werlatone	C8060-102	2148	N/A
DC Power Supply	Sorensen	1611	1817A2680	N/A
Synthesized Signal Generator	Agilent	N5181A	MY50240680	5/25/2019
Power Meter	Keysight	N1912A	MY55196004	7/26/2019
Power Sensor	Agilent	N1921A	MY52200012	10/18/2019
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	BK Precision	XT 15-4	215-02292	N/A
Synthesized Signal Generator	R & S	SMB 100A	1406	7/4/2019
Power Sensor	R & S	NRP18A	1424	6/19/2019

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab A)	SPEAG	EX3DV4	3885	9/18/2019
E-Field Probe (SAR Lab B)	SPEAG	EX3DV4	3772	2/13/2019
E-Field Probe (SAR Lab D)	SPEAG	EX3DV4	3773	4/23/2019
E-Field Probe (SAR Lab E)	SPEAG	EX3DV4	3990	8/17/2019
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 A)	SPEAG	DAE4	1540	2/23/2019
Data Acquisition Electronics (SAR Lab B)	SPEAG	DAE4	1377	9/14/2019
Data Acquisition Electronics (SAR Lab D)*	SPEAG	DAE4	1352	11/6/2019
Data Acquisition Electronics (SAR Lab E)	SPEAG	DAE4	1548	5/3/2019
Data Acquisition Electronics (SAR Lab G)	SPEAG	DAE4	1359	2/9/2019
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	D1900V2	5d140	4/11/2019
System Validation Dipole	SPEAG	D2450V2	899	3/16/2019
System Validation Dipole	SPEAG	D2600V2	1006	10/16/2019
System Validation Dipole	SPEAG	D5GHzV2	1138	8/21/2019

Note(s):

*Equipment not used past calibration due date.

Other

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY50001018	10/18/2019
Power Sensor	Agilent	N1921A	MY52200012	10/18/2019
Power Sensor	Agilent	N1921A	MY53260010	10/17/2019
Base Station Simulator	R & S	CMW500	164541	2/19/2019
Base Station Simulator	R & S	CMW500	135384	6/1/2019
Spectrum Analyzer PXA	Agilent	E4446A	MY45300064	8/13/2019

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width): 158.5 mm x 74.5 mm Overall Diagonal: 165.27 mm Display Diagonal: 157.5 mm 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 GHz Ch 149)
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other. Wi-Fi Direct is only available in hand use configuration. ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☒ Wi-Fi Direct (Wi-Fi 5.2/5.8 GHz)
Bluetooth Tethering	BT Tethering mode permits the device to share its cellular data connection with other devices. ☒ BT Tethering (Bluetooth 2.4 GHz)
Test sample information	**S/N** / **IMEI** / **Notes** R38KC08WKGY / 354872100024904 / Radiated Sample R38KC08WKVH / 354872100025026 / Radiated Sample R38KC08WJSN / 354872100024672 / Radiated Sample R38KC08WLXV / 354872100025372 / Radiated Sample R38KC08WKMZ / 354872100024953 / Radiated Sample R38KC08WHJE / 354872100024268 / Conducted Sample R38KC08WG2A / 354872100023773 / Conducted Sample
Hardware Version	REV 1.0
Software Version	A305F.001

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode		Duty Cycle used for SAR testing
GSM	850 1900	Voice (GMSK) GPRS (GMSK) EDGE (8PSK)	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			
W-CDMA (UMTS)	Band II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Category 24) HSUPA (Category 6) HSPA+ (Rel. 9 DL only)		100%
LTE	FDD Band 5 TDD Band 41	QPSK 16QAM 64AQM (Rx only) Rel. 10 Carrier Aggregation support downlink only		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)		100% (802.11b) [1]
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		93.97% (802.11a) [1] 74.26% (802.11ac 80MHz BW) [1]
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No			
	Does this device support Band gap channel(s)? ☒ Yes ☐ No			
Bluetooth	2.4 GHz	Version 5.0 LE		76.68%[2]

Notes:

1. Duty cycle for Wi-Fi is referenced from the DTS and UNII report.
2. Refer to §9.7 for Bluetooth GFSK Duty Cycle

6.3. General LTE SAR Test and Reporting Considerations

<table>
<tr><td rowspan="11">Frequency range, Channel Bandwidth, Numbers and Frequencies</td><td rowspan="2">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="2">Band 41[2]</td><td colspan="6">Frequency range: 2496 - 2690 MHz (BW = 194 MHz)</td></tr>
<tr><td colspan="6">Channel Bandwidth</td></tr>
<tr><td>20 MHz</td><td>15 MHz</td><td>10 MHz</td><td>5 MHz</td><td>3 MHz</td><td>1.4 MHz</td></tr>
<tr><td>Low</td><td colspan="4">39750 / 2506.0</td><td></td><td></td></tr>
<tr><td>Low-Mid</td><td colspan="4">40185 / 2549.5</td><td></td><td></td></tr>
<tr><td>Mid</td><td colspan="4">40620 / 2593.0</td><td></td><td></td></tr>
<tr><td>Mid-High</td><td colspan="4">41055 / 2636.5</td><td></td><td></td></tr>
<tr><td>High</td><td colspan="4">41490 / 2680.0</td><td></td><td></td></tr>
<tr><td>LTE transmitter and antenna implementation</td><td colspan="7">Refer to Appendix A.</td></tr>
<tr><td>Maximum power reduction (MPR)</td><td colspan="7">Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3
<table>
<tr><th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (N_{RB})</th><th rowspan="2">MPR (dB)</th></tr>
<tr><th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr>
<tr><td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr>
<tr><td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 2</td></tr>
<tr><td>64 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 3</td></tr>
<tr><td>256 QAM</td><td colspan="6">≥ 1</td><td>≤ 5</td></tr>
</table>
MPR Built-in by design
The manufacturer MPR values are always within the 3GPP maximum MPR allowance but may not follow the default MPR values.
A-MPR (additional MPR) was disabled during SAR testing</td></tr>
<tr><td>Power reduction</td><td colspan="7">No</td></tr>
<tr><td>Spectrum plots for RB configurations</td><td colspan="7">A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.</td></tr>
</table>

Notes:

1. 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. LTE band 41 test channels in accordance with October 2014 TCB workshop for all channels bandwidths.
3. SAR Testing for LTE was performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

6.4. LTE (TDD) Considerations

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

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

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

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

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

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

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

Note(s):

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

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 note 2		
			Front			
			Edge 1 (Top)			
			Edge 2 (Right)			
			Edge 3 (Bottom)			
			Edge 4 (Left)			
WWAN (Main Ant. 2) LTE B41 only	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	> 25 mm	No	1
			Edge 2 (Right)	< 25 mm	Yes	
			Edge 3 (Bottom)	< 25 mm	Yes	
			Edge 4 (Left)	> 25 mm	No	1
	Product Specifc 10g	0 mm	Rear	Refer to note 2		
			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. WWAN Main Antenna #2 Supports LTE Band 41.

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required	Note
WLAN & BT	Head	0 mm	Left Touch	N/A	Yes	
			Left Tilt (15°)	N/A	Yes	
			Right Touch	N/A	Yes	
			Right Tilt (15°)	N/A	Yes	
	Body	15 mm	Rear	N/A	Yes	
			Front	N/A	Yes	
	Hotspot (2.4/5.8 GHz Bands)	10 mm	Rear	< 25 mm	Yes	
			Front	< 25 mm	Yes	
			Edge 1 (Top)	< 25 mm	Yes	
			Edge 2 (Right)	< 25 mm	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 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 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.
4. Wi-Fi Direct is only available in hand use configuration.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.
The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance; for example, when the parameters are marginal at the beginning of the measurement series.
Tissue dielectric parameters were measured at the low, middle and high frequency of each operating frequency range of the test device.
The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
A	1/22/2019	5250	Head	5250	35.54	35.93	-1.09	4.48	4.70	-4.83
				5150	35.73	36.05	-0.88	4.38	4.60	-4.71
				5350	35.39	35.82	-1.20	4.60	4.80	-4.26
A	1/22/2019	5250	Body	5250	46.96	48.95	-4.07	5.38	5.35	0.41
				5150	47.17	49.09	-3.91	5.27	5.24	0.68
				5350	46.83	48.82	-4.07	5.53	5.47	1.03
B	1/23/2019	2450	Head	2450	37.60	39.20	-4.08	1.73	1.80	-4.00
				2400	37.65	39.30	-4.19	1.69	1.75	-3.41
				2480	37.59	39.16	-4.01	1.75	1.83	-4.72
B	1/22/2019	2450	Body	2450	50.23	52.70	-4.69	2.00	1.95	2.41
				2400	50.39	52.77	-4.51	1.93	1.90	1.74
				2480	50.15	52.66	-4.77	2.03	1.99	2.00
B	2/1/2019	2450	Body	2450	51.56	52.70	-2.16	2.04	1.95	4.46
				2400	51.76	52.77	-1.92	1.97	1.90	3.84
				2480	51.48	52.66	-2.24	2.07	1.99	4.11
D	1/23/2019	2600	Head	2600	38.77	39.01	-0.62	1.90	1.96	-3.02
				2495	38.88	39.14	-0.67	1.81	1.85	-1.98
				2690	38.59	38.90	-0.79	1.98	2.06	-4.00
D	1/23/2019	2600	Body	2600	51.81	52.51	-1.33	2.11	2.16	-2.49
				2495	52.05	52.64	-1.13	1.98	2.01	-1.65
				2690	51.54	52.40	-1.64	2.22	2.29	-3.16
E	1/16/2019	5250	Head	5250	37.65	35.93	4.78	4.54	4.70	-3.49
				5150	37.80	36.05	4.86	4.42	4.60	-3.87
				5350	37.44	35.82	4.53	4.66	4.80	-3.03
E	1/16/2019	5600	Head	5600	37.06	35.53	4.29	4.92	5.06	-2.73
				5500	37.27	35.65	4.55	4.80	4.96	-3.17
				5725	36.80	35.39	3.98	5.09	5.19	-1.93
E	1/16/2019	5750	Head	5750	36.83	35.36	4.15	5.13	5.21	-1.53
				5700	36.90	35.42	4.18	5.04	5.16	-2.35
				5850	36.65	35.30	3.82	5.23	5.27	-0.80
E	1/16/2019	5250	Body	5250	48.63	48.95	-0.66	5.34	5.35	-0.26
				5150	48.76	49.09	-0.67	5.19	5.24	-0.83
				5350	48.40	48.82	-0.85	5.50	5.47	0.48
E	1/16/2019	5600	Body	5600	47.99	48.48	-1.01	5.84	5.76	1.35
				5500	48.22	48.61	-0.81	5.68	5.64	0.56
				5725	47.71	48.31	-1.24	6.05	5.91	2.36
E	1/16/2019	5750	Body	5750	47.77	48.27	-1.05	6.09	5.94	2.66
				5700	47.78	48.34	-1.16	5.99	5.88	1.90
				5850	47.53	48.20	-1.39	6.23	6.00	3.87
E	1/28/2019	5600	Body	5600	47.23	48.48	-2.57	5.89	5.76	2.20
				5500	47.10	48.61	-3.11	5.64	5.64	-0.15
				5725	46.88	48.31	-2.96	6.09	5.91	3.17

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	1/14/2019	835	Head	835	41.72	41.50	0.53	0.89	0.90	-1.22
				805	41.75	41.68	0.17	0.88	0.90	-1.71
				850	41.71	41.50	0.51	0.89	0.92	-2.34
G	1/14/2019	835	Body	835	53.66	55.20	-2.79	0.96	0.97	-1.45
				805	53.66	55.33	-3.03	0.95	0.97	-1.93
				850	53.64	55.16	-2.75	0.96	0.99	-2.69
G	1/29/2019	5750	Body	5750	46.52	48.27	-3.63	6.03	5.94	1.52
				5700	46.43	48.34	-3.96	6.13	5.88	4.26
				5850	46.23	48.20	-4.09	6.26	6.00	4.33
H	1/14/2019	1900	Head	1900	38.46	40.00	-3.85	1.42	1.40	1.14
				1850	38.55	40.00	-3.63	1.39	1.40	-1.00
				1920	38.45	40.00	-3.87	1.43	1.40	2.21
H	1/14/2019	1900	Body	1900	52.65	53.30	-1.22	1.58	1.52	3.82
				1850	52.71	53.30	-1.11	1.54	1.52	1.38
				1920	52.62	53.30	-1.28	1.59	1.52	4.87
H	1/22/2019	2450	Body	2450	50.33	52.70	-4.50	2.03	1.95	4.00
				2400	50.38	52.77	-4.53	1.99	1.90	4.64
				2480	50.30	52.66	-4.49	2.05	1.99	2.80
H	1/23/2018	2450	Head	2450	37.73	39.20	-3.75	1.75	1.80	-2.78
				2400	37.79	39.30	-3.83	1.71	1.75	-2.26
				2480	37.73	39.16	-3.66	1.77	1.83	-3.52
H	1/30/2019	5250	Body	5250	47.60	48.95	-2.76	5.31	5.35	-0.84
				5150	47.78	49.09	-2.66	5.17	5.24	-1.23
				5350	47.41	48.82	-2.88	5.44	5.47	-0.50

8.2. System Check

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

System Performance Check Measurement Conditions:

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

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within ±10% of the manufacturer calibrated dipole SAR target. Refer to Appendix B for the SAR System Check Plots.

SAR Lab	Date	Tissue Type	Dipole Type_Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
A	1/22/2019	Head	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	7.990	79.90	82.60	**-3.27**	2.280	22.80	23.80	-4.20	1,2
A	1/22/2019	Body	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	7.570	75.70	76.60	-1.17	2.160	21.60	21.40	0.93	
B	1/23/2019	Body	D2450V2 SN:899	3/16/2019	5.550	55.50	50.55	**9.79**	2.530	25.30	23.20	9.05	3,4
B	1/23/2019	Head	D2450V2 SN:899	3/16/2019	4.990	49.90	51.75	-3.57	2.320	23.20	24.20	-4.13	
B	2/1/2019	Body	D2450V2 SN:899	3/16/2019	5.280	52.80	50.55	4.45	2.430	24.30	23.20	4.74	
D	1/23/2019	Head	D2600V2 SN:1006	10/16/2019	5.740	57.40	59.31	-3.22	2.570	25.70	26.43	-2.76	
D	1/23/2019	Body	D2600V2 SN:1006	10/16/2019	6.080	60.80	58.52	**3.90**	2.670	26.70	26.15	2.10	5,6
E	1/16/2019	Head	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	8.080	80.80	82.60	-2.18	2.350	23.50	23.80	-1.26	
E	1/16/2019	Head	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	8.620	86.20	86.00	0.23	2.470	24.70	24.60	0.41	
E	1/16/2019	Head	D5GHzV2 SN:1138 (5.75 GHz)	8/21/2019	7.610	76.10	82.40	**-7.65**	2.180	21.80	23.60	-7.63	7,8
E	1/16/2019	Body	D5GHzV2 SN:1138 (5.25 GHz)	8/21/2019	8.020	80.20	76.60	**4.70**	2.280	22.80	21.40	6.54	9,10
E	1/16/2019	Body	D5GHzV2 SN:1138 (5.6 GHz)	8/21/2019	8.190	81.90	79.50	3.02	2.310	23.10	22.20	4.05	
E	1/16/2019	Body	D5GHzV2 SN:1138 (5.75 GHz)	8/21/2019	7.350	73.50	74.10	-0.81	2.070	20.70	20.60	0.49	
E	1/28/2019	Body	D5GHzV2 SN:1003 (5.60 GHz)	3/13/2019	8.170	81.70	77.70	**5.15**	2.300	23.00	21.70	5.99	11,12
G	1/14/2019	Head	D835V2 SN:4d142	8/23/2019	0.942	9.42	9.48	-0.63	0.617	6.17	6.10	1.15	
G	1/14/2019	Body	D835V2 SN:4d142	8/23/2019	1.010	10.10	9.68	**4.34**	0.663	6.63	6.36	4.25	13,14
G	1/29/2019	Body	D5GHzV2 SN:1003 (5.75 GHz)	3/13/2019	7.670	76.70	73.90	**3.79**	2.160	21.60	20.60	4.85	15,16
H	1/14/2019	Head	D1900V2 SN:5d140	4/11/2019	4.210	42.10	38.93	**8.14**	2.160	21.60	20.14	7.25	17,18
H	1/14/2019	Body	D1900V2 SN:5d140	4/11/2019	4.260	42.60	41.00	3.90	2.190	21.90	21.05	4.04	
H	1/22/2019	Body	D2450V2 SN:899	3/16/2019	4.940	49.40	50.55	-2.27	2.290	22.90	23.20	-1.29	
H	1/23/2019	Head	D2450V2 SN:899	3/16/2019	5.340	53.40	51.75	**3.19**	2.470	24.70	24.20	2.07	19,20
H	1/30/2019	Body	D5GHzV2 SN:1003 (5.25 GHz)	3/13/2019	7.440	74.40	73.60	**1.09**	2.100	21.00	20.50	2.44	21,22

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.

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	32.61	23.58	34.00	24.97
			190	836.6	32.61	23.58		
			251	848.8	32.72	23.69		
		2	128	824.2	30.13	24.11	31.00	24.98
			190	836.6	29.92	23.90		
			251	848.8	30.05	24.03		
		3	128	824.2	28.55	24.29	30.00	**25.74**
			190	836.6	28.73	24.47		
			251	848.8	28.75	24.49		
		4	128	824.2	27.22	24.21	28.50	25.49
			190	836.6	27.32	24.31		
			251	848.8	27.26	24.25		
EDGE (8PSK)	MCS5	1	128	824.2	26.54	17.51	27.50	18.47
			190	836.6	26.48	17.45		
			251	848.8	26.34	17.31		
		2	128	824.2	24.71	18.69	25.50	19.48
			190	836.6	24.54	18.52		
			251	848.8	24.43	18.41		
		3	128	824.2	23.28	19.02	24.20	19.94
			190	836.6	23.22	18.96		
			251	848.8	23.13	18.87		
		4	128	824.2	21.85	18.84	22.50	19.49
			190	836.6	21.68	18.67		
			251	848.8	21.74	18.73		

Notes:

GPRS/EDGE (GMSK) mode with 3 time slots for Max power based on the Tune-up Procedure.

GSM1900 Measured Results

Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Maximum Average Power (dBm)			
					Measured		Tune-up Limit	
					Burst Pwr	Frame Pwr	Burst Pwr	Frame Pwr
GPRS/EDGE (GMSK)	CS1	1	512	1850.2	29.84	20.81	31.00	21.97
			661	1880.0	29.88	20.85		
			810	1909.8	29.63	20.60		
		2	512	1850.2	26.56	20.54	28.00	21.98
			661	1880.0	26.62	20.60		
			810	1909.8	26.59	20.57		
		3	512	1850.2	25.20	20.94	26.60	**22.34**
			661	1880.0	25.11	20.85		
			810	1909.8	25.11	20.85		
		4	512	1850.2	23.47	20.46	25.00	21.99
			661	1880.0	23.55	20.54		
			810	1909.8	23.57	20.56		
EDGE (8PSK)	MCS5	1	512	1850.2	26.31	17.28	27.00	17.97
			661	1880.0	26.33	17.30		
			810	1909.8	26.25	17.22		
		2	512	1850.2	23.84	17.82	24.20	18.18
			661	1880.0	23.79	17.77		
			810	1909.8	23.79	17.77		
		3	512	1850.2	22.34	18.08	23.00	18.74
			661	1880.0	22.32	18.06		
			810	1909.8	22.32	18.06		
		4	512	1850.2	21.07	18.06	21.50	18.49
			661	1880.0	21.17	18.16		
			810	1909.8	21.19	18.18		

Notes:

GPRS/EDGE (GMSK) mode with 3 time slots for Max power based on the Tune-up Procedure.

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} *(Note1, 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} (Note1)	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.

HSPA+ Setup Procedures used to establish the test signals

Since 16QAM is not used for uplink, the uplink Category and release is same as HSUPA. Therefore, the RF conducted power is not measured.

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

W-CDMA Band II Measured Results

Mode		UL Ch No.	Freq. (MHz)	Maximum Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	25.04	N/A	25.50
		9400	1880.0	25.20		
		9538	1907.6	25.20		
HSDPA	Subtest 1	9262	1852.4	24.68	0	25.50
		9400	1880.0	24.54		
		9538	1907.6	24.42		
	Subtest 2	9262	1852.4	24.65	0	25.50
		9400	1880.0	24.56		
		9538	1907.6	24.44		
	Subtest 3	9262	1852.4	23.66	0.0	25.50
		9400	1880.0	23.55		
		9538	1907.6	23.38		
	Subtest 4	9262	1852.4	25.05	0.0	25.50
		9400	1880.0	25.20		
		9538	1907.6	25.28		
HSUPA	Subtest 1	9262	1852.4	23.00	2	23.00
		9400	1880.0	21.48		
		9538	1907.6	21.38		
	Subtest 2	9262	1852.4	21.09	3	22.00
		9400	1880.0	20.54		
		9538	1907.6	20.42		
	Subtest 3	9262	1852.4	23.00	2	23.00
		9400	1880.0	21.58		
		9538	1907.6	21.44		
	Subtest 4	9262	1852.4	21.65	3	22.00
		9400	1880.0	20.55		
		9538	1907.6	20.39		
	Subtest 5	9262	1852.4	24.99	0	25.00
		9400	1880.0	23.43		
		9538	1907.6	23.28		

W-CDMA Band V Measured Results

Mode		UL Ch No.	Freq. (MHz)	Maximum Average Power (dBm)		
				Measured Pwr	MPR	Tune-up Limit
Release 99	Rel 99 (RMC, 12.2 kbps)	4132	826.4	24.74	N/A	25.50
		4183	836.6	24.52		
		4233	846.6	24.27		
HSDPA	Subtest 1	4132	826.4	23.37	0	24.00
		4183	836.6	23.15		
		4233	846.6	22.87		
	Subtest 2	4132	826.4	22.56	0	24.00
		4183	836.6	22.25		
		4233	846.6	22.02		
	Subtest 3	4132	826.4	21.36	0.5	23.50
		4183	836.6	21.41		
		4233	846.6	21.64		
	Subtest 4	4132	826.4	21.45	0.5	23.50
		4183	836.6	21.08		
		4233	846.6	21.12		
HSUPA	Subtest 1	4132	826.4	19.89	2	21.80
		4183	836.6	19.68		
		4233	846.6	19.33		
	Subtest 2	4132	826.4	18.91	3	20.80
		4183	836.6	18.66		
		4233	846.6	18.33		
	Subtest 3	4132	826.4	19.93	2	21.80
		4183	836.6	19.68		
		4233	846.6	19.35		
	Subtest 4	4132	826.4	18.87	3	20.80
		4183	836.6	18.55		
		4233	846.6	18.31		
	Subtest 5	4132	826.4	22.76	0	23.80
		4183	836.6	22.42		
		4233	846.6	22.02		

9.3. LTE

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

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

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 1, 2 and 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3
256 QAM	≥ 1						≤ 5

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

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

Network Signalling value	Requirements (subclause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	N/A

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

SAR measurement is not required for the 16QAM. When the highest maximum output power for 16QAM 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.

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		24.50		0	25
		1	25		24.50		0	25
		1	49		24.50		0	25
		25	0		23.05		1	24
		25	12		23.05		1	24
		25	25		23.06		1	24
		50	0		23.05		1	24
	16QAM	1	0		23.50		1	24
		1	25		23.50		1	24
		1	49		23.50		1	24
		25	0		22.50		2	23
		25	12		22.50		2	23
		25	25		22.50		2	23
		50	0		22.50		2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20425	20525	20625		
				826.5 MHz	836.5 MHz	846.5 MHz		
5 MHz	QPSK	1	0	23.72	23.78	23.55	0	25
		1	12	23.74	23.75	23.51	0	25
		1	24	23.68	23.76	23.47	0	25
		12	0	22.17	22.25	22.00	1	24
		12	7	22.16	22.25	22.00	1	24
		12	13	22.15	22.27	22.00	1	24
		25	0	22.18	22.25	22.02	1	24
	16QAM	1	0	22.67	22.76	22.51	1	24
		1	12	22.60	22.71	22.45	1	24
		1	24	22.60	22.73	22.44	1	24
		12	0	21.58	21.59	21.49	2	23
		12	7	21.61	21.66	21.42	2	23
		12	13	21.58	21.61	21.43	2	23
		25	0	21.71	21.70	21.42	2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				20415	20525	20635		
				825.5 MHz	836.5 MHz	847.5 MHz		
3 MHz	QPSK	1	0	23.79	23.87	23.65	0	25
		1	8	23.78	23.84	23.62	0	25
		1	14	23.74	23.86	23.54	0	25
		8	0	22.17	22.26	22.02	1	24
		8	4	22.15	22.28	22.00	1	24
		8	7	22.16	22.28	22.00	1	24
		15	0	22.17	22.25	22.00	1	24
	16QAM	1	0	22.91	22.63	22.42	1	24
		1	8	22.98	22.49	22.32	1	24
		1	14	22.87	22.59	22.45	1	24
		8	0	21.72	21.72	21.46	2	23
		8	4	21.71	21.75	21.45	2	23
		8	7	21.70	21.75	21.42	2	23
		15	0	21.62	21.69	21.41	2	23

Note(s):

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

LTE Band 5 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				
				20407	20525	20643	MPR	Tune-up Limit
				824.7 MHz	836.5 MHz	848.3 MHz		
1.4 MHz	QPSK	1	0	23.51	23.79	23.51	0	25
		1	3	23.44	23.76	23.44	0	25
		1	5	23.44	23.77	23.44	0	25
		3	0	23.54	23.74	23.54	0	25
		3	1	23.51	23.75	23.51	0	25
		3	3	23.52	23.74	23.52	0	25
		6	0	22.00	22.22	22.00	1	24
	16QAM	1	0	22.39	22.59	22.39	1	24
		1	3	22.44	22.60	22.44	1	24
		1	5	22.35	22.59	22.35	1	24
		3	0	22.38	22.63	22.38	1	24
		3	1	22.41	22.63	22.41	1	24
		3	3	22.35	22.62	22.35	1	24
		6	0	21.35	21.68	21.35	2	23

LTE Band 41 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
20 MHz	QPSK	1	0	23.37	23.63	23.31	23.19	23.36	0	25
		1	49	23.26	23.55	23.52	23.13	23.36	0	25
		1	99	23.28	23.41	23.53	23.05	23.37	0	25
		50	0	22.59	22.88	22.68	22.40	22.62	1	24
		50	24	22.57	22.83	22.72	22.36	22.61	1	24
		50	50	22.52	22.77	22.76	22.33	22.58	1	24
		100	0	22.56	22.81	22.74	22.37	22.62	1	24
	16QAM	1	0	22.70	22.90	22.52	22.60	22.89	1	24
		1	49	22.66	23.00	22.70	22.52	22.94	1	24
		1	99	22.36	22.75	22.64	22.46	22.91	1	24
		50	0	21.63	21.90	21.79	21.43	21.70	2	23
		50	24	21.59	21.84	21.81	21.37	21.65	2	23
		50	50	21.57	21.80	21.82	21.34	21.64	2	23
		100	0	21.61	21.83	21.78	21.41	21.64	2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
15 MHz	QPSK	1	0	23.36	23.55	23.35	23.12	23.29	0	25
		1	37	23.24	23.49	23.50	23.13	23.35	0	25
		1	74	23.27	23.41	23.47	23.09	23.21	0	25
		36	0	22.60	22.93	22.72	22.43	22.63	1	24
		36	20	22.58	22.88	22.77	22.39	22.62	1	24
		36	39	22.56	22.84	22.79	22.36	22.61	1	24
		75	0	22.56	22.89	22.77	22.40	22.62	1	24
	16QAM	1	0	22.27	23.06	22.72	22.29	22.80	1	24
		1	37	22.47	23.02	22.58	22.10	22.78	1	24
		1	74	22.42	22.91	22.51	22.13	22.83	1	24
		36	0	21.60	21.96	21.74	21.45	21.72	2	23
		36	20	21.59	21.94	21.78	21.41	21.72	2	23
		36	39	21.63	21.91	21.75	21.39	21.71	2	23
		75	0	21.60	21.92	21.80	21.40	21.64	2	23

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
10 MHz	QPSK	1	0	23.27	23.49	23.45	23.17	23.28	0	25
		1	25	23.26	23.43	23.49	23.14	23.27	0	25
		1	49	23.25	23.41	23.54	23.11	23.28	0	25
		25	0	22.55	22.84	22.75	22.38	22.60	1	24
		25	12	22.54	22.81	22.77	22.36	22.59	1	24
		25	25	22.53	22.79	22.80	22.35	22.59	1	24
		50	0	22.50	22.79	22.75	22.35	22.57	1	24
	16QAM	1	0	22.26	23.05	22.59	22.34	22.86	1	24
		1	25	22.23	23.00	22.61	22.32	22.84	1	24
		1	49	22.22	22.98	22.65	22.29	22.84	1	24
		25	0	21.60	21.89	21.77	21.43	21.67	2	23
		25	12	21.59	21.85	21.80	21.41	21.65	2	23
		25	25	21.58	21.84	21.81	21.41	21.65	2	23
		50	0	21.59	21.83	21.80	21.41	21.64	2	23

LTE Band 41 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)					MPR	Tune-up Limit
				39750	40185	40620	41055	41490		
				2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz		
5 MHz	QPSK	1	0	23.31	23.52	23.42	23.12	23.31	0	25
		1	12	23.30	23.50	23.43	23.09	23.30	0	25
		1	24	23.27	23.48	23.46	23.09	23.34	0	25
		12	0	22.57	22.83	22.75	22.36	22.58	1	24
		12	7	22.56	22.82	22.74	22.35	22.57	1	24
		12	13	22.55	22.81	22.75	22.33	22.57	1	24
		25	0	22.55	22.80	22.74	22.34	22.57	1	24
	16QAM	1	0	22.53	22.45	22.69	22.29	22.20	1	24
		1	12	22.50	22.44	22.70	22.29	22.20	1	24
		1	24	22.51	22.45	22.76	22.27	22.23	1	24
		12	0	21.52	21.74	21.80	21.30	21.55	2	23
		12	7	21.50	21.71	21.81	21.29	21.53	2	23
		12	13	21.51	21.70	21.81	21.28	21.52	2	23
		25	0	21.58	21.81	21.83	21.37	21.62	2	23

9.4. LTE Carrier Aggregation

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

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

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

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

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

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

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

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

Where M_A is defined as follows

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

$3.83 – 0.83A$;$0.4 \le A \le 1$

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 ∈ [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.

LTE Down-Link Carrier Aggregation

The tables below show the supported frequency bands of the device for DL Inter-band and 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_5B	N/A	No
Intra-Band Non-Contiguous			
2CC# 2	CA_5A-5A	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)			CC3 (DL)			CC4 (DL)			CC5 (DL)			Aggregated BW	MPR	CA Inactive (dBm)	CA Active (dBm)	Delta
		Mode	BW (MHz)	Channel	Freq (MHz)	RB,Offset	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)					
CA_5B	13	QPSK	10	20476	831.6	1,0	10	2575	886.5										20	0	25.00	25.00	0.00

DL Intra-Band Non-Contiguous Measured Results

E-UTRA CA configuration	3GPP Rel. #	CC1 (UL)					CC2 (DL)			CC3 (DL)			CC4 (DL)			CC5 (DL)			Aggregated BW	MPR	CA Inactive (dBm)	CA Active (dBm)	Delta
		Mode	BW (MHz)	Channel	Freq (MHz)	RB,Offset	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)	BW (MHz)	Channel	Freq (MHz)					
CA_5A-5A	13	QPSK	10	20450	829	1,0	10	2600	889										20	0	25.00	24.91	-0.09

9.5. Wi-Fi 2.4GHz (DTS Band)

Device is set to operate at its normal maximum output WLAN output power when receiver is off state. While the device has a receiver on state, the maximum power becomes reduced power.

Refer to Operational Description for WLAN power back-off explanation.

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)	Reduced Power			Maximum Power		
					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	11.50	12.00	Yes	18.30	19.00	Yes
			6	2437	11.80	12.00		18.40	19.00	
			11	2462	11.60	12.00		17.80	19.00	
			12	2467		8.00			8.00	
			13	2472		8.00			8.00	
OFDM 2.4 GHz	802.11g	6 Mbps	1	2412		12.00	No		17.00	No
			6	2437		12.00			17.00	
			11	2462		12.00			17.00	
			12	2467		7.50			7.50	
			13	2472		7.50			7.50	
	802.11n (HT20)	6.5 Mbps	1	2412		12.00	No		17.00	No
			6	2437		12.00			17.00	
			11	2462		12.00			17.00	
			12	2467		5.50			5.50	
			13	2472		5.50			5.50	

Note(s):

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

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

Device is set to operate at its normal maximum output WLAN output power when receiver is off state. While the device has a receiver on state, the maximum power becomes reduced power.

Refer to Operational Description for WLAN power back-off explanation.

When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/n/ac/ax modes, the channel in the lower order/sequence 802.11 mode (i.e. a, n, ac then ax) 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.

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

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 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

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.

Wi-Fi Direct is supported in U-NII Band 1. Therefore, Wi-Fi Direct was tested separately for SAR for U-NII Band 1.

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Reduced Power			Maximum Power		
					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		12.00	No	16.00	17.00	Yes
			40	5200		12.00		16.00	17.00	
			44	5220		12.00		16.00	17.00	
			48	5240		12.00		16.00	17.00	
	802.11n (HT20)	6.5 Mbps	36	5180		12.00	No		16.00	No
			40	5200		12.00			16.00	
			44	5220		12.00			16.00	
			48	5240		12.00			16.00	
	802.11ac (VHT20)	6.5 Mbps	36	5180		12.00	No		16.00	No
			40	5200		12.00			16.00	
			44	5220		12.00			16.00	
			48	5240		12.00			16.00	
	802.11n (HT40)	13.5 Mbps	38	5190		12.00	No		15.00	No
			46	5230		12.00			15.00	
	802.11ac (VHT40)	13.5 Mbps	38	5190		12.00	No		15.00	No
			46	5230		12.00			15.00	
	802.11ac (VHT80)	29.3 Mbps	42	5210	11.00	12.00	Yes		14.00	No

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Reduced Power			Maximum Power		
					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		12.00	No	16.00	17.00	Yes
			56	5280		12.00		16.00	17.00	
			60	5300		12.00		16.00	17.00	
			64	5320		12.00		16.00	17.00	
	802.11n (HT20)	6.5 Mbps	52	5260		12.00	No		16.00	No
			56	5280		12.00			16.00	
			60	5300		12.00			16.00	
			64	5320		12.00			16.00	
	802.11ac (VHT20)	6.5 Mbps	52	5260		12.00	No		16.00	No
			56	5280		12.00			16.00	
			60	5300		12.00			16.00	
			64	5320		12.00			16.00	
	802.11n (HT40)	13.5 Mbps	54	5270		12.00	No		15.00	No
			62	5310		12.00			15.00	
	802.11ac (VHT40)	13.5 Mbps	54	5270		12.00	No		15.00	No
			62	5310		12.00			15.00	
	802.11ac (VHT80)	29.3 Mbps	58	5290	11.00	12.00	Yes		14.00	No

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Reduced Power			Maximum Power		
					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		12.00	No	16.00	17.00	Yes
			116	5580		12.00		16.00	17.00	
			124	5620		12.00		16.00	17.00	
			144	5720		12.00		15.90	17.00	
	802.11n (HT20)	6.5 Mbps	100	5500		12.00	No		16.00	No
			116	5580		12.00			16.00	
			124	5620		12.00			16.00	
			144	5720		12.00			16.00	
	802.11ac (VHT20)	6.5 Mbps	100	5500		12.00	No		16.00	No
			116	5580		12.00			16.00	
			124	5620		12.00			16.00	
			144	5720		12.00			16.00	
	802.11n (HT40)	13.5 Mbps	102	5510		12.00	No		13.00	No
			118	5590		12.00			15.00	
			126	5630		12.00			15.00	
			142	5710		12.00			15.00	
	802.11ac (VHT40)	13.5 Mbps	102	5510		12.00	No		13.00	No
			118	5590		12.00			15.00	
			126	5630		12.00			15.00	
			142	5710		12.00			15.00	
	802.11ac (VHT80)	29.3 Mbps	106	5530	11.00	12.00	Yes		14.00	No
			122	5610	11.00	12.00			14.00	
			138	5690	11.00	12.00			14.00	

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Reduced Power			Maximum Power		
					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		12.00	No	16.00	17.00	Yes
			157	5785		12.00		15.80	17.00	
			165	5825		12.00		15.90	17.00	
	802.11n (HT20)	6.5 Mbps	149	5745		12.00	No		16.00	No
			157	5785		12.00			16.00	
			165	5825		12.00			16.00	
	802.11ac (VHT20)	6.5 Mbps	149	5745		12.00	No		16.00	No
			157	5785		12.00			16.00	
			165	5825		12.00			16.00	
	802.11n (HT40)	13.5 Mbps	151	5755		12.00	No		15.00	No
			159	5795		12.00			15.00	
	802.11ac (VHT40)	13.5 Mbps	151	5755		12.00	No		15.00	No
			159	5795		12.00			15.00	
	802.11ac (VHT80)	29.3 Mbps	155	5775	10.70	12.00	Yes		14.00	No

9.7. 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)	Chain 0 Average Power (dBm)		
				Meas Pwr	Tune-up	SAR Test (Yes/No)
2.4	GFSK	0	2402	8.95	10.00	Yes
		39	2441	9.17	10.00	
		78	2480	9.17	10.00	
	EDR, π/4 DQPSK	0	2402	5.60	10.00	No
		39	2441	5.80	10.00	
		78	2480	5.62	10.00	
	EDR, 8-DPSK	0	2402	5.58	10.00	No
		39	2441	5.38	10.00	
		78	2480	5.45	10.00	
	LE, GFSK	0	2402	1.68	6.50	No
		19	2440	1.96	6.50	
		39	2480	2.19	6.50	

Duty Factor Measured Results

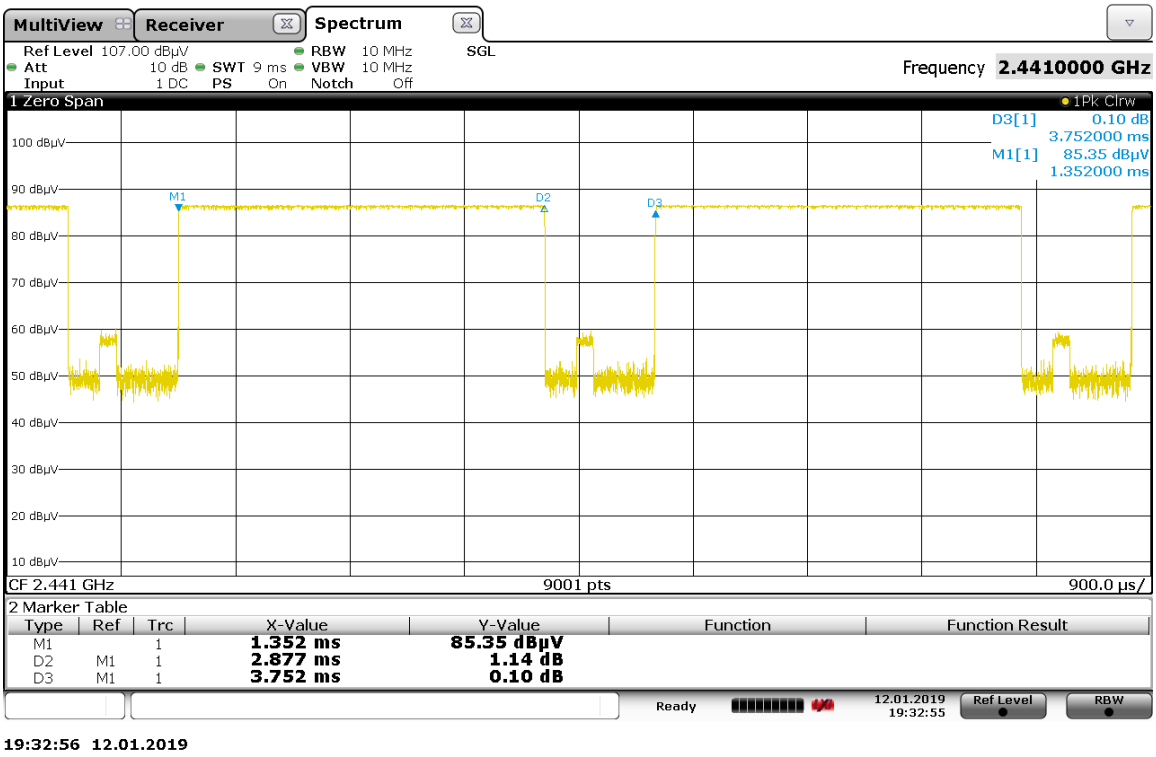
Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	2.877	3.752	76.68%	1.30

Note(s):

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

Duty Cycle plots

GFSK



19:32:56 12.01.2019

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

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

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 648474 D04 Handset SAR:

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

KDB 648474 D04 Handset SAR (Phablet Only):

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.

Additional 1-g SAR testing at 5 mm is not required when hotspot mode 10-g extremity SAR is not required for the surfaces and edges; since all 1-g reported SAR < 1.2 W/kg.

KDB 941225 D01 SAR test for 3G devices:

When the maximum output power and tune-up tolerance specified for production units in a secondary mode is ≤ ¼ dB higher than the primary mode or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is ≤ 1.2 W/kg, SAR measurement is not required for the secondary mode.

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

- Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB, and 50% RB allocation, using the RB offset and required test channel combination with the highest maximum output power among RB offsets at the upper edge, middle and lower edge of each required test channel.
- When the reported SAR is > 0.8 W/kg, testing for other Channels is performed at the highest output power level for 1RB, and 50% RB configuration for that channel.
- Testing for 100% RB configuration is performed at the highest output power level for 100% RB configuration across the Low, Mid and High Channel when the highest reported SAR for 1 RB and 50% RB are > 0.8 W/kg. Testing for the remaining required channels is not needed because the reported SAR for 100% RB Allocation < 1.45 W/kg.
- Testing for 16-QAM modulation is not required because the reported SAR for QPSK is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of QPSK.
- Testing for the other channel bandwidths is not required because the reported SAR for the highest channel bandwidth is < 1.45 W/Kg and its output power is not more than 0.5 dB higher than that of the highest channel bandwidth.
- For LTE bands that do not support at least three non-overlapping channels in certain channel bandwidths, test the available non-overlapping channels instead. When a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing; therefore, the requirement for H, M and L channels may not fully apply.

KDB 248227 D01 SAR meas for 802.11:

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

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the initial test position(s) by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The initial test position(s) is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). Initial Test Position SAR Test Reduction Procedure is outlined in KDB 248227 D01 §5.1.1. To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

10.1. GSM850

RF Exposure Conditions	Mode	Power Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	GPRS 3 Slots	OFF	0	Left Touch	190	836.6	30.0	28.7	0.162	0.217	
				Left Tilt	190	836.6	30.0	28.7	0.084	0.113	
				Right Touch	190	836.6	30.0	28.7	0.217	**0.291**	1
				Right Tilt	190	836.6	30.0	28.7	0.089	0.119	
Body-worn	GPRS 3 Slots	OFF	15	Rear	190	836.6	30.0	28.7	0.390	**0.522**	2
				Front	190	836.6	30.0	28.7	0.162	0.217	
Hotspot	GPRS 3 Slots	OFF	10	Rear	128	826.4	30.0	28.6	0.714	0.997	
					190	836.6	30.0	28.7	0.839	1.124	
					251	848.8	30.0	28.8	0.861	**1.148**	3
				Front	190	836.6	30.0	28.7	0.174	0.233	
				Edge 2	190	836.6	30.0	28.7	0.227	0.304	
				Edge 3	190	836.6	30.0	28.7	0.289	0.387	
				Edge 4	190	836.6	30.0	28.7	0.058	0.078	

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
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	GPRS 3 Slots	OFF	0	Left Touch	661	1880.0	26.6	25.1	0.151	**0.213**	4
				Left Tilt	661	1880.0	26.6	25.1	0.081	0.114	
				Right Touch	661	1880.0	26.6	25.1	0.097	0.137	
				Right Tilt	661	1880.0	26.6	25.1	0.063	0.089	
Body-worn	GPRS 3 Slots	OFF	15	Rear	661	1880.0	26.6	25.1	0.132	**0.186**	5
				Front	661	1880.0	26.6	25.1	0.112	0.158	
Hotspot	GPRS 3 Slots	OFF	10	Rear	661	1880.0	26.6	25.1	0.368	**0.519**	6
				Front	661	1880.0	26.6	25.1	0.217	0.306	
				Edge 2	661	1880.0	26.6	25.1	0.072	0.101	
				Edge 3	661	1880.0	26.6	25.1	0.215	0.303	
				Edge 4	661	1880.0	26.6	25.1	0.228	0.321	

10.3. W-CDMA Band II

RF Exposure Conditions	Mode	Pwr Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC 12.2 kbps	OFF	0	Left Touch	9400	1880.0	25.5	25.2	0.294	**0.315**	7
				Left Tilt	9400	1880.0	25.5	25.2	0.145	0.155	
				Right Touch	9400	1880.0	25.5	25.2	0.181	0.194	
				Right Tilt	9400	1880.0	25.5	25.2	0.135	0.145	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	9400	1880.0	25.5	25.2	0.191	0.205	
				Front	9400	1880.0	25.5	25.2	0.192	**0.206**	8
Hotspot	Rel 99 RMC 12.2 kbps	OFF	10	Rear	9400	1880.0	25.5	25.2	0.533	**0.571**	9
				Front	9400	1880.0	25.5	25.2	0.332	0.356	
				Edge 2	9400	1880.0	25.5	25.2	0.123	0.132	
				Edge 3	9400	1880.0	25.5	25.2	0.346	0.371	
				Edge 4	9400	1880.0	25.5	25.2	0.374	0.401	

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
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC 12.2 kbps	OFF	0	Left Touch	4183	836.6	25.5	24.5	0.091	0.114	
				Left Tilt	4183	836.6	25.5	24.5	0.048	0.060	
				Right Touch	4183	836.6	25.5	24.5	0.128	**0.160**	10
				Right Tilt	4183	836.6	25.5	24.5	0.054	0.068	
Body-worn	Rel 99 RMC 12.2 kbps	OFF	15	Rear	4183	836.6	25.5	24.5	0.227	**0.284**	11
				Front	4183	836.6	25.5	24.5	0.104	0.130	
Hotspot	Rel 99 RMC 12.2 kbps	OFF	10	Rear	4183	836.6	25.5	24.5	0.487	**0.610**	12
				Front	4183	836.6	25.5	24.5	0.102	0.128	
				Edge 2	4183	836.6	25.5	24.5	0.159	0.199	
				Edge 3	4183	836.6	25.5	24.5	0.198	0.248	
				Edge 4	4183	836.6	25.5	24.5	0.042	0.053	

10.5. 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
									Tune-up Limit	Meas.	Meas.	Scaled	
Head	QPSK	OFF	0	Left Touch	20525	836.5	1	0	25.0	24.5	0.098	0.110	
							25	25	24.0	23.1	0.061	0.076	
				Left Tilt (15°)	20525	836.5	1	0	25.0	24.5	0.055	0.062	
							25	25	24.0	23.1	0.033	0.041	
				Right Touch	20525	836.5	1	0	25.0	24.5	0.131	**0.147**	13
							25	25	24.0	23.1	0.076	0.094	
				Right Tilt (15°)	20525	836.5	1	0	25.0	24.5	0.061	0.068	
							25	25	24.0	23.1	0.034	0.042	
Body-worn	QPSK	OFF	15	Rear	20525	836.5	1	0	25.0	24.5	0.223	**0.250**	14
							25	25	24.0	23.1	0.153	0.190	
				Front	20525	836.5	1	0	25.0	24.5	0.086	0.096	
							25	25	24.0	23.1	0.050	0.062	
Hotspot	QPSK	OFF	10	Rear	20525	836.5	1	0	25.0	24.5	0.388	**0.435**	15
							25	25	24.0	23.1	0.264	0.328	
				Front	20525	836.5	1	0	25.0	24.5	0.087	0.098	
							25	25	24.0	23.1	0.054	0.067	
				Edge 2	20525	836.5	1	0	25.0	24.5	0.156	0.175	
							25	25	24.0	23.1	0.092	0.114	
				Edge 3	20525	836.5	1	0	25.0	24.5	0.172	0.193	
							25	25	24.0	23.1	0.125	0.155	
				Edge 4	20525	836.5	1	0	25.0	24.5	0.042	0.047	
							25	25	24.0	23.1	0.022	0.027	

10.6. 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
									Tune-up Limit	Meas.	Meas.	Scaled	
Head	QPSK	OFF	0	Left Touch	40620	2593.0	1	99	25.0	23.5	0.124	0.174	
							50	50	24.0	22.8	0.099	0.132	
				Left Tilt (15°)	40620	2593.0	1	99	25.0	23.5	0.105	0.147	
							50	50	24.0	22.8	0.087	0.116	
				Right Touch	40620	2593.0	1	99	25.0	23.5	0.170	**0.238**	16
							50	50	24.0	22.8	0.138	0.184	
				Right Tilt (15°)	40620	2593.0	1	99	25.0	23.5	0.057	0.080	
							50	50	24.0	22.8	0.045	0.060	
Body-worn	QPSK	OFF	15	Rear	40620	2593.0	1	99	25.0	23.5	0.166	**0.233**	17
							50	50	24.0	22.8	0.109	0.145	
				Front	40620	2593.0	1	99	25.0	23.5	0.139	0.195	
							50	50	24.0	22.8	0.115	0.153	
Hotspot	QPSK	OFF	10	Rear	40620	2593.0	1	99	25.0	23.5	0.323	**0.453**	18
							50	50	24.0	22.8	0.217	0.289	
				Front	40620	2593.0	1	99	25.0	23.5	0.240	0.337	
							50	50	24.0	22.8	0.218	0.290	
				Edge 2	40620	2593.0	1	99	25.0	23.5	0.217	0.304	
							50	50	24.0	22.8	0.177	0.235	
				Edge 3	40620	2593.0	1	99	25.0	23.5	0.143	0.201	
							50	50	24.0	22.8	0.116	0.154	

10.7. Wi-Fi (DTS Band)

When the 802.11b reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, no further SAR testing is required. If SAR is > 0.8 W/kg and ≤ 1.2 W/kg, SAR is required for the next highest measured output power channel. Finally, if SAR is > 1.2 W/kg, SAR is required for the third channel.

SAR testing is not required for OFDM mode(s) when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

RF Exposure Conditions	Mode	Antenna	Pwr-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
										Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11b 1 Mbps	Wi-Fi Antenna #1	ON	0	Left Touch	6	2437	100.00%	0.246	12.0	11.8	0.101	**0.106**	19
					Left Tilt	6	2437	100.00%	0.149	12.0	11.8			
					Right Touch	6	2437	100.00%	0.015	12.0	11.8			
					Right Tilt	6	2437	100.00%	0.020	12.0	11.8			
Body-worn	802.11b 1 Mbps	Wi-Fi Antenna #1	OFF	15	Rear	6	2437	100.00%	**0.151**	19.0	18.4	0.102	**0.117**	20
					Front	6	2437	100.00%	0.028	19.0	18.4			
Hotspot	802.11b 1 Mbps	Wi-Fi Antenna #1	OFF	10	Rear	6	2437	100.00%	**0.421**	19.0	18.4	0.244	**0.280**	21
					Front	6	2437	100.00%	0.058	19.0	18.4			
					Edge 1	6	2437	100.00%	0.074	19.0	18.4			
					Edge 2	6	2437	100.00%	0.088	19.0	18.4			

10.8. Wi-Fi (U-NII Band)

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.

UNII-2A

RF Exposure Conditions	Mode	Antenna	Pwr 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
										Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	Wi-Fi Antenna #1	ON	0	Left Touch	58	5290	74.26%	0.133	12.0	11.0			
					Left Tilt	58	5290	74.26%	**0.156**	12.0	11.0	0.084	**0.142**	22
					Right Touch	58	5290	74.26%	0.126	12.0	11.0			
					Right Tilt	58	5290	74.26%	0.136	12.0	11.0			
Body-worn	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	15	Rear	64	5320	93.97%	**0.203**	17.0	16.0	0.089	**0.119**	23
					Front	64	5320	93.97%	0.053	17.0	16.0			
RF Exposure Conditions	Mode	Antenna	Pwr 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
										Tune-up Limit	Meas.	Meas.	Scaled	
Product Specific 10g	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	0	Rear	64	5320	93.97%	3.250	17.0	16.0			
					Front	64	5320	93.97%	1.110	17.0	16.0			
					Edge 1	64	5320	93.97%	**6.690**	17.0	16.0	0.435	**0.583**	24
					Edge 2	64	5320	93.97%	0.069	17.0	16.0			

UNII-2C

RF Exposure Conditions	Mode	Antenna	Pwr 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
										Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	Wi-Fi Antenna #1	ON	0	Left Touch	122	5610	74.26%	0.125	12.0	11.0			
					Left Tilt	122	5610	74.26%	0.134	12.0	11.0			
					Right Touch	122	5610	74.26%	0.110	12.0	11.0			
					Right Tilt	122	5610	74.26%	**0.140**	12.0	11.0	0.064	**0.108**	25
Body-worn	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	15	Rear	124	5620	93.97%	**0.284**	17.0	16.0	0.125	**0.167**	26
					Front	124	5620	93.97%	0.053	17.0	16.0			
RF Exposure Conditions	Mode	Antenna	Pwr 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
										Tune-up Limit	Meas.	Meas.	Scaled	
Product Specific 10g	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	10	Rear	124	5620	93.97%	3.300	17.0	16.0			
					Front	124	5620	93.97%	0.743	17.0	16.0			
					Edge 1	124	5620	93.97%	**5.650**	17.0	16.0	0.361	**0.484**	27
					Edge 2	124	5620	93.97%	0.023	17.0	16.0			

UNII-3

RF Exposure Conditions	Mode	Antenna	Pwr 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
										Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11ac VHT80	Wi-Fi Antenna #1	ON	0	Left Touch	155	5775	74.26%	0.085	12.0	10.7			
					Left Tilt	155	5775	74.26%	**0.121**	12.0	10.7	0.038	**0.069**	28
					Right Touch	155	5775	74.26%	0.039	12.0	10.7			
					Right Tilt	155	5775	74.26%	0.049	12.0	10.7			
Body-worn	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	15	Rear	149	5745	93.97%	**0.137**	17.0	16.0	0.108	**0.145**	29
					Front	149	5745	93.97%	0.036	17.0	16.0			
Hotspot	802.11a 6 Mbps	Wi-Fi Antenna #1	OFF	10	Rear	149	5745	93.97%	0.218	17.0	16.0			
					Front	149	5745	93.97%	0.048	17.0	16.0			
					Edge 1	149	5745	93.97%	**0.263**	17.0	16.0	0.114	**0.153**	30
					Edge 2	149	5745	93.97%	0.029	17.0	16.0			

10.9. Bluetooth

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot
							Tune-up Limit	Meas.	Meas.	Scaled	
Head	GFSK	Antenna #1	0	Left Touch	39	2441	10.0	9.2	0.033	0.040	
				Left Tilt	39	2441	10.0	9.2	0.042	**0.051**	31
				Right Touch	39	2441	10.0	9.2	0.023	0.028	
				Right Tilt	39	2441	10.0	9.2	0.029	0.035	
Body-worn	GFSK	Antenna #1	15	Rear	39	2441	10.0	9.2	0.003	**0.004**	32
				Front	39	2441	10.0	9.2	0.003	0.003	
BT Tethering	GFSK	Antenna #1	10	Rear	39	2441	10.0	9.2	0.015	**0.018**	33
				Front	39	2441	10.0	9.2	0.006	0.007	
				Edge 1	39	2441	10.0	9.2	0.004	0.005	
				Edge 2	39	2441	10.0	9.2	0.002	0.002	

11. SAR Measurement Variability

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

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	First Repeated	
						Measured SAR (W/kg)	Largest to Smallest SAR Ratio
850	GSM 850	Hotspot	Rear	Yes	0.861	0.777	1.11
	WCDMA Band V	Hotspot	Rear	No	0.487	N/A	N/A
	LTE Band 5	Hotspot	Rear	No	0.388	N/A	N/A
1900	GSM 1900	Hotspot	Rear	No	0.368	N/A	N/A
	WCDMA Band II	Hotspot	Rear	No	0.533	N/A	N/A
2400	Wi-Fi 802.11b/g/n	Hotspot	Rear	No	0.244	N/A	N/A
	BT	Head	Left Tilt	No	0.042	N/A	N/A
2600	LTE Band 41	Hotspot	Rear	No	0.323	N/A	N/A
5200	Wi-Fi 802.11a/n/ac	Hotspot	Edge 1	No	0.149	N/A	N/A
5300	Wi-Fi 802.11a/n/ac	Body	Rear	No	0.089	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Body	Rear	No	0.125	N/A	N/A
5800	Wi-Fi 802.11a/n/ac	Hotspot	Edge 1	No	0.114	N/A	N/A

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	Edge 1	No	0.435	N/A	N/A
5500	Wi-Fi 802.11a/n/ac	Product Specific 10g	Edge 1	No	0.361	N/A	N/A

Note(s):

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

12. Simultaneous Transmission Conditions

RF Exposure Condition	Item	Capable Transmit Configurations		
Head Body-worn 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	W-CDMA	+	BT
	10	LTE	+	DTS
	11	LTE	+	U-NII
	12	LTE	+	BT

Notes:
1. DTS & UNII (ch 149 only) supports Hotspot.
2. VoIP is supported in GPRS/EDGE, W-CDMA, and LTE.
3. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
4. U-NII Radio cannot transmit simultaneously with Bluetooth Radio.

Note(s):

Product Specific 10 SAR is not required simultaneous transmission.

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	0.315	0.106	0.142	0.051	**0.421**	**0.457**	**0.366**
Body-worn	0.522	0.117	0.167	0.004	**0.639**	**0.689**	**0.526**
Hotspot	1.148	0.280	0.153	0.018	**1.428**	**1.301**	**1.166**

Conclusion:

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

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