FCC 47 CFR § 2.1093
IEEE Std 1528-2013

SAR EVALUATION REPORT

FOR

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

MODEL NUMBER: SM-A405FN/DS

FCC ID: A3LSMA405FN

REPORT NUMBER: 4788874100-S1V2

ISSUE DATE: 3/5/2019

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ACCREDITED
Testing Laboratory

TL-637

Revision History

Rev.	Date	Revisions	Revised By
V1	2/28/2019	Initial Issue	Sunghoon Kim
V2	3/5/2019	Sec.4.3 -Revised D2600V2's Cal. Due Date in table.	Sunghoon Kim

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Table of Contents

1. Attestation of Test Results 5

2. Test Specification, Methods and Procedures 6

3. Facilities and Accreditation 6

4. SAR Measurement System & Test Equipment 7

4.1. SAR Measurement System 7

4.2. SAR Scan Procedures 8

4.3. Test Equipment 10

5. Measurement Uncertainty 11

6. Device Under Test (DUT) Information 11

6.1. DUT Description 11

6.2. Wireless Technologies 12

6.3. Nominal and Maximum Output Power 13

6.4. General LTE SAR Test and Reporting Considerations 15

6.5. LTE (TDD) Considerations 16

6.6. Proximity Sensor feature 17

6.6.1. Proximity Sensor Triggering Distance (KDB 616217 §6.2) 17

6.6.2. Resulting test positions for SAR measurements 18

7. RF Exposure Conditions (Test Configurations) 19

8. Dielectric Property Measurements & System Check 20

8.1 Dielectric Property Measurements 20

8.2 System Check 23

9. Conducted Output Power Measurements 25

9.1 GSM 25

9.2 W-CDMA 27

9.3 LTE 32

9.4 Wi-Fi 2.4 GHz (DTS Band) 40

9.5 Wi-Fi 5GHz (U-NII Bands) 41

9.6 Bluetooth 42

10. Measured and Reported (Scaled) SAR Results 43

10.1 GSM 850 45

10.2 GSM1900 45

10.3 W-CDMA Band II 46

10.4 W-CDMA Band V 46

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10.5 LTE Band 5 (10MHz Bandwidth) ... 47
10.6 LTE Band 41 (20MHz Bandwidth) ... 47
10.7 Wi-Fi (DTS Band) ... 48
10.8 Wi-Fi (U-NII Bands) ... 48
10.9 Bluetooth ... 49

11. SAR Measurement Variability ... 50

12. DUT Holder Perturbations ... 51

13. Simultaneous Transmission SAR Analysis ... 51
13.1 Sum of the SAR for WWAN & Wi-Fi & BT ... 53

Appendixes ... 54
4788874100-S1V2 FCC Report SAR_App A_Photos & Ant. Locations ... 54
4788874100-S1V2 FCC Report SAR_App B_Highest SAR Test Plots ... 54
4788874100-S1V2 FCC Report SAR_App C_System Check Plots ... 54
4788874100-S1V2 FCC Report SAR_App D_SAR Tissue Ingredients ... 54
4788874100-S1V2 FCC Report SAR_App E_Probe Cal. Certificates ... 54
4788874100-S1V2 FCC Report SAR_App F_Dipole Cal. Certificates ... 54

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1. Attestation of Test Results

Applicant Name		SAMSUNG ELECTRONICS CO.,LTD.			
FCC ID		A3LSMA405FN			
Model Number		SM-A405FN/DS			
Applicable Standards		FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
SAR Limits (W/Kg)					
Exposure Category		Peak spatial-average(1g of tissue)			
General population / Uncontrolled exposure		1.6			
The Highest Reported SAR (W/kg)					
RF Exposure Conditions		**Equipment Class**			
		Licensed	**DTS**	**U-NII**	**DSS(BT)**
Head		0.51	0.19	0.27	<0.10
Body-worn		0.46	0.24	<0.10	N/A
Hotspot		0.61	0.41	0.10	
Simultaneous TX	Head	0.77	0.70	0.77	0.58
	Body-worn	0.70		0.54	N/A
	Hotspot	1.02		0.72	
Date Tested		2/14/2019 to 2/23/2019			
Test Results		Pass			

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

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.

Approved & Released By:	Prepared By:
Justin Park Lead Test Engineer UL Korea, Ltd. Suwon Laboratory	Sunghoon Kim Test Engineer UL Korea, Ltd. Suwon Laboratory

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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
- 648474 D04 Handset SAR v01r03
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D01 3G SAR Procedures v03r01
- 941225 D05 SAR for LTE Devices v02r05
- 941225 D06 Hotspot Mode v02r01

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

- TCB workshop October, 2014; Page 37, RF Exposure Procedures Update (Other LTE Considerations)
- TCB workshop October, 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)
- TCB workshop October, 2016; Page 18, RF Exposure Procedures (DUT Holder Perturbations)

3. Facilities and Accreditation

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

Suwon
SAR 1 Room
SAR 2 Room
SAR 3 Room
SAR 4 Room

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

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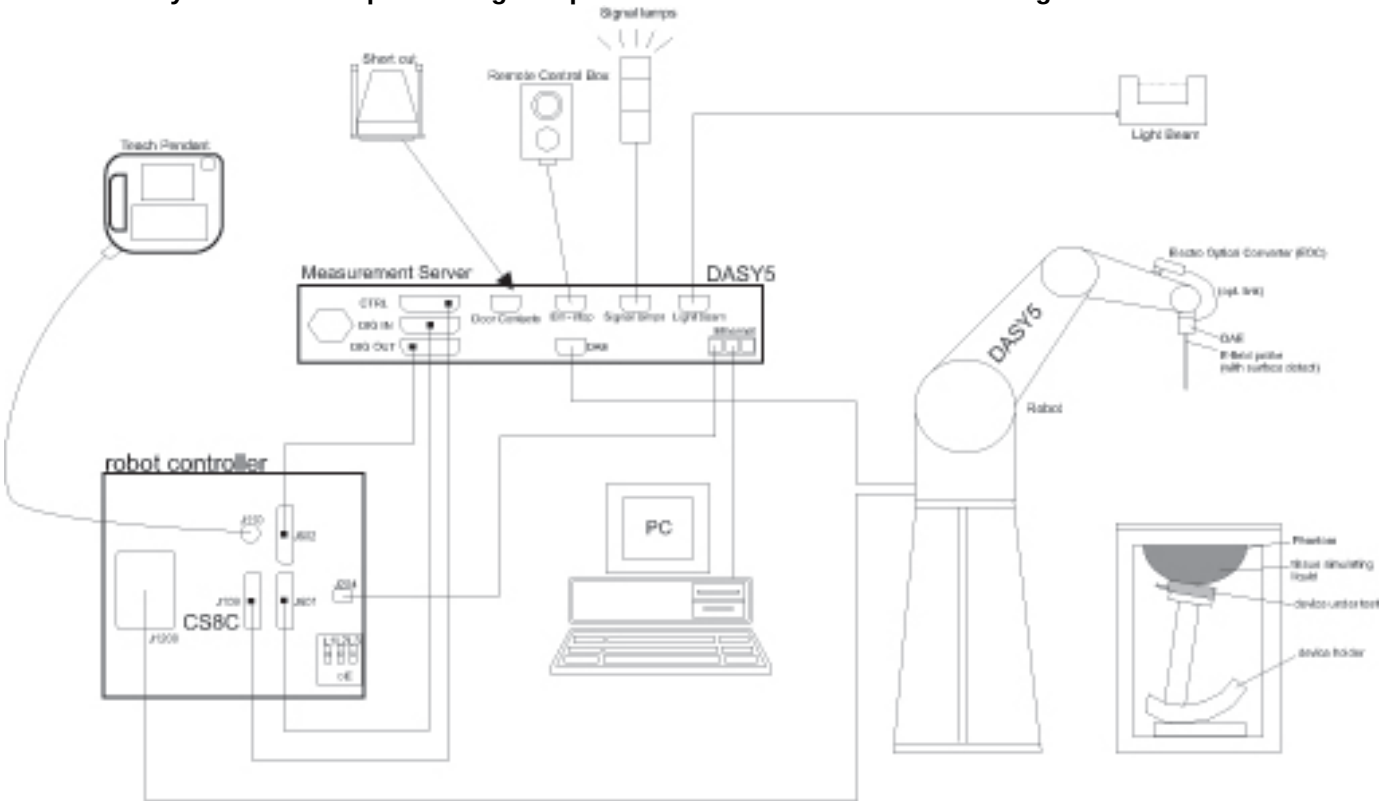
4. SAR Measurement System & Test Equipment

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.

Step 5: Z-Scan (FCC only)

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

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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.

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	E5071C	MY46522054	8-7-2019
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	6-26-2019
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3424	8-9-2019

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8-7-2019
Power Sensor	Agilent	U2000A	MY54260010	8-7-2019
Power Sensor	Agilent	U2000A	MY54260007	8-7-2019
Power Amplifier	EXODUS	1410025-AMP2027-10003	10003	8-8-2019
Directional Coupler	Agilent	772D	MY52180193	8-7-2019
Directional Coupler	Agilent	778D	MY52180432	8-7-2019
Low Pass Filter	MICROLAB	LA-15N	03943	8-7-2019
Low Pass Filter	FILTRON	L14012FL	1410003S	8-7-2019
Low Pass Filter	MICROLAB	LA-60N	03942	8-7-2019
Attenuator	Agilent	8491B/003	MY39269292	8-7-2019
Attenuator	Agilent	8491B/010	MY39269315	8-7-2019
Attenuator	Agilent	8491B/020	MY39269298	8-7-2019
E-Field Probe (SAR1)	SPEAG	EX3DV4	7376	9-26-2019
E-Field Probe (SAR2)	SPEAG	EX3DV4	7330	1-31-2020
E-Field Probe (SAR3)	SPEAG	EX3DV4	7314	8-30-2019
E-Field Probe (SAR4)	SPEAG	EX3DV4	3991	5-24-2019
Data Acquisition Electronics (SAR1)	SPEAG	DAE4	1494	7-23-2019
Data Acquisition Electronics (SAR2)	SPEAG	DAE4	1447	3-15-2019
Data Acquisition Electronics (SAR3)	SPEAG	DAE4	1468	8-22-2019
Data Acquisition Electronics (SAR4)	SPEAG	DAE4	1259	7-26-2019
System Validation Dipole	SPEAG	D835V2	4d194	7-24-2019
System Validation Dipole	SPEAG	D1900V2	5d199	3-15-2019
System Validation Dipole	SPEAG	D2450V2	960	3-20-2019
System Validation Dipole	SPEAG	D2600V2	1097	1-17-2020
System Validation Dipole	SPEAG	D5GHzV2	1184	8-21-2019
Thermometer (SAR1)	Lutron	MHB-382SD	AH.91463	8-8-2019
Thermometer (SAR2)	Lutron	MHB-382SD	AH.50215	8-13-2019
Thermometer (SAR3)	Lutron	MHB-382SD	AH.50213	8-14-2019
Thermometer (SAR4)	Lutron	MHB-382SD	AH.91478	8-8-2019

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Base Station Simulator	R & S	CMW500	150313	8-9-2019
Base Station Simulator	R & S	CMW500	150314	8-9-2019
Base Station Simulator	R & S	CMW500	162790	8-9-2019
Wireless Connectivity Tester	R & S	CMW270	100982	8-8-2019
Bluetooth Tester	TESCOM	TC-3000C	3000C000546	8-7-2019

Note(s):

Refer to Appendix F that mentioned about justification for Extended SAR Dipole Calibrations (D2600, SN : 1097)

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5. Measurement Uncertainty

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

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width): 144.3 mm x 69.1 mm Overall Diagonal: 153.0 mm Display Diagonal: 145.0 mm		
Back Cover	☒ The Back Cover is not removable.		
Battery Options	☒ The rechargeable battery is not user accessible		
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☒ Mobile Hotspot (Wi-Fi 5 GHz : Only Ch.149)		
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other ☒ Wi-Fi Direct (Wi-Fi 2.4 GHz) ☒ Wi-Fi Direct (Wi-Fi 5 GHz_20MHz BW : Ch.36-48, Ch.149-165)		
Test Sample Information	**No.**	**S/N**	**Notes**
	1	R38M10DY3AD	Wi-Fi/BT conduction
	2	R38M10DXZMP	Main conduction
	3	R38M102MFCE	SAR
	4	R38M10DYWWJ	SAR
	5	R38M10DYWJA	SAR
	6	RBG0705H	SAR

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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) EGPRS (8PSK)	GPRS Multi-Slot Class: ☐ Class 8 - 1 Up, 4 Down ☐ Class 10 - 2 Up, 4 Down ☐ Class 12 - 4 Up, 4 Down ☒ Class 33 - 4 Up, 5 Down	GSM Voice: 12.5% (E)GPRS: 1 Slot: 12.5% 2 Slots: 25% 3 Slots: 37.5% 4 Slots: 50%
	Does this device support DTM (Dual Transfer Mode)? ☐ Yes ☒ No			
W-CDMA (UMTS)	Band II Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Category 24) HSUPA (Category 6) DC-HSDPA (Category 24) HSPA+ (DL only)		100%
LTE	FDD Band 5 TDD Band 41	QPSK 16QAM Rel. 10 Does not support Carrier Aggregation (CA)		100% (FDD) 63.3% (TDD)[1]
	Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No			
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)		99.6% (802.11b) 94.9% (802.11g) 94.7% (802.11n 20MHz BW)
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		97.2% (802.11a) 97.0% (802.11n,ac 20MHz BW) 92.1% (802.11n,ac 40MHz BW) 94.7% (802.11ac 80MHz BW)
Bluetooth	2.4 GHz	Version 5.0 LE		76.8% (DH5)

Notes:

1. This device supports uplink-downlink configuration 0-6. The configuration with the highest duty cycle was used (Subframe Number 0 at 63.3%).
2. The Bluetooth protocol is considered source-based averaging. Bluetooth GFSK (DH5) was verified to have the highest duty cycle of 76.8% and was considered and used for SAR Testing.
3. Duty cycle for Wi-Fi is referenced from the DTS and UNII report.

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6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1. at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit

RF Air interface	Antenna	Mode	Time Slots	Max. RF Output Power (dBm)	
				Tune-up Limit	Frame Pwr
GSM850	Main 1	Voice/GPRS	1	**33.2**	**24.2**
		GPRS	2	**30.0**	**24.0**
		GPRS	3	**29.0**	**24.7**
		GPRS	4	**28.0**	**25.0**
		EGPRS	1	**28.0**	**19.0**
		EGPRS	2	**25.5**	**19.5**
		EGPRS	3	**24.0**	**19.7**
		EGPRS	4	**22.2**	**19.2**
GSM1900	Main 1	Voice/GPRS	1	**30.5**	**21.5**
		GPRS	2	**28.0**	**22.0**
		GPRS	3	**26.5**	**22.2**
		GPRS	4	**25.0**	**22.0**
		EGPRS	1	**26.8**	**17.8**
		EGPRS	2	**24.0**	**18.0**
		EGPRS	3	**22.5**	**18.2**
		EGPRS	4	**20.8**	**17.8**

RF Air interface	Antenna	Mode	Max. RF Output Power (dBm)
W-CDMA Band II	Main 1	R99	**24.6**
		HSDPA	**24.5**
		HSUPA	**23.8**
		DC-HSDPA	**24.5**
W-CDMA Band V	Main 1	R99	**25.0**
		HSDPA	**24.2**
		HSUPA	**23.5**
		DC-HSDPA	**24.2**

RF Air interface	Antenna	Mode	Max. RF Output Power (dBm)
LTE Band 5	Main 1	QPSK	**25.0**
LTE Band 41	Main 2	QPSK	**24.5**

Notes:

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

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RF Air interface	Mode	Max. RF Output Power (dBm)	Reduced. RF Output Power (dBm)
WiFi 2.4 GHz (Ch.1)	802.11b	**19.0**	**16.0**
	802.11g	**17.0**	**16.0**
	802.11n HT20	**16.0**	**16.0**
WiFi 2.4 GHz (Ch.2 - Ch.10)	802.11b	**19.0**	**16.0**
	802.11g	**17.0**	**16.0**
	802.11n HT20	**17.0**	**16.0**
WiFi 2.4 GHz (Ch.11)	802.11b	**19.0**	**16.0**
	802.11g	**16.0**	**16.0**
	802.11n HT20	**16.0**	**16.0**
WiFi 2.4 GHz (Ch.12)	802.11b	**8.0**	**8.0**
	802.11g	**8.0**	**8.0**
	802.11n HT20	**6.0**	**6.0**
WiFi 2.4 GHz (Ch.13)	802.11b	**8.0**	**8.0**
	802.11g	**8.0**	**8.0**
	802.11n HT20	**5.0**	**5.0**
WiFi 5 GHz	802.11a	**16.0**	**14.0**
	802.11n HT20	**16.0**	**14.0**
	802.11n HT40	**15.0**	**14.0**
	802.11ac VHT20	**16.0**	**14.0**
	802.11ac VHT40	**15.0**	**14.0**
	802.11ac VHT80	**13.0**	
Bluetooth		**10.5**	
Bluetooth EDR		**9.0**	
Bluetooth LE		**6.5**	

Note(s):

This device uses an independent fixed level power reduction mechanism for WLAN operations during voice or VoIP held to ear scenarios. Per FCC Guidance, the held-to-ear exposure conditions were evaluated at reduced power according to the head SAR positions described in IEEE 1528-2013. Detailed descriptions of the power reduction mechanism are included in the operational description.

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6.4. General LTE SAR Test and Reporting Considerations

Item	Description

Frequency range, Channel Bandwidth, Numbers and Frequencies

Band 5	Frequency range: 824 - 849 MHz					
	Channel Bandwidth					
	20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
Low			20450/ 829	20425/ 826.5	20415/ 825.5	20407/ 824.7
Mid			20525/ 836.5	20525/ 836.5	20525/ 836.5	20525/ 836.5
High			20600/ 844	20625/ 846.5	20635/ 847.5	20643/ 848.3

Band 41	Frequency range: 2496 - 2690 MHz					
	Channel Bandwidth					
	20 MHz	15 MHz	10 MHz	5 MHz	3 MHz	1.4 MHz
Low	39750 / 2506.0					
Low-Mid	40185 / 2549.5					
Mid	40620 / 2593.0					
Mid-High	41055 / 2636.5					
High	41490 / 2680.0					

LTE transmitter and antenna implementation

Refer to Appendix A.

Maximum power reduction (MPR)

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

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

Power reduction

Yes

Spectrum plots for RB configurations

A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.

Note(s):

1. 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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6.5. 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	$6592 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$	$7680 \cdot T_s$	$2192 \cdot T_s$	$2560 \cdot T_s$
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	$26336 \cdot T_s$			$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-	-	-
9	$13168 \cdot T_s$			-	-	-

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	63.33
1	5 ms	D	S	U	U	D	D	S	U	U	D	43.33
2	5 ms	D	S	U	D	D	D	S	U	D	D	23.33
3	10 ms	D	S	U	U	U	D	D	D	D	D	31.67
4	10 ms	D	S	U	U	D	D	D	D	D	D	21.67
5	10 ms	D	S	U	D	D	D	D	D	D	D	11.67
6	5 ms	D	S	U	U	U	D	S	U	U	D	53.33

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

<u>Example for Calculated Duty Cycle for Uplink-Downlink Configuration 0:</u>
Calculated Duty Cycle = 5120 x [1/(15000 x 2048)] x 2 + 6 ms = 63.33%
where
T_s = 1/(15000 x 2048) seconds

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

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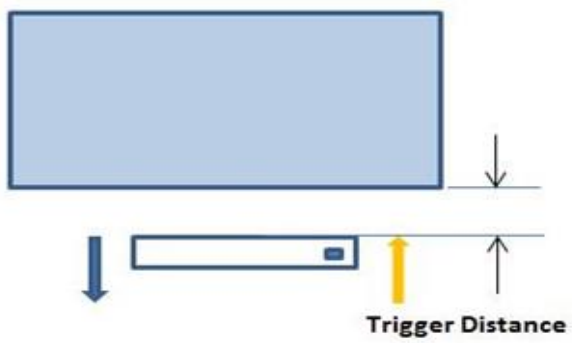
6.6. Proximity Sensor feature

6.6.1. Proximity Sensor Triggering Distance (KDB 616217 §6.2)

Front of the DUT was placed directly below the flat phantom. The DUT was moved toward the phantom in accordance with the steps outlined in KDB 616217 §6.2 to determine the trigger distance for enabling power reduction. The DUT was moved away from the phantom to determine the trigger distance for resuming full power.

The DUT featured a visual indicator on its display that showed the status of the proximity sensor (Triggered or not triggered). This was used to determine the status of the sensor during the proximity sensor assessment as monitoring the output power directly was not practical without affecting the measurement.

It was confirmed separately that the output power was altered according to the proximity sensor status indication. This was achieved by observing the proximity sensor status at the same time as monitoring the conducted power. Section 9 contains both the full and reduced conducted power measurements.



Proximity Sensor Trigger Distance Assessment
KDB 616217 §6.2, Front

LEGEND

Direction of DUT travel for determination of power reduction triggering point

Direction of DUT travel for determination of full power resumption triggering point

Summary of Trigger Distances

Tissue simulating liquid	Trigger distance - Front	
	Moving toward phantom	Moving from phantom
2.4G Head	20 mm	20 mm
5G Head	20 mm	20 mm

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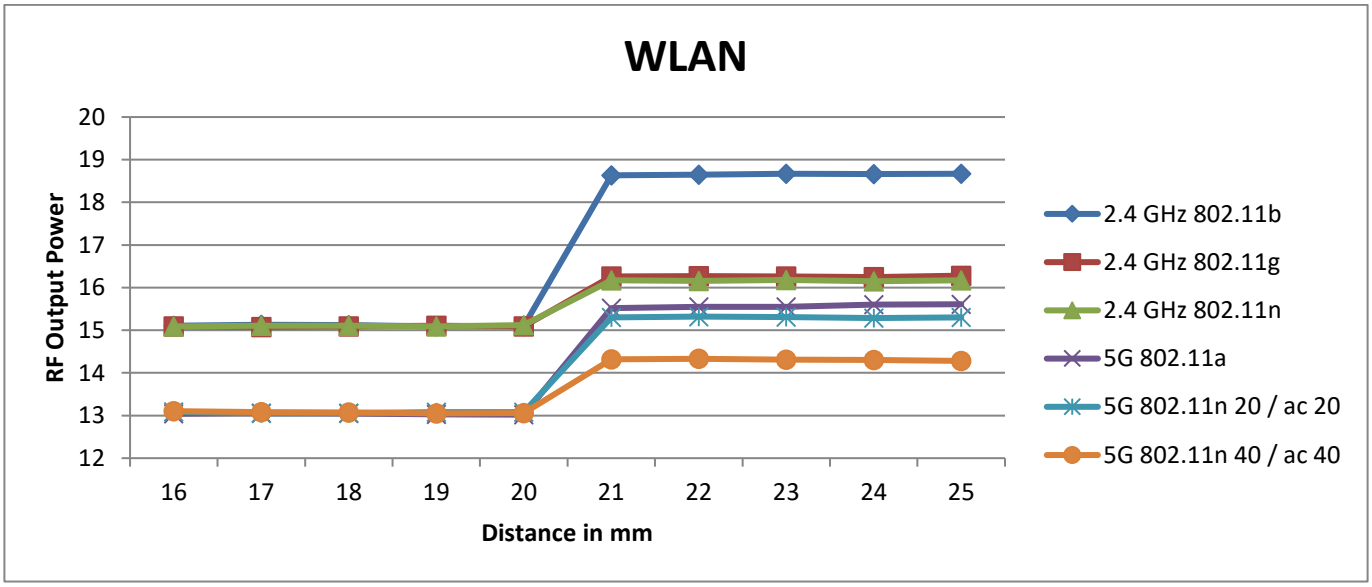
Proximity Sensor Triggering Distance Measurement Results

WLAN

Front, DUT Moving Toward (Trigger) from the Phantom

Distance to DUT vs. Output Power in dBm										
Distance	16	17	18	19	20	21	22	23	24	25
2.4 GHz 802.11b	15.1	15.1	15.1	15.1	15.1	18.6	18.7	18.7	18.7	18.7
2.4 GHz 802.11g	15.1	15.1	15.1	15.1	15.1	16.3	16.3	16.3	16.3	16.3
2.4 GHz 802.11n	15.1	15.1	15.1	15.1	15.1	16.2	16.2	16.2	16.2	16.2
5G 802.11a	13.0	13.1	13.1	13.0	13.0	15.5	15.6	15.6	15.6	15.6
5G 802.11n 20 / ac 20	13.1	13.1	13.1	13.1	13.1	15.3	15.3	15.3	15.3	15.3
5G 802.11n 40 / ac 40	13.1	13.1	13.1	13.1	13.1	14.3	14.3	14.3	14.3	14.3



6.6.2. Resulting test positions for SAR measurements

Wireless technologies	DUT Position	§6.2 Triggering Distance	§6.3 Coverage	§6.4 Tilt Angle	Worst case distance for SAR
WLAN	Front	20 mm	N/A	N/A	19 mm

Notes:

1. Worst case distance for WLAN SAR is not considered for body exposure condition. Because Power reduction is applied only voice or VoIP held to ear scenarios.
2. For WLAN, This proximity sensor is only operating in Head exposure condition. So tilt (15 degree) position of Head exposure was additional verified.

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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	Antenaa	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required	Note
WWAN	Head	Main Ant. 1 & 2	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	Main Ant. 1 & 2	15 mm	Rear	N/A	Yes	
				Front	N/A	Yes	
	Hotspot	Main Ant.1	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	
	Hotspot	Main Ant.2	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	
WLAN & BT	Head	WiFi & BT Ant.	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	

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.

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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.

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:

SAR 1 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2-14-2019	Body 2600	e'	52.6200	Relative Permittivity (ε_r):	52.62	52.51	0.21	5
		e''	15.2400	Conductivity (σ):	2.20	2.16	1.96	5
	Body 2500	e'	52.8900	Relative Permittivity (ε_r):	52.89	52.64	0.48	5
		e''	14.9400	Conductivity (σ):	2.08	2.02	2.80	5
	Body 2700	e'	52.3700	Relative Permittivity (ε_r):	52.37	52.38	-0.03	5
		e''	15.5500	Conductivity (σ):	2.33	2.30	1.44	5
2-15-2019	Head 2600	e'	39.1800	Relative Permittivity (ε_r):	39.18	39.01	0.43	5
		e''	13.4500	Conductivity (σ):	1.94	1.96	-0.90	5
	Head 2500	e'	39.5000	Relative Permittivity (ε_r):	39.50	39.14	0.93	5
		e''	13.2100	Conductivity (σ):	1.84	1.85	-0.96	5
	Head 2700	e'	38.8900	Relative Permittivity (ε_r):	38.89	38.88	0.01	5
		e''	13.6700	Conductivity (σ):	2.05	2.07	-0.87	5
2-18-2019	Body 2600	e'	51.2800	Relative Permittivity (ε_r):	51.28	52.51	-2.34	5
		e''	15.2500	Conductivity (σ):	2.20	2.16	2.03	5
	Body 2500	e'	51.5500	Relative Permittivity (ε_r):	51.55	52.64	-2.06	5
		e''	14.8900	Conductivity (σ):	2.07	2.02	2.45	5
	Body 2700	e'	50.9300	Relative Permittivity (ε_r):	50.93	52.38	-2.78	5
		e''	15.4200	Conductivity (σ):	2.31	2.30	0.59	5
2-20-2019	Body 2450	e'	51.3800	Relative Permittivity (ε_r):	51.38	52.70	-2.50	5
		e''	14.7900	Conductivity (σ):	2.01	1.95	3.32	5
	Body 2400	e'	51.4600	Relative Permittivity (ε_r):	51.46	52.77	-2.49	5
		e''	14.6600	Conductivity (σ):	1.96	1.90	3.07	5
	Body 2480	e'	51.3500	Relative Permittivity (ε_r):	51.35	52.66	-2.49	5
		e''	14.8900	Conductivity (σ):	2.05	1.99	3.07	5
2-21-2019	Head 2450	e'	38.6400	Relative Permittivity (ε_r):	38.64	39.20	-1.43	5
		e''	13.4300	Conductivity (σ):	1.83	1.80	1.64	5
	Head 2400	e'	38.8200	Relative Permittivity (ε_r):	38.82	39.30	-1.21	5
		e''	13.2800	Conductivity (σ):	1.77	1.75	1.17	5
	Head 2480	e'	38.5300	Relative Permittivity (ε_r):	38.53	39.16	-1.61	5
		e''	13.5100	Conductivity (σ):	1.86	1.83	1.67	5
2-21-2019	Head 5250	e'	35.7200	Relative Permittivity (ε_r):	35.72	35.93	-0.59	5
		e''	16.0500	Conductivity (σ):	4.69	4.70	-0.36	5
	Head 5260	e'	35.6800	Relative Permittivity (ε_r):	35.68	35.92	-0.67	5
		e''	16.0600	Conductivity (σ):	4.70	4.71	-0.32	5
	Head 5600	e'	34.9400	Relative Permittivity (ε_r):	34.94	35.53	-1.67	5
		e''	16.2700	Conductivity (σ):	5.07	5.06	0.12	5
	Head 5750	e'	34.6700	Relative Permittivity (ε_r):	34.67	35.36	-1.96	5
		e''	16.3400	Conductivity (σ):	5.22	5.21	0.20	5
	Head 5825	e'	34.5000	Relative Permittivity (ε_r):	34.50	35.30	-2.27	5
		e''	16.3600	Conductivity (σ):	5.30	5.27	0.55	5

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SAR 2 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2-18-2019	Body 835	e'	55.8400	Relative Permittivity (ε_r):	55.84	55.20	1.16	5
		e''	20.5000	Conductivity (σ):	0.95	0.97	-1.88	5
	Body 820	e'	55.9800	Relative Permittivity (ε_r):	55.98	55.28	1.27	5
		e''	20.6000	Conductivity (σ):	0.94	0.97	-3.02	5
	Body 850	e'	55.7000	Relative Permittivity (ε_r):	55.70	55.16	0.98	5
		e''	20.4300	Conductivity (σ):	0.97	0.99	-2.18	5

SAR 3 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2-16-2019	Head 835	e'	41.2100	Relative Permittivity (ε_r):	41.21	41.50	-0.70	5
		e''	19.5300	Conductivity (σ):	0.91	0.90	0.75	5
	Head 820	e'	41.3100	Relative Permittivity (ε_r):	41.31	41.60	-0.70	5
		e''	19.5400	Conductivity (σ):	0.89	0.90	-0.84	5
	Head 850	e'	41.0900	Relative Permittivity (ε_r):	41.09	41.50	-0.99	5
		e''	19.5300	Conductivity (σ):	0.92	0.92	0.88	5
2-19-2019	Head 835	e'	40.8000	Relative Permittivity (ε_r):	40.80	41.50	-1.69	5
		e''	19.4000	Conductivity (σ):	0.90	0.90	0.08	5
	Head 820	e'	40.9700	Relative Permittivity (ε_r):	40.97	41.60	-1.52	5
		e''	19.4500	Conductivity (σ):	0.89	0.90	-1.30	5
	Head 850	e'	40.6400	Relative Permittivity (ε_r):	40.64	41.50	-2.07	5
		e''	19.3500	Conductivity (σ):	0.91	0.92	-0.05	5
2-21-2019	Body 5250	e'	48.5300	Relative Permittivity (ε_r):	48.53	48.95	-0.86	5
		e''	18.2100	Conductivity (σ):	5.32	5.35	-0.69	5
	Body 5260	e'	48.5000	Relative Permittivity (ε_r):	48.50	48.94	-0.90	5
		e''	18.2200	Conductivity (σ):	5.33	5.36	-0.67	5
	Body 5600	e'	47.9100	Relative Permittivity (ε_r):	47.91	48.48	-1.17	5
		e''	18.5400	Conductivity (σ):	5.77	5.76	0.21	5
	Body 5750	e'	47.6800	Relative Permittivity (ε_r):	47.68	48.27	-1.23	5
		e''	18.6900	Conductivity (σ):	5.98	5.94	0.67	5
	Body 5825	e'	47.5400	Relative Permittivity (ε_r):	47.54	48.20	-1.37	5
		e''	18.7700	Conductivity (σ):	6.08	6.00	1.32	5

SAR 4 Room

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
2-18-2019	Body 1900	e'	52.7500	Relative Permittivity (ε_r):	52.75	53.30	-1.03	5
		e''	14.9100	Conductivity (σ):	1.58	1.52	3.63	5
	Body 1850	e'	52.8600	Relative Permittivity (ε_r):	52.86	53.30	-0.83	5
		e''	15.1000	Conductivity (σ):	1.55	1.52	2.19	5
	Body 1910	e'	52.7500	Relative Permittivity (ε_r):	52.75	53.30	-1.03	5
		e''	14.9100	Conductivity (σ):	1.58	1.52	4.18	5
2-20-2019	Head 1900	e'	40.2200	Relative Permittivity (ε_r):	40.22	40.00	0.55	5
		e''	13.5200	Conductivity (σ):	1.43	1.40	2.02	5
	Head 1850	e'	40.2700	Relative Permittivity (ε_r):	40.27	40.00	0.68	5
		e''	13.5900	Conductivity (σ):	1.40	1.40	-0.15	5
	Head 1910	e'	40.2100	Relative Permittivity (ε_r):	40.21	40.00	0.53	5
		e''	13.5300	Conductivity (σ):	1.44	1.40	2.64	5

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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 2.5 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 1.4 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

Reference Target SAR Values

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

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)		
				1g/10g	Head	Body
D835V2	4d194	7-24-2018	835	1g	9.36	9.61
				10g	6.02	6.32
D1900V2	5d199	3-15-2018	1900	1g	40.40	39.60
				10g	21.10	20.80
D2450V2	960	3-20-2018	2450	1g	53.60	49.80
				10g	25.10	23.50
D2600V2	1097	1-17-2018	2600	1g	56.40	54.40
				10g	25.30	24.20
D5GHzV2	1184	8-21-2018	5250	1g	81.10	75.00
				10g	23.40	20.90
			5600	1g	85.00	78.60
				10g	24.40	22.00
			5750	1g	82.60	76.20
				10g	23.70	21.20

Note(s):

Refer to Appendix F that mentioned about justification for Extended SAR Dipole Calibrations (D2600, SN : 1097)

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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.

SAR 1 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2-14-2019	D2600V2	1097	Body	1g	5.68	56.80	54.40	4.41	
				10g	2.54	25.40	24.20	4.96	
2-15-2019	D2600V2	1097	Head	1g	6.04	60.40	56.40	7.09	1, 2
				10g	2.66	26.60	25.30	5.14	
2-18-2019	D2600V2	1097	Body	1g	5.48	54.80	54.40	0.74	
				10g	2.34	23.40	24.20	-3.31	
2-20-2019	D2450V2	960	Body	1g	4.97	49.70	49.80	-0.20	
				10g	2.25	22.50	23.50	-4.26	
2-21-2019	D2450V2	960	Head	1g	5.78	57.80	53.60	7.84	3, 4
				10g	2.65	26.50	25.10	5.58	
2-21-2019	D5GHzV2 (5250)	1184	Head	1g	7.71	77.10	81.10	-4.93	
				10g	2.20	22.00	23.40	-5.98	
2-21-2019	D5GHzV2 (5600)	1184	Head	1g	8.03	80.30	85.00	-5.53	5, 6
				10g	2.27	22.70	24.40	-6.97	
2-21-2019	D5GHzV2 (5750)	1184	Head	1g	7.93	79.30	82.60	-4.00	
				10g	2.25	22.50	23.70	-5.06	

SAR 2 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2-18-2019	D835V2	4d194	Body	1g	0.95	9.53	9.61	-0.83	7, 8
				10g	0.62	6.24	6.32	-1.27	

SAR 3 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2-16-2019	D835V2	4d194	Head	1g	0.97	9.70	9.36	3.63	
				10g	0.64	6.39	6.02	6.15	
2-19-2019	D835V2	4d194	Head	1g	0.98	9.75	9.36	4.17	9, 10
				10g	0.64	6.42	6.02	6.64	
2-21-2019	D5GHzV2 (5250)	1184	Body	1g	7.16	71.60	75.00	-4.53	
				10g	2.00	20.00	20.90	-4.31	
2-21-2019	D5GHzV2 (5600)	1184	Body	1g	7.86	78.60	78.60	0.00	
				10g	2.17	21.70	22.00	-1.36	
2-21-2019	D5GHzV2 (5750)	1184	Body	1g	7.24	72.40	76.20	-4.99	
				10g	2.01	20.10	21.20	-5.19	

SAR 4 Room

Date Tested	System Dipole		T.S. Liquid		Measured Results		Target (Ref. Value)	Delta ±10 %	Plot No.
	Type	Serial #			Zoom Scan to 100 mW	Normalize to 1 W			
2-18-2019	D1900V2	5d199	Body	1g	4.21	42.10	39.60	6.31	11, 12
				10g	2.21	22.10	20.80	6.25	
2-20-2019	D1900V2	5d199	Head	1g	3.89	38.90	40.40	-3.71	
				10g	2.01	20.10	21.10	-4.74	

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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.

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
GSM (Voice)	CS1	1	128	824.2	32.3	23.3	33.2	24.2
			190	836.6	32.3	23.2		
			251	848.8	32.0	23.0		
GPRS (GMSK)	CS1	1	128	824.2	32.3	23.3	33.2	24.2
			190	836.6	32.4	23.4		
			251	848.8	32.1	23.1		
		2	128	824.2	29.8	23.8	30.0	24.0
			190	836.6	29.7	23.7		
			251	848.8	29.6	23.6		
		3	128	824.2	28.5	24.3	29.0	24.7
			190	836.6	28.7	24.4		
			251	848.8	27.8	23.5		
		4	128	824.2	27.0	24.0	28.0	**25.0**
			190	836.6	26.9	23.9		
			251	848.8	26.6	23.6		
EGPRS (8PSK)	MCS5	1	128	824.2	26.8	17.8	28.0	19.0
			190	836.6	26.9	17.9		
			251	848.8	26.5	17.4		
		2	128	824.2	24.6	18.5	25.5	19.5
			190	836.6	24.5	18.5		
			251	848.8	24.2	18.2		
		3	128	824.2	22.8	18.6	24.0	19.7
			190	836.6	22.8	18.5		
			251	848.8	22.5	18.2		
		4	128	824.2	21.1	18.1	22.2	19.2
			190	836.6	21.1	18.1		
			251	848.8	20.8	17.8		

Notes:

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

- GMSK (GPRS) mode with 4 time slots for Max power, based on the Tune-up Procedure. Refer to §6.3.
- SAR is not required for EGPRS (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GMSK GPRS or the adjusted SAR of the highest reported SAR of GMSK GPRS is ≤ 1.2W/kg.

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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
GSM (Voice)	CS1	1	512	1850.2	29.9	20.9	30.5	21.5
			661	1880.0	29.5	20.5		
			810	1909.8	29.7	20.6		
GPRS (GMSK)	CS1	1	512	1850.2	29.9	20.9	30.5	21.5
			661	1880.0	29.6	20.6		
			810	1909.8	29.6	20.6		
		2	512	1850.2	27.5	21.5	28.0	22.0
			661	1880.0	26.9	20.9		
			810	1909.8	27.1	21.1		
		3	512	1850.2	25.5	21.3	26.5	**22.2**
			661	1880.0	25.2	20.9		
			810	1909.8	25.2	20.9		
		4	512	1850.2	24.4	21.4	25.0	22.0
			661	1880.0	24.0	21.0		
			810	1909.8	24.0	21.0		
EGPRS (8PSK)	MCS5	1	512	1850.2	26.1	17.1	26.8	17.8
			661	1880.0	25.8	16.8		
			810	1909.8	25.6	16.6		
		2	512	1850.2	23.3	17.3	24.0	18.0
			661	1880.0	23.0	16.9		
			810	1909.8	23.0	17.0		
		3	512	1850.2	21.9	17.6	22.5	18.2
			661	1880.0	21.5	17.2		
			810	1909.8	21.5	17.2		
		4	512	1850.2	20.3	17.3	20.8	17.8
			661	1880.0	19.7	16.7		
			810	1909.8	19.7	16.7		

Notes:

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

- GMSK (GPRS) mode with 3 time slots for Max power, based on the Tune-up Procedure. Refer to §6.3.
- SAR is not required for EGPRS (8PSK) mode because the maximum output power and tune-up limit is ≤ 1/4dB higher than GMSK GPRS or the adjusted SAR of the highest reported SAR of GMSK GPRS is ≤ 1.2W/kg.

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9.2 W-CDMA

Release 99 Setup Procedures used to establish the test signals

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

Mode	Subtest	Rel99
WCDMA General Settings	Loopback Mode	Test Mode 2
	Rel99 RMC	12.2kbps RMC
	Power Control Algorithm	Algorithm2
	βc/βd	8/15

HSDPA Setup Procedures used to establish the test signals

The following 4 Sub-tests were completed according to Release 5 procedures in section 5.2 of 3GPP TS34.121. A summary of these settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
W-CDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set 1			
	Power Control Algorithm	Algorithm 2			
	βc	2/15	11/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	βc/βd	2/15	11/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	MPR (dB)	0	0	0.5	0.5
HSDPA Specific Settings	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	Ahs=βhs/βc	30/15			

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HSPA (HSDPA & HSUPA) Setup Procedures used to establish the test signals

The following 5 Sub-tests were completed according to Release 6 procedures in table C,11.1.3 of 3GPP TS 34.121-1 v13.
A summary of these settings are illustrated below:

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

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DC-HSDPA Setup Procedures used to establish the test signals

The following tests were completed according to procedures in section 7.3.13 of 3GPP TS34.108 v9.5.0. A summary of these settings are illustrated below:

Downlink Physical Channels are set as per 3GPP TS34.121-1 v9.0.0 E.5.0

Table E.5.0: Levels for HSDPA connection setup

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

Call is set up as per 3GPP TS34.108 v9.5.0 sub clause 7.3.13

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

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

Parameter	Unit	Value
Nominal Avg. Inf. Bit Rate	kbps	60
Inter-TTI Distance	TTI's	1
Number of HARQ Processes	Processes	6
Information Bit Payload (N_{INF})	Bits	120
Number Code Blocks	Blocks	1
Binary Channel Bits Per TTI	Bits	960
Total Available SML's in UE	SML's	19200
Number of SML's per HARQ Proc.	SML's	3200
Coding Rate		0.15
Number of Physical Channel Codes	Codes	1
Modulation		QPSK

Note 1: The RMC is intended to be used for DC-HSDPA mode and both cells shall transmit with identical parameters as listed in the table.
Note 2: Maximum number of transmission is limited to 1, i.e., retransmission is not allowed. The redundancy and constellation version 0 shall be used.

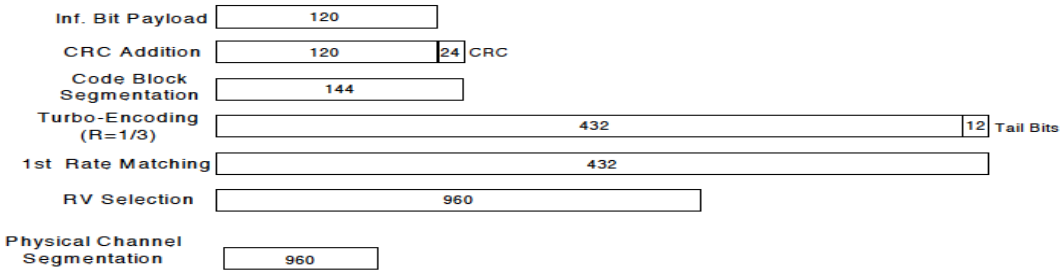

Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

The following 4 Sub-tests for HSDPA were completed according to Release 8 procedures in section 5.2 of 3GPP TS34.121. A summary of subtest settings are illustrated below:

	Mode	HSDPA	HSDPA	HSDPA	HSDPA
	Subtest	1	2	3	4
WCDMA General Settings	Loopback Mode	Test Mode 1			
	Rel99 RMC	12.2kbps RMC			
	HSDPA FRC	H-Set 12			
	Power Control Algorithm	Algorithm2			
	βc	2/15	11/15	15/15	15/15
	βd	15/15	15/15	8/15	4/15
	βd (SF)	64			
	βc/βd	2/15	11/15	15/8	15/4
	βhs	4/15	24/15	30/15	30/15
	MPR (dB)	0	0	0.5	0.5
HSDPA Specific Settings	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack Repetition factor	3			
	CQI Feedback	4ms			
	CQI Repetition Factor	2			
	Ahs = βhs/ βc	30/15			

HSPA+

It support to down link only.

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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	24.3	N/A	24.6
		9400	1880.0	24.1		
		9538	1907.6	24.1		
HSDPA	Subtest 1	9262	1852.4	24.4	0	24.5
		9400	1880.0	24.1		
		9538	1907.6	24.1		
	Subtest 2	9262	1852.4	23.5	0	24.5
		9400	1880.0	23.2		
		9538	1907.6	23.2		
	Subtest 3	9262	1852.4	22.5	0.5	24.0
		9400	1880.0	22.2		
		9538	1907.6	22.2		
	Subtest 4	9262	1852.4	22.5	0.5	24.0
		9400	1880.0	22.3		
		9538	1907.6	22.2		
HSUPA	Subtest 1	9262	1852.4	22.4	0	23.8
		9400	1880.0	22.2		
		9538	1907.6	22.1		
	Subtest 2	9262	1852.4	20.6	2	21.8
		9400	1880.0	20.3		
		9538	1907.6	20.2		
	Subtest 3	9262	1852.4	21.5	1	22.8
		9400	1880.0	21.3		
		9538	1907.6	21.3		
	Subtest 4	9262	1852.4	20.5	2	21.8
		9400	1880.0	20.3		
		9538	1907.6	20.3		
	Subtest 5	9262	1852.4	23.4	0	23.8
		9400	1880.0	23.1		
		9538	1907.6	23.0		
DC-HSDPA	Subtest 1	9262	1852.4	24.4	0	24.5
		9400	1880.0	24.1		
		9538	1907.6	24.1		
	Subtest 2	9262	1852.4	23.4	0	24.5
		9400	1880.0	23.1		
		9538	1907.6	23.1		
	Subtest 3	9262	1852.4	22.4	0.5	24.0
		9400	1880.0	22.1		
		9538	1907.6	22.1		
	Subtest 4	9262	1852.4	22.4	0.5	24.0
		9400	1880.0	22.1		
		9538	1907.6	22.1		

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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	24.0	N/A	25.0
		4183	836.6	23.8		
		4233	846.6	23.7		
HSDPA	Subtest 1	4132	826.4	23.4	0	24.2
		4183	836.6	23.2		
		4233	846.6	23.1		
	Subtest 2	4132	826.4	22.5	0	24.2
		4183	836.6	22.3		
		4233	846.6	22.2		
	Subtest 3	4132	826.4	21.2	1	23.2
		4183	836.6	21.0		
		4233	846.6	21.0		
	Subtest 4	4132	826.4	21.2	1	23.2
		4183	836.6	21.0		
		4233	846.6	20.9		
HSUPA	Subtest 1	4132	826.4	20.3	1	22.5
		4183	836.6	20.2		
		4233	846.6	20.1		
	Subtest 2	4132	826.4	18.2	4	19.5
		4183	836.6	18.0		
		4233	846.6	18.0		
	Subtest 3	4132	826.4	21.2	1	22.5
		4183	836.6	21.0		
		4233	846.6	20.9		
	Subtest 4	4132	826.4	18.2	4	19.5
		4183	836.6	18.0		
		4233	846.6	18.0		
	Subtest 5	4132	826.4	23.4	0	23.5
		4183	836.6	23.2		
		4233	846.6	23.2		
DC-HSDPA	Subtest 1	4132	826.4	23.4	0	24.2
		4183	836.6	23.2		
		4233	846.6	23.1		
	Subtest 2	4132	826.4	22.4	0	24.2
		4183	836.6	22.2		
		4233	846.6	22.1		
	Subtest 3	4132	826.4	21.1	1	23.2
		4183	836.6	20.9		
		4233	846.6	20.9		
	Subtest 4	4132	826.4	21.1	1	23.2
		4183	836.6	20.9		
		4233	846.6	20.9		

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9.3 LTE

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

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

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

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

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

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

Network Signalling value	Requirements (subclause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	N/A
NS_03	6.6.2.2.1	2, 4,10, 23, 25, 35, 36, 66, 70	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2, 6.6.3.3.19	41	5, 10, 15, 20	Table 6.2.4-4, Table 6.2.4-4a	
NS_05	6.6.3.3.1	1	10,15,20	≥ 50 (NOTE1)	≤ 1 (NOTE1)
			15, 20	Table 6.2.4-18 (NOTE2)	
		65 (NOTE 3)	10,15,20	≥ 50	≤ 1 (NOTE 1)
			15,20	Table 6.2.4-18 (NOTE 2)	
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	N/A
NS_07	6.6.2.2.3 6.6.3.3.2	13	10	Table 6.2.4-2	
NS_08	6.6.3.3.3	19	10, 15	> 44	≤ 3
NS_09	6.6.3.3.4	21	10, 15	> 40	≤ 1
				> 55	≤ 2
NS_10		20	15, 20	Table 6.2.4-3	
NS_11	6.6.2.2.1 6.6.3.3.13	23	1.4, 3, 5, 10, 15, 20	Table 6.2.4-5	
NS_12	6.6.3.3.5	26	1.4, 3, 5, 10, 15	Table 6.2.4-6	
NS_13	6.6.3.3.6	26	5	Table 6.2.4-7	
NS_14	6.6.3.3.7	26	10, 15	Table 6.2.4-8	
NS_15	6.6.3.3.8	26	1.4, 3, 5, 10, 15	Table 6.2.4-9 Table 6.2.4-10	
NS_16	6.6.3.3.9	27	3, 5, 10	Table 6.2.4-11, Table 6.2.4-12, Table 6.2.4-13	
NS_17	6.6.3.3.10	28	5, 10	Table 5.6-1	N/A
NS_18	6.6.3.3.11	28	5	≥ 2	≤ 1
			10, 15, 20	≥ 1	≤ 4
NS_19	6.6.3.3.12	44	10, 15, 20	Table 6.2.4-14	
NS_20	6.2.2 6.6.2.2.1 6.6.3.3.14	23	5, 10, 15, 20	Table 6.2.4-15	
NS_21	6.6.2.2.1 6.6.3.3.15	30	5, 10	Table 6.2.4-16	
NS_22	6.6.3.3.16	42, 43	5, 10, 15, 20	Table 6.2.4-17	
NS_23	6.6.3.3.17	42, 43	5, 10, 15, 20	N/A	
NS_24	6.6.3.3.20	65 (NOTE 4)	5, 10, 15, 20	Table 6.2.4-19	
NS_25	6.6.3.3.21	65 (NOTE 4)	5, 10, 15, 20	Table 6.2.4-20	
NS_26	6.6.3.3.22	68	10, 15	Table 6.2.4-21	
NS_27	6.6.2.2.5, 6.6.3.3.23	48	5, 10, 15, 20	Table 6.2.4-22	
NS_28	6.2.2A, 6.6.3.3.24	46 (NOTE 5)	20	Table 6.2.4-23	
NS_29	6.2.2A, 6.6.2.3.1a, 6.6.3.3.25	46 (NOTE 5)	20	Table 6.2.4-24	
NS_30	6.2.2A, 6.6.3.3.26	46 (NOTE 5)	20	Table 6.2.4-25	
NS_31	6.2.2A, 6.6.3.3.27	46 (NOTE 5)	20	Table 6.2.4-26	
NS_32	-	-	-	-	-
NOTE 1: Applicable when the lower edge of the assigned E-UTRA UL channel bandwidth frequency is larger than or equal to the upper edge of PHS band (1915.7 MHz) + 4 MHz + the channel BW assigned, where channel BW is as defined in subclause 5.6. A-MPR for					

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LTE Band 5 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)			MPR	Tune-up Limit
				Measured Pwr (dBm)				
				[redacted]	20525	[redacted]		
					836.5 MHz			
10 MHz	QPSK	1	0		24.2		0.0	25
		1	25		24.1		0.0	25
		1	49		24.1		0.0	25
		25	0		22.2		1.0	24
		25	12		22.1		1.0	24
		25	25		22.1		1.0	24
		50	0		22.1		1.0	24
	16QAM	1	0		22.1		1.0	24
		1	25		22.0		1.0	24
		1	49		22.0		1.0	24
		25	0		20.9		2.0	23
		25	12		20.9		2.0	23
		25	25		21.0		2.0	23
		50	0		21.0		2.0	23

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				20425	20525	20625		
				826.5 MHz	836.5 MHz	846.5 MHz		
5 MHz	QPSK	1	0	24.1	24.0	24.1	0.0	25
		1	12	24.0	24.0	24.1	0.0	25
		1	24	24.1	24.0	24.1	0.0	25
		12	0	22.3	22.1	22.1	1.0	24
		12	7	22.3	22.1	22.1	1.0	24
		12	13	22.3	22.1	22.1	1.0	24
		25	0	22.4	22.1	22.2	1.0	24
	16QAM	1	0	22.0	22.1	22.1	1.0	24
		1	12	22.0	22.0	22.1	1.0	24
		1	24	22.0	22.1	22.1	1.0	24
		12	0	21.2	21.0	21.0	2.0	23
		12	7	21.2	21.0	21.0	2.0	23
		12	13	21.2	21.0	21.0	2.0	23
		25	0	21.2	21.1	21.1	2.0	23

BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (dBm)			MPR	Tune-up Limit
				20415	20525	20635		
				825.5 MHz	836.5 MHz	847.5 MHz		
3 MHz	QPSK	1	0	24.4	24.1	24.0	0.0	25
		1	8	24.3	24.0	24.1	0.0	25
		1	14	24.3	24.1	24.0	0.0	25
		8	0	22.3	22.1	22.1	1.0	24
		8	4	22.3	22.0	22.1	1.0	24
		8	7	22.3	22.1	22.1	1.0	24
		15	0	22.4	22.1	22.2	1.0	24
	16QAM	1	0	22.3	21.8	22.2	1.0	24
		1	8	22.2	21.9	22.3	1.0	24
		1	14	22.2	21.9	22.2	1.0	24
		8	0	21.1	21.0	21.1	2.0	23
		8	4	21.1	21.0	21.0	2.0	23
		8	7	21.1	21.0	21.0	2.0	23
		15	0	21.1	20.9	21.0	2.0	23

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LTE Band 5 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)				
				Measured Pwr (dBm)			MPR	Tune-up Limit
				20407	20525	20643		
				824.7 MHz	836.5 MHz	848.3 MHz		
1.4 MHz	QPSK	1	0	24.4	24.0	24.1	0.0	25
		1	3	24.4	24.0	24.1	0.0	25
		1	5	24.5	24.0	24.1	0.0	25
		3	0	24.3	24.0	24.0	0.0	25
		3	1	24.3	24.0	24.0	0.0	25
		3	3	24.3	24.0	24.1	0.0	25
		6	0	22.3	22.1	22.1	1.0	24
	16QAM	1	0	22.1	22.0	21.9	1.0	24
		1	3	22.1	22.0	21.8	1.0	24
		1	5	22.1	22.0	21.9	1.0	24
		3	0	22.2	22.0	22.1	1.0	24
		3	1	22.2	22.0	22.1	1.0	24
		3	3	22.2	22.0	22.1	1.0	24
		6	0	21.2	20.8	21.0	2.0	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

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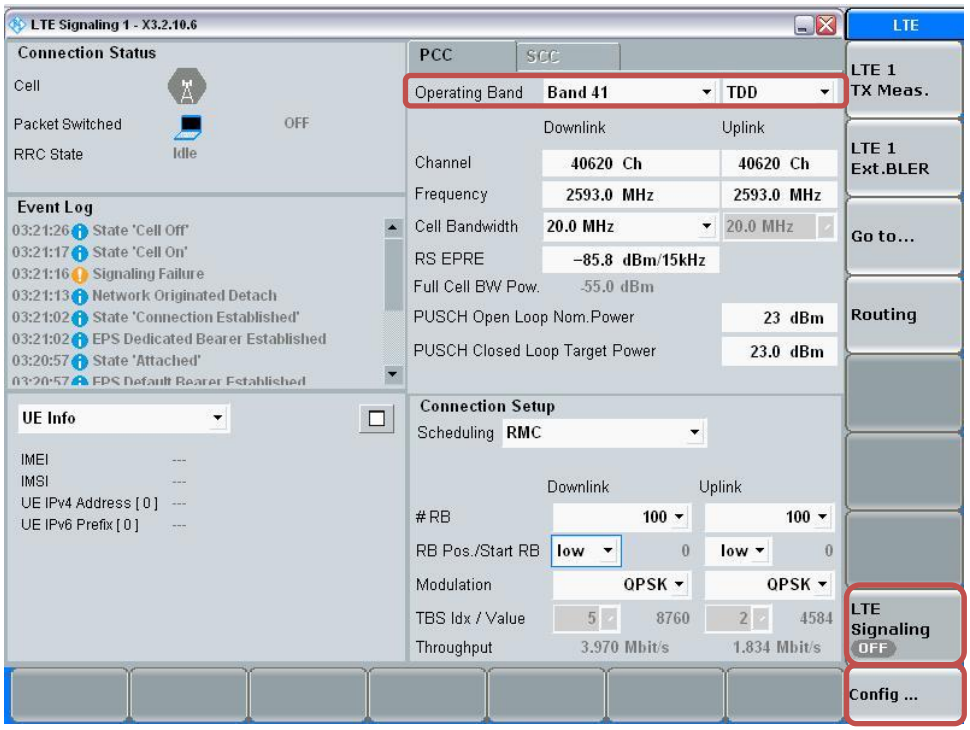
LTE Band TDD Measured Results

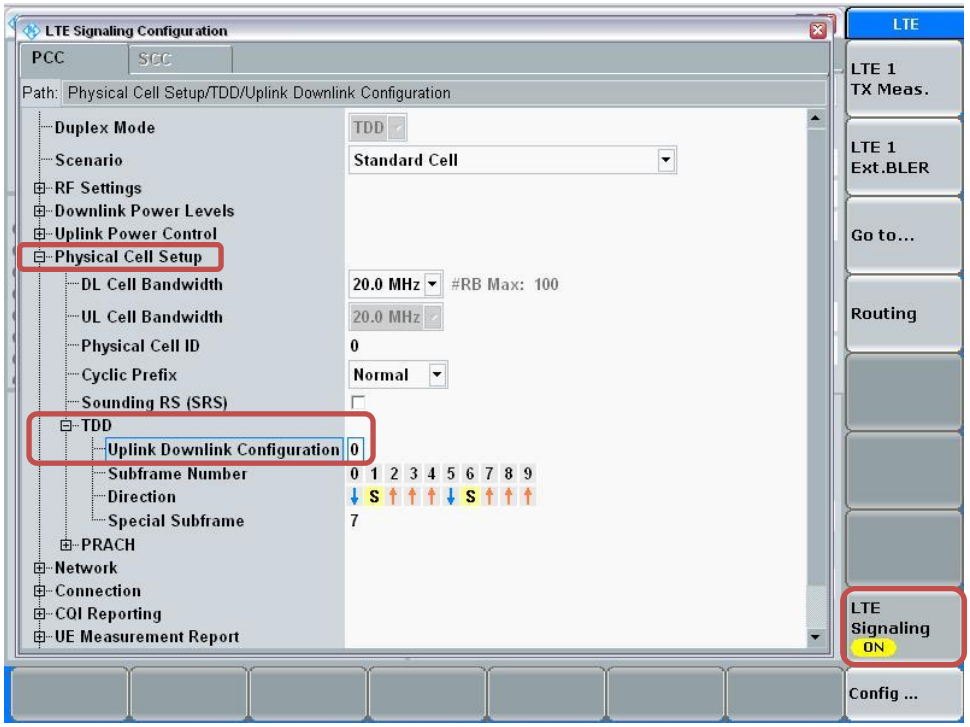
Procedure used to establish SAR test signal for LTE TDD Band

Set to CMW-500 with following parameters:

- Turn the LTE Signaling off using “ON | OFF” key
- Operating Band: Select Band 41 and TDD
- Go to “Config….”



- Go to “Physical Cell Setup”
- Select “TDD” and Set “Uplink Downlink Configuration” to “0”
- Turn the cell on using “ON | OFF” key



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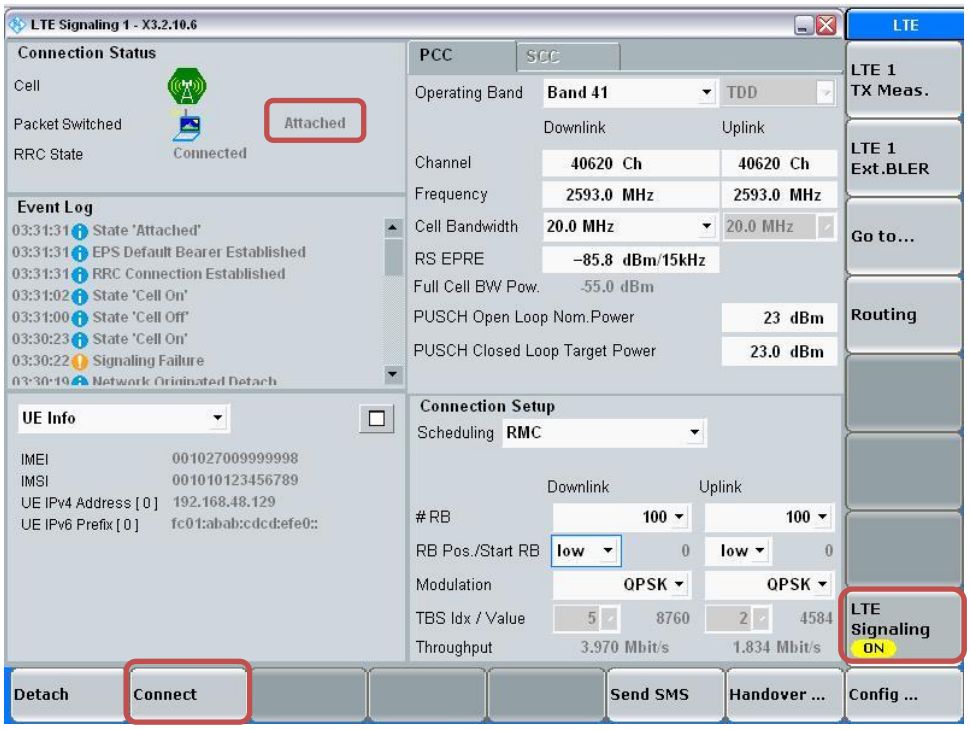
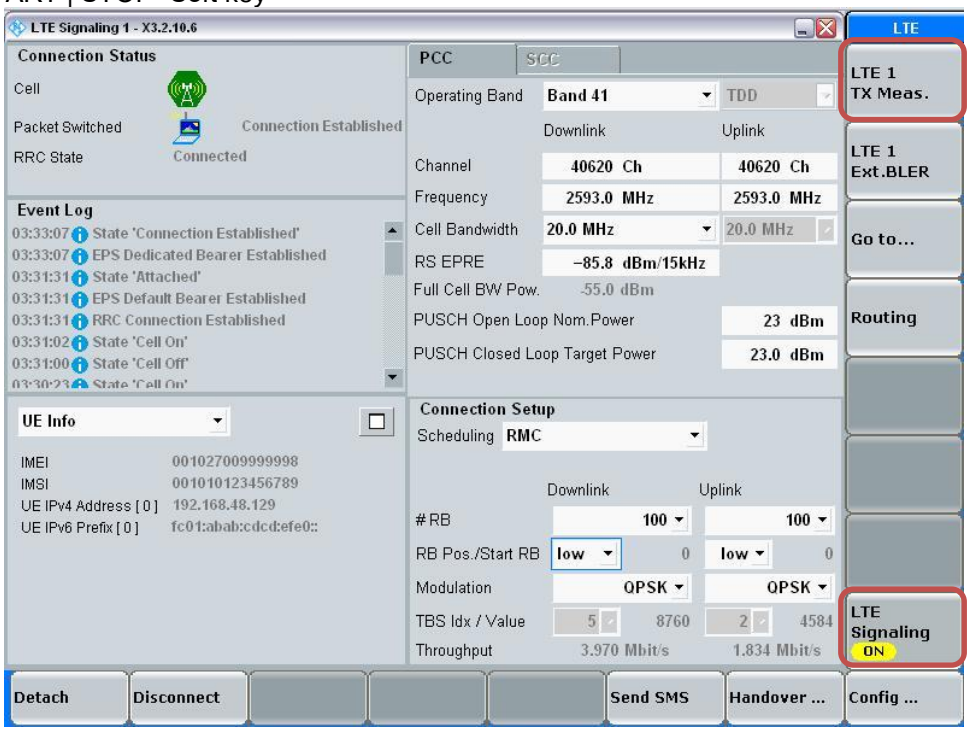
Connect to EUT

- Turn the cell on using “ON | OFF” key
- After EUT is Attached
- Select “Connect”



Max Power Setting

- Select “LTE 1 TX Meas.”
- Press “RESTART | STOP” Soft key



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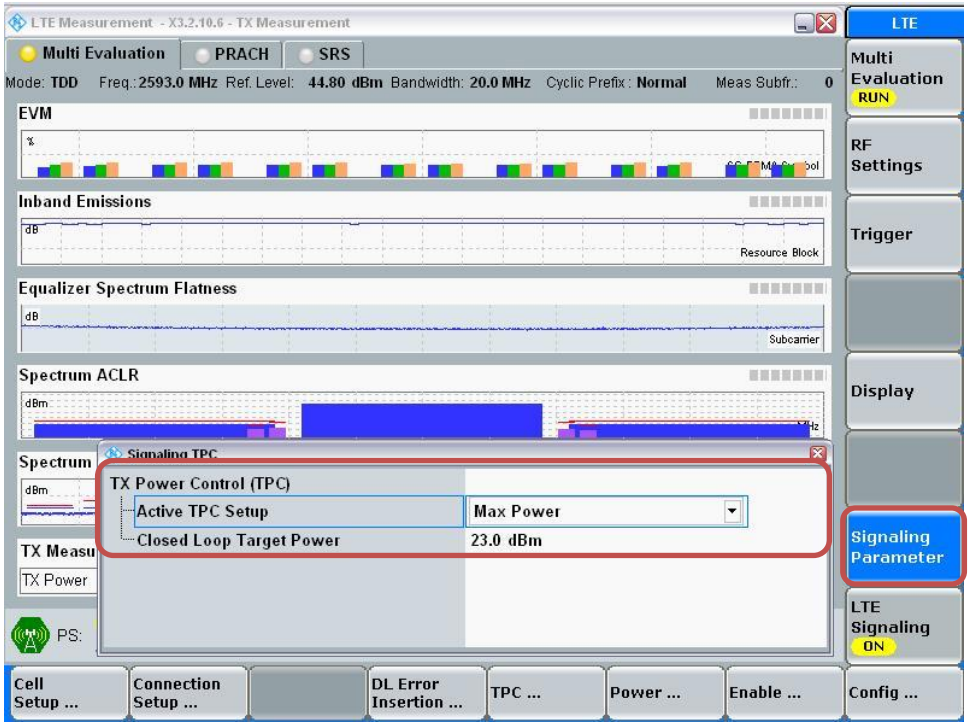
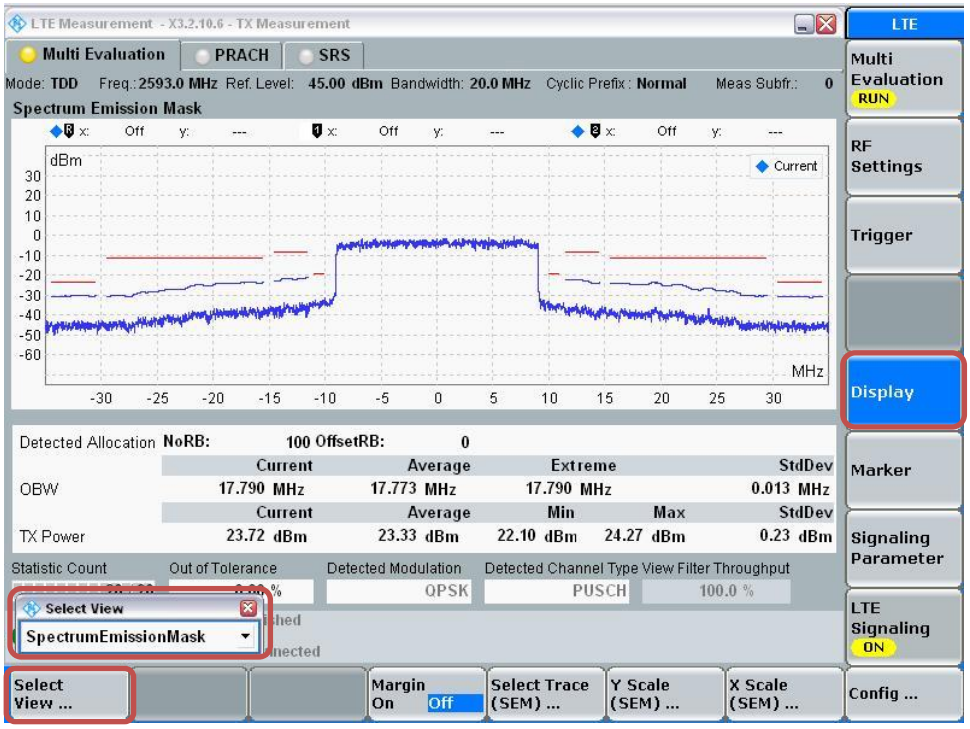
- Select “Signaling Parameter”
- Select “TX Power Control (TPC)” > Select “Active TPC Setup” to “Max Power” > Set “Closed Loop Target Power” to “23 dBm”



View TX Power

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



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LTE Band 41 Measured Results

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						
				Measured Pwr (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	23.6	23.8	23.3	22.9	23.2	0.0	24.5
		1	49	23.7	23.8	23.3	22.9	23.3	0.0	24.5
		1	99	23.7	23.9	23.3	23.0	23.4	0.0	24.5
		50	0	22.2	22.3	21.8	21.6	21.8	1.0	23.5
		50	24	22.2	22.3	21.8	21.6	21.9	1.0	23.5
		50	50	22.2	22.3	21.9	21.6	21.9	1.0	23.5
		100	0	22.2	22.3	21.8	21.6	21.9	1.0	23.5
	16QAM	1	0	21.9	22.1	21.6	21.4	21.6	1.0	23.5
		1	49	22.2	22.3	21.4	21.1	21.9	1.0	23.5
		1	99	21.8	22.3	21.5	21.6	21.9	1.0	23.5
		50	0	20.9	21.0	20.6	20.4	20.7	2.0	22.5
		50	24	21.0	21.0	20.6	20.3	20.7	2.0	22.5
		50	50	21.0	21.0	20.6	20.4	20.8	2.0	22.5
		100	0	20.9	21.1	20.7	20.4	20.8	2.0	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (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	23.6	23.7	23.1	23.0	23.2	0.0	24.5
		1	37	23.7	23.8	23.3	23.0	23.3	0.0	24.5
		1	74	23.7	23.8	23.3	23.0	23.3	0.0	24.5
		36	0	22.2	22.3	21.9	21.6	21.9	1.0	23.5
		36	20	22.2	22.3	21.9	21.6	21.9	1.0	23.5
		36	39	22.2	22.3	21.9	21.6	21.9	1.0	23.5
		75	0	22.2	22.3	21.8	21.6	21.9	1.0	23.5
	16QAM	1	0	22.3	22.1	21.6	21.3	21.9	1.0	23.5
		1	37	21.9	22.1	21.4	21.6	21.6	1.0	23.5
		1	74	22.1	22.0	21.6	21.7	21.6	1.0	23.5
		36	0	21.2	21.1	20.7	20.5	20.8	2.0	22.5
		36	20	21.1	21.2	20.7	20.5	20.8	2.0	22.5
		36	39	21.1	21.2	20.7	20.5	20.7	2.0	22.5
		75	0	21.1	21.2	20.8	20.5	20.8	2.0	22.5
BW (MHz)	Mode	RB Allocation	RB offset	Measured Pwr (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	23.7	23.8	23.3	23.0	23.2	0.0	24.5
		1	25	23.7	23.9	23.3	23.0	23.2	0.0	24.5
		1	49	23.7	23.8	23.3	23.0	23.3	0.0	24.5
		25	0	22.1	22.3	21.9	21.6	21.8	1.0	23.5
		25	12	22.2	22.3	21.8	21.6	21.8	1.0	23.5
		25	25	22.2	22.3	21.9	21.6	21.8	1.0	23.5
		50	0	22.2	22.3	21.8	21.5	21.8	1.0	23.5
	16QAM	1	0	22.1	22.0	22.0	21.3	21.5	1.0	23.5
		1	25	22.1	22.0	22.0	21.4	21.5	1.0	23.5
		1	49	22.1	22.1	22.0	21.4	21.6	1.0	23.5
		25	0	21.0	21.1	20.7	20.4	20.7	2.0	22.5
		25	12	21.0	21.1	20.7	20.4	20.7	2.0	22.5
		25	25	21.0	21.1	20.7	20.4	20.8	2.0	22.5
		50	0	21.0	21.1	20.7	20.4	20.7	2.0	22.5

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LTE Band 41 Measured Results (continued)

BW (MHz)	Mode	RB Allocation	RB offset	Maximum Average Power (dBm)						
				Measured Pwr (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	23.6	23.8	23.3	23.0	23.3	0.0	24.5
		1	12	23.7	23.9	23.3	23.0	23.3	0.0	24.5
		1	24	23.7	23.8	23.3	23.0	23.3	0.0	24.5
		12	0	22.2	22.3	21.9	21.6	21.8	1.0	23.5
		12	7	22.2	22.3	21.8	21.6	21.8	1.0	23.5
		12	13	22.2	22.3	21.8	21.5	21.9	1.0	23.5
		25	0	22.2	22.3	21.8	21.6	21.8	1.0	23.5
	16QAM	1	0	21.7	22.1	21.6	21.0	21.7	1.0	23.5
		1	12	21.8	22.1	21.7	21.0	21.7	1.0	23.5
		1	24	21.8	22.1	21.7	21.0	21.7	1.0	23.5
		12	0	20.8	21.0	20.6	20.3	20.6	2.0	22.5
		12	7	20.8	21.0	20.6	20.3	20.6	2.0	22.5
		12	13	20.8	21.0	20.7	20.3	20.6	2.0	22.5
		25	0	20.9	21.1	20.7	20.3	20.7	2.0	22.5

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9.4 Wi-Fi 2.4 GHz (DTS Band)

Measured Results (Max power)

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)		
					Meas Pwr	Tune-up Limit	SAR Test (Yes/No)
2.4	802.11b	1 Mbps	1	2412.0	18.4	19.0	Yes
			6	2437.0	18.4		
			11	2462.0	18.3		
			12	2467.0	7.4	8.0	No
			13	2472.0	7.9		
	802.11g	6 Mbps	1	2412.0	Not Required	17.0	No
			6	2437.0			
			11	2462.0		16.0	
			12	2467.0		8.0	
			13	2472.0			
	802.11n (HT20)	6.5 Mbps	1	2412.0	Not Required	16.0	No
			6	2437.0		17.0	
			11	2462.0		16.0	
			12	2467.0		6.0	
			13	2472.0		5.0	

Measured Results (reduced power)

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Reduced Average Power (dBm)		
					Meas Pwr	Tune-up Limit	SAR Test (Yes/No)
2.4	802.11b	1 Mbps	1	2412.0	15.2	16.0	Yes
			6	2437.0	15.1		
			11	2462.0	15.6		
			12	2467.0	7.4	8.0	No
			13	2472.0	7.9		
	802.11g	6 Mbps	1	2412.0	Not Required	16.0	No
			6	2437.0			
			11	2462.0			
			12	2467.0		8.0	
			13	2472.0			
	802.11n (HT20)	6.5 Mbps	1	2412.0	Not Required	16.0	No
			6	2437.0			
			11	2462.0			
			12	2467.0		6.0	
			13	2472.0		5.0	

Note(s):

1. SAR is not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 1.2 W/kg.
2. 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.
3. 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. Refer to §6.3.

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9.5 Wi-Fi 5GHz (U-NII Bands)

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Maximum Average Power (dBm)			Reduced Average Power (dBm)		
					Meas Pwr	Tune-up Limit	SAR Test (Yes/No)	Meas Pwr	Tune-up Limit	SAR Test (Yes/No)
5.3 (U-NII 2A)	802.11a	6 Mbps	52	5260.0	15.3	16.0	Yes	Not Required	14.0	No
			56	5280.0	14.7					
			60	5300.0	15.1					
			64	5320.0	15.1					
	802.11n (HT20)	6.5 Mbps	52	5260.0	15.0	16.0	No	Not Required	14.0	No
			56	5280.0	14.5					
			60	5300.0	14.9					
			64	5320.0	15.0					
	802.11n (HT40)	13.5 Mbps	54	5270.0	Not Required	15.0	No	13.1	14.0	Yes
			62	5310.0				13.2		
	802.11ac (VHT20)	6.5 Mbps	52	5260.0	15.0	16.0	No	Not Required	14.0	No
			56	5280.0	14.4					
			60	5300.0	14.8					
			64	5320.0	15.0					
	802.11ac (VHT40)	13.5 Mbps	54	5270.0	Not Required	15.0	No	12.9	14.0	No
			62	5310.0				13.1		
	802.11ac (VHT80)	29.3 Mbps	58	5290.0	Not Required	13.0	No	Not Required	13.0	No
5.5 (U-NII 2C)	802.11a	6 Mbps	100	5500.0	15.1	16.0	Yes	Not Required	14.0	No
			120	5600.0	14.6					
			124	5620.0	14.8					
			144	5720.0	14.8					
	802.11n (HT20)	6.5 Mbps	100	5500.0	14.8	16.0	No	Not Required	14.0	No
			120	5600.0	14.6					
			124	5620.0	14.7					
			144	5720.0	14.6					
	802.11n (HT40)	13.5 Mbps	102	5510.0	Not Required	15.0	No	13.3	14.0	Yes
			118	5590.0				12.8		
			126	5630.0				12.0		
			142	5710.0				12.3		
	802.11ac (VHT20)	6.5 Mbps	100	5500.0	14.8	16.0	No	Not Required	14.0	No
			120	5600.0	14.5					
			124	5620.0	14.7					
			144	5720.0	14.6					
	802.11ac (VHT40)	13.5 Mbps	102	5510.0	Not Required	15.0	No	13.2	14.0	No
			118	5590.0				12.8		
			126	5630.0				12.0		
			142	5710.0				12.3		
	802.11ac (VHT80)	29.3 Mbps	106	5530.0	Not Required	13.0	No	Not Required	13.0	No
			122	5610.0						
			138	5690.0						
5.8 (U-NII 3)	802.11a	6 Mbps	149	5745.0	15.2	16.0	Yes	Not Required	14.0	No
			157	5785.0	14.7					
			165	5825.0	15.0					
	802.11n (HT20)	6.5 Mbps	149	5745.0	14.5	16.0	No	Not Required	14.0	No
			157	5785.0	14.7					
			165	5825.0	14.8					
	802.11n (HT40)	13.5 Mbps	151	5755.0	Not Required	15.0	No	12.7	14.0	Yes
			159	5795.0				12.7		
	802.11ac (VHT20)	6.5 Mbps	149	5745.0	14.4	16.0	No	Not Required	14.0	No
			157	5785.0	14.7					
			165	5825.0	14.7					
	802.11ac (VHT40)	13.5 Mbps	151	5755.0	Not Required	15.0	No	12.6	14.0	No
			159	5795.0				12.6		
	802.11ac (VHT80)	29.3 Mbps	155	5775.0	Not Required	13.0	No	Not Required	13.0	No

Note(s):

1. 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.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac/ax modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n ac) is selected.
3. When UNII band 2A's specified maximum output power is higher or same than UNII band 1, 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 1
   - > 1.2 W/kg, both bands should be tested independently for SAR.

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9.6 Bluetooth

Average Power Measured Results

Band (GHz)	Mode	Ch #	Freq. (MHz)	Maximum Average Power (dBm)	
				Meas Pwr	Tune-up Limit
2.4	GFSK	0	2402	8.1	10.5
		39	2441	10.0	
		78	2480	8.9	
	EDR, 8-DPSK	0	2402	6.8	9.0
		39	2441	8.7	
		78	2480	7.7	
	LE, GFSK-1M	0	2402	4.4	6.5
		19	2440	6.2	
		39	2480	5.5	
	LE, GFSK-2M	0	2402	4.2	
		19	2440	6.0	
		39	2480	5.3	

Note(s):

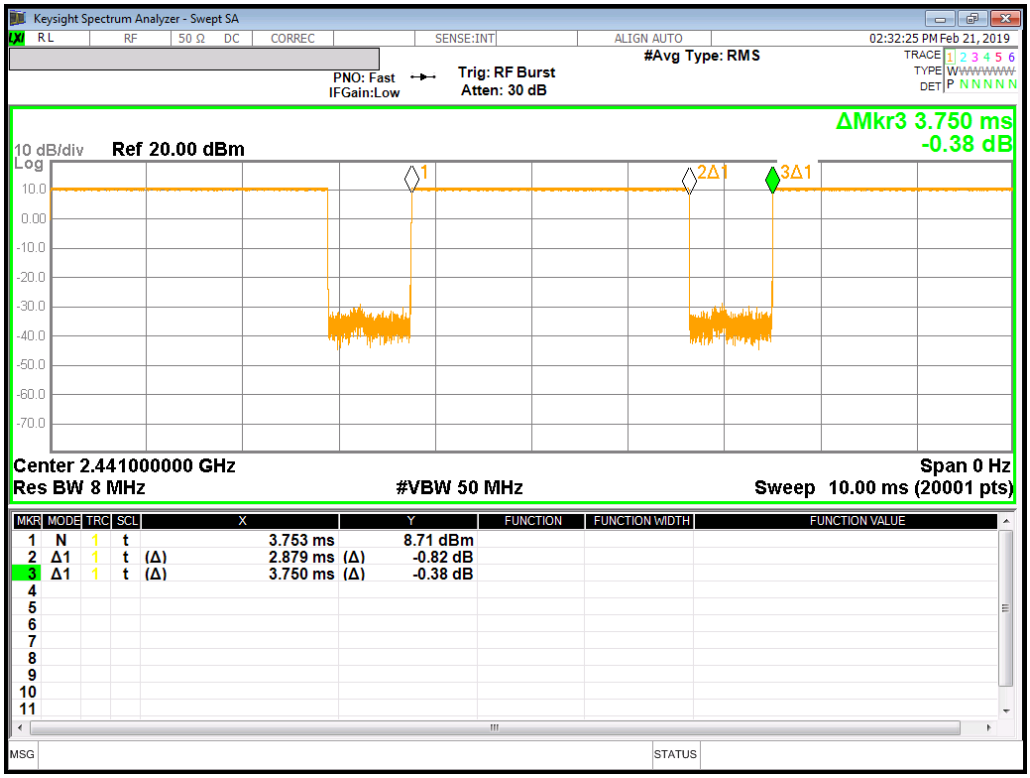
SAR test is evaluated at GFSK mode in Bluetooth

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	2.879	3.750	76.8%	1.30

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= 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

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 648474 D04 Handset SAR:

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

KDB 648474 D04 Handset SAR (Phablet Only):

When hotspot mode does not apply, 10-g Extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg .

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.

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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). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

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10.1 GSM 850

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
Main 1	Head	GPRS 4 Slot	0	Left Touch	190	836.6	28.0	26.9	0.100	0.128	
				Left Tilt	190	836.6	28.0	26.9	0.055	0.071	
				Right Touch	190	836.6	28.0	26.9	0.112	0.144	1
				Right Tilt	190	836.6	28.0	26.9	0.058	0.075	
	Body-worn	GPRS 4 Slot	15	Rear	190	836.6	28.0	26.9	0.197	0.254	2
				Front	190	836.6	28.0	26.9	0.117	0.151	
	Hotspot	GPRS 4 Slot	10	Rear	190	836.6	28.0	26.9	0.325	0.418	3
				Front	190	836.6	28.0	26.9	0.106	0.136	
				Edge 2	190	836.6	28.0	26.9	0.160	0.206	
				Edge 3	190	836.6	28.0	26.9	0.102	0.131	
				Edge 4	190	836.6	28.0	26.9	0.085	0.110	

10.2 GSM1900

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
Main 1	Head	GPRS 3 Slot	0	Left Touch	661	1880.0	26.5	25.2	0.034	0.046	
				Left Tilt	661	1880.0	26.5	25.2	0.022	0.030	
				Right Touch	661	1880.0	26.5	25.2	0.037	0.050	4
				Right Tilt	661	1880.0	26.5	25.2	0.013	0.017	
	Body-worn	GPRS 3 Slot	15	Rear	661	1880.0	26.5	25.2	0.067	0.091	5
				Front	661	1880.0	26.5	25.2	0.045	0.061	
	Hotspot	GPRS 3 Slot	10	Rear	661	1880.0	26.5	25.2	0.152	0.206	6
				Front	661	1880.0	26.5	25.2	0.071	0.097	
				Edge 2	661	1880.0	26.5	25.2	0.016	0.022	
				Edge 3	661	1880.0	26.5	25.2	0.090	0.122	
				Edge 4	661	1880.0	26.5	25.2	0.043	0.058	

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10.3 W-CDMA Band II

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
Main 1	Head	Rel.99 RMC	0	Left Touch	9400	1880.0	24.6	24.1	0.106	0.118	
				Left Tilt	9400	1880.0	24.6	24.1	0.071	0.079	
				Right Touch	9400	1880.0	24.6	24.1	0.150	0.168	7
				Right Tilt	9400	1880.0	24.6	24.1	0.049	0.054	
	Body-worn	Rel.99 RMC	15	Rear	9400	1880.0	24.6	24.1	0.216	0.241	8
				Front	9400	1880.0	24.6	24.1	0.156	0.174	
	Hotspot	Rel.99 RMC	10	Rear	9400	1880.0	24.6	24.1	0.479	0.535	9
				Front	9400	1880.0	24.6	24.1	0.242	0.270	
				Edge 2	9400	1880.0	24.6	24.1	0.059	0.066	
				Edge 3	9400	1880.0	24.6	24.1	0.288	0.322	
				Edge 4	9400	1880.0	24.6	24.1	0.142	0.159	

10.4 W-CDMA Band V

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
Main 1	Head	Rel.99 RMC	0	Left Touch	4183	836.6	25.0	23.8	0.162	0.213	
				Left Tilt	4183	836.6	25.0	23.8	0.090	0.119	
				Right Touch	4183	836.6	25.0	23.8	0.179	0.236	10
				Right Tilt	4183	836.6	25.0	23.8	0.100	0.131	
	Body-worn	Rel.99 RMC	15	Rear	4183	836.6	25.0	23.8	0.310	0.408	11
				Front	4183	836.6	25.0	23.8	0.211	0.278	
	Hotspot	Rel.99 RMC	10	Rear	4183	836.6	25.0	23.8	0.466	0.614	12
				Front	4183	836.6	25.0	23.8	0.187	0.246	
				Edge 2	4183	836.6	25.0	23.8	0.283	0.373	
				Edge 3	4183	836.6	25.0	23.8	0.160	0.211	
				Edge 4	4183	836.6	25.0	23.8	0.147	0.194	

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10.5 LTE Band 5 (10MHz Bandwidth)

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Main 1	Head	QPSK	0	Left Touch	20525	836.5	1	0	25.0	24.2	0.181	0.219	
							25	0	24.0	22.2	0.113	0.173	
				Left Tilt	20525	836.5	1	0	25.0	24.2	0.117	0.142	
							25	0	24.0	22.2	0.073	0.111	
				Right Touch	20525	836.5	1	0	25.0	24.2	0.204	0.247	13
							25	0	24.0	22.2	0.134	0.205	
				Right Tilt	20525	836.5	1	0	25.0	24.2	0.116	0.141	
							25	0	24.0	22.2	0.078	0.119	
	Body-worn	QPSK	15	Rear	20525	836.5	1	0	25.0	24.2	0.382	0.463	14
							25	0	24.0	22.2	0.238	0.364	
				Front	20525	836.5	1	0	25.0	24.2	0.252	0.305	
							25	0	24.0	22.2	0.158	0.241	
	Hotspot	QPSK	10	Rear	20525	836.5	1	0	25.0	24.2	0.491	0.595	15
							25	0	24.0	22.2	0.320	0.489	
				Front	20525	836.5	1	0	25.0	24.2	0.225	0.273	
							25	0	24.0	22.2	0.143	0.218	
				Edge 2	20525	836.5	1	0	25.0	24.2	0.332	0.402	
							25	0	24.0	22.2	0.212	0.324	
				Edge 3	20525	836.5	1	0	25.0	24.2	0.177	0.214	
							25	0	24.0	22.2	0.119	0.182	
				Edge 4	20525	836.5	1	0	25.0	24.2	0.189	0.229	
							25	0	24.0	22.2	0.115	0.176	

10.6 LTE Band 41 (20MHz Bandwidth)

Antenna	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offest	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	
Main 2	Head	QPSK	0	Left Touch	40185	2549.5	1	99	24.5	23.9	0.166	0.192	
							50	0	23.5	22.3	0.122	0.160	
				Left Tilt	40185	2549.5	1	99	24.5	23.9	0.072	0.083	
							50	0	23.5	22.3	0.046	0.060	
				Right Touch	40185	2549.5	1	99	24.5	23.9	0.436	0.505	16
							50	0	23.5	22.3	0.318	0.417	
				Right Tilt	40185	2549.5	1	99	24.5	23.9	0.148	0.172	
							50	0	23.5	22.3	0.107	0.140	
	Body-worn	QPSK	15	Rear	40185	2549.5	1	99	24.5	23.9	0.203	0.235	17
							50	0	23.5	22.3	0.166	0.218	
				Front	40185	2549.5	1	99	24.5	23.9	0.055	0.063	
							50	0	23.5	22.3	0.044	0.057	
	Hotspot	QPSK	10	Rear	40185	2549.5	1	99	24.5	23.9	0.502	0.582	18
							50	0	23.5	22.3	0.411	0.539	
				Front	40185	2549.5	1	99	24.5	23.9	0.103	0.119	
							50	0	23.5	22.3	0.078	0.103	
				Edge 1	40185	2549.5	1	99	24.5	23.9	0.013	0.015	
							50	0	23.5	22.3	0.009	0.012	
				Edge 4	40185	2549.5	1	99	24.5	23.9	0.181	0.210	
							50	0	23.5	22.3	0.149	0.196	

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10.7 Wi-Fi (DTS Band)

Frequency Band	Mode	RF Exposure Conditions	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		Note	Plot No.
										Tune-up limit	Meas.	Meas.	Scaled		
2.4GHz	802.11b 1 Mbps	Head	On	0	Left Touch	11	2462.0	0.151	99.6	16.0	15.6				
					Left Tilt	11	2462.0	0.202	99.6	16.0	15.6				
					Right Touch	11	2462.0	0.207	99.6	16.0	15.6	0.176	0.194	1	19
					Rightt Tilt	11	2462.0	0.185	99.6	16.0	15.6				
		Body-worn	Off	15	Rear	1	2412.0	0.273	99.6	19.0	18.4	0.206	0.237	1	20
					Front	1	2412.0	0.094	99.6	19.0	18.4				
		Hotspot	Off	10	Rear	1	2412.0	0.468	99.6	19.0	18.4	0.355	0.409		21
					Front	1	2412.0	0.152	99.6	19.0	18.4				
					Edge 1	1	2412.0	0.242	99.6	19.0	18.4	0.189	0.218	2	
					Edge 4	1	2412.0	0.066	99.6	19.0	18.4				

Note(s):

1. When the Highest reported SAR is ≤ 0.4 or 1.0 W/kg (1-g or 10-g respectively). Therefore, further SAR measurements within this exposure condition are not required.
2. Highest reported SAR is > 0.4 or 1.0 W/kg (1-g or 10-g respectively). Due to the highest reported SAR for this test position, other test positions in this exposure condition were evaluated until a SAR ≤ 0.8 or 2.0 W/kg (1-g or 10-g respectively) was reported.
3. Testing for a second channel was required because the reported SAR for this test position was > 0.8 or 2.0 W/kg (1-g or 10-g respectively).
4. Additional testing required in order satisfying FCC simultaneous transmission limit criteria.
5. 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.

10.8 Wi-Fi (U-NII Bands)

Frequency Band	Mode	RF Exposure Conditions	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		Note	Plot No.
										Tune-up limit	Meas.	Meas.	Scaled		
5.3 GHz U-NII 2A	802.11n HT 40 13.5 Mbps	Head	On	0	Left Touch	62	5310.0	0.203	92.1	14.0	13.2				
					Left Tilt	62	5310.0	0.234	92.1	14.0	13.2				
					Right Touch	62	5310.0	0.260	92.1	14.0	13.2				
					Right Tilt	62	5310.0	0.328	92.1	14.0	13.2	0.139	0.182	1	22
	802.11a 6 Mbps	Body-worn	Off	15	Rear	52	5260.0	0.098	97.2	16.0	15.3	0.046	0.056	1	23
					Front	52	5260.0	0.062	97.2	16.0	15.3				
Frequency Band	Mode	RF Exposure Conditions	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		Note	Plot No.
										Tune-up limit	Meas.	Meas.	Scaled		
5.5 GHz U-NII 2C	802.11n HT 40 13.5 Mbps	Head	On	0	Left Touch	102	5510.0	0.268	92.1	14.0	13.3				
					Left Tilt	102	5510.0	0.296	92.1	14.0	13.3				
					Right Touch	102	5510.0	0.334	92.1	14.0	13.3				
					Right Tilt	102	5510.0	0.492	92.1	14.0	13.3	0.209	0.266	1	24
	802.11a 6 Mbps	Body-worn	Off	15	Rear	100	5500.0	0.128	97.2	16.0	15.1	0.057	0.072	1	25
					Front	100	5500.0	0.075	97.2	16.0	15.1				
Frequency Band	Mode	RF Exposure Conditions	PWR Back-off	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		Note	Plot No.
										Tune-up limit	Meas.	Meas.	Scaled		
5.8 GHz U-NII 3	802.11n HT 40 13.5 Mbps	Head	On	0	Left Touch	159	5795.0	0.131	92.1	14.0	12.7				
					Left Tilt	159	5795.0	0.160	92.1	14.0	12.7				
					Right Touch	159	5795.0	0.337	92.1	14.0	12.7				
					Right Tilt	159	5795.0	0.390	92.1	14.0	12.7	0.128	0.188	1	26
	802.11a 6 Mbps	Body-worn	Off	15	Rear	149	5745.0	0.073	97.2	16.0	15.2	0.027	0.033	1	27
					Front	149	5745.0	0.057	97.2	16.0	15.2				
		Hotspot	Off	10	Rear	149	5745.0	0.112	97.2	16.0	15.2				
					Front	149	5745.0	0.098	97.2	16.0	15.2				
					Edge 1	149	5745.0	0.192	97.2	16.0	15.2	0.082	0.101	1	28
					Edge 4	149	5745.0	0.105	97.2	16.0	15.2				

Note(s):

1. Highest *reported* SAR is ≤ 0.4 or 1.0 W/kg (1-g or 10-g respectively). Therefore, further SAR measurements within this exposure condition are not required.
2. Highest *reported* SAR is > 0.4 or 1.0 W/kg (1-g or 10-g respectively). Due to the highest *reported* SAR for this test position, other test positions in this exposure condition were evaluated until a SAR ≤ 0.8 or 2.0 W/kg (1-g or 10-g respectively) was *reported*.
3. Testing for a second channel was required because the *reported* SAR for this test position was > 0.8 or 2.0 W/kg (1-g or 10-g respectively).
4. Additional testing required in order satisfying FCC simultaneous transmission limit criteria.

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10.9 Bluetooth

Frequency Band	Mode	RF Exposure Conditions	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
2.4GHz	GFSK	Head	0	Left Touch	39	2441.0	76.8	10.5	10.0	0.031	0.045	
				Left Tilt	39	2441.0	76.8	10.5	10.0	0.034	0.050	
				Right Touch	39	2441.0	76.8	10.5	10.0	0.051	0.074	29
				Rightt Tilt	39	2441.0	76.8	10.5	10.0	0.049	0.071	

Standalone SAR Test Exclusion Considerations & Estimated SAR

RF Air interface	RF Exposure Conditions	Frequency (GHz)	Max. tune-up tolerance Pow er		Min. test separation distance (mm)	SAR test exclusion Result*	Estimated 1-g SAR (W/kg)
			(dBm)	(mW)			
Bluetooth	Body-w orn	2.480	10.5	11	15	1.2	0.154
	Hotspot	2.480	10.5	11	10	1.7	0.231

Conclusion:

*: The computed value is ≤ 3; therefore, this qualifies for Standalone SAR test exclusion.

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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.

Peak spatial-average (1g of tissue)

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
835	GSM 850	Hotspot	Rear	No	0.325	N/A	N/A
	WCDMA Band V	Hotspot	Rear	No	0.466	N/A	N/A
	LTE Band 5	Hotspot	Rear	No	0.491	N/A	N/A
1900	GSM 1900	Hotspot	Rear	No	0.152	N/A	N/A
	WCDMA Band II	Hotspot	Rear	No	0.479	N/A	N/A
2400	Wi-Fi 802.11b/g/n	Hotspot	Rear	No	0.355	N/A	N/A
	Bluetooth	Head	Right Touch	No	0.051	N/A	N/A
2600	LTE Band 41	Hotspot	Rear	No	0.502	N/A	N/A
5300	Wi-Fi 802.11a/n	Head	Right Tilt	No	0.139	N/A	N/A
5500	Wi-Fi 802.11a/n	Head	Right Tilt	No	0.209	N/A	N/A
5800	Wi-Fi 802.11a/n	Head	Right Tilt	No	0.128	N/A	N/A

Note(s):

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

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12. DUT Holder Perturbations

In accordance with published DUT Holder Perturbations in Oct.2016 TCB workshop,

When Highest reported SAR is over 1.2 or 3.0 W/kg (1-g or 10-g respectively), Holder perturbation verification is required for each antenna, using the highest configuration among all applicable frequency bands. Both Head test and Body test (Edge 1-4 sides) are evaluated with DUT holder. Both Front and Rear sides are evaluated without DUT holder. (Details of test setup are refer to Appendix A.)

So we are only consider about Head test and Body test (Edge 1-4 sides).

All highest SAR level is not over 1.2 or 3.0 W/kg (1-g or 10-g respectively) in All bands.

Please refer to Section 10. **So DUT Holder perturbations verification are not required.**

13. Simultaneous Transmission SAR Analysis

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Head & Body-worn &	1	GSM(Voice/GPRS)	+	DTS
	2	GSM(Voice/GPRS)	+	UNII
	3	GSM(Voice/GPRS)	+	BT
	4	W-CDMA	+	DTS
	5	W-CDMA	+	UNII
	6	W-CDMA	+	BT
	7	LTE	+	DTS
	8	LTE	+	UNII
	9	LTE	+	BT
Hotspot	10	GSM(GPRS)	+	DTS
	11	GSM(GPRS)	+	UNII
	12	GSM(GPRS)	+	BT
	13	W-CDMA	+	DTS
	14	W-CDMA	+	UNII
	15	W-CDMA	+	BT
	16	LTE	+	DTS
	17	LTE	+	UNII
	18	LTE	+	BT

Notes:
1. DTS supports Wi-Fi Direct, Hotspot and VoIP.
2. U-NII supports Wi-Fi Direct, Hotspot and VoIP.
3. GPRS, W-CDMA, LTE supports Hotspot and VoIP.
4. U-NII Radio cannot transmit simultaneously with Bluetooth Radio.
5. DTS Radio cannot transmit simultaneously with Bluetooth Radio.
6. DTS Radio cannot transmit simultaneously with UNII Radio.
7. BT tethering is consider about each RF exposure conditions

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Simultaneous transmission SAR test exclusion considerations

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

Sum of SAR

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

SAR to Peak Location Ratio (SPLSR)

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

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

Where:

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

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

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of

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

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

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

When an individual antenna transmits at on two bands simultaneously, the sum of the highest *reported* SAR for the frequency bands should be used to determine SAR_1.or SAR_2. When SPLSR is necessary, the smallest distance between the peak SAR locations for the antenna pair with respect to the peaks from each antenna should be used.

The antennas in all antenna pairs that do not qualify for simultaneous transmission SAR test exclusion must be tested for SAR compliance, according to the enlarged zoom scan and volume scan post-processing procedures in KDB Publication 865664 D01

The antennas for the unlicensed transmitters are closely situated. As a result, the associated SAR hotspots are also closely situated. Some of the sum of SAR calculations yielded results over 1.6 W/kg. The SPSLR calculations for these situations were performed by treating the unlicensed SAR values as a single transmitter. The most conservative distance between all the unlicensed hotspots to the licensed hotspot was used for the value of *d* in the SPSLR calculation.

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Simultaneous transmission SAR measurement

When simultaneous transmission SAR measurements are required in different frequency bands not covered by a single probe calibration point then separate tests for each frequency band are performed. The tests are performed using enlarged zoom scans which are processed, by means of superposition, using the DASY5 volume scan postprocessing procedures to determine the 1-g SAR for the aggregate SAR distribution.

The spatial resolution used for all enlarged zoom scans is the same as used for the most stringent zoom scans. I.E. the scan parameters required for the highest frequency assessed are used for all enlarged zoom scans. The scans cover the complete area of the device to ensure all transmitting antennas and radiating structures are assessed.

DASY5 provides the ability to perform Multiband Evaluations according to the latest standards using the Volume Scan job as well as appropriate routines for the Post-processing.

In order to extract and process measurements within different frequency bands, the SEMCAD X Post-processor performs the combination and subsequent superposition of these measurement data via DASY5= Combined MultiBand Averaged SAR.

Combined Multi Band Averaged SAR allows - in addition to the data extraction - an evaluation of the 1 g, 10 g and/or arbitrary averaged mass SAR.
Power Scaling Factor is used to allow the volume scans to be scaled by a value other than "1", this is important when the results need to be scaled to different maximum power levels. The Power Scaling Factor is applied to each individual point of the scan. When power scaling is used in multi-band combinations the scaling factor is applied to each individual point of the first scan, the second factor is then applied to each individual point of the second scan and so on. The scans are then combined.

13.1 Sum of the SAR for WWAN & Wi-Fi & BT

RF Exposure conditions	Test Position	① WWAN	② DTS	③ U-NII	④ BT	① + ② WWAN + DTS		① + ③ WWAN + U-NII		① + ④ WWAN + BT	
						∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)	∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)	∑ 1-g SAR (mW/g)	SPLSR (Yes/ No)
Head	All Position	0.505	0.194	0.266	0.074	0.699	No	0.771	No	0.579	No
Body-worn	All Position	0.463	0.237	0.072	0.154	0.700	No	0.535	No	0.617	No
Hotspot	All Position	0.614	0.409	0.101	0.231	1.023	No	0.715	No	0.845	No

Conclusion:

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

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Appendixes

Refer to separated files for the following appendixes.

4788874100-S1V2 FCC Report SAR_App A_Photos & Ant. Locations

4788874100-S1V2 FCC Report SAR_App B_Highest SAR Test Plots

4788874100-S1V2 FCC Report SAR_App C_System Check Plots

4788874100-S1V2 FCC Report SAR_App D_SAR Tissue Ingredients

4788874100-S1V2 FCC Report SAR_App E_Probe Cal. Certificates

4788874100-S1V2 FCC Report SAR_App F_Dipole Cal. Certificates

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