



SAR EVALUATION REPORT

**FCC 47 CFR § 2.1093
IEEE Std 1528-2013**

For
GSM/WCDMA Phone + Bluetooth, WLAN 2.4GHz b/g/n & ANT+

**Model: SM-G5108Q
FCC ID: A3LSMG5108Q**

**Report Number: 14U18462-S1A
Issue Date: 9/3/2014**

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NVLAP LAB CODE 200065-0

REVISION HISTORY

Rev.	Issue Date	Revisions	Revised By
--	8/12/2014	Initial Issue	--
A	9/3/2014	Added LTE Band 41	Coltyce Sanders

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1. Attestation of Test Results

Applicant Name	Samsung Electronics		
Application Purpose	☒ Original Grant ☐ Class II Permissive Change		
FCC ID	A3LSMG5108Q		
DUT Description	GSM/WCDMA Phone + Bluetooth, WLAN 2.4GHz b/g/n & ANT+		
Exposure Category	General Population/Uncontrolled Exposure (1g SAR limit: 1.6 W/kg)		
The Highest Reported SAR	RF Exposure Conditions	Equipment Class	
		Licensed	DTS
	Head	0.869 W/kg	0.651 W/kg
	Body-worn Accessory	1.018 W/kg	0.483 W/kg
	Wireless Router (Hotspot)		
	Wi-Fi Direct	N/A	
	Simultaneous Transmission	Head: 1.185 W/kg Body: 1.501 W/kg	N/A
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013		
Test Results	Pass		
Date tested	08/04/2014 – 08/06/2014, 09/2/2014 – 09/3/2014		
UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report. Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.			
Approved & Released By:  Dave Weaver Program Manager UL Verification Services Inc.		Prepared By:  Richard Jankovics Engineer UL Verification Services Inc.	

2. Test Specification, Methods and Procedures

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

- 447498 D01 General RF Exposure Guidance v05r02
- 648474 D04 Handset SAR v01r02
- 941225 D01 SAR test for 3G devices v02
- 941225 D02 HSPA and 1x Advanced v02r02
- 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- 941225 D05 SAR for LTE Devices v02r03
- 941225 D05A LTE Rel.10 KDB Inquiry Sheet v01
- 941225 D06 Hotspot Mode SAR v01r01
- 248227 D01 SAR Meas for 802 11abg v01r02
- 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r03
- 865664 D02 SAR Reporting v01r01
- 690783 D01 SAR Listings on Grants v01r03

3. Facilities and Accreditation

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

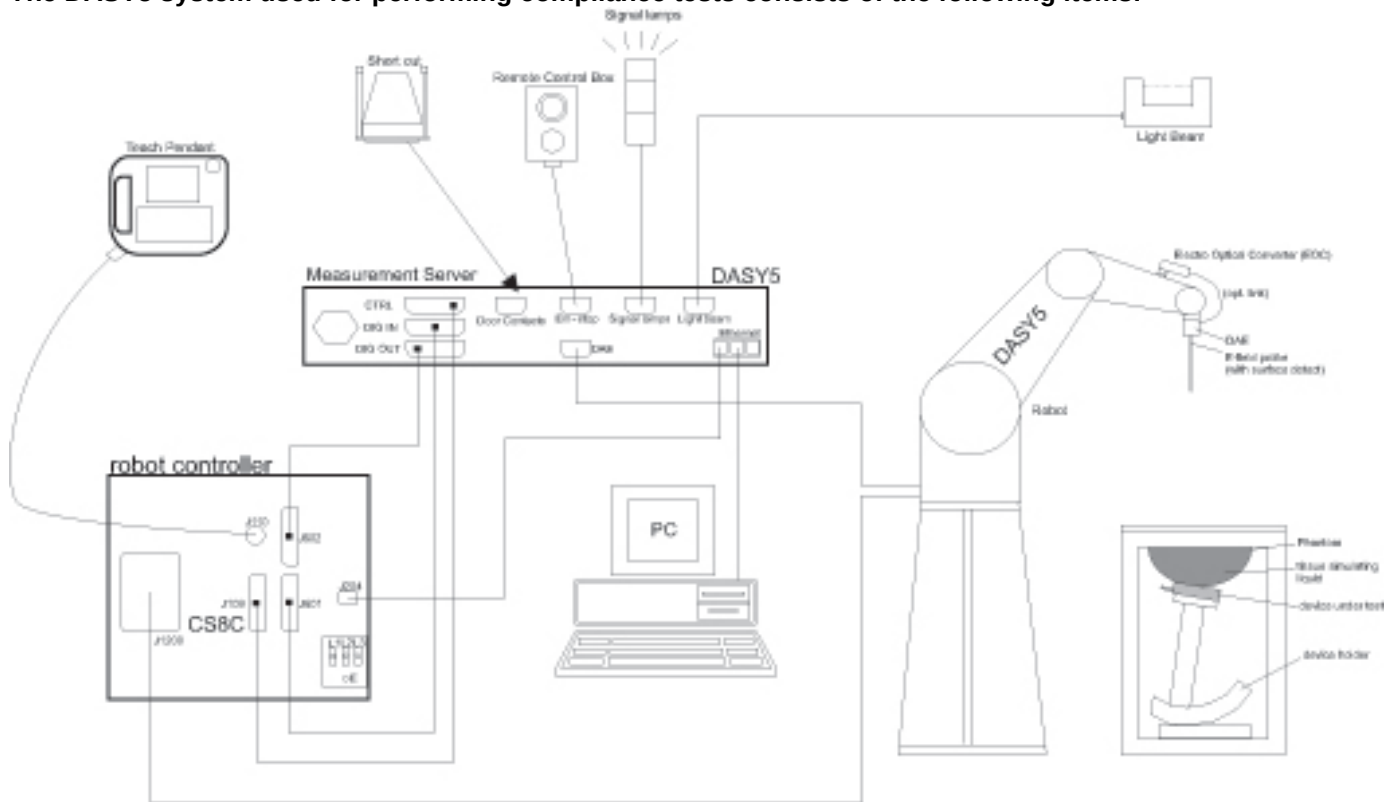
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://ts.nist.gov/standards/scopes/2000650.htm>.

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



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

4.2. 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	ENA Series/E5071B	MY42100131	2/24/2015
Dielectric Probe kit	SPEAG	DAK-3.5	1087	11/13/2014
Dielectric Probe kit	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	Control Company	4242	122529163	9/19/2014
Thermometer	EXTECH	445703	CCS-200	3/24/2015

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
HP Signal Generator	HP	8665B	3546A00784	6/23/2015
Power Meter	HP	437B	3125U16345	6/16/2015
Power Meter	HP	437B	3125U09516	9/30/2014
Power Sensor	Agilent	8481A	2237A31744	10/2/2014
Power Sensor	Agilent	8481A	2349A36506	9/30/2014
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1808939	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2710	N/A
DC Power Supply	Sorensen Ametek	XT15-4	1319A02778	N/A
HP Signal Generator	HP	8665B	3438A00633	7/10/2015
Power Meter	HP	438A	3513U04320	10/2/2014
Power Sensor	Agilent	8481A	2702A66876	9/30/2014
Power Sensor	Agilent	8481A	3318A95392	9/30/2014
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1622052	N/A
Bi-directional coupler	Werlatone, Inc.	C8060-102	2711	N/A
DC Power Supply	HP	6296A	2841A-05955	N/A
E-Field Probe (SAR 1)	SPEAG	EX3DV4	3902	5/19/2015
E-Field Probe (SAR 2)	SPEAG	EX3DV3	3531	11/21/2014
E-Field Probe (SAR 4)	SPEAG	EX3DV4	3929	5/9/2015
E-Field Probe (SAR 5)	SPEAG	EX3DV4	3991	5/6/2015
Data Acquisition Electronics (SAR 1)	SPEAG	DAE3	427	1/14/2015
Data Acquisition Electronics (SAR 2)	SPEAG	DAE4	1359	2/17/2015
Data Acquisition Electronics (SAR 4)	SPEAG	DAE4	1352	9/11/2014
Data Acquisition Electronics (SAR 5)	SPEAG	DAE4	1439	5/14/2015
System Validation Dipole	SPEAG	D835V2	4d002	11/15/2015
System Validation Dipole	SPEAG	D1900V2	5d043	11/12/2015
System Validation Dipole	SPEAG	D2450V2	899	9/10/2014
System Validation Dipole	SPEAG	D2600V2	1006	9/11/2014
Thermometer (SAR Lab 1)	EXTECH	445703	CCS-2305	3/24/2015
Thermometer (SAR Lab 2)	EXTECH	445703	CCS-203	3/28/2015
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/3/2015
Thermometer (SAR Lab 5)	EXTECH	445703	CCS-239	6/3/2015

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Sensor	Agilent	N1921A	MY52020011	5/6/2015
Power Meter	Agilent	N1911A	MY53040015	7/10/2015
Base Station Simulator	R & S	CMW500	125236-es	5/29/2015
Base Station Simulator	R & S	CMW500	127733-cy	6/2/2015

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, the 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

Model: SM-G5108Q	
Device Dimension	Overall (Length x Width): 136.23 mm x 69.60 mm Overall Diagonal: 145.92 mm Display Diagonal: 122.96 mm
Battery Back Cover	☒ Normal Battery Cover ☐ Normal Battery Cover with NFC ☐ Wireless Charger Battery Cover ☐ Wireless Charger Battery Cover with NFC.
Battery Options	☒ Standard – Lithium-ion battery, Rating 3.85Vdc, 8.47Wh ☐ Extended (large capacity)
Accessory	Headset
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5 GHz)
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)
SIM Information	☐ Single SIM ☒ Dual SIM

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)	GSM Voice: 12.5%; GPRS/EGPRS: 1 Slot: 12.5%; 2 Slots: 25%, 3 Slots: 37.5%, 4 Slots: 50%,
	GPRS Multi-Slot Class: ☐ Class 8 - One Up ☐ Class 10 - Two Up ☐ Class 12 - Four Up ☒ Class 33 - Four Up Is DTM (Dual Transfer Mode) supported: ☐ Yes ☒ No		
W-CDMA (UMTS)	Band V and II	UMTS Rel. 99 (Voice & Data) HSDPA (Category 24, Rel. 8) HSUPA ((Category 6, Rel. 6) DC-HSDPA (Category 21, Rel. 8) HSPA+	100%
LTE (TDD)	Band 41	QPSK, 16QAM	63.3%
	Does this device SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No		
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	100%
Bluetooth	2.4 GHz	Version 4.0 LE + EDR + HS	32.25% (DH1), 66.68% (DH3), 77.52% (DH5)

6.3. Nominal and Maximum Output Power

Upper limit (dB): 0.5 ~ -1.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
GSM850	Voice	32.5	33.0
	GPRS 1 slot	32.5	33.0
	GPRS 2 slots	30.0	30.5
	GPRS 3 slots	27.0	27.5
	GPRS 4 slots	25.5	26.0
	EGPRS 1 slot	27.0	27.5
	EGPRS 2 slots	26.0	26.5
	EGPRS 3 slots	23.5	24.0
	EGPRS 4 slots	23.5	24.0
GSM1900	Voice	30.0	30.5
	GPRS 1 slot	30.0	30.5
	GPRS 2 slots	27.5	28.0
	GPRS 3 slots	25.5	26.0
	GPRS 4 slots	24.0	24.5
	EGPRS 1 slot	26.0	26.5
	EGPRS 2 slots	25.5	26.0
	EGPRS 3 slots	23.0	23.5
	EGPRS 4 slots	23.0	23.5
W-CDMA Band V	R99	22.5	23.0
	HSDPA	21.5	22.0
	HSUPA	22.5	23.0
	DC-DSPA	21.5	22.0
W-CDMA Band II	R99	22.0	22.5
	HSDPA	21.0	21.5
	HSUPA	22.0	22.5
	DC-DSPA	21.0	21.5
LTE Band 41	QPSK	22.5	23.0

Upper limit (dB): 0.5		RF Output Power (dBm)	
RF Air interface	Mode	Target	Max. tune-up tolerance limit
WiFi 2.4 GHz	802.11b	17.0	17.5
	802.11g	13.0	13.5
	802.11n HT20	12.0	12.5
Bluetooth		9.0	9.5
Bluetooth LE		8.0	8.5

6.4. Simultaneous Transmission Condition

RF Exposure Condition	Capable Transmit Configurations
Head	1. GSM 850/1900 Voice + Wi-Fi 2.4GHz 2. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4GHz 3. WCDMA Band 2/5 + Wi-Fi 2.4GHz 4. LTE B41 + Wi-Fi 2.4GHz
Body-worn Accessory	1. GSM 850/1900 Voice + Wi-Fi 2.4GHz 2. GSM 850/1900 Voice + BT 3. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4GHz 4. GSM 850/1900 (GPRS/EDGE) + BT 5. WCDMA Band 2/5 + Wi-Fi 2.4GHz 6. WCDMA Band 2/5 + BT 7. LTE B41 + Wi-Fi 2.4GHz 8. LTE B41 + BT
Wireless Router (Hotspot) and Wi-Fi Direct	1. GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4GHz 2. WCDMA Band 2/5 + Wi-Fi 2.4GHz 3. LTE B41 + Wi-Fi 2.4GHz
Notes: 1. Wi-Fi 2.4GHz supports Hotspot and Wi-Fi Direct. 2. GPRS/EDGE, LTE and WCDMA support Hotspot. 3. VoIP is supported in LTE, WCDMA and GPRS. 4. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio.	

6.5. General LTE SAR Test and Reporting Considerations

Item	Description																																												
Frequency range, Channel Bandwidth, Numbers and Frequencies	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	39725/ 2503.5	39700/ 2501	39675/ 2498.5																																								
	Low-Mid	40185/ 2549.5	40173/ 2548.3	40160/ 2547.0	40148/ 2545.8																																								
	Mid	40620/ 2593.0	40620/ 2593.0	40620/ 2593.0	40620/ 2593.0																																								
	Mid-High	41055/ 2636.5	41068/ 2547.8	41080/ 2639.0	41093/ 2640.3																																								
	High	41490/ 2680.0	41515/ 2682.5	41540/ 2685.0	41565/ 2687.5																																								
LTE transmitter and antenna implementation	LTE has one (1) TX/RX antennas and one (1) RX antennas Refer to Appendix 14.1. Photos and Antenna Locations.																																												
Maximum power reduction (MPR)	Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3 <table border="1"> <thead> <tr> <th rowspan="2">Modulation</th><th colspan="6">Channel bandwidth / Transmission bandwidth (RB)</th><th rowspan="2">MPR (dB)</th></tr> <tr> <th>1.4 MHz</th><th>3.0 MHz</th><th>5 MHz</th><th>10 MHz</th><th>15 MHz</th><th>20 MHz</th></tr> </thead> <tbody> <tr> <td>QPSK</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 1</td></tr> <tr> <td>16 QAM</td><td>≤ 5</td><td>≤ 4</td><td>≤ 8</td><td>≤ 12</td><td>≤ 16</td><td>≤ 18</td><td>≤ 1</td></tr> <tr> <td>16 QAM</td><td>> 5</td><td>> 4</td><td>> 8</td><td>> 12</td><td>> 16</td><td>> 18</td><td>≤ 2</td></tr> </tbody> </table> MPR Built-in by design A-MPR (additional MPR) was disabled during SAR testing							Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1	16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1	16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2
Modulation	Channel bandwidth / Transmission bandwidth (RB)						MPR (dB)																																						
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz																																							
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1																																						
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1																																						
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2																																						
Power reduction	No																																												
Spectrum plots for RB configurations	A properly configured base station simulator was used for the SAR and power measurements; therefore, spectrum plots for each RB allocation and offset configuration are not included in the SAR report.																																												

6.6. LTE (TDD) Considerations

According to KDB 941225 D05 SAR for LTE Devices v02r02, 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.

SAR was tested with the highest transmission duty factor (63.33%) using Uplink-downlink configuration 0 and Special subframe configuration 7.

LTE TDD Band 41 supports 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	$26336 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$	$7680 \cdot T_s$	$4384 \cdot T_s$	$5120 \cdot T_s$
5	$6592 \cdot T_s$			$20480 \cdot T_s$		
6	$19760 \cdot T_s$			$23040 \cdot T_s$		
7	$21952 \cdot T_s$			$12800 \cdot T_s$		
8	$24144 \cdot T_s$			-	-	-
9	$13168 \cdot T_s$			-	-	-

Table 4.2-2: Uplink-downlink configurations.

Uplink-downlink configuration	Downlink-to-Uplink Switch-point periodicity	Subframe number									
		0	1	2	3	4	5	6	7	8	9
0	5 ms	D	S	U	U	U	D	S	U	U	U
1	5 ms	D	S	U	U	D	D	S	U	U	D
2	5 ms	D	S	U	D	D	D	S	U	D	D
3	10 ms	D	S	U	U	U	D	D	D	D	D
4	10 ms	D	S	U	U	D	D	D	D	D	D
5	10 ms	D	S	U	D	D	D	D	D	D	D
6	5 ms	D	S	U	U	U	D	S	U	U	D

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 $\times (T_s) \times \#$ of S + $\#$ of U

Example for Calculated Duty Cycle for Uplink-Downlink Configuration 0:

Calculated Duty Cycle = $5120 \times [1/(15000 \times 2048)] \times 2 + 6 \text{ ms} = 63.33\%$

where

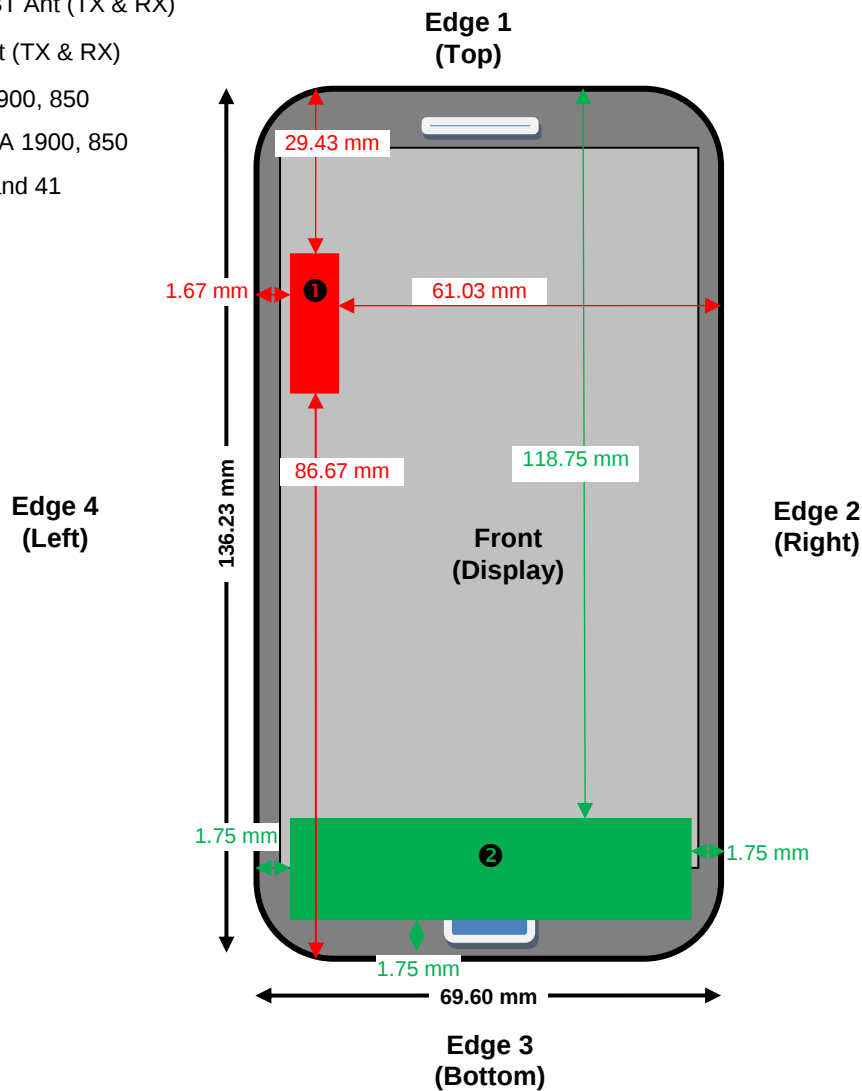
$T_s = 1/(15000 \times 2048)$ seconds

6.7. Antenna Dimensions and Separation Distances

① Wi-Fi / BT Ant (TX & RX)

② Main Ant (TX & RX)

- GSM 1900, 850
- WCDMA 1900, 850
- LTE Band 41



7. RF Exposure Conditions (Test Configurations)

Refer to Appendix 14.1.Photos and Antenna Locations for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Head

For WWAN, LTE and Wi-Fi

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

7.2. Body-worn Accessory

For WWAN and LTE

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

For Wi-Fi

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

7.3. Wireless Router (Hotspot) and Wi-Fi Direct

For WWAN and LTE

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	<25 mm	Yes	
Front	<25 mm	Yes	
Edge 1 (Top)	118.75 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR
Edge 2 (Right)	1.75 mm	Yes	
Edge 3 (Bottom)	1.75 mm	Yes	
Edge 4 (Left)	1.75 mm	Yes	

For Wi-Fi

Test Configurations	Antenna-to-edge/surface	SAR Required	Note
Rear	<25 mm	Yes	
Front	<25 mm	Yes	
Edge 1 (Top)	29.43 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR
Edge 2 (Right)	61.03 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR
Edge 3 (Bottom)	86.67 mm	No	SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR
Edge 4 (Left)	1.67 mm	Yes	

8. Conducted Output Power Measurements

The proprietary logic is used to determine when head/body power table is used.

8.1. GSM850 and GSM1900

GSM850 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
850	GSM (Voice)	CS1	1	128	824.2	33.0	24.0
				190	836.6	32.9	23.9
				251	848.8	32.8	23.8
	GPRS (GMSK)	CS1	1	128	824.2	33.0	24.0
				190	836.6	32.9	23.8
				251	848.8	32.8	23.8
			2	128	824.2	28.6	22.6
				190	836.6	28.8	22.8
				251	848.8	29.0	22.9
			3	128	824.2	27.3	23.0
				190	836.6	27.5	23.2
				251	848.8	27.5	23.2
			4	128	824.2	25.5	22.5
				190	836.6	25.5	22.5
				251	848.8	25.7	22.7
	EGPRS (8PSK)	MCS5	1	128	824.2	26.9	17.9
				190	836.6	27.0	18.0
				251	848.8	27.1	18.1
			2	128	824.2	25.1	19.0
				190	836.6	25.2	19.2
				251	848.8	25.3	19.3
			3	128	824.2	22.5	18.2
				190	836.6	22.6	18.3
				251	848.8	22.8	18.5
			4	128	824.2	22.3	19.2
				190	836.6	22.3	19.3
				251	848.8	22.5	19.5

Notes:

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

- Head & Body-worn Accessory: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 2 time slots, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) mode because its output power is less than that of GPRS Mode

GSM1900 Measured Results

Band	Mode	Coding Scheme	Time Slots	Ch No.	Freq. (MHz)	Burst Pwr (dBm)	Frame Pwr (dBm)
1900	GSM (Voice)	CS1	1	512	1850.2	30.3	21.3
				661	1880.0	30.5	21.5
				810	1909.8	30.4	21.4
	GPRS (GMSK)	CS1	1	512	1850.2	30.3	21.3
				661	1880.0	30.5	21.5
				810	1909.8	30.4	21.4
			2	512	1850.2	26.4	20.4
				661	1880.0	26.4	20.4
				810	1909.8	26.5	20.5
			3	512	1850.2	24.0	19.8
				661	1880.0	24.3	20.0
				810	1909.8	24.4	20.1
			4	512	1850.2	22.8	19.8
				661	1880.0	22.9	19.8
				810	1909.8	22.9	19.9
	EGPRS (8PSK)	MCS5	1	512	1850.2	26.3	17.2
				661	1880.0	26.3	17.2
				810	1909.8	26.3	17.3
			2	512	1850.2	24.3	18.3
				661	1880.0	24.3	18.3
				810	1909.8	24.4	18.4
			3	512	1850.2	22.3	18.0
				661	1880.0	22.4	18.1
				810	1909.8	22.4	18.2
			4	512	1850.2	22.0	19.0
				661	1880.0	22.1	19.1
				810	1909.8	22.2	19.2

Notes:

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

- Head & Body-worn Accessory: GMSK Voice Mode
- Hotspot mode: GMSK (GPRS) mode with 2 time slots, based on the output power measurements above
- SAR is not required for EGPRS (8PSK) mode because its output power is less than that of GPRS Mode

8.2. W-CDMA Band V and II

Release 99

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

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

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	Avg Pwr (dBm)
W-CDMA Band V	Rel 99 (RMC, 12.2 kbps)	4132	826.4	22.6
		4183	836.6	22.6
		4233	846.6	22.7
W-CDMA Band II	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	22.2
		9400	1880.0	22.1
		9538	1907.6	22.2

HSDPA

The following 4 Sub-tests were completed according to Release 8 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-Set1			
	Power Control Algorithm	Algorithm 2			
	β_c	2/15	12/15	15/15	15/15
	β_d	15/15	15/15	8/15	4/15
	Bd (SF)	64			
	β_c/β_d	2/15	12/15	15/8	15/4
	β_{hs}	4/15	24/15	30/15	30/15
HSDPA Specific Settings	MPR (dB)	0	1	1.5	1.5
	D_{ACK}	8			
	D_{NAK}	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
	$A_{hs} = \beta_{hs}/\beta_c$	30/15			

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	0	21.6
		4183	836.6	0	21.6
		4233	846.6	0	21.6
	Subtest 2	4132	826.4	0	21.2
		4183	836.6	0	21.1
		4233	846.6	0	21.4
	Subtest 3	4132	826.4	0.5	21.0
		4183	836.6	0.5	21.0
		4233	846.6	0.5	21.1
	Subtest 4	4132	826.4	0.5	21.0
		4183	836.6	0.5	21.0
		4233	846.6	0.5	21.1
W-CDMA Band II	Subtest 1	9262	1852.4	0	21.2
		9400	1880.0	0	21.0
		9538	1907.6	0	21.2
	Subtest 2	9262	1852.4	0	20.2
		9400	1880.0	0	20.0
		9538	1907.6	0	20.2
	Subtest 3	9262	1852.4	0.5	20.5
		9400	1880.0	0.5	20.3
		9538	1907.6	0.5	20.8
	Subtest 4	9262	1852.4	0.5	20.6
		9400	1880.0	0.5	20.5
		9538	1907.6	0.5	20.1

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

HSPA (HSDPA & HSUPA)

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

Mode	HSPA	HSPA	HSPA	HSPA	HSPA
Subtest	1	2	3	4	5
WCDMA General Settings	Test Mode 1				
	12.2kbps RMC				
	H-Set1				
	HSUPA Loopback				
	Algorithm2				
	β_c	11/15	6/15	15/15	2/15
	β_d	15/15	15/15	9/15	15/15
	β_{ec}	209/225	12/15	30/15	2/15
	β_c/β_d	11/15	6/15	15/9	2/15
	β_{hs}	22/15	12/15	30/15	4/15
	β_{ed}	1309/225	94/75	47/15	56/75
	CM (dB)	1.0	3.0	2.0	3.0
HSDPA Specific Settings	MPR (dB)	0	2	1	2
	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack repetition factor	3			
	CQI Feedback (Table 5.2B.4)	4ms			
	CQI Repetition Factor (Table 5.2B.4)	2			
HSUPA Specific Settings	Ahs = β_{hs}/β_c	30/15			
	D E-DPCCH	6	8	8	5
	DHARQ	0	0	0	0
	AG Index	20	12	15	17
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8
	Reference E_TFCIs	E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27		E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27	
		E-TFCI 11 E-TFCI PO 4 E-TFCI 92 E-TFCI PO 18		E-TFCI 11 E-TFCI PO 4 E-TFCI 67 E-TFCI PO 18 E-TFCI 71 E-TFCI PO 23 E-TFCI 75 E-TFCI PO 26 E-TFCI 81 E-TFCI PO 27	

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	0	21.4
		4183	836.6	0	21.8
		4233	846.6	0	21.0
	Subtest 2	4132	826.4	2	20.1
		4183	836.6	2	20.2
		4233	846.6	2	20.1
	Subtest 3	4132	826.4	1	20.3
		4183	836.6	1	20.1
		4233	846.6	1	20.6
	Subtest 4	4132	826.4	2	20.3
		4183	836.6	2	20.6
		4233	846.6	2	20.6
	Subtest 5	4132	826.4	0	21.7
		4183	836.6	0	21.6
		4233	846.6	0	21.7
W-CDMA Band II	Subtest 1	9262	1852.4	0	21.1
		9400	1880.0	0	20.5
		9538	1907.6	0	21.2
	Subtest 2	9262	1852.4	2	20.5
		9400	1880.0	2	19.6
		9538	1907.6	2	19.8
	Subtest 3	9262	1852.4	1	20.2
		9400	1880.0	1	19.8
		9538	1907.6	1	20.0
	Subtest 4	9262	1852.4	2	20.4
		9400	1880.0	2	20.2
		9538	1907.6	2	20.0
	Subtest 5	9262	1852.4	0	21.2
		9400	1880.0	0	21.0
		9538	1907.6	0	21.1

DC-HSDPA

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 E_c/I_{or}	dB	-10
P-CCPCH and SCH E_c/I_{or}	dB	-12
PICH E_c/I_{or}	dB	-15
HS-PDSCH	dB	off
HS-SCCH_1	dB	off
DPCH E_c/I_{or}	dB	-5
OCNS E_c/I_{or}	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.		

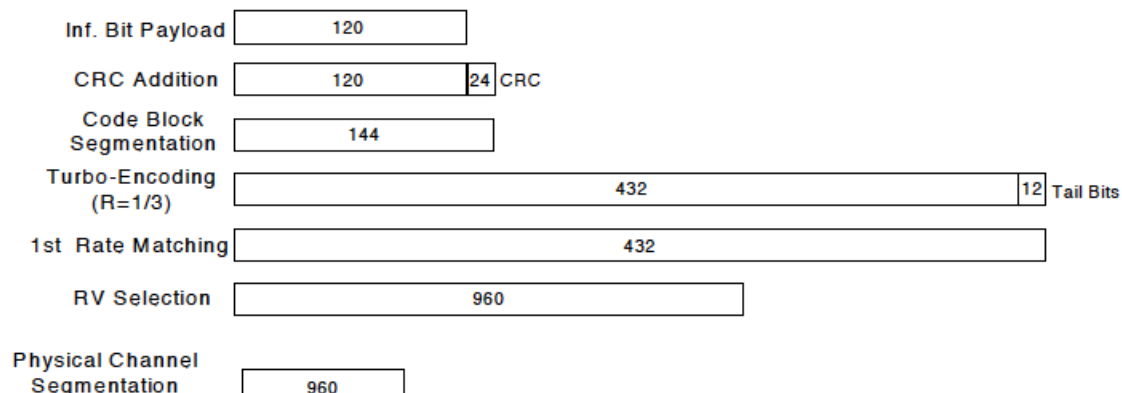


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

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-Set1			
	Power Control Algorithm	Algorithm2			
	β_c	2/15	12/15	15/15	15/15
	β_d	15/15	15/15	8/15	4/15
	β_d (SF)	64			
	β_c/β_d	2/15	12/15	15/8	15/4
	β_{hs}	4/15	24/15	30/15	30/15
HSDPA Specific Settings	MPR (dB)	0	0	0.5	0.5
	DACK	8			
	DNAK	8			
	DCQI	8			
	Ack-Nack Repetition factor	3			
	CQI Feedback	4ms			
	CQI Repetition Factor	2			
	$A_{hs} = \beta_{hs}/\beta_c$	30/15			

Up commands are set continuously to set the UE to Max power.

Measured Results

Band	Mode	UL Ch No.	Freq. (MHz)	MPR	Avg Pwr (dBm)
W-CDMA Band V	Subtest 1	4132	826.4	0	21.6
		4183	836.6	0	21.6
		4233	846.6	0	21.6
	Subtest 2	4132	826.4	0	21.5
		4183	836.6	0	21.4
		4233	846.6	0	21.5
	Subtest 3	4132	826.4	0.5	20.9
		4183	836.6	0.5	21.0
		4233	846.6	0.5	20.9
	Subtest 4	4132	826.4	0.5	20.9
		4183	836.6	0.5	21.0
		4233	846.6	0.5	21.0
W-CDMA Band II	Subtest 1	9262	1852.4	0	21.3
		9400	1880.0	0	21.2
		9538	1907.6	0	21.2
	Subtest 2	9262	1852.4	0	21.3
		9400	1880.0	0	21.2
		9538	1907.6	0	21.4
	Subtest 3	9262	1852.4	0.5	20.5
		9400	1880.0	0.5	20.7
		9538	1907.6	0.5	20.6
	Subtest 4	9262	1852.4	0.5	20.6
		9400	1880.0	0.5	20.5
		9538	1907.6	0.5	20.5

HSPA+

Since 16QAM is not used for uplink, the uplink Category and release is same as HSUPA, i.e., CAT 6 Rel 6. Therefore, the RF conducted power is not measured.

8.3. LTE Band 41

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

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

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

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

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

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

Network Signalling value	Requirements (sub-clause)	E-UTRA Band	Channel bandwidth (MHz)	Resources Blocks (N_{RB})	A-MPR (dB)
NS_01	6.6.2.1.1	Table 5.5-1	1.4, 3, 5, 10, 15, 20	Table 5.6-1	NA
NS_03	6.6.2.2.1	2, 4, 10, 23, 25, 35, 36	3	>5	≤ 1
			5	>6	≤ 1
			10	>6	≤ 1
			15	>8	≤ 1
			20	>10	≤ 1
NS_04	6.6.2.2.2	41	5	>6	≤ 1
			10, 15, 20	See Table 6.2.4-4	
NS_05	6.6.3.3.1	1	10, 15, 20	≥ 50	≤ 1
NS_06	6.6.2.2.3	12, 13, 14, 17	1.4, 3, 5, 10	Table 5.6-1	n/a
NS_07	6.6.2.2.3 6.6.3.3.2	13	10	Table 6.2.4-2	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	Table 6.2.4-3
NS_11	6.6.2.2.1	23 ¹	1.4, 3, 5, 10	Table 6.2.4-5	Table 6.2.4-5
..					
NS_32	-	-	-	-	-

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

LTE Band 41 Measured Results**Procedure used to establish SAR test signal for LTE TDD Band 41**

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....”

LTE Signaling 1 - X3.2.10.6

Connection Status

Cell: OFF

Packet Switched: OFF

RRC State: Idle

Event Log

- 03:21:26 State 'Cell Off'
- 03:21:17 State 'Cell On'
- 03:21:16 Signaling Failure
- 03:21:13 Network Originated Detach
- 03:21:02 State 'Connection Established'
- 03:21:02 EPS Dedicated Bearer Established
- 03:20:57 State 'Attached'
- 03:20:57 EPS Default Bearer Established

UE Info

IMEI: ---

IMSI: ---

UE IPv4 Address [0]: ---

UE IPv6 Prefix [0]: ---

Connection Setup

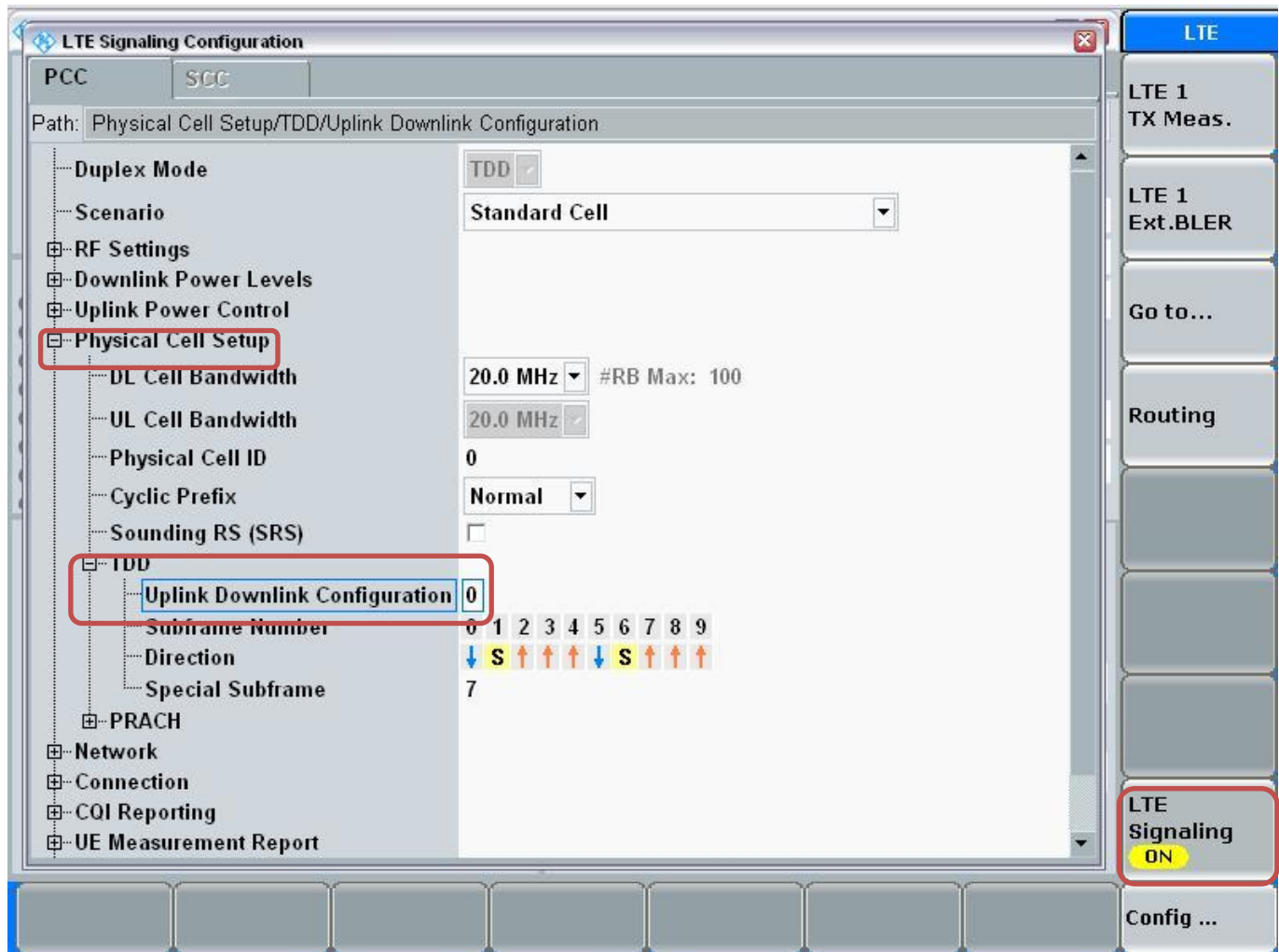
Scheduling: RMC

	Downlink	Uplink
Operating Band	Band 41	TDD
Channel	40620 Ch	40620 Ch
Frequency	2593.0 MHz	2593.0 MHz
Cell Bandwidth	20.0 MHz	20.0 MHz
RS EPRE	-85.8 dBm/15kHz	
Full Cell BW Pow.	-55.0 dBm	
PUSCH Open Loop Nom. Power		23 dBm
PUSCH Closed Loop Target Power		23.0 dBm
# RB	100	100
RB Pos./Start RB	low	low
Modulation	QPSK	QPSK
TBS Idx / Value	5 / 8760	2 / 4584
Throughput	3.970 Mbit/s	1.834 Mbit/s

LTE Signaling
OFF

Config ...

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



Connect to EUT

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

The screenshot displays the 'LTE Signaling 1 - X3.2.10.6' application window. The interface is divided into several sections:

- Connection Status:** Shows 'Cell' with a signal icon, 'Packet Switched' with a laptop icon, and 'RRC State' as 'Connected'. A red box highlights the 'Attached' status.
- Event Log:** Lists recent events such as 'State 'Attached'', 'EPS Default Bearer Established', 'RRC Connection Established', 'State 'Cell On'', 'State 'Cell Off'', 'State 'Cell On'', 'Signaling Failure', and 'Network Originated Detach'.
- UE Info:** Displays fields for IMEI (001027009999998), IMSI (001010123456789), UE IPv4 Address [0] (192.168.48.129), and UE IPv6 Prefix [0] (fc01:abab:cdcd:efe0::).
- Connection Setup:**
 - PCC/SCC:** Operating Band is 'Band 41', TDD is selected.
 - Channel:** 40620 Ch for both Downlink and Uplink.
 - Frequency:** 2593.0 MHz for both.
 - Cell Bandwidth:** 20.0 MHz for both.
 - RS EPRE:** -85.8 dBm/15kHz.
 - Full Cell BW Pow.:** -55.0 dBm.
 - PUSCH Open Loop Nom.Power:** 23 dBm.
 - PUSCH Closed Loop Target Power:** 23.0 dBm.
 - Scheduling:** RMC.
 - # RB:** 100 for both Downlink and Uplink.
 - RB Pos./Start RB:** low for both, starting at 0.
 - Modulation:** QPSK for both.
 - TBS Idx / Value:** 5 / 8760 for Downlink, 2 / 4584 for Uplink.
 - Throughput:** 3.970 Mbit/s for Downlink, 1.834 Mbit/s for Uplink.
- Bottom Bar:** Contains buttons for 'Detach', 'Connect' (highlighted with a red box), 'Send SMS', 'Handover ...', and 'Config ...'.
- Right Panel:** Includes buttons for 'LTE 1 TX Meas.', 'LTE 1 Ext.BLER', 'Go to...', 'Routing', and 'LTE Signaling ON' (highlighted with a red box).

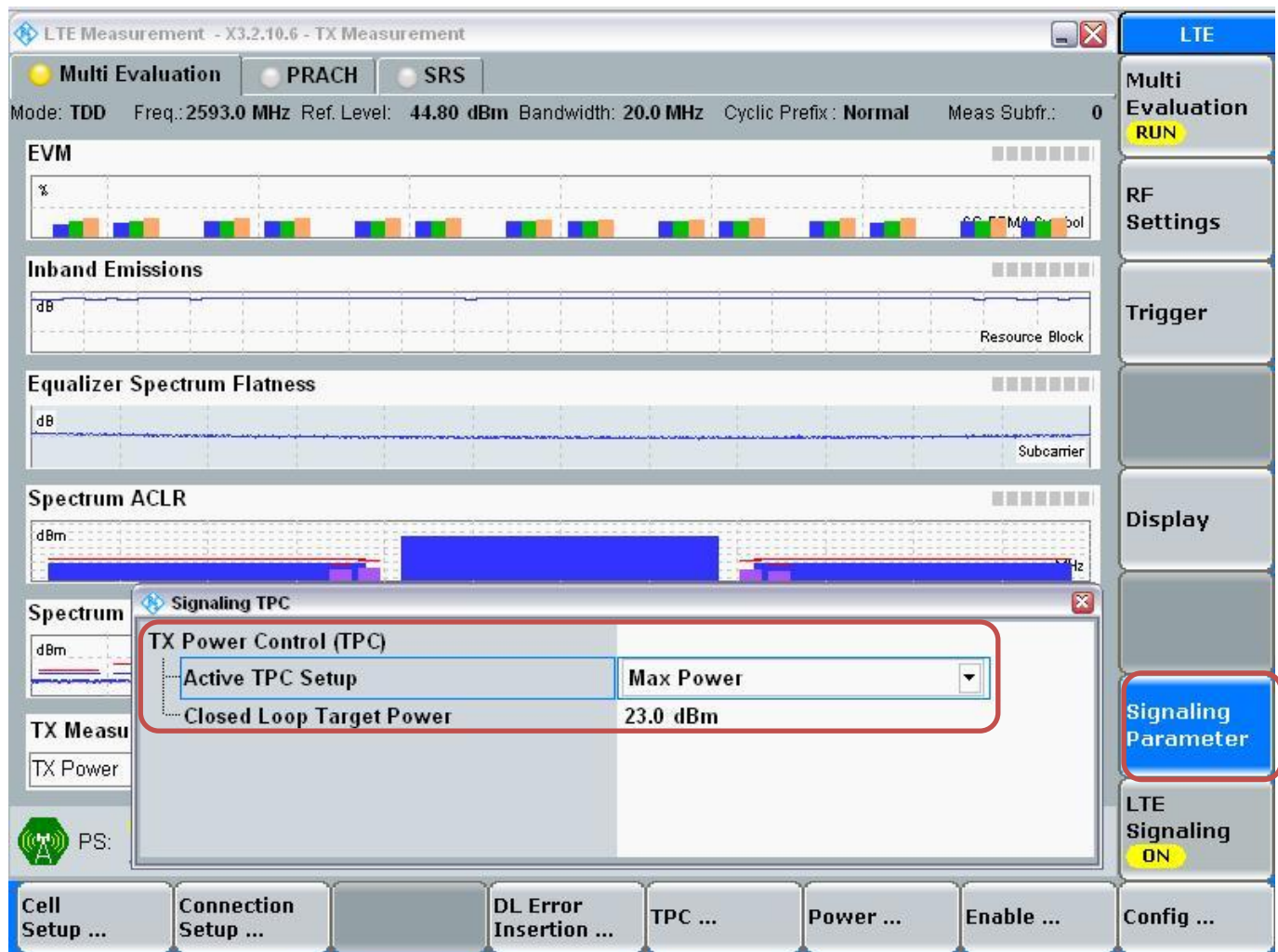
Max Power Setting

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

LTE Signaling 1 - X3.2.10.6

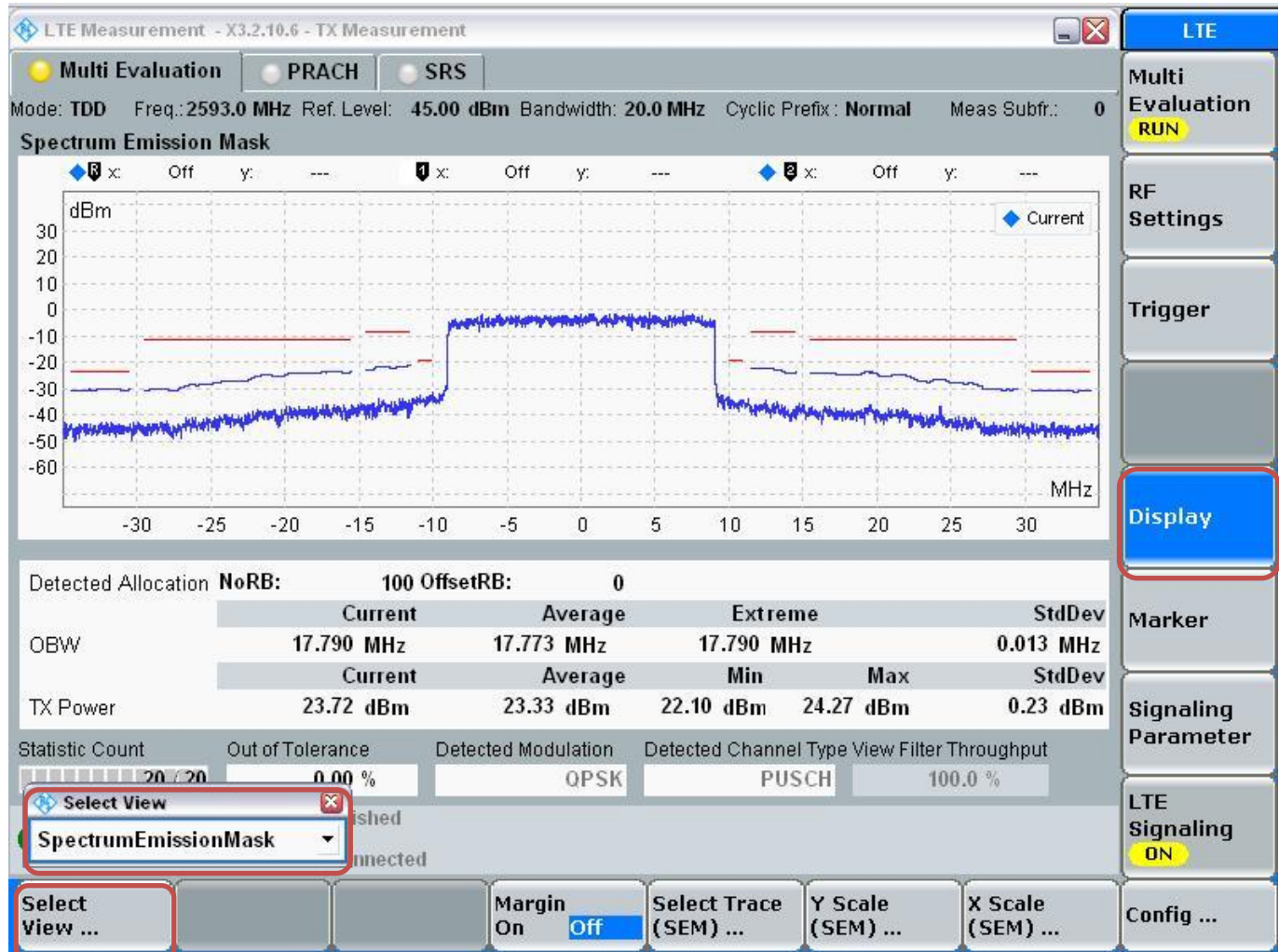
Connection Status		PCC	SCC	LTE	
Cell		Operating Band	Band 41	TDD	LTE 1 TX Meas.
Packet Switched	Connection Established	Channel	40620 Ch	40620 Ch	LTE 1 Ext.BLER
RRC State	Connected	Frequency	2593.0 MHz	2593.0 MHz	Go to...
Event Log		Cell Bandwidth	20.0 MHz	20.0 MHz	Routing
03:33:07 State 'Connection Established'		RS EPRE	-85.8 dBm/15kHz		
03:33:07 EPS Dedicated Bearer Established		Full Cell BW Pow.	-55.0 dBm		
03:31:31 State 'Attached'		PUSCH Open Loop Nom.Power		23 dBm	
03:31:31 EPS Default Bearer Established		PUSCH Closed Loop Target Power		23.0 dBm	
03:31:31 RRC Connection Established		Connection Setup			
03:31:02 State 'Cell On'		Scheduling	RMC		
03:31:00 State 'Cell Off'		# RB	100	100	
03:30:23 State 'Cell On'		RB Pos./Start RB	low	low	
UE Info		Modulation	QPSK	QPSK	
IMEI	001027009999998	TBS Idx / Value	5 8760	2 4584	LTE Signaling ON
IMSI	001010123456789	Throughput	3.970 Mbit/s	1.834 Mbit/s	
UE IPv4 Address [0]	192.168.48.129				
UE IPv6 Prefix [0]	fc01:abab:cdcd:efe0::				
Detach		Disconnect		Send SMS	Handover ...
				Config ...	

- 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”



LTE Band 41 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)				
							2506 MHz	2549.5 MHz	2593 MHz	2636.5 MHz	2680 MHz
LTE Band 41	20	QPSK	1	0	0	0	22.4	22.6	22.5	22.8	22.0
			1	50	0	0	22.8	22.9	22.8	22.8	22.6
			1	99	0	0	22.5	22.5	22.4	22.2	22.0
			50	0	1	1	21.8	21.9	21.9	22.0	21.5
			50	25	1	1	21.8	22.0	22.0	21.9	21.7
			50	50	1	1	21.7	21.9	21.8	21.9	21.5
			100	0	1	1	21.8	22.0	21.9	22.0	21.5
		16QAM	1	0	1	1	21.5	21.6	21.5	22.0	21.0
			1	50	1	1	21.8	22.0	21.8	22.0	21.4
			1	99	1	1	21.6	21.5	21.4	21.4	21.0
			50	0	2	2	20.8	20.8	21.0	21.0	20.6
			50	25	2	2	20.8	20.9	21.0	20.8	20.9
			50	50	2	2	20.7	20.7	20.8	20.9	20.7
			100	0	2	2	20.8	21.0	21.0	21.0	20.7
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)				
							2503.5 MHz	2548.3 MHz	2593 MHz	2637.8 MHz	2682.5 MHz
LTE Band 41	15	QPSK	1	0	0	0	22.1	22.3	22.7	22.8	22.2
			1	36	0	0	22.4	22.3	22.7	22.6	22.2
			1	74	0	0	22.3	22.2	22.6	22.3	22.0
			36	0	1	1	21.5	21.6	21.9	22.0	21.7
			36	18	1	2	21.6	21.6	21.0	22.0	21.7
			36	37	1	1	21.7	21.6	21.9	22.0	21.7
			75	0	1	1	21.6	21.5	21.9	22.0	21.6
		16QAM	1	0	1	1	21.2	21.4	21.8	22.0	21.4
			1	36	1	1	21.4	21.4	21.8	21.8	21.5
			1	74	1	1	21.4	21.3	21.7	21.5	21.0
			36	0	2	2	20.6	20.8	20.8	21.0	20.9
			36	18	2	2	20.7	20.8	20.9	21.0	20.9
			36	37	2	2	20.8	20.7	21.0	21.0	20.8
			75	0	2	2	20.7	20.7	21.0	21.0	20.7
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)				
							2501 MHz	2547 MHz	2593 MHz	2639 MHz	2685 MHz
LTE Band 41	10	QPSK	1	0	0	0	22.2	22.2	22.7	22.7	22.3
			1	25	0	0	22.3	22.3	22.7	22.6	22.3
			1	49	0	0	22.2	22.1	22.5	22.3	22.0
			25	0	1	1	21.5	21.6	21.9	21.9	21.7
			25	12	1	1	21.6	21.6	22.0	21.9	21.8
			25	25	1	1	21.6	21.5	21.9	21.9	21.6
			50	0	1	1	21.6	21.6	22.0	22.0	21.7
		16QAM	1	0	1	1	21.2	21.3	21.7	21.8	21.5
			1	25	1	1	21.4	21.5	21.8	21.8	21.6
			1	49	1	1	21.2	21.2	21.6	21.5	21.1
			25	0	2	2	20.6	20.8	20.9	21.0	20.9
			25	12	2	2	20.7	20.7	20.9	21.0	20.9
			25	25	2	2	20.7	20.7	21.0	21.0	20.8
			50	0	2	2	20.7	20.7	20.9	21.0	20.9

LTE Band 41 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)				
							2498.5 MHz	2545.8 MHz	2593 MHz	2640.3 MHz	2687.5 MHz
LTE Band 41	5	QPSK	1	0	0	0	22.4	22.3	22.9	22.7	22.3
			1	12	0	0	22.4	22.3	22.6	22.5	22.2
			1	24	0	0	22.4	22.3	22.7	22.4	22.0
			12	0	1	1	21.6	21.6	21.9	21.0	21.7
			12	7	1	1	21.5	21.6	21.9	21.9	21.6
			12	13	1	1	21.6	21.6	22.0	21.9	21.6
			25	0	1	1	21.5	21.6	21.9	21.9	21.7
		16QAM	1	0	1	1	21.5	21.4	21.8	21.8	21.5
			1	12	1	1	21.5	21.3	21.7	21.7	21.4
			1	24	1	1	21.5	21.3	21.7	21.6	21.2
			12	0	2	2	20.7	20.7	20.9	20.9	21.0
			12	7	2	2	20.7	20.8	20.9	20.9	20.9
			12	13	2	2	20.7	20.7	20.9	20.9	20.8
			25	0	2	2	20.6	20.7	20.9	20.9	20.8

8.4. Wi-Fi (2.4 GHz Band)

Required Test Channels per KDB 248227 D01

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
2.4 (DTS)	802.11b	1 Mbps	1	2412	17.0	Yes
			6	2437	17.3	
			11	2462	17.5	
	802.11g	6 Mbps	1	2412	13.4	No
			6	2437	13.5	
			11	2462	13.5	
	802.11n (HT20)	MCS0	1	2412	12.4	No
			6	2437	12.5	
			11	2462	12.5	

Note(s):

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

Power measurements to determine worst-case data rates

Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
802.11b	6	2437	1 Mbps	17.3	Yes
			2 Mbps	17.2	No
			5.5 Mbps	17.2	No
			11 Mbps	17.1	No

8.5. Bluetooth

Maximum tune-up tolerance limit is 9.5 dBm from the rated nominal maximum output power. This power level qualifies for exclusion of SAR testing.

9. Dielectric Property Measurements

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

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

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

9.1. 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 of IEEE Std 1528-2013

9.2. Dielectric Property Measurements Results

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

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

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

SAR Lab 1

	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit $\pm$ (%)
8/4/2014	Body 2450	e'	50.2800	Relative Permittivity (ϵ_r):	50.28	52.70	-4.59	5
		e"	14.7100	Conductivity (σ):	2.00	1.95	2.76	5
	Body 2410	e'	50.4100	Relative Permittivity (ϵ_r):	50.41	52.76	-4.45	5
		e"	14.6300	Conductivity (σ):	1.96	1.91	2.78	5
	Body 2475	e'	50.2000	Relative Permittivity (ϵ_r):	50.20	52.67	-4.69	5
		e"	14.7700	Conductivity (σ):	2.03	1.99	2.39	5
8/4/2014	Head 2450	e'	38.7000	Relative Permittivity (ϵ_r):	38.70	39.20	-1.28	5
		e"	13.6700	Conductivity (σ):	1.86	1.80	3.46	5
	Head 2410	e'	38.8800	Relative Permittivity (ϵ_r):	38.88	39.28	-1.02	5
		e"	13.5600	Conductivity (σ):	1.82	1.76	3.22	5
	Head 2475	e'	38.6800	Relative Permittivity (ϵ_r):	38.68	39.17	-1.25	5
		e"	13.7800	Conductivity (σ):	1.90	1.83	3.80	5

SAR Lab 2

	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
9/2/2014	Body 2600	e'	50.2300	Relative Permittivity (ϵ_r):	50.23	52.51	-4.34	5
		e"	15.2100	Conductivity (σ):	2.20	2.16	1.76	5
	Body 2500	e'	50.5100	Relative Permittivity (ϵ_r):	50.51	52.64	-4.04	5
		e"	14.9800	Conductivity (σ):	2.08	2.02	3.07	5
	Body 2700	e'	49.9600	Relative Permittivity (ϵ_r):	49.96	52.38	-4.63	5
		e"	15.4200	Conductivity (σ):	2.31	2.30	0.59	5
9/2/2014	Head 2600	e'	37.9100	Relative Permittivity (ϵ_r):	37.91	39.01	-2.82	5
		e"	14.0600	Conductivity (σ):	2.03	1.96	3.59	5
	Head 2500	e'	38.3200	Relative Permittivity (ϵ_r):	38.32	39.14	-2.09	5
			13.7600	Conductivity (σ):	1.91	1.85	3.17	5
	Head 2700	e'	37.4900	Relative Permittivity (ϵ_r):	37.49	38.88	-3.59	5
		e"	14.3300	Conductivity (σ):	2.15	2.07	3.92	5

SAR Lab 4

	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
8/4/2014	Head 835	e'	43.2100	Relative Permittivity (ϵ_r):	43.21	41.50	4.12	5
		e"	20.0000	Conductivity (σ):	0.93	0.90	3.17	5
	Head 820	e'	43.4100	Relative Permittivity (ϵ_r):	43.41	41.60	4.34	5
		e"	20.0100	Conductivity (σ):	0.91	0.90	1.55	5
	Head 850	e'	43.0100	Relative Permittivity (ϵ_r):	43.01	41.50	3.64	5
		e"	19.9500	Conductivity (σ):	0.94	0.92	3.05	5
8/4/2014	Body 835	e'	52.5800	Relative Permittivity (ϵ_r):	52.58	55.20	-4.75	5
		e"	21.8500	Conductivity (σ):	1.01	0.97	4.58	5
	Body 820	e'	52.7300	Relative Permittivity (ϵ_r):	52.73	55.28	-4.61	5
		e"	21.8800	Conductivity (σ):	1.00	0.97	3.01	5
	Body 850	e'	52.4300	Relative Permittivity (ϵ_r):	52.43	55.16	-4.94	5
		e"	21.7900	Conductivity (σ):	1.03	0.99	4.33	5

SAR Lab 5

	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit $\pm$ (%)
8/4/2014	Head 1900	e'	39.2300	Relative Permittivity (ϵ_r):	39.23	40.00	-1.93	5
		e''	13.2000	Conductivity (σ):	1.39	1.40	-0.39	5
	Head 1850	e'	39.4400	Relative Permittivity (ϵ_r):	39.44	40.00	-1.40	5
		e''	13.1000	Conductivity (σ):	1.35	1.40	-3.75	5
	Head 1910	e'	39.1900	Relative Permittivity (ϵ_r):	39.19	40.00	-2.03	5
		e''	13.2200	Conductivity (σ):	1.40	1.40	0.28	5
8/4/2014	Body 1900	e'	51.2000	Relative Permittivity (ϵ_r):	51.20	53.30	-3.94	5
		e''	14.2500	Conductivity (σ):	1.51	1.52	-0.96	5
	Body 1850	e'	51.3800	Relative Permittivity (ϵ_r):	51.38	53.30	-3.60	5
		e''	14.1500	Conductivity (σ):	1.46	1.52	-4.24	5
	Body 1910	e'	51.1600	Relative Permittivity (ϵ_r):	51.16	53.30	-4.02	5
		e''	14.2700	Conductivity (σ):	1.52	1.52	-0.30	5

10. 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 remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

10.1. 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	4d002	11/15/2013	835	1g	9.49	9.43
				10g	6.18	6.21
D1900V2	5d043	11/12/2013	1900	1g	40.1	39.0
				10g	21.1	20.8
D2450V2	899	9/10/2013	2450	1g	51.3	49.7
				10g	23.9	23.3
D2600V2	1006	9/13/2013	2600	1g	56.5	55.7
				10g	25.2	24.8

10.2. 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 Lab 1

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
8/4/2014	D2450V2	899	Head	1g	5.76	5.48	54.80	51.30	6.82	4.86
				10g	2.53	2.47	24.70	23.90	3.35	
8/4/2014	D2450V2	899	Body	1g	5.42	5.44	54.40	49.70	9.46	-0.37
				10g	2.35	2.51	25.10	23.30	7.73	

SAR Lab 2

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
9/2/2014	D2600V2	1006	Head	1g	5.97	5.74	57.4	56.50	1.59	3.85
				10g	2.640	2.700	27.0	25.20	7.14	
9/2/2014	D2600V2	1006	Body	1g	5.61	5.32	53.2	55.70	-4.49	5.17
				10g	2.430	2.500	25.0	24.80	0.81	

SAR Lab 4

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
8/4/2014	D835V2	4d002	Head	1g	1.00	0.97	9.70	9.49	2.21	3.00
				10g	0.67	0.64	6.38	6.18	3.24	
8/4/2014	D835V2	4d002	Body	1g	1.05	1.02	10.20	9.43	8.17	2.86
				10g	0.70	0.67	6.71	6.21	8.05	

SAR Lab 5

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta $\pm 10\%$	Est./Zoom Ratio	Plot No.
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
8/4/2014	D1900V2	5d043	Head	1g	3.89	3.83	38.30	40.10	-4.49	1.54
				10g	2.05	1.98	19.80	21.10	-6.16	
8/4/2014	D1900V2	5d043	Body	1g	4.11	4.08	40.80	39.00	4.62	0.73
				10g	2.07	2.13	21.30	20.80	2.40	

11. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 648474 D04 Handset SAR:

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

KDB 941225 D01 SAR test for 3G devices:

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

KDB 941225 D05 SAR for LTE Devices:

SAR test reduction is applied using the following criteria:

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

KDB 248227 D01 SAR Measurements Procedures for 802.11 a/b/g Transmitters v01r02 (pg.6):

Each channel should be tested at the lowest data rate in each a-b/g mode or 4.9 GHz channel BW configuration.

When the extrapolated maximum peak SAR for the maximum output channel is ≤ 1.6 W/kg and the 1-g averaged SAR is ≤ 0.8 W/kg, testing of other channels in the "default test channels" or "required test channels" configuration is optional.

April 2013 TCB Workshop Updates:

Apply usual 802.11 test exclusion considerations, but include 802.11ac SAR for highest 802.11a configuration in each frequency band and each exposure condition.

11.1. GSM850

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Voice	0	Left Touch	190	836.6	33.0	32.9	0.398	0.407	1
			Left Tilt	190	836.6	33.0	32.9	0.261	0.267	
			Right Touch	190	836.6	33.0	32.9	0.348	0.356	
			Right Tilt	190	836.6	33.0	32.9	0.252	0.258	
Head VoIP	GPRS 2 Slots	0	Left Touch	190	836.6	30.5	28.8	0.369	0.546	2
			Left Tilt	190	836.6	30.5	28.8	0.249	0.368	
			Right Touch	190	836.6	30.5	28.8	0.361	0.534	
			Right Tilt	190	836.6	30.5	28.8	0.281	0.416	
Body-worn	Voice	10	Rear	190	836.6	33.0	32.9	0.648	0.663	3
			Front	190	836.6	33.0	32.9	0.468	0.479	
Body-worn(VoIP) & Hotspot	GPRS 2 Slots	10	Rear	128	824.2	30.5	28.6	0.657	1.018	4
				190	836.6	30.5	28.8	0.637	0.942	
				251	848.8	30.5	29.0	0.608	0.859	
			Front	190	836.6	30.5	28.8	0.487	0.720	
Hotspot			Edge 2	190	836.6	30.5	28.8	0.476	0.704	
			Edge 3	190	836.6	30.5	28.8	0.060	0.089	
			Edge 4	128	824.2	30.5	28.6	0.611	0.946	
				190	836.6	30.5	28.8	0.545	0.806	
				251	848.8	30.5	29.0	0.515	0.727	

11.2. GSM1900

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Voice	0	Left Touch	661	1880.0	30.5	30.5	0.775	0.775	5
			Left Tilt	661	1880.0	30.5	30.5	0.232	0.232	
			Right Touch	661	1880.0	30.5	30.5	0.298	0.298	
			Right Tilt	661	1880.0	30.5	30.5	0.192	0.192	
Head VoIP	GPRS 2 Slots	0	Left Touch	661	1880.0	28.0	26.4	0.521	0.753	6
			Left Tilt	661	1880.0	28.0	26.4	0.168	0.243	
			Right Touch	661	1880.0	28.0	26.4	0.210	0.304	
			Right Tilt	661	1880.0	28.0	26.4	0.138	0.199	
Body-worn	Voice	10	Rear	661	1880.0	30.5	30.5	0.594	0.594	7
			Front	661	1880.0	30.5	30.5	0.588	0.588	
Body-worn(VoIP) & Hotspot	GPRS 2 Slots	10	Rear	661	1880.0	28.0	26.4	0.430	0.622	
Front			661	1880.0	28.0	26.4	0.440	0.636	8	
Hotspot			Edge 2	661	1880.0	28.0	26.4	0.073	0.106	
			Edge 3	661	1880.0	28.0	26.4	0.179	0.259	
			Edge 4	661	1880.0	28.0	26.4	0.282	0.408	

11.3. W-CDMA Band V

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	4183	836.6	23.0	22.6	0.301	0.330	
			Left Tilt	4183	836.6	23.0	22.6	0.183	0.201	
			Right Touch	4183	836.6	23.0	22.6	0.303	0.332	9
			Right Tilt	4183	836.6	23.0	22.6	0.222	0.243	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	4183	836.6	23.0	22.6	0.492	0.539	10
			Front	4183	836.6	23.0	22.6	0.378	0.414	
Hotspot	Rel 99 RMC	10	Edge 2	4183	836.6	23.0	22.6	0.265	0.291	
			Edge 3	4183	836.6	23.0	22.6	0.047	0.052	
			Edge 4	4183	836.6	23.0	22.6	0.296	0.325	

11.4. W-CDMA Band II

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
						Tune-up limit	Meas.	Meas.	Scaled	
Head	Rel 99 RMC	0	Left Touch	9262	1852.4	22.5	22.2	0.811	0.869	11
				9400	1880.0	22.5	22.1	0.760	0.833	
				9538	1907.6	22.5	22.2	0.796	0.853	
			Left Tilt	9400	1880.0	22.5	22.1	0.246	0.270	
			Right Touch	9400	1880.0	22.5	22.1	0.376	0.412	
			Right Tilt	9400	1880.0	22.5	22.1	0.244	0.268	
Body-worn & Hotspot	Rel 99 RMC	10	Rear	9400	1880.0	22.5	22.1	0.566	0.621	
			Front	9400	1880.0	22.5	22.1	0.597	0.655	12
Hotspot	Rel 99 RMC	10	Edge 2	9400	1880.0	22.5	22.1	0.112	0.123	
			Edge 3	9400	1880.0	22.5	22.1	0.252	0.276	
			Edge 4	9400	1880.0	22.5	22.1	0.471	0.516	

11.5. LTE Band 41 (20MHz Bandwidth)

RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	RB Allocation	RB offset	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	
Head	QPSK	0	Left Touch	40620	2593.0	1	49	23.0	22.8	0.406	0.425	
						50	24	22.0	22.0	0.356	0.356	
			Left Tilt	40620	2593.0	1	49	23.0	22.8	0.276	0.289	
						50	24	22.0	22.0	0.245	0.245	
			Right Touch	40620	2593.0	1	49	23.0	22.8	0.584	0.612	13
						50	24	22.0	22.0	0.485	0.485	
			Right Tilt	40620	2593.0	1	49	23.0	22.8	0.197	0.206	
						50	24	22.0	22.0	0.167	0.167	
Body-worn & Hotspot	QPSK	10	Rear	40620	2593.0	1	49	23.0	22.8	0.518	0.542	14
						50	24	22.0	22.0	0.436	0.436	
			Front	40620	2593.0	1	49	23.0	22.8	0.405	0.424	
						50	24	22.0	22.0	0.339	0.339	
Hotspot	QPSK	10	Edge 2	40620	2593.0	1	49	23.0	22.8	0.246	0.258	
						50	24	22.0	22.0	0.211	0.211	
			Edge 3	40620	2593.0	1	49	23.0	22.8	0.248	0.260	
						50	24	22.0	22.0	0.257	0.257	
			Edge 4	40620	2593.0	1	49	23.0	22.8	0.120	0.126	
						50	24	22.0	22.0	0.101	0.101	

11.6. Wi-Fi (DTS Band)

Frequency Band	RF Exposure Conditions	Mode	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Power (dBm)		1-g SAR (W/kg)		Plot No.
							Tune-up limit	Meas.	Meas.	Scaled	
2.4 GHz	Head	802.11b 1 Mbps	0	Left Touch	6	2437.0	17.5	17.3	0.168	0.176	
				Left Tilt	6	2437.0	17.5	17.3	0.134	0.140	
				Right Touch	6	2437.0	17.5	17.3	0.622	0.651	15
				Right Tilt	6	2437.0	17.5	17.3	0.227	0.238	
	Body-worn, Hotspot & Wi-Fi Direct	802.11b 1 Mbps	10	Rear	6	2437.0	17.5	17.3	0.461	0.483	16
				Front	6	2437.0	17.5	17.3	0.135	0.141	
	Hotspot & Wi-Fi Direct	802.11b 1 Mbps	10	Edge 4	6	2437.0	17.5	17.3	0.364	0.381	

11.7. Bluetooth

11.7.1. Standalone SAR Test Exclusion Considerations

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

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

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

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

Body-worn Accessory Exposure Conditions

Max. tune-up tolerance limit		Min. test separation distance (mm)	Frequency (GHz)	Result
(dBm)	(mW)			
9.5	9	10	2.480	1.4

Conclusion:

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

11.7.2. Estimated SAR

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

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

Estimated SAR Result for Body-worn Accessory Conditions:

Test Configuration	Max. tune-up tolerance limit (mW)	Min. test separation distance (mm)	Frequency (GHz)	Estimated 1-g SAR (W/kg)
Rear/Front	9	10	2.480	0.189

12. SAR Measurement Variability

In accordance with published RF Exposure KDB procedure 865664 D01 SAR measurement 100 MHz to 6 GHz v01. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the **ratio of largest to smallest SAR** for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .

12.1. The Highest Measured SAR Configuration in Each Frequency Band

Frequency Band (MHz)	Air Interface	Head (W/kg)	Body-worn Accessory (W/kg)	Wireless Router (Hotspot) and Wi-Fi Direct (W/kg)	Repeated SAR (Yes/No)
850	GSM 850		0.657		No
	WCDMA Band V				
1900	GSM 1900				
	WCDMA Band II	0.811			Yes
2400	Wi-Fi 802.11b/g/n	0.622			No
2600	LTE Band 41	0.584			No

12.2. Repeated Measurement Results

Head

Frequency band	Test Position	Mode	Ch #.	Freq. (MHz)	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio	Note
					Original	Repeated		
WCDMA Band II	Left Touch	Rel.99 RMC	9262	1852.4	0.811	0.759	1.07	1

Body-worn Accessory, Wireless Router (Hotspot) and Wi-Fi Direct

N/A

Note(s):

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

13. Simultaneous Transmission SAR Analysis

13.1. Sum of the SAR for GSM850 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① GSM850	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.546	0.176		0.722	No
	Left Tilt	① + ②	0.368	0.140		0.508	No
	Right Touch	① + ②	0.534	0.651		1.185	No
	Right Tilt	① + ②	0.416	0.238		0.654	No
Body-w orn Accessory & Hotspot	Rear	① + ②	1.018	0.483		1.501	No
		① + ③	1.018		0.189	1.207	No
	Front	① + ②	0.720	0.141		0.861	No
		① + ③	0.720		0.189	0.909	No
Hotspot	Edge 1	① + ②				0.000	No
	Edge 2	①	0.704			0.704	No
	Edge 3	①	0.089			0.089	No
	Edge 4	① + ②	0.946	0.381		1.327	No

SAR to Peak Location Separation Ratio (SPLSR)

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

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

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① GSM1900	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.775	0.176		0.951	No
	Left Tilt	① + ②	0.243	0.140		0.383	No
	Right Touch	① + ②	0.304	0.651		0.955	No
	Right Tilt	① + ②	0.199	0.238		0.437	No
Body-w orn Accessory & Hotspot	Rear	① + ②	0.622	0.483		1.105	No
		① + ③	0.622		0.189	0.811	No
	Front	① + ②	0.636	0.141		0.777	No
		① + ③	0.636		0.189	0.825	No
Hotspot	Edge 1	① + ②				0.000	No
	Edge 2	①	0.106			0.106	No
	Edge 3	①	0.259			0.259	No
	Edge 4	① + ②	0.408	0.381		0.789	No

SAR to Peak Location Separation Ratio (SPLSR)

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

13.3. Sum of the SAR for WCDMA Band V & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① WCDMA Band V	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.330	0.176		0.506	No
	Left Tilt	① + ②	0.201	0.140		0.341	No
	Right Touch	① + ②	0.332	0.651		0.983	No
	Right Tilt	① + ②	0.243	0.238		0.481	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.539	0.483		1.022	No
		① + ③	0.539		0.189	0.728	No
	Front	① + ②	0.414	0.141		0.555	No
		① + ③	0.414		0.189	0.603	No
Hotspot	Edge 1	① + ②				0.000	No
	Edge 2	①	0.291			0.291	No
	Edge 3	①	0.052			0.052	No
	Edge 4	① + ②	0.325	0.381		0.706	No

SAR to Peak Location Separation Ratio (SPLSR)

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

13.4. Sum of the SAR for WCDMA Band II & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① WCDMA Band II	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.869	0.176		1.045	No
	Left Tilt	① + ②	0.270	0.140		0.410	No
	Right Touch	① + ②	0.412	0.651		1.063	No
	Right Tilt	① + ②	0.268	0.238		0.506	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.621	0.483		1.104	No
		① + ③	0.621		0.189	0.810	No
	Front	① + ②	0.655	0.141		0.796	No
		① + ③	0.655		0.189	0.844	No
Hotspot	Edge 1	① + ②				0.000	No
	Edge 2	①	0.123			0.123	No
	Edge 3	①	0.276			0.276	No
	Edge 4	① + ②	0.516	0.381		0.897	No

SAR to Peak Location Separation Ratio (SPLSR)

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

13.5. Sum of the SAR for LTE Band 41 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario			Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① LTE Band 41	② Wi-Fi(DTS)	③ Bluetooth		
Head	Left Touch	① + ②	0.425	0.176		0.601	No
	Left Tilt	① + ②	0.289	0.140		0.429	No
	Right Touch	① + ②	0.612	0.651		1.263	No
	Right Tilt	① + ②	0.206	0.238		0.444	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.542	0.483		1.025	No
		① + ③	0.542		0.189	0.731	No
	Front	① + ②	0.424	0.141		0.565	No
		① + ③	0.424		0.189	0.613	No
Hotspot	Edge 1	① + ②				0.000	No
	Edge 2	①	0.258			0.258	No
	Edge 3	①	0.260			0.260	No
	Edge 4	① + ②	0.126	0.381		0.507	No

SAR to Peak Location Separation Ratio (SPLSR)

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

14. Appendixes

Refer to separated files for the following appendixes.

- 14.1. Photos and Antenna Locations**
- 14.2. System Performance Check Plots**
- 14.3. Highest SAR Test Plots**
- 14.4. Calibration Certificate for E-Field Probe EX3DV4 - SN 3902**
- 14.5. Calibration Certificate for E-Field Probe EX3DV4 - SN 3531**
- 14.6. Calibration Certificate for E-Field Probe EX3DV4 - SN 3929**
- 14.7. Calibration Certificate for E-Field Probe EX3DV3 - SN 3991**
- 14.8. Calibration Certificate for D835V2 - SN 4d002**
- 14.9. Calibration Certificate for D1900V2- SN 5d043**
- 14.10. Calibration Certificate for D2450V2 - SN 899**
- 14.11. Calibration Certificate for D2600V2 - SN 1006**

END OF REPORT