



SAR EVALUATION REPORT

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

For

GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n, ANT+ & NFC

**Model: SM-G510F
FCC ID: A3LSMG510F**

**Report Number: 14U18192-S8
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Prepared for

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REVISION HISTORY

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--	7/22/2014	Initial Issue	--

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1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO. LTD.			
Application Purpose	☒ Original Grant ☐ Class II Permissive Change			
FCC ID	A3LSMG510F			
DUT Description	GSM/WCDMA/LTE Phone + Bluetooth, DTS/UNII a/b/g/n, ANT+ & NFC			
Exposure Category	General Population/Uncontrolled Exposure (1g SAR limit: 1.6 W/kg)			
The highest reported SAR	RF Exposure Conditions	Equipment Class		
		Licensed	DTS	UNII
	Head	0.316 W/kg	0.148 W/kg	0.197 W/kg
	Body-worn Accessory	0.345 W/kg	0.087 W/kg	0.309 W/kg
	Wireless Router (Hotspot)	0.345 W/kg	0.087 W/kg	N/A
	Wi-Fi Direct	N/A	0.087 W/kg	0.173 W/kg
	Simultaneous Transmission	Head: 0.478 W/kg Body: 0.654 W/kg	Head: 0.378 W/kg Body: 0.432 W/kg	Head: 0.478 W/kg Body: 0.654 W/kg
Highest SAR across exposure conditions	0.345 W/kg			
Applicable Standards	FCC 47 CFR § 2.1093 KDB publication IEEE Std 1528-2013			
Test Results	Pass			
Date tested	07/01/2014 – 07/06/2014			
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:		Prepared By:		
				
Devin Chang Senior Engineer UL Verification Services Inc.		Mark Balauro Laboratory Technician UL Verification Services Inc.		

2. Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2003 & 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 D04 SAR for GSM E GPRS Dual Xfer Mode v01
- 941225 D05 SAR for LTE Devices v02r03
- 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

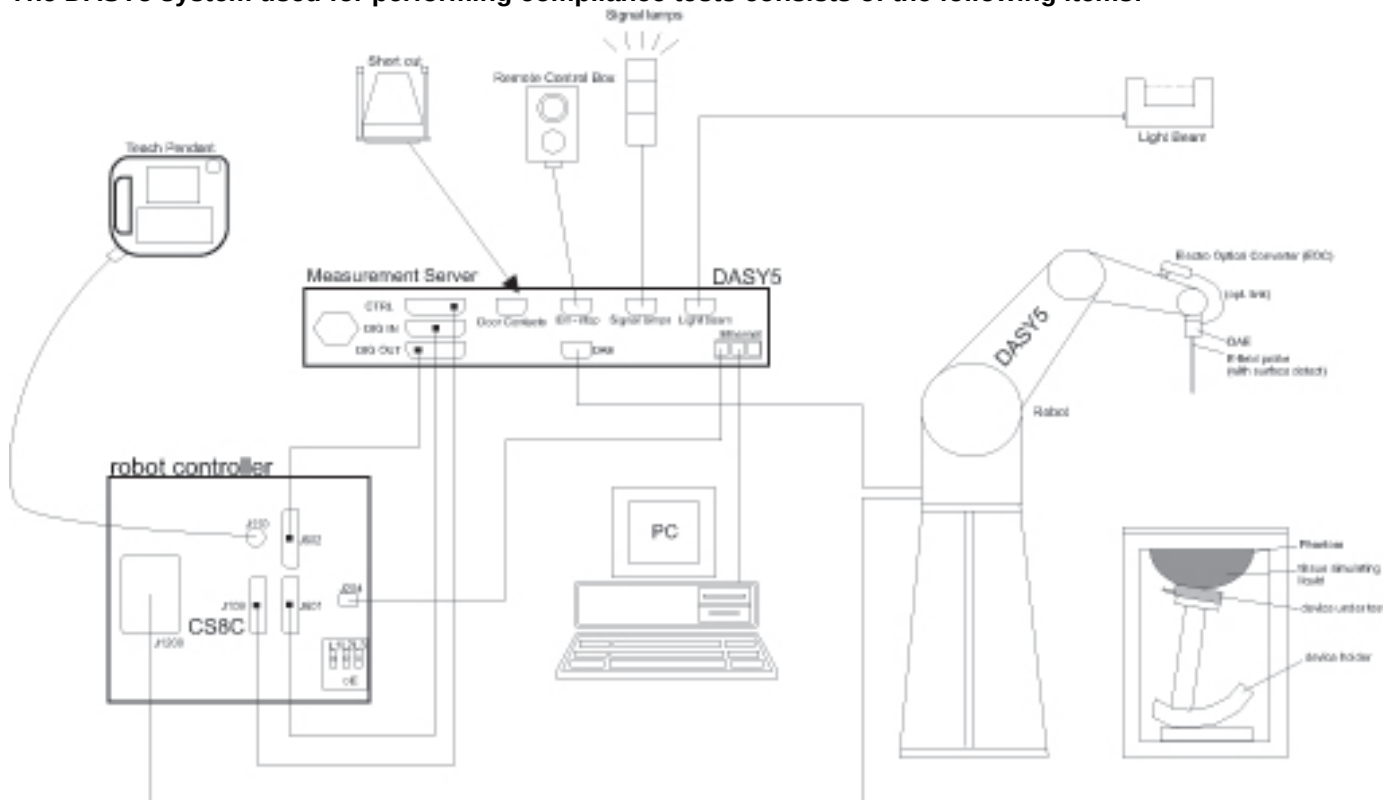
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	SAR Lab 5
SAR Lab F	
SAR Lab G	
SAR Lab H	

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

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
Dielectronic Probe kit	SPEAG	DAK-3.5	1087	11/13/2014
Dielectronic 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
ESG Vecto Signal Generator	Agilent	E4438C	MY47271507	6/17/2015
Power Meter	HP	438A	2822A05684	10/10/2014
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
ESG Vecto Signal Generator	Agilent	E4438C	MY47271045	6/18/2015
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 4)	SPEAG	EX3DV4	3929	5/9/2015
Data Acquisition Electronics (SAR 4)	SPEAG	DAE4	1352	9/11/2014
System Validation Dipole	SPEAG	D835V2	4d002	11/15/2014
System Validation Dipole	SPEAG	D1900V2	5d043	11/12/2014
System Validation Dipole	SPEAG	D2450V2	899	9/10/2014
System Validation Dipole	SPEAG	D5GHzV2	1138	11/19/2014
Thermometer (SAR Lab 4)	EXTECH	445703	CCS-238	6/3/2015

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Power Meter	Agilent	N1912A	MY53040015	6/29/2015
Power Sensor	Agilent	N1921A	MY52020011	5/6/2015
Base Station Simulator	Agilent	8960	GB46160222	11/21/2014
Base Station Simulator	R & S	CMW500	132910-cp	4/25/2015

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 1528-2003 & 2013 is not required in SAR reports submitted for equipment approval.

6. Device Under Test (DUT) Information

6.1. DUT Description

Model: SM-G510F	
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, 8.78Wh ☐ 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) (FCC: Ch.149 ~ Ch.165)

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 DTM (Dual Transfer Mode): Not support		
W-CDMA (UMTS)	Band V and II	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6) DC-HSDPA (Rel. 8) HSPA+ (Rel. 7)	100%
LTE (FDD)	Band 5	QPSK, 16QAM	100%
	Does this device SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No		
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	100%
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40)	100%
Bluetooth	2.4 GHz	Version 4.0 LE + HS + EDR	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	30.5	31.0
	GPRS 3 slots	28.5	29.0
	GPRS 4 slots	27.0	27.5
	EGPRS 1 slot	27.0	27.5
	EGPRS 2 slot	26.0	26.5
	EGPRS 3 slot	23.5	24.0
	EGPRS 4 slots	23.5	24.0
GSM1900	Voice	29.5	30.0
	GPRS 1 slot	29.5	30.0
	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 slot	25.5	26.0
	EGPRS 3 slot	23.0	23.5
	EGPRS 4 slots	23.0	23.5
W-CDMA Band V	R99	23.5	24.0
	HSDPA	22.0	22.5
	HSUPA	22.5	23.0
	HSPA+	22.0	22.5
	DC-DSPA	22.0	22.5
W-CDMA Band II	R99	23.5	24.0
	HSDPA	22.0	22.5
	HSUPA	22.0	22.5
	HSPA+	22.0	22.5
	DC-DSPA	22.0	22.5
LTE Band 5	QPSK	22.5	23.0
Upper limit (dB): 0.5 ~ -1.5		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
WiFi 5 GHz	802.11a	12.0	12.5
	802.11n HT20	10.0	10.5
	802.11n HT40	10.0	10.5
Bluetooth		10.0	10.5
Bluetooth LE		1.0	1.5

6.4. Simultaneous Transmission Condition

Item	Capable Transmit Configurations	RF Exposure Condition			
		Head	Body-worn Accessory	Wireless Router (Hotspot)	Wi-Fi Direct
1	GSM 850/1900 Voice + Wi-Fi 2.4 GHz	v	v	v	v
2	GSM 850/1900 (GPRS/EDGE) + Wi-Fi 2.4 GHz (VoIP)	v	v	v	v
3	WCDMA Band V/II + Wi-Fi 2.4 GHz	v	v	v	v
4	LTE B5 + Wi-Fi 2.4 GHz	v	v	v	v
5	GSM 850/1900 Voice + Wi-Fi 5 GHz	v	v		v
6	GSM 850/1900 (GPRS/EDGE) + Wi-Fi 5 GHz (VoIP)	v	v		v
7	WCDMA Band V/II + Wi-Fi 5 GHz	v	v		v
8	LTE B5 + Wi-Fi 5 GHz	v	v		v
9	GSM 850/1900 Voice + Wi-Fi 5 GHz + BT		v		
10	GSM 850/1900 (GPRS/EDGE) + Wi-Fi 5 GHz + BT (VoIP)		v		
11	WCDMA Band V/II + Wi-Fi 5 GHz + BT		v		
12	LTE B5 + Wi-Fi 5 GHz + BT		v		

Notes:

1. Wi-Fi 2.4GHz supports Hotspot and Wi-Fi Direct.
2. Wi-Fi 5.8GHz supports Wi-Fi Direct.
3. GPRS/EDGE, WCDMA, and LTE support Hotspot.
4. VoIP is support in GPRS/EDGE, WCDMA, and LTE.
5. Wi-Fi 2.4 GHz Radio cannot transmit simultaneously with Bluetooth Radio.
6. Wi-Fi 5 GHz Radio can transmit simultaneously with Bluetooth Radio.

6.5. 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																																						
LTE transmitter and antenna implementation	LTE has one (1) TX/RX antennas and one (1) RX antennas Refer to Section 6.6. Antenna Dimensions and Separation Distance																																												
Maximum power reduction (MPR)	Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3 <table><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><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></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. Antenna Dimensions and Separation Distances

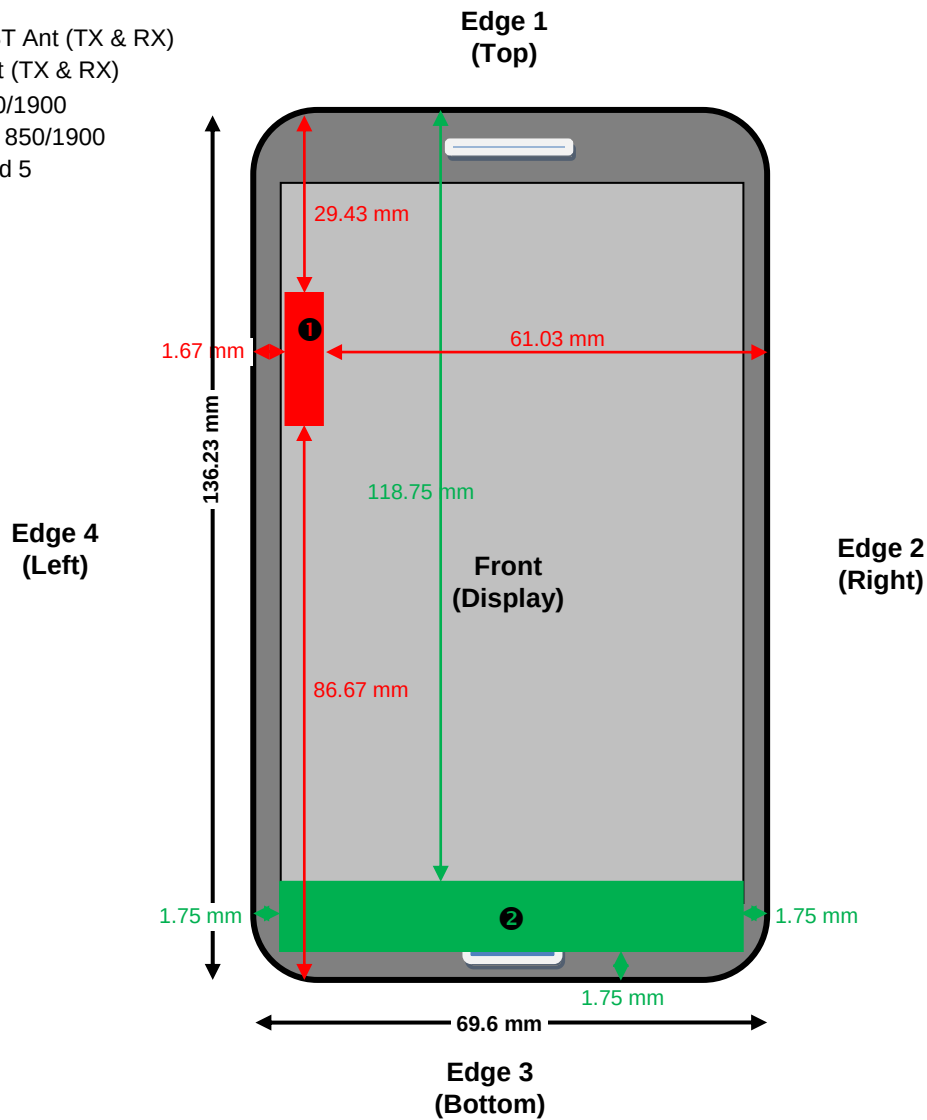
① Wi-Fi / BT Ant (TX & RX)

② Main Ant (TX & RX)

GSM 850/1900

WCDMA 850/1900

LTE Band 5



7. RF Exposure Conditions (Test Configurations)

Refer to Appendix "Antenna Locations and Separation Distances" 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 (2.4GHz and 5.8 GHz only)

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

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	32.4	23.4
				190	836.6	32.4	23.4
				251	848.8	32.4	23.4
	GPRS (GMSK)	CS1	1	128	824.2	32.4	23.4
				190	836.6	32.4	23.4
				251	848.8	32.4	23.4
			2	128	824.2	29.8	23.8
				190	836.6	29.7	23.7
				251	848.8	29.6	23.6
			3	128	824.2	28.0	23.7
				190	836.6	27.9	23.6
				251	848.8	27.9	23.6
			4	128	824.2	26.1	23.1
				190	836.6	26.1	23.1
				251	848.8	26.0	23.0
	EGPRS (8PSK)	MCS5	1	128	824.2	26.8	17.8
				190	836.6	26.7	17.7
				251	848.8	26.6	17.6
			2	128	824.2	26.5	20.5
				190	836.6	26.5	20.5
				251	848.8	26.3	20.3
			3	128	824.2	23.9	19.6
				190	836.6	23.8	19.5
				251	848.8	23.7	19.4
			4	128	824.2	23.5	20.5
				190	836.6	23.5	20.5
				251	848.8	23.4	20.4

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	30.0	21.0
				661	1880.0	30.0	21.0
				810	1909.8	30.0	21.0
	GPRS (GMSK)	CS1	1	512	1850.2	30.0	21.0
				661	1880.0	30.0	21.0
				810	1909.8	30.0	21.0
			2	512	1850.2	27.1	21.1
				661	1880.0	27.2	21.2
				810	1909.8	27.3	21.3
			3	512	1850.2	25.1	20.8
				661	1880.0	25.1	20.8
				810	1909.8	25.2	20.9
			4	512	1850.2	23.9	20.9
				661	1880.0	23.8	20.8
				810	1909.8	24.0	21.0
	EGPRS (8PSK)	MCS5	1	512	1850.2	26.0	17.0
				661	1880.0	26.0	17.0
				810	1909.8	26.2	17.2
			2	512	1850.2	25.9	19.9
				661	1880.0	25.9	19.9
				810	1909.8	26.0	20.0
			3	512	1850.2	23.2	18.9
				661	1880.0	23.3	19.0
				810	1909.8	23.5	19.2
			4	512	1850.2	23.1	20.1
				661	1880.0	23.1	20.1
				810	1909.8	23.3	20.3

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	23.1
		4183	836.6	23.1
		4233	846.6	23.0
W-CDMA Band II	Rel 99 (RMC, 12.2 kbps)	9262	1852.4	22.4
		9400	1880.0	22.5
		9538	1907.6	22.5

HSDPA

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-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	22.4
		4183	836.6	0	22.3
		4233	846.6	0	22.4
	Subtest 2	4132	826.4	0	21.9
		4183	836.6	0	21.9
		4233	846.6	0	21.9
	Subtest 3	4132	826.4	0.5	21.8
		4183	836.6	0.5	21.8
		4233	846.6	0.5	21.9
	Subtest 4	4132	826.4	0.5	21.8
		4183	836.6	0.5	21.7
		4233	846.6	0.5	21.8
W-CDMA Band II	Subtest 1	9262	1852.4	0	21.7
		9400	1880.0	0	21.8
		9538	1907.6	0	21.8
	Subtest 2	9262	1852.4	0	21.2
		9400	1880.0	0	21.3
		9538	1907.6	0	21.3
	Subtest 3	9262	1852.4	0.5	21.1
		9400	1880.0	0.5	21.3
		9538	1907.6	0.5	21.2
	Subtest 4	9262	1852.4	0.5	21.1
		9400	1880.0	0.5	21.3
		9538	1907.6	0.5	21.2

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	Loopback Mode	Test Mode 1				
	Rel99 RMC	12.2kbps RMC				
	HSDPA FRC	H-Set1				
	HSUPA Test	HSUPA Loopback				
	Power Control Algorithm	Algorithm2				
	β_c	11/15	6/15	15/15	2/15	15/15
	β_d	15/15	15/15	9/15	15/15	15/15
	β_{ec}	209/225	12/15	30/15	2/15	24/15
	β_c/β_d	11/15	6/15	15/9	2/15	15/15
	β_{hs}	22/15	12/15	30/15	4/15	30/15
	β_{ed}	1309/225	94/75	47/15 47/15	56/75	134/15
	CM (dB)	1.0	3.0	2.0	3.0	1.0
MPR (dB)	0	2	1	2	0	
HSDPA Specific Settings	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				
	Ahs = β_{hs}/β_c	30/15				
HSUPA Specific Settings	D E-DPCCH	6	8	8	5	7
	DHARQ	0	0	0	0	0
	AG Index	20	12	15	17	21
	ETFCI (from 34.121 Table C.11.1.3)	75	67	92	71	81
	Associated Max UL Data Rate kbps	242.1	174.9	482.8	205.8	308.9
	Reference E_TFCIs	E-TFCI 11		E-TFCI 11	E-TFCI 11	
		E-TFCI PO 4			E-TFCI PO 4	
		E-TFCI 67			E-TFCI 67	
		E-TFCI PO 18			E-TFCI PO 18	
E-TFCI 71		E-TFCI 71				
E-TFCI PO 23	E-TFCI 11 E-TFCI PO 4 E-TFCI 92 E-TFCI PO 18	E-TFCI PO 23				
E-TFCI 75		E-TFCI 75				
E-TFCI PO 26		E-TFCI PO 26				
E-TFCI 81		E-TFCI 81				
E-TFCI PO 27		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	22.0
		4183	836.6	0	21.8
		4233	846.6	0	22.0
	Subtest 2	4132	826.4	2	20.7
		4183	836.6	2	20.6
		4233	846.6	2	20.5
	Subtest 3	4132	826.4	1	20.8
		4183	836.6	1	21.0
		4233	846.6	1	20.9
	Subtest 4	4132	826.4	2	21.0
		4183	836.6	2	20.9
		4233	846.6	2	21.0
W-CDMA Band II	Subtest 1	4132	826.4	0	22.3
		4183	836.6	0	22.3
		4233	846.6	0	22.4
	Subtest 2	9262	1852.4	0	20.9
		9400	1880.0	0	21.1
		9538	1907.6	0	20.8
	Subtest 3	9262	1852.4	2	20.4
		9400	1880.0	2	20.3
		9538	1907.6	2	20.1
	Subtest 4	9262	1852.4	1	20.6
		9400	1880.0	1	20.3
		9538	1907.6	1	20.7
	Subtest 5	9262	1852.4	2	20.5
		9400	1880.0	2	20.5
		9538	1907.6	2	20.2
	Subtest 6	9262	1852.4	0	21.7
		9400	1880.0	0	21.8
		9538	1907.6	0	21.6

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_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.		

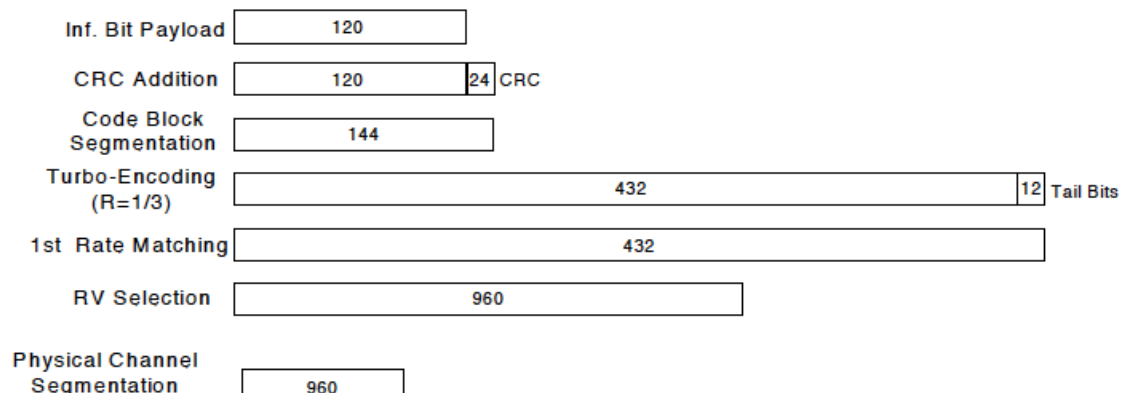


Figure C.8.19: Coding rate for Fixed reference Channel H-Set 12 (QPSK)

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-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	22.4
		4183	836.6	0	22.4
		4233	846.6	0	22.5
	Subtest 2	4132	826.4	0	22.1
		4183	836.6	0	21.8
		4233	846.6	0	21.6
	Subtest 3	4132	826.4	0.5	22.0
		4183	836.6	0.5	21.6
		4233	846.6	0.5	21.6
	Subtest 4	4132	826.4	0.5	21.3
		4183	836.6	0.5	21.6
		4233	846.6	0.5	21.6
W-CDMA Band II	Subtest 1	9262	1852.4	0	22.0
		9400	1880.0	0	22.2
		9538	1907.6	0	22.1
	Subtest 2	9262	1852.4	0	20.8
		9400	1880.0	0	21.2
		9538	1907.6	0	21.2
	Subtest 3	9262	1852.4	0.5	21.2
		9400	1880.0	0.5	21.6
		9538	1907.6	0.5	21.6
	Subtest 4	9262	1852.4	0.5	20.5
		9400	1880.0	0.5	20.0
		9538	1907.6	0.5	20.1

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 5

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	13	10	Table 6.2.4-2	Table 6.2.4-2
	6.6.3.3.2				
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 5 Measured Results

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							829 MHz	836.5 MHz	844 MHz
LTE Band 5	10	QPSK	1	0	0	0	23.0	23.0	23.0
			1	25	0	0	23.0	23.0	22.9
			1	49	0	0	23.0	22.9	23.0
			25	0	1	1	21.9	22.0	22.0
			25	12	1	1	22.0	21.9	22.0
			25	25	1	1	22.0	21.9	22.0
			50	0	1	1	21.9	21.9	22.0
		16QAM	1	0	1	1	21.7	21.7	21.4
			1	25	1	1	21.7	21.6	21.3
			1	49	1	1	21.6	21.6	21.5
			25	0	2	2	21.0	20.9	21.0
			25	12	2	2	21.0	20.9	21.0
			25	25	2	2	21.0	20.9	21.0
			50	0	2	2	20.9	20.8	21.0
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							826.5 MHz	836.5 MHz	846.5 MHz
LTE Band 5	5	QPSK	1	0	0	0	23.0	22.9	23.0
			1	12	0	0	22.9	22.8	23.0
			1	24	0	0	23.0	23.0	23.0
			12	0	1	1	22.0	22.0	22.0
			12	6	1	1	22.0	22.0	22.0
			12	11	1	1	22.0	22.0	22.0
			25	0	1	1	22.0	21.9	22.0
		16QAM	1	0	1	1	21.4	21.3	22.0
			1	12	1	1	21.4	21.4	22.0
			1	24	1	1	21.4	21.4	22.0
			12	0	2	2	21.0	20.9	21.0
			12	6	2	2	21.0	20.9	21.0
			12	11	2	2	20.9	20.9	21.0
			25	0	2	2	21.0	20.9	20.9
Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							825.5 MHz	836.5 MHz	847.5 MHz
LTE Band 5	3	QPSK	1	0	0	0	23.0	22.9	23.0
			1	7	0	0	23.0	22.9	23.0
			1	14	0	0	23.0	22.9	23.0
			8	0	1	0	22.0	22.0	22.0
			8	4	1	0	22.0	22.0	22.0
			8	7	1	0	22.0	22.0	22.0
			15	0	1	0	22.0	21.9	22.0
		16QAM	1	0	1	0	21.7	21.3	21.7
			1	7	1	0	21.7	21.3	21.8
			1	14	1	0	21.7	21.3	21.8
			8	0	2	0	21.0	20.8	21.0
			8	4	2	0	21.0	20.8	21.0
			8	7	2	0	21.0	20.8	21.0
			15	0	2	0	21.0	20.8	21.0

LTE Band 5 Measured Results (continued)

Band	BW (MHz)	Mode	RB Allocation	RB offset	Target MPR	Meas. MPR	Avg Pwr (dBm)		
							824.7 MHz	836.5 MHz	848.3 MHz
LTE Band 5	1.4	QPSK	1	0	0	0	23.0	22.9	23.0
			1	2	0	0	23.0	22.9	23.0
			1	5	0	0	23.0	22.9	23.0
			3	0	0	0	23.0	23.0	23.0
			3	1	0	0	23.0	23.0	23.0
			3	2	0	0	23.0	23.0	23.0
			6	0	1	0	22.0	22.0	22.0
		16QAM	1	0	1	0	21.7	21.3	21.8
			1	2	1	0	21.6	21.2	21.8
			1	5	1	0	21.7	21.3	21.9
			3	0	1	0	22.0	22.0	22.0
			3	1	1	0	22.0	22.0	22.0
			3	2	1	0	22.0	22.0	22.0
			6	0	2	0	20.9	21.0	21.0

Wi-Fi (2.4 GHz Band) (reference to additional KDB in footnote)

Required Test Channels per KDB 248227 D01

Mode	Band	GHz	Channel	"Default Test Channels"	
				802.11b	802.11g
802.11b/g	2.4 GHz	2.412	1 [#]	√	▽
		2.437	6	√	▽
		2.462	11 [#]	√	▽

Notes:

√ = "default test channels"

▽ = possible 802.11g channels with maximum average output $\frac{1}{4}$ dB $\geq$ the "default test channels"

[#] = when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

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	17.2	
			11	2462	16.8	
	802.11g	6 Mbps	1	2412	13.2	No
			6	2437	13.3	
			11	2462	13.5	
	802.11n (HT20)	MCS0	1	2412	12.3	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	17.2	Yes
			2 Mbps	17.2	No
			5.5 Mbps	17.2	No
			11 Mbps	17.2	No

8.4. Wi-Fi (5 GHz Bands)

Required Test Channels per KDB 248227 D01

Mode		Band	GHz	Channel	"Default Test Channels"	
					802.11a	
802.11a	UNII (15.407)	5.2 GHz	5.180	36	√	
			5.200	40		*
			2.220	44		*
			5.240	48	√	
		5.3 GHz	5.260	52	√	
			5.280	56		*
			5.300	60		*
			5.320	64	√	
		5.5 GHz	5.500	100		
			5.520	104	√	
			5.540	108		*
			5.560	112		*
			5.580	116	√	
			5.600	120		*
			5.620	124	√	
			5.640	128		*
			5.660	132		*
			5.680	136	√	
			5.700	140		*
	DTS (15.247)	5.8 GHz	5.745	149	√	
			5.765	153		*
			5.785	157	√	
			5.805	161		*
			5.825	165	√	

√ = "default test channels"

* = possible 802.11a channels with maximum average output > the "default test channels"

= when output power is reduced for channel 1 and /or 11 to meet restricted band requirements the highest output channels closest to each of these channels should be tested.

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Avg Pwr (dBm)	SAR Test (Yes/No)
5.2 (U-NII-1)	802.11a	6 Mbps	36	5180	11.8	Yes
			40	5200	11.8	
			44	5220	11.8	
			48	5240	11.7	
	802.11n (HT20)	MCS0	36	5180	10.5	No
			40	5200	10.5	
			48	5240	10.5	
	802.11n (HT40)	MCS0	38	5190	10.5	No
			46	5230	10.5	
5.3 (U-NII-2A)	802.11a	6 Mbps	52	5260	11.8	Yes
			56	5280	11.8	
			60	5300	11.8	
			64	5320	11.8	
	802.11n (HT20)	MCS0	52	5260	10.5	No
			60	5300	10.5	
			64	5320	10.5	
	802.11n (HT40)	MCS0	54	5270	10.5	No
			62	5310	10.5	
5.5 (U-NII-2C)	802.11a	6 Mbps	100	5500	12.0	Yes
			104	5520	12.0	
			108	5540	12.0	
			112	5560	12.0	
			116	5580	12.2	
			120	5600	12.2	
			124	5620	12.2	
			128	5640	12.2	
			132	5660	12.3	
			136	5680	12.3	
			140	5700	12.4	
	802.11n (HT20)	MCS0	100	5500	10.0	No
			116	5580	10.0	
			140	5700	10.3	
	802.11n (HT40)	MCS0	102	5510	9.9	No
			110	5550	9.8	
			134	5670	10.1	
5.8 (U-NII-3)	802.11a	6 Mbps	149	5745	12.5	Yes
			153	5765	12.5	
			157	5785	12.4	
			161	5805	12.5	
			165	5825	12.5	
	802.11n (HT20)	MCS0	149	5745	10.4	No
			157	5785	10.5	
			161	5805	10.5	
	802.11n (HT40)	MCS0	151	5755	10.5	No
			159	5795	10.5	

Note(s):

Per KDB 248227, SAR is not required for 802.11n HT20/HT40 channels when the maximum average output power is less than 1/4 dB higher than that measured on the corresponding 802.11a channels.

Power measurements to determine worst-case data rates

Band	Mode	Ch #	Freq. (MHz)	Data Rate	Avg Pwr (dBm)	SAR test (Yes/No)
5.2 GHz (U-NII-1)	802.11a	36	5180	6 Mbps	11.8	Yes
				9 Mbps	11.7	No
				12 Mbps	11.8	No
				18 Mbps	11.8	No
				24 Mbps	11.8	No
				36 Mbps	11.8	No
				48 Mbps	11.8	No
5.3 GHz (U-NII-2A)	802.11a	56	5280	54 Mbps	11.8	No
				6 Mbps	11.8	Yes
				9 Mbps	11.8	No
				12 Mbps	11.8	No
				18 Mbps	11.8	No
				24 Mbps	11.8	No
				36 Mbps	11.8	No
5.5 GHz (U-NII-2C)	802.11a	116	5580	48 Mbps	11.8	No
				54 Mbps	11.8	No
				6 Mbps	12.4	Yes
				9 Mbps	12.4	No
				12 Mbps	12.4	No
				18 Mbps	12.4	No
				24 Mbps	12.4	No
5.8 GHz (U-NII-3)	802.11a	149	5745	36 Mbps	12.4	No
				48 Mbps	12.4	No
				54 Mbps	12.4	No
				6 Mbps	12.5	Yes
				9 Mbps	12.3	No
				12 Mbps	12.4	No
				18 Mbps	12.4	No

8.5. Bluetooth

Maximum tune-up tolerance limit is 10.5 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

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 4

	Freq. (MHz)		Liquid Parameters		Measured	Target	Delta (%)	Limit $\pm$ (%)
6/30/2014	Head 1900	e'	38.3300	Relative Permittivity (ϵ_r):	38.33	40.00	-4.18	5
		e"	13.2800	Conductivity (σ):	1.40	1.40	0.21	5
	Head 1850	e'	38.5200	Relative Permittivity (ϵ_r):	38.52	40.00	-3.70	5
		e"	13.1700	Conductivity (σ):	1.35	1.40	-3.23	5
	Head 1910	e'	38.2900	Relative Permittivity (ϵ_r):	38.29	40.00	-4.28	5
		e"	13.2900	Conductivity (σ):	1.41	1.40	0.82	5
7/1/2014	Body 1900	e'	52.0700	Relative Permittivity (ϵ_r):	52.07	53.30	-2.31	5
		e"	14.7000	Conductivity (σ):	1.55	1.52	2.17	5
	Body 1850	e'	52.2500	Relative Permittivity (ϵ_r):	52.25	53.30	-1.97	5
		e"	14.6500	Conductivity (σ):	1.51	1.52	-0.86	5
	Body 1910	e'	52.0500	Relative Permittivity (ϵ_r):	52.05	53.30	-2.35	5
		e"	14.7000	Conductivity (σ):	1.56	1.52	2.71	5
7/2/2014	Head 835	e'	40.2500	Relative Permittivity (ϵ_r):	40.25	41.50	-3.01	5
		e"	19.6700	Conductivity (σ):	0.91	0.90	1.47	5
	Head 820	e'	40.4500	Relative Permittivity (ϵ_r):	40.45	41.60	-2.77	5
		e"	19.7100	Conductivity (σ):	0.90	0.90	0.02	5
	Head 850	e'	40.0600	Relative Permittivity (ϵ_r):	40.06	41.50	-3.47	5
		e"	19.6300	Conductivity (σ):	0.93	0.92	1.40	5
7/2/2014	Body 835	e'	52.8400	Relative Permittivity (ϵ_r):	52.84	55.20	-4.28	5
		e"	21.8500	Conductivity (σ):	1.01	0.97	4.58	5
	Body 820	e'	52.9700	Relative Permittivity (ϵ_r):	52.97	55.28	-4.17	5
		e"	21.9200	Conductivity (σ):	1.00	0.97	3.20	5
	Body 850	e'	52.6800	Relative Permittivity (ϵ_r):	52.68	55.16	-4.49	5
		e"	21.7700	Conductivity (σ):	1.03	0.99	4.23	5
7/2/2014	Body 2450	e'	52.1800	Relative Permittivity (ϵ_r):	52.18	52.70	-0.99	5
		e"	14.8800	Conductivity (σ):	2.03	1.95	3.95	5
	Body 2410	e'	52.3000	Relative Permittivity (ϵ_r):	52.30	52.76	-0.87	5
		e"	14.7900	Conductivity (σ):	1.98	1.91	3.90	5
	Body 2475	e'	52.1100	Relative Permittivity (ϵ_r):	52.11	52.67	-1.06	5
		e"	14.9400	Conductivity (σ):	2.06	1.99	3.57	5
7/2/2014	Head 2450	e'	38.1900	Relative Permittivity (ϵ_r):	38.19	39.20	-2.58	5
		e"	13.7400	Conductivity (σ):	1.87	1.80	3.99	5
	Head 2410	e'	38.3200	Relative Permittivity (ϵ_r):	38.32	39.28	-2.44	5
		e"	13.6600	Conductivity (σ):	1.83	1.76	3.98	5
	Head 2475	e'	38.0900	Relative Permittivity (ϵ_r):	38.09	39.17	-2.75	5
		e"	13.7900	Conductivity (σ):	1.90	1.83	3.87	5

SAR Lab 4 (continued)

	Freq. (MHz)		Liquid Parameters		Measured	Target	Delta (%)	Limit ±(%)
7/3/2014	Body 5180	e'	47.5200	Relative Permittivity (ϵ_r):	47.52	49.05	-3.11	5
		e''	18.0200	Conductivity (σ):	5.19	5.27	-1.54	5
	Body 5200	e'	47.4900	Relative Permittivity (ϵ_r):	47.49	49.02	-3.12	5
		e''	18.0500	Conductivity (σ):	5.22	5.29	-1.43	5
	Body 5600	e'	46.9000	Relative Permittivity (ϵ_r):	46.90	48.48	-3.25	5
		e''	18.3300	Conductivity (σ):	5.71	5.76	-0.93	5
	Body 5800	e'	46.5900	Relative Permittivity (ϵ_r):	46.59	48.20	-3.34	5
		e''	18.5000	Conductivity (σ):	5.97	6.00	-0.56	5
	Body 5825	e'	46.5600	Relative Permittivity (ϵ_r):	46.56	48.20	-3.40	5
		e''	18.5400	Conductivity (σ):	6.00	6.00	0.08	5
7/4/2014	Head 5180	e'	36.6100	Relative Permittivity (ϵ_r):	36.61	36.01	1.66	5
		e''	15.4800	Conductivity (σ):	4.46	4.63	-3.71	5
	Head 5200	e'	36.5800	Relative Permittivity (ϵ_r):	36.58	35.99	1.64	5
		e''	15.5000	Conductivity (σ):	4.48	4.65	-3.64	5
	Head 5600	e'	36.0600	Relative Permittivity (ϵ_r):	36.06	35.53	1.48	5
		e''	15.6800	Conductivity (σ):	4.88	5.06	-3.51	5
	Head 5800	e'	35.8100	Relative Permittivity (ϵ_r):	35.81	35.30	1.44	5
		e''	15.7700	Conductivity (σ):	5.09	5.27	-3.50	5
	Head 5825	e'	35.7900	Relative Permittivity (ϵ_r):	35.79	35.30	1.39	5
		e''	15.7900	Conductivity (σ):	5.11	5.27	-2.96	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	889	9/10/2013	2450	1g	51.3	49.7
				10g	23.9	23.3
D5GHzV2	1138	11/19/2013	5200	1g	78.5	72.9
				10g	22.5	20.4
			5600	1g	82.7	78.3
				10g	23.5	21.7
			5800	1g	78.3	72.8
				10g	22.4	20.1

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 4

Date Tested	System Dipole		T.S. Liquid	Measured Results			Target (Ref. Value)	Delta ±10 %	Est./Zoom Ratio	Plot No.
	Type	Serial #		Area Scan	Zoom Scan	Normalize to 1 W				
7/1/2014	D1900V2	5d043	Head	1g	4.26	4.16	41.60	40.10	3.74	2.35
				10g	2.21	2.17	21.70	21.10	2.84	
7/1/2014	D1900V2	5d043	Body	1g	4.07	4.08	40.80	39.00	4.62	-0.25
				10g	2.03	2.17	21.70	20.80	4.33	
7/2/2014	D835V2	4d002	Head	1g	0.98	0.95	9.54	9.50	0.42	2.35
				10g	0.66	0.63	6.27	6.20	1.13	
7/2/2014	D835V2	4d002	Body	1g	1.00	0.98	9.77	9.43	3.61	2.30
				10g	0.67	0.65	6.45	6.21	3.86	
7/2/2014	D2450V2	899	Body	1g	5.02	5.02	50.20	49.7	1.01	0.00
				10g	2.16	2.33	23.30	23.3	0.00	
7/2/2014	D2450V2	899	Head	1g	5.37	5.29	52.90	51.3	3.12	1.49
				10g	2.35	2.45	24.50	23.9	2.51	
7/3/2014	D5GHzV2 (5.2 GHz)	1138	Body	1g	7.03	7.61	76.10	72.9	4.39	-8.25
				10g	1.93	2.20	22.00	20.4	7.84	
7/3/2014	D5GHzV2 (5.6 GHz)	1138	Body	1g	7.64	8.26	82.60	78.3	5.49	-8.12
				10g	2.06	2.36	23.60	21.7	8.76	
7/3/2014	D5GHzV2 (5.8 GHz)	1138	Body	1g	6.77	7.32	73.20	72.8	0.55	-8.12
				10g	1.83	2.10	21.00	20.1	4.48	
7/4/2014	D5GHzV2 (5.2 GHz)	1138	Head	1g	7.84	8.14	81.40	78.5	3.69	-3.83
				10g	2.18	2.38	23.80	22.5	5.78	
7/4/2014	D5GHzV2 (5.6 GHz)	1138	Head	1g	7.57	8.18	81.80	82.70	-1.09	-8.06
				10g	2.08	2.37	23.70	23.50	0.85	
7/4/2014	D5GHzV2 (5.8 GHz)	1138	Head	1g	7.39	7.96	79.60	78.3	1.66	-7.71
				10g	2.04	2.32	23.20	22.4	3.57	

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.

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	32.4	0.052	0.060	1
			Left Tilt	190	836.6	33.0	32.4	0.049	0.056	
			Right Touch	190	836.6	33.0	32.4	0.069	0.079	
			Right Tilt	190	836.6	33.0	32.4	0.052	0.060	
Head VoIP	GPRS 2 Slots	0	Left Touch	190	836.6	31.0	29.7	0.061	0.082	2
			Left Tilt	190	836.6	31.0	29.7	0.056	0.076	
			Right Touch	190	836.6	31.0	29.7	0.081	0.109	
			Right Tilt	190	836.6	31.0	29.7	0.068	0.092	
Body-worn	Voice	10	Rear	190	836.6	33.0	32.4	0.167	0.192	3
			Front	190	836.6	33.0	32.4	0.087	0.100	
Body-worn(VoIP) & Hotspot	GPRS 2 Slots	10	Rear	190	836.6	31.0	29.7	0.178	0.240	4
Front			190	836.6	31.0	29.7	0.094	0.127		
Hotspot			Edge 2	190	836.6	31.0	29.7	0.100	0.135	
			Edge 3	190	836.6	31.0	29.7	0.039	0.053	
			Edge 4	190	836.6	31.0	29.7	0.071	0.096	

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	30.0	30.0	0.186	0.186	5
			Left Tilt	661	1880.0	30.0	30.0	0.069	0.069	
			Right Touch	661	1880.0	30.0	30.0	0.088	0.088	
			Right Tilt	661	1880.0	30.0	30.0	0.060	0.060	
Head VoIP	GPRS 2 Slots	0	Left Touch	661	1880.0	28.0	27.2	0.204	0.245	6
			Left Tilt	661	1880.0	28.0	27.2	0.067	0.081	
			Right Touch	661	1880.0	28.0	27.2	0.081	0.097	
			Right Tilt	661	1880.0	28.0	27.2	0.059	0.071	
Body-worn	Voice	10	Rear	661	1880.0	30.0	30.0	0.191	0.191	7
			Front	661	1880.0	30.0	30.0	0.182	0.182	
Body-worn(VoIP) & Hotspot	GPRS 2 Slots	10	Rear	661	1880.0	28.0	27.2	0.179	0.215	8
Front			661	1880.0	28.0	27.2	0.163	0.196		
Hotspot			Edge 2	661	1880.0	28.0	27.2	0.024	0.029	
			Edge 3	661	1880.0	28.0	27.2	0.060	0.072	
			Edge 4	661	1880.0	28.0	27.2	0.113	0.136	

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 12.2 kbps	0	Left Touch	4183	836.6	23.5	23.1	0.059	0.065	9
			Left Tilt	4183	836.6	23.5	23.1	0.057	0.062	
			Right Touch	4183	836.6	23.5	23.1	0.083	0.091	
			Right Tilt	4183	836.6	23.5	23.1	0.066	0.072	
Body-worn & Hptspot	Rel 99 RMC 12.2 kbps	10	Rear	4183	836.6	23.5	23.1	0.170	0.186	10
			Front	4183	836.6	23.5	23.1	0.081	0.089	
Hotspot	Rel 99 RMC 12.2 kbps	10	Edge 2	4183	836.6	23.5	23.1	0.096	0.105	
			Edge 3	4183	836.6	23.5	23.1	0.036	0.039	
			Edge 4	4183	836.6	23.5	23.1	0.071	0.078	

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 12.2 kbps	0	Left Touch	9400	1880.0	23.5	22.5	0.251	0.316	11
			Left Tilt	9400	1880.0	23.5	22.5	0.092	0.116	
			Right Touch	9400	1880.0	23.5	22.5	0.114	0.144	
			Right Tilt	9400	1880.0	23.5	22.5	0.087	0.110	
Body-worn & Hotspot	Rel 99 RMC 12.2 kbps	10	Rear	9400	1880.0	23.5	22.5	0.274	0.345	12
			Front	9400	1880.0	23.5	22.5	0.253	0.319	
Hotspot	Rel 99 RMC 12.2 kbps	10	Edge 2	9400	1880.0	23.5	22.5	0.030	0.038	
			Edge 3	9400	1880.0	23.5	22.5	0.084	0.106	
			Edge 4	9400	1880.0	23.5	22.5	0.170	0.214	

11.5. LTE Band 5 (10MHz 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	20525	836.5	1	0	23.0	23.0	0.057	0.057	
						25	0	22.0	22.0	0.042	0.042	
			Left Tilt	20525	836.5	1	0	23.0	23.0	0.048	0.048	
						25	0	22.0	22.0	0.038	0.038	
			Right Touch	20525	836.5	1	0	23.0	23.0	0.070	0.070	13
						25	0	22.0	22.0	0.056	0.056	
			Right Tilt	20525	836.5	1	0	23.0	23.0	0.050	0.050	
						25	0	22.0	22.0	0.040	0.040	
Body-worn & Hotspot	QPSK	10	Rear	20525	836.5	1	0	23.0	23.0	0.175	0.175	14
						25	0	22.0	22.0	0.135	0.135	
			Front	20525	836.5	1	0	23.0	23.0	0.096	0.096	
						25	0	22.0	22.0	0.073	0.073	
Hotspot	QPSK	10	Edge 2	20525	836.5	1	0	23.0	23.0	0.149	0.149	
						25	0	22.0	22.0	0.108	0.108	
			Edge 3	20525	836.5	1	0	23.0	23.0	0.034	0.034	
						25	0	22.0	22.0	0.028	0.028	
			Edge 4	20525	836.5	1	0	23.0	23.0	0.060	0.060	
						25	0	22.0	22.0	0.046	0.046	

11.6. Wi-Fi (DTS 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	
Head	802.11b 1 Mbps	0	Left Touch	6	2437.0	17.5	17.2	0.058	0.062	
			Left Tilt	6	2437.0	17.5	17.2	0.050	0.054	
			Right Touch	6	2437.0	17.5	17.2	0.138	0.148	15
			Right Tilt	6	2437.0	17.5	17.2	0.064	0.069	
Body-worn & Hotspot	802.11b 1 Mbps	10	Rear	6	2437.0	17.5	17.2	0.081	0.087	16
			Front	6	2437.0	17.5	17.2	0.038	0.041	
Hotspot	802.11b 1 Mbps	10	Edge 4	6	2437.0	17.5	17.2	0.060	0.064	

11.7. Wi-Fi (U-NII Bands)

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	
5.2 GHz (U-NII-1)	Head	802.11a 6 Mbps	0	Left Touch	36	5180.0	12.5	11.8	0.107	0.126	
				Left Tilt	36	5180.0	12.5	11.8	0.097	0.114	
				Right Touch	36	5180.0	12.5	11.8	0.158	0.186	17
				Right Tilt	36	5180.0	12.5	11.8	0.113	0.133	
	Body-worn	802.11a 6 Mbps	10	Rear	36	5180.0	12.5	11.8	0.190	0.223	18
				Front	36	5180.0	12.5	11.8	0.089	0.104	
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	
5.3 GHz (U-NII-2A)	Head	802.11a 6 Mbps	0	Left Touch	52	5260	12.5	11.8	0.138	0.162	
				Left Tilt	52	5260	12.5	11.8	0.117	0.137	
				Right Touch	52	5260	12.5	11.8	0.168	0.197	19
				Right Tilt	52	5260	12.5	11.8	0.107	0.126	
	Body-worn	802.11a 6 Mbps	10	Rear	52	5260	12.5	11.8	0.263	0.309	20
				Front	52	5260	12.5	11.8	0.095	0.111	
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	
5.5 GHz (U-NII-2C)	Head	802.11a 6 Mbps	0	Left Touch	140	5700.0	12.5	12.4	0.115	0.118	21
				Left Tilt	140	5700.0	12.5	12.4	0.092	0.094	
				Right Touch	140	5700.0	12.5	12.4	0.102	0.104	
				Right Tilt	140	5700.0	12.5	12.4	0.097	0.099	
	Body-worn	802.11a 6 Mbps	10	Rear	140	5700.0	12.5	12.4	0.152	0.156	22
				Front	140	5700.0	12.5	12.4	0.074	0.076	
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	
5.8 GHz (U-NII-3)	Head	802.11a 6 Mbps	0	Left Touch	149	5745	12.5	12.5	0.079	0.079	
				Left Tilt	149	5745	12.5	12.5	0.078	0.078	
				Right Touch	149	5745	12.5	12.5	0.078	0.078	
				Right Tilt	149	5745	12.5	12.5	0.094	0.094	23
	Body-worn & Wi-Fi Direct	802.11a 6 Mbps	10	Rear	149	5745	12.5	12.5	0.136	0.136	
				Front	149	5745	12.5	12.5	0.073	0.073	
				Edge 4	149	5745	12.5	12.5	0.173	0.173	24

11.8. Bluetooth

11.8.1. 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)			
10.5	11	10	2.480	1.8

Conclusion:

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

11.8.2. 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	11	10	2.480	0.231

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) & Wi-Fi Direct (W/kg)	Repeated SAR (Yes/No)
850	GSM 850		0.178		No
	WCDMA Band V				No
	LTE Band 5				No
1900	GSM 1900				No
	WCDMA Band II		0.274		No
2400	Wi-Fi 802.11b/g/n	0.138			No
5200	Wi-Fi 802.11a/n/ac		0.190		No
5300	Wi-Fi 802.11a/n/ac		0.263		No
5500	Wi-Fi 802.11a/n/ac		0.152		No
5800	Wi-Fi 802.11a/n/ac			0.173	No

12.2. Repeated Measurement Results

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

KDB 447498 D01 General RF Exposure Guidance v05, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

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

Where:

SAR₁ is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR₂ is the highest measured 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 $[(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2]$

A new threshold of 0.04 is also introduced in the draft KDB. Thus, 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:

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

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 Wi-Fi(UNII)	④ Bluetooth		
Head	Left Touch	① + ②	0.820	0.062			0.882	No
		① + ③	0.820		0.162		0.982	No
	Left Tilt	① + ②	0.076	0.054			0.130	No
		① + ③	0.076		0.137		0.213	No
	Right Touch	① + ②	0.109	0.148			0.257	No
		① + ③	0.109		0.197		0.306	No
	Right Tilt	① + ②	0.092	0.069			0.161	No
		① + ③	0.092		0.133		0.225	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.240	0.087			0.327	No
		① + ③	0.240		0.309		0.549	No
		①+③+④	0.240		0.309	0.231	0.780	No
	Front	① + ②	0.127	0.041			0.168	No
		① + ③	0.127		0.111		0.238	No
		①+③+④	0.127		0.111	0.231	0.469	No
Hotspot	Edge 1	① + ②					0.000	No
	Edge 2	① + ②	0.100				0.100	No
	Edge 3	① + ②	0.039				0.039	No
	Edge 4	① + ②	0.071	0.064			0.135	No
		① + ③	0.071		0.173		0.244	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 Wi-Fi(UNII)	④ Bluetooth		
Head	Left Touch	① + ②	0.245	0.062			0.307	No
		① + ③	0.245		0.162		0.407	No
	Left Tilt	① + ②	0.081	0.054			0.135	No
		① + ③	0.081		0.137		0.218	No
	Right Touch	① + ②	0.097	0.148			0.245	No
		① + ③	0.097		0.197		0.294	No
	Right Tilt	① + ②	0.071	0.069			0.140	No
		① + ③	0.071		0.133		0.204	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.215	0.087			0.302	No
		① + ③	0.215		0.309		0.524	No
		①+③+④	0.215		0.309	0.231	0.755	No
	Front	① + ②	0.196	0.041			0.237	No
		① + ③	0.196		0.111		0.307	No
		①+③+④	0.196		0.111	0.231	0.538	No
Hotspot	Edge 1	① + ②					0.000	No
	Edge 2	① + ②	0.029				0.029	No
	Edge 3	① + ②	0.072				0.072	No
	Edge 4	① + ②	0.136	0.064			0.200	No
		① + ③	0.136		0.173		0.309	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 Wi-Fi(UNII)	④ Bluetooth		
Head	Left Touch	① + ②	0.065	0.062			0.127	No
		① + ③	0.065		0.162		0.227	No
	Left Tilt	① + ②	0.062	0.054			0.116	No
		① + ③	0.062		0.137		0.199	No
	Right Touch	① + ②	0.091	0.148			0.239	No
		① + ③	0.091		0.197		0.288	No
	Right Tilt	① + ②	0.072	0.069			0.141	No
		① + ③	0.072		0.133		0.205	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.186	0.087			0.273	No
		① + ③	0.186		0.309		0.495	No
		①+③+④	0.186		0.309	0.231	0.726	No
	Front	① + ②	0.089	0.041			0.130	No
		① + ③	0.089		0.111		0.200	No
		①+③+④	0.089		0.111	0.231	0.431	No
Hotspot	Edge 1	① + ②					0.000	No
	Edge 2	① + ②	0.105				0.105	No
	Edge 3	① + ②	0.039				0.039	No
	Edge 4	① + ②	0.078	0.064			0.142	No
		① + ③	0.078		0.173		0.251	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 Wi-Fi(UNII)	④ Bluetooth		
Head	Left Touch	① + ②	0.316	0.062			0.378	No
		① + ③	0.316		0.162		0.478	No
	Left Tilt	① + ②	0.116	0.054			0.170	No
		① + ③	0.116		0.137		0.253	No
	Right Touch	① + ②	0.144	0.148			0.292	No
		① + ③	0.144		0.197		0.341	No
	Right Tilt	① + ②	0.110	0.069			0.179	No
		① + ③	0.110		0.133		0.243	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.345	0.087			0.432	No
		① + ③	0.345		0.309		0.654	No
		①+③+④	0.345		0.309	0.231	0.885	No
	Front	① + ②	0.319	0.041			0.360	No
		① + ③	0.319		0.111		0.430	No
		①+③+④	0.319		0.111	0.231	0.661	No
Hotspot	Edge 1	① + ②					0.000	No
	Edge 2	① + ②	0.038				0.038	No
	Edge 3	① + ②	0.106				0.106	No
	Edge 4	① + ②	0.214	0.064			0.278	No
		① + ③	0.214		0.173		0.387	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 5 & Wi-Fi & BT

RF Exposure conditions	Test Position		Simultaneous Transmission Scenario				Σ 1-g SAR (mW/g)	SPLSR (Yes/ No)
			① LTE Band 5	② Wi-Fi(DTS)	③ Wi-Fi(UNII)	④ Bluetooth		
Head	Left Touch	① + ②	0.057	0.062			0.119	No
		① + ③	0.057		0.162		0.219	No
	Left Tilt	① + ②	0.048	0.054			0.102	No
		① + ③	0.048		0.137		0.185	No
	Right Touch	① + ②	0.070	0.148			0.218	No
		① + ③	0.070		0.197		0.267	No
	Right Tilt	① + ②	0.050	0.069			0.119	No
		① + ③	0.050		0.133		0.183	No
Body-worn Accessory & Hotspot	Rear	① + ②	0.175	0.087			0.262	No
		① + ③	0.175		0.309		0.484	No
		①+③+④	0.175		0.309	0.231	0.715	No
	Front	① + ②	0.096	0.041			0.137	No
		① + ③	0.096		0.111		0.207	No
		①+③+④	0.096		0.111	0.231	0.438	No
Hotspot	Edge 1	① + ②					0.000	No
	Edge 2	① + ②	0.149				0.149	No
	Edge 3	① + ②	0.034				0.034	No
	Edge 4	① + ②	0.060	0.064			0.124	No
		① + ③	0.060		0.173		0.233	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 3929
- 14.5. Calibration Certificate for D835V2 - SN 4d002
- 14.6. Calibration Certificate for D1900V2- SN 5d043
- 14.7. Calibration Certificate for D2450V2 - SN 899
- 14.8. Calibration Certificate for D5GHzV2 - SN 1138

END OF REPORT