SAR EVALUATION REPORT

PERMISSIVE CHANGE

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

For
GSM/WCDMA/LTE Phone with BT, DTS/UNII a/b/g/n/ac & NFC

FCC ID: PY7-72474U

Report Number: 12247888-S1V2
Issue Date: 5/10/2018

Prepared for
SONY MOBILE COMMUNICATIONS INC.
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Date	Revisions	Revised By
V1	4/11/2018	Initial Issue	--
V2	5/10/2018	Sec. 1, 6.1, 10.1 and 12 : Updated.	Art Thammanavarat

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1. Attestation of Test Results

Applicant Name	SONY MOBILE COMMUNICATIONS INC.			
FCC ID	PY7-72474U			
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013			
Exposure Category	SAR Limits (W/Kg)			
	Peak spatial-average (1g of tissue)		Product specific (10g of tissue)	
General population / Uncontrolled exposure	1.6		4	
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)			
	PCE	DTS	NII	DSS
Head	N/A	N/A	0.269	N/A
Body-worn	N/A	N/A	0.022	N/A
Hotspot/Wi-Fi Direct	N/A	N/A	N/A	N/A
Product specific 10g SAR	N/A	N/A	0.071	N/A
Simultaneous TX	N/A	N/A	0.688	N/A
Date Tested	4/9/2018 to 4/11/2018			
Test Results	Pass			

Note: The proposed Permissive Change requires SAR testing for WLAN 5GHz chain 0 due to antenna gain differences from the original model. The SAR measurement results from the original filing can be found in FCC SAR report 12097277-S1. This report only contains the SAR values for the modified WLAN 5GHz chain 0 bands. Please refer to the original filling for the highest SAR values. The WWAN, WLAN 2.4GHz, WLAN 5GHz chain 1, and BT results from the original filling have been used in this report for simultaneous transmission analysis. The WWAN, WLAN 2.4GHz, and BT results from the original filling are listed above.

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 Test Engineer UL Verification Services Inc.	Chakrit Thammanavarat Test 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:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 447498 D03 Supplement C Cross-Reference v01
- 648474 D04 Handset SAR v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D06 Hotspot Mode v02r01

3. Facilities and Accreditation

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

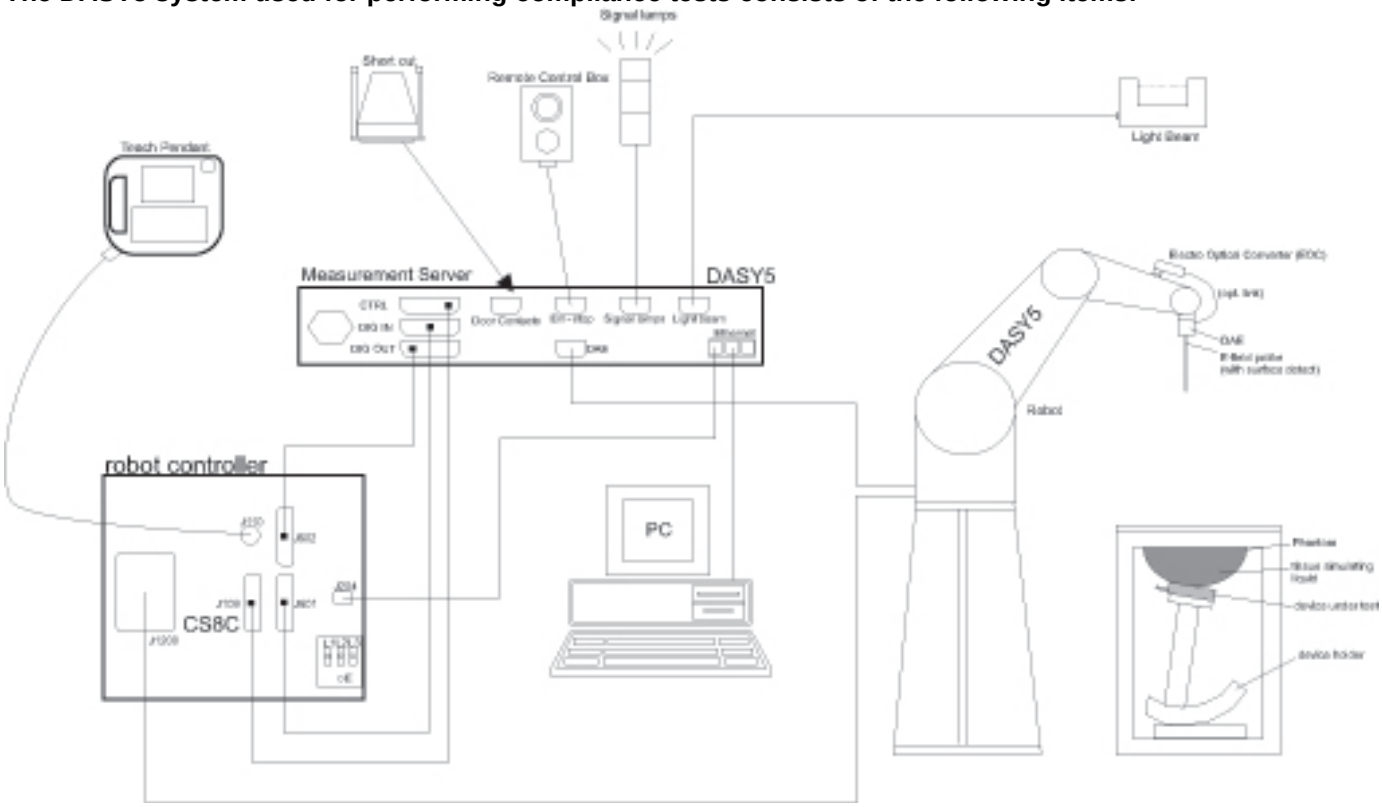
47173 Benicia Street	47266 Benicia Street
SAR Lab A	SAR Lab 1
SAR Lab B	SAR Lab 2
SAR Lab C	SAR Lab 3
SAR Lab D	SAR Lab 4
SAR Lab E	
SAR Lab F	
SAR Lab G	
SAR Lab H	

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

4. SAR Measurement System & Test Equipment

4.1. SAR Measurement System

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



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

4.2. SAR Scan Procedures

Step 1: Power Reference Measurement

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

Step 2: Area Scan

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

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

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

Step 3: Zoom Scan

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

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

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

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

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

Step 4: Power drift measurement

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

Step 5: Z-Scan (FCC only)

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

4.3. Test Equipment

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

Dielectric Property Measurements

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Network Analyzer	Agilent	8753ES	MY40001647	9/15/2018
Dielectric Probe kit	SPEAG	DAK-3.5	1087	11/14/2018
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	11/14/2018
Thermometer	Traceable Calibration Control Co.	4242	150378159	5/26/2018

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Synthesized Signal Generator	Agilent	N5181A	MY50140630	5/16/2018
Power Meter	HP	437B	3125U12345	8/10/2018
Power Meter	HP	437B	3125U11347	8/15/2018
Power Sensor	HP	8481A	3318A92374	8/15/2018
Power Sensor	HP	8481A	1926A27048	8/10/2018
Amplifier	MITEQ	AMF-4D-00400600-50-30P	1795092	N/A
Directional coupler	Werlatone	C8060-102	2141	N/A
DC Power Supply	BK Precision	1611	215-02292	N/A

Lab Equipment

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
E-Field Probe (SAR Lab G)	SPEAG	EX3DV4	3871	8/23/2018
Data Acquisition Electronics (SAR Lab G)	SPEAG	DAE4	1359	2/9/2019
System Validation Dipole	SPEAG	D5GHzV2	1003	3/13/2019

Other

Name of Equipment	Manufacturer	Type/Model	T Number	Serial No.	Cal. Due Date
Power Meter	Keysight	N1912A	T229	MY45100242	8/14/2018
Power Sensor*	Agilent	N1921A	T1223	MY55120015	3/29/2018
DC Power Supply	HP	6296A	N/A	2841A-05955	N/A

Note(s):

*Equipment not used past calibration due date.

5. Measurement Uncertainty

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

Therefore, the measurement uncertainty is not required.

6. Device Under Test (DUT) Information

6.1. DUT Description

The proposed Permissive Change requires SAR testing for WLAN 5GHz chain 0 due to antenna gain differences from the original model. The SAR measurement results from the original filing can be found in FCC SAR report 12097277-S1. This report only contains the SAR values for the modified WLAN 5GHz chain 0 bands. Please refer to the original filling for the highest SAR values. The WWAN, WLAN 2.4GHz, WLAN 5GHz chain 1, and BT results from the original filling have been used in this report for simultaneous transmission analysis. The WWAN, WLAN 2.4GHz, and BT results from the original filling are listed above.	
Device Dimension	Please refer to Appendix A
Back Cover	☒ The Back Cover is not removable.
Battery Options	☒ The rechargeable battery is not user accessible.
Accessory	Headset
Wireless Router (Hotspot)	Wi-Fi Hotspot mode permits the device to share its cellular data connection with other Wi-Fi-enabled devices. ☒ Mobile Hotspot (Wi-Fi 2.4 GHz) ☐ Mobile Hotspot (Wi-Fi 5 GHz)
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)
Test sample information	**S/N** / **Technology** / **Notes** BH90007VAY / WLAN - 5GHz #1 / Conducted BH90009SAY / WLAN - 5GHz / Radiated BH900096AY / WLAN - 5GHz / Radiated BH9000A9AY / WLAN - 5GHz / Radiated
Hardware Version	A
Software Version	0.202

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)	Multi-Slot Class: ☐ Class 8 - 1 Up, 4 Down ☐ Class 10 - 2 Up, 4 Down ☐ Class 12 - 4 Up, 4 Down ☒ Class 33 - 4 Up, 5 Down	GSM Voice: 12.5% (E)GPRS: 1 Slot: 12.5% 2 Slots: 25% 3 Slots: 37.5% 4 Slots: 50%
	Does this device support DTM (Dual Transfer Mode)? ☒ Yes ☐ No			
W-CDMA (UMTS)	Band II Band IV Band V	UMTS Rel. 99 (Voice & Data) HSDPA (Rel. 5) HSUPA (Rel. 6) HSPA+ (Rel. 9) DC-HSDPA (Rel. 9)		100%
LTE	FDD Band 2 FDD Band 4 FDD Band 5 FDD Band 7 FDD Band 12 FDD Band 13 FDD Band 17 FDD Band 26 FDD Band 29 (Rx Only) TDD Band 41 FDD Band 66	QPSK 16QAM 64AQM Rel. 12 Carrier Aggregation 4CC (1 Uplink and 4 Downlinks)		100% (FDD) 63.3% (TDD) [2]
	Does this device support SV-LTE (1xRTT-LTE)? ☐ Yes ☒ No			
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)		99.03% (802.11b) [1] 98.31% (802.11g) [1] 97.10% (802.11n) [1]
	5 GHz	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)		98.1% (802.11a) [1] 96.9% (802.11n HT20) [1] 89.5% (802.11n HT40) [1] 84.5% (802.11ac VHT80) [1]
	Does this device support bands 5.60 ~ 5.65 GHz? ☒ Yes ☐ No			
	Does this device support Band gap channel(s)? ☒ Yes ☐ No			
Bluetooth	2.4 GHz	Version 5.0 LE		76.93%(DH5)

Notes:

1. Duty cycle for Wi-Fi is referenced from the DTS and UNII report.
2. This device supports uplink-downlink configuration 0-6. The configuration with the highest duty cycle was used (Subframe Number 0 at 63.3%).

7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

Wireless technologies	RF Exposure Conditions	DUT-to-User Separation	Test Position	Antenna-to-edge/surface	SAR Required
WLAN/BT (Chain 0)	Head	0 mm	Left Touch	N/A	Yes
			Left Tilt (15°)	N/A	Yes
			Right Touch	N/A	Yes
			Right Tilt (15°)	N/A	Yes
	Body	15 mm	Rear	N/A	Yes
			Front	N/A	Yes
	Product specific (5 GHz bands only)	0 mm	Rear	< 25 mm	Yes
			Front	< 25 mm	Yes
			Edge 1 (Top)	< 25 mm	Yes
			Edge 2 (Right)	> 25 mm	No
			Edge 3 (Bottom)	> 25 mm	No
			Edge 4 (Left)	< 25 mm	Yes

Notes:

1. SAR is not required because the distance from the antenna to the edge is > 25 mm as per KDB 941225 D06 Hot Spot SAR.
2. When Hotspot Mode is not supported, 10-g Extremity SAR is required for all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge in direct contact with a flat phantom, to address interactive hand use exposure conditions.
3. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg.
4. The WWAN Sub Antenna does not support FCC bands.

8. Dielectric Property Measurements & System Check

8.1. Dielectric Property Measurements

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized.

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

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

The dielectric constant (εr) and conductivity (σ) of typical tissue-equivalent media recipes are expected to be within ± 5% of the required target values; but for SAR measurement systems that have implemented the SAR error compensation algorithms documented in IEEE Std 1528-2013, to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters, the tolerance for εr and σ may be relaxed to ± 10%. This is limited to frequencies ≤ 3 GHz.

Tissue Dielectric Parameters

FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

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

IEEE Std 1528-2013

Refer to Table 3 within the IEEE Std 1528-2013

Dielectric Property Measurements Results:

SAR Lab	Date	Band (MHz)	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
					Measured	Target	Delta (%)	Measured	Target	Delta (%)
G	4/9/2018	5250	Head	5250	36.24	35.93	0.85	4.63	4.70	-1.49
				5150	36.35	36.05	0.84	4.50	4.60	-2.28
				5350	36.24	35.82	1.18	4.63	4.80	-3.59
G	4/9/2018	5250	Body	5250	49.07	48.95	0.24	5.39	5.35	0.71
				5150	49.20	49.09	0.23	5.21	5.24	-0.49
				5350	48.96	48.82	0.29	5.52	5.47	0.98
G	4/9/2018	5600	Head	5600	35.56	35.53	0.07	5.04	5.06	-0.50
				5500	35.81	35.65	0.45	4.88	4.96	-1.61
				5725	35.51	35.39	0.34	5.15	5.19	-0.70
G	4/9/2018	5600	Body	5600	48.22	48.48	-0.53	5.95	5.76	3.28
				5500	48.62	48.61	0.01	5.73	5.64	1.57
				5725	48.14	48.31	-0.35	6.11	5.91	3.36
G	4/9/2018	5750	Head	5750	35.40	35.36	0.11	5.17	5.21	-0.76
				5700	35.37	35.42	-0.14	5.11	5.16	-0.98
				5850	35.18	35.30	-0.34	5.30	5.27	0.51
G	4/9/2018	5750	Body	5750	48.12	48.27	-0.32	6.17	5.94	3.89
				5700	48.12	48.34	-0.46	6.03	5.88	2.58
				5850	47.86	48.20	-0.71	6.29	6.00	4.75

8.2. System Check

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

System Performance Check Measurement Conditions:

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

System Check Results

The 1-g and 10-g SAR measured with a reference dipole, using the required tissue-equivalent medium at the test frequency, must be within 10% of the manufacturer calibrated dipole SAR target.

SAR Lab	Date	Tissue Type	Dipole Type _Serial #	Dipole Cal. Due Data	Measured Results for 1g SAR				Measured Results for 10g SAR				Plot No.
					Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	Zoom Scan to 100 mW	Normalize to 1 W	Target (Ref. Value)	Delta ±10 %	
G	4/9/2018	Head	D5GHzV2 SN:1003 (5.25 GHz)	3/13/2019	7.690	76.90	80.60	-4.59	2.190	21.90	23.20	-5.60	
G	4/9/2018	Body	D5GHzV2 SN:1003 (5.25 GHz)	3/13/2019	7.540	75.40	73.60	2.45	2.110	21.10	20.50	2.93	
G	4/9/2018	Head	D5GHzV2 SN:1003 (5.60 GHz)	3/13/2019	8.200	82.00	84.50	-2.96	2.320	23.20	24.00	-3.33	
G	4/9/2018	Body	D5GHzV2 SN:1003 (5.60 GHz)	3/13/2019	8.350	83.50	77.70	7.46	2.320	23.20	21.70	6.91	
G	4/9/2018	Head	D5GHzV2 SN:1003 (5.75 GHz)	3/13/2019	7.060	70.60	78.40	-9.95	2.020	20.20	22.20	-9.01	1,2
G	4/9/2018	Body	D5GHzV2 SN:1003 (5.75 GHz)	3/13/2019	7.350	73.50	73.90	-0.54	2.050	20.50	20.60	-0.49	

9. Conducted Output Power Measurements

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

Measured Results

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm) Chain 0	Max Output Power (dBm) Chain 0	SAR Test (Yes/No)
5.2 U-NII 1	802.11a	6 Mbps	36	5180	Not Required	12.2	No
			40	5200			
			44	5220			
			48	5240			
	802.11n (HT20)	6.5 Mbps	36	5180		12.2	No
			40	5200			
			44	5220			
			48	5240			
	802.11n (HT40)	13.5 Mbps	38	5190		12.2	No
			46	5230			
	802.11ac (VHT20)	6.5 Mbps	36	5180		12.3	No
			40	5200			
			44	5220			
			48	5240			
	802.11ac (VHT40)	13.5 Mbps	38	5190		12.3	No
			46	5230			
	802.11ac (VHT80)	29.3 Mbps	42	5210		12.2	No
5.3 U-NII-2A	802.11a	6 Mbps	52	5260	11.7	12.5	Yes
			56	5280	11.7		
			60	5300	12.1		
			64	5320	11.6		
	802.11n (HT20)	6.5 Mbps	52	5260	Not Required	12.4	No
			56	5280			
			60	5300			
			64	5320			
	802.11n (HT40)	13.5 Mbps	54	5270		12.4	Yes
			62	5310			
	802.11ac (VHT20)	6.5 Mbps	52	5260		12.2	No
			56	5280			
			60	5300			
			64	5320			
	802.11ac (VHT40)	13.5 Mbps	54	5270		12.2	No
			62	5310			
	802.11ac (VHT80)	29.3 Mbps	58	5290		12.1	No

Note(s):

1. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
3. When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest *reported* SAR for UNII band 2A is
   - ≤ 1.2 W/kg, SAR is not required for UNII band I
   - > 1.2 W/kg, both bands should be tested independently for SAR.

Band (GHz)	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm) Chain 0	Max Output Power (dBm) Chain 0	SAR Test (Yes/No)
5.5 U-NII-2C	802.11a	6 Mbps	100	5500	Not Required	10.4	No
			116	5580			
			124	5620			
			144	5720			
	802.11n (HT20)	6.5 Mbps	100	5500		10.4	Yes
			116	5580			
			124	5620			
			144	5720			
	802.11n (HT40)	13.5 Mbps	102	5510	9.3	10.4	Yes
			118	5590	9.4		
			126	5630	9.2		
			142	5710	9.6		
	802.11ac (VHT20)	6.5 Mbps	100	5500	Not Required	10.1	No
			116	5580			
			124	5620			
			144	5720			
	802.11ac (VHT40)	13.5 Mbps	102	5510		10.1	No
			118	5590			
			126	5630			
			142	5710			
	802.11ac (VHT80)	29.3 Mbps	106	5530		10.1	No
			122	5610			
			138	5690			
5.8 U-NII-3	802.11a	6 Mbps	149	5745	10.4	11.5	Yes
			157	5785	10.3		
			165	5825	10.4		
	802.11n (HT20)	6.5 Mbps	149	5745	Not Required	10.4	No
			157	5785			
			165	5825			
	802.11n (HT40)	13.5 Mbps	151	5755		10.4	No
			159	5795			
	802.11ac (VHT20)	6.5 Mbps	149	5745		10.9	No
			157	5785			
			165	5825			
	802.11ac (VHT40)	13.5 Mbps	151	5755		10.9	No
			159	5795			
	802.11ac (VHT80)	29.3 Mbps	155	5775		10.3	No

Note(s):

1. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.

10. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

Reported SAR(W/kg) for Wi-Fi and Bluetooth= Measured SAR * Tune-up scaling factor * Duty Cycle scaling factor

KDB 447498 D01 General RF Exposure Guidance:

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

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

KDB 648474 D04 Handset SAR:

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

KDB 648474 D04 Handset SAR (Phablet Only):

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

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

KDB 248227 D01 SAR meas for 802.11:

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

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

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

- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

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

10.1. Wi-Fi (U-NII Band)

U-NII-1 & U-NII-2A

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11a	Chain 0	0	Left Touch	60	5300	0.161	1.019	12.50	12.13			
				Left Tilt	60	5300	0.180	1.019	12.50	12.13			
				Right Touch	60	5300	0.230	1.019	12.50	12.13	0.115	0.128	1
				Right Tilt	60	5300	0.194	1.019	12.50	12.13			
Body-worn	802.11a	Chain 0	15	Rear	60	5300	0.064	1.019	12.50	12.13	0.020	0.022	2
				Front	60	5300	0.011	1.019	12.50	12.13			
RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		10-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Product Specific	802.11a	Chain 0	0	Rear	60	5300	0.293	1.019	12.50	12.13			
				Front	60	5300	0.511	1.019	12.50	12.13	0.061	0.068	3
				Edge 1	60	5300	0.115	1.019	12.50	12.13			
				Edge 4	60	5300	0.235	1.019	12.50	12.13			

U-NII-2C

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11n	Chain 0	0	Left Touch	142	5710	0.347	1.117	10.40	9.63			
				Left Tilt	142	5710	0.228	1.117	10.40	9.63			
				Right Touch	142	5710	0.510	1.117	10.40	9.63	0.161	0.215	4
				Right Tilt	142	5710	0.437	1.117	10.40	9.63			
Body-worn	802.11n	Chain 0	15	Rear	142	5710	0.0196	1.117	10.40	9.63			
				Front	142	5710	0.0379	1.117	10.40	9.63	0.014	0.019	5
RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		10-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Product Specific	802.11n	Chain 0	0	Rear	142	5710	0.3090	1.117	10.40	9.63			
				Front	142	5710	0.3650	1.117	10.40	9.63	0.045	0.060	6
				Edge 1	142	5710	0.3160	1.117	10.40	9.63			
				Edge 4	142	5710	0.1810	1.117	10.40	9.63			

U-NII-3

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Head	802.11a	Chain 0	0	Left Touch	165	5825	0.164	1.019	11.50	10.47			
				Left Tilt	165	5825	0.133	1.019	11.50	10.47			
				Right Touch	165	5825	0.546	1.019	11.50	10.47	0.208	0.269	7
				Right Tilt	165	5825	0.134	1.019	11.50	10.47			
Body-worn	802.11a	Chain 0	15	Rear	165	5825	0.0221	1.019	11.50	10.47	0.005	0.007	8
				Front	165	5825	0.0086	1.019	11.50	10.47			
RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle Factor	Power (dBm)		10-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Product Specific	802.11a	Chain 0	0	Rear	165	5825	0.528	1.019	11.50	10.47			
				Front	165	5825	0.694	1.019	11.50	10.47	0.055	0.071	9
				Edge 1	165	5825	0.249	1.019	11.50	10.47			
				Edge 4	165	5825	0.352	1.019	11.50	10.47			

11. SAR Measurement Variability

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

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

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)
5300	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.115
5500	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.161
5800	Wi-Fi 802.11a/n/ac	Head	Right Touch	No	0.208

Note(s):

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

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)
5300	Wi-Fi 802.11a/n/ac	Product Specific	Front	No	0.061
5500	Wi-Fi 802.11a/n/ac	Product Specific	Front	No	0.045
5800	Wi-Fi 802.11a/n/ac	Product Specific	Front	No	0.055

Note(s):

Repeated Measurement is not required since measured SAR is < 2 W/kg.

12. Simultaneous Transmission SAR Analysis

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

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

Where:

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

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

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of $\mathbf{[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]}$

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

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

Simultaneous Transmission Condition

Case	Cellular	WLAN Chain0 / BT	WLAN Chain1
1	GSM/GPRS/EDGE	BT/BLE	(None)
2	GSM/GPRS/EDGE	WLAN 2.4G	WLAN 2.4G
3	GSM/GPRS/EDGE	WLAN 5G	WLAN 5G
4	UMTS/HSPA	BT/BLE	(None)
5	UMTS/HSPA	WLAN 2.4G	WLAN 2.4G
6	UMTS/HSPA	WLAN 5G	WLAN 5G
7	LTE	BT/BLE	(None)
8	LTE	WLAN 2.4G	WLAN 2.4G
9	LTE	WLAN 5G	WLAN 5G
10	(None)	BT/BLE WLAN 5G	 WLAN 5G
11	GSM/GPRS/EDGE	BT/BLE WLAN 5G	 WLAN 5G
12	UMTS/HSPA	BT/BLE WLAN 5G	 WLAN 5G
13	LTE	BT/BLE WLAN 5G	 WLAN 5G
14	GSM/GPRS/EDGE	WLAN 2.4G	WLAN 5G
15	UMTS/HSPA	WLAN 2.4G	WLAN 5G
16	LTE	WLAN 2.4G	WLAN 5G

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

RF Exposure conditions	Test Position	Standalone SAR (W/kg)						∑ 1-g SAR (W/kg)						
		WWAN	DTS		U-NII		BT	WWAN + BT	WWAN + DTS	WWAN + DTS	WWAN + DTS + U-NII	WWAN + U-NII	WWAN+U-NII+BT	U-NII+BT
		①	Chain 0 ②	Chain 1 ③	Chain 0 ④	Chain 1 ⑤	Chain 0 ⑥	① + ⑥	① + ②	① + ② + ③	① + ② + ⑤	① + ④ + ⑤	① + ④ + ⑤ + ⑥	④ + ⑤ + ⑥
Head	Left Touch	0.170	0.383	0.120	0.269	0.135	0.083	0.253	0.553	0.673	0.688	0.574	0.657	0.487
	Left Tilt	0.074	0.383	0.120	0.269	0.135	0.087	0.161	0.457	0.577	0.592	0.478	0.565	0.491
	Right Touch	0.142	0.383	0.120	0.269	0.135	0.243	0.385	0.525	0.645	0.660	0.546	0.789	0.647
	Right Tilt	0.062	0.383	0.120	0.269	0.135	0.223	0.285	0.445	0.565	0.580	0.466	0.689	0.627
Body-worn	Rear	0.259	0.033	0.011	0.022	0.021	0.210	0.469	0.292	0.303	0.313	0.302	0.512	0.253
	Front	0.350	0.033	0.011	0.022	0.021	0.210	0.560	0.383	0.394	0.404	0.393	0.603	0.253
Hotspot	Rear	0.378	0.048	0.031			0.315	0.693	0.426	0.457				
	Front	0.523	0.048	0.031			0.315	0.838	0.571	0.602				
	Edge 2	0.148	0.048	0.031			0.315	0.463	0.196	0.227				
	Edge 3	0.570	0.048	0.031			0.315	0.885	0.618	0.649				
	Edge 4	0.342	0.048	0.031			0.315	0.657	0.390	0.421				

Conclusion:

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

Appendixes

Refer to separated files for the following appendixes.

12247888-S1V1 Appendix A: SAR Setup Photos

12247888-S1V1 Appendix B: SAR System Check Plots

12247888-S1V1 Appendix C: Highest SAR Test Plots

12247888-S1V1 Appendix D: SAR Liquid Tissue Ingredients

12247888-S1V1 Appendix E: SAR Probe Calibration Certificates

12247888-S1V1 Appendix F: SAR Dipole Calibration Certificates

END OF REPORT