



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

SAR EVALUATION REPORT

FOR

DTS b/g/n Wrist device and BT/BLE

MODEL NUMBER: SM-R500, SM-R500X

FCC ID: A3LSMR500

REPORT NUMBER: 4788805488-S1V4

ISSUE DATE: 1/21/2019

Prepared for
**SAMSUNG ELECTRONICS CO., LTD.
129 SAMSUNG-RO, YEONGTONG-GU, SUWON-SI,
GYEONGGI-DO, 16677, KOREA**

Prepared by

UL Korea, Ltd.

26th floor, 152, Teheran-ro, Gangnam-gu Seoul, 06236, Korea

**Suwon Test Site: UL Korea, Ltd. Suwon Laboratory
218 Maeyeong-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16675, Korea
TEL: (031) 337-9902
FAX: (031) 213-5433**



TL-637


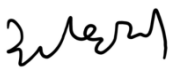
Revision History

Rev.	Date	Revisions	Revised By
V1	1/2/2019	Initial Issue	Eunji Choi
V2	1/10/2019	Revised Sec.6.3, 8.1, 9.1 and Appendix A Sec.6.3, 9.1: revised tune-up limit of g/n modes in ch13 Sec.8.1: revised liquid check result	Eunji Choi
V3	1/14/2019	Revised Sec.1 and Sec.6.3, revised tune-up limit of Bluetooth	Eunji Choi
V4	1/21/2019	Revised Sec.1, 3, 7, 8, 10, 11 and Appendix B/C/D/E -added Next-to-Mouth 1-g SAR data	Eunji Choi

Table of Contents

1.	Attestation of Test Results	4
2.	Test Specification, Methods and Procedures.....	5
3.	Facilities and Accreditation.....	5
4.	SAR Measurement System & Test Equipment	6
4.1.	<i>SAR Measurement System.....</i>	6
4.2.	<i>SAR Scan Procedures.....</i>	7
4.3.	<i>Test Equipment.....</i>	9
5.	Measurement Uncertainty.....	9
6.	Device Under Test (DUT) Information	10
6.1.	<i>DUT Description</i>	10
6.2.	<i>Wireless Technologies.....</i>	10
6.3.	<i>Nominal and Maximum Output Power.....</i>	11
7.	RF Exposure Conditions (Test Configurations).....	11
8.	Dielectric Property Measurements & System Check	12
8.1.	<i>Dielectric Property Measurements</i>	12
8.2.	<i>System Check.....</i>	13
9.	Conducted Output Power Measurements.....	15
9.1.	<i>Wi-Fi 2.4 GHz (DTS Band).....</i>	15
9.2.	<i>Bluetooth</i>	16
10.	Measured and Reported (Scaled) SAR Results.....	17
10.1.	<i>Wi-Fi (DTS Band).....</i>	18
10.2.	<i>Bluetooth.....</i>	18
11.	SAR Measurement Variability.....	19
12.	Simultaneous Transmission SAR Analysis.....	19
Appendixes	20	
	<i>4788805488-S1V4 FCC Report SAR_App A_Photos & Ant. Locations.....</i>	20
	<i>4788805488-S1V4 FCC Report SAR_App B_Highest SAR Test Plots.....</i>	20
	<i>4788805488-S1V4 FCC Report SAR_App C_System Check Plots.....</i>	20
	<i>4788805488-S1V4 FCC Report SAR_App D_SAR Tissue Ingredients</i>	20
	<i>4788805488-S1V4 FCC Report SAR_App E_Probe Cal. Certificates</i>	20
	<i>4788805488-S1V4 FCC Report SAR_App F_Dipole Cal. Certificates.....</i>	20

1. Attestation of Test Results

Applicant Name	SAMSUNG ELECTRONICS CO.,LTD.	
FCC ID	A3LSMR500	
Model Number	SM-R500, SM-R500X	
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013	
SAR Limits (W/Kg)		
Exposure Category	Peak spatial-average (1g of tissue)	Extremities (hands, wrists, ankles, etc.) (10g of tissue)
General population / Uncontrolled exposure	1.6	4.0
The Highest Reported SAR (W/kg)		
RF Exposure Conditions	Equipment Class	
	DTS	DSS(BT)
Next-to-Mouth 1g SAR	0.41	0.22
Extremity (Wrist) 10g SAR	0.73	0.41
Date Tested	12/27/2018 to 1/2/2019 and 1/17/2019	
Test Results	Pass	
<p>UL Korea, Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Korea, Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p>Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Korea, Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Korea, Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by IAS, any agency of the Federal Government, or any agency of any government.</p>		
Approved & Released By:	Prepared By:	
		
Justin Park Lead Test Engineer UL Korea, Ltd. Suwon Laboratory	Eunji Choi Associate Test Engineer UL Korea, Ltd. Suwon Laboratory	

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
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

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

- [TCB workshop](#) October, 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)

3. Facilities and Accreditation

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

Suwon
SAR 1 Room
SAR 4 Room

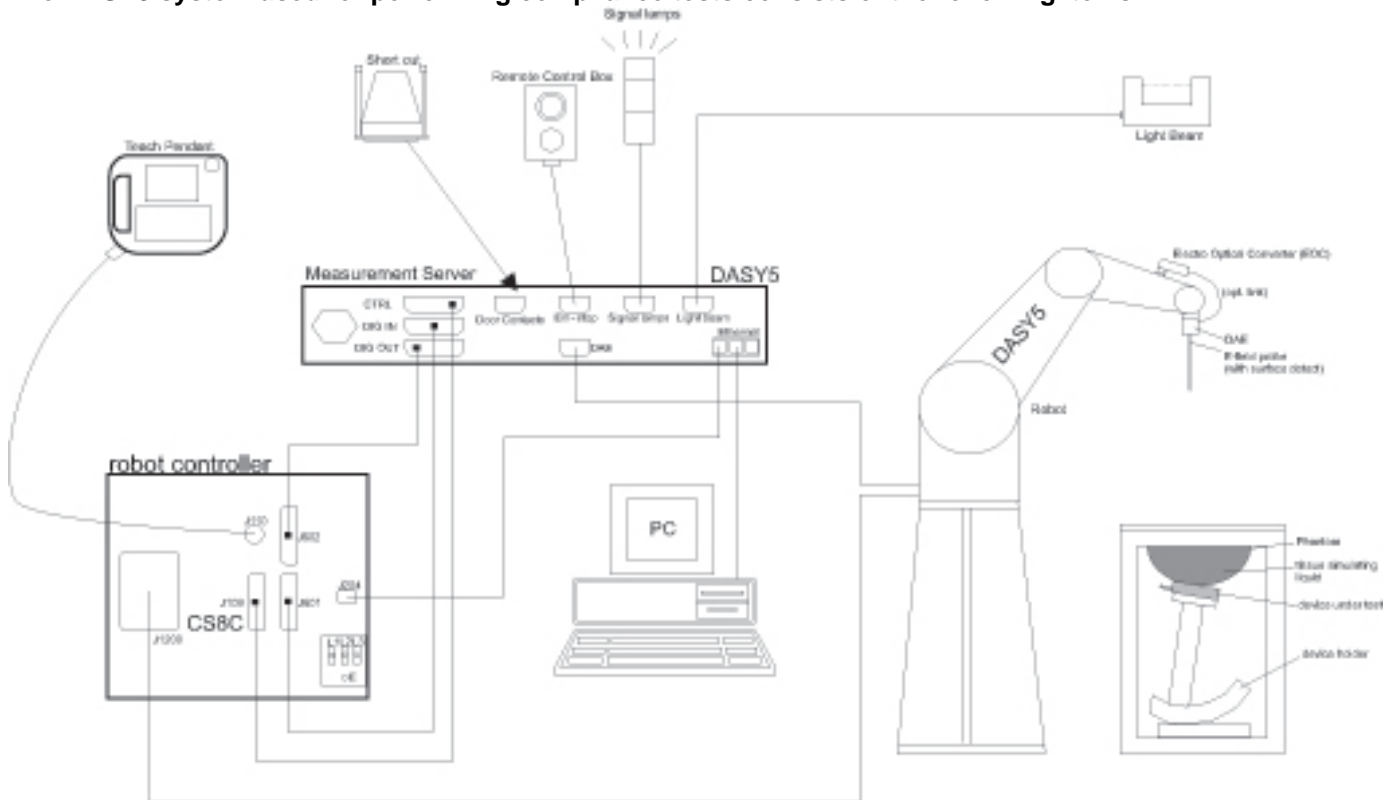
UL Korea, Ltd. is accredited by IAS, Laboratory Code TL-637.

The full scope of accreditation can be viewed at <http://www.iasonline.org/PDF/TL/TL-637.pdf>.

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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
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 \leq 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: $\Delta x_{Zoom}, \Delta y_{Zoom}$			≤ 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 1 st 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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> 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	E5071C	MY46522054	8-7-2019
Dielectric Assessment Kit	SPEAG	DAK-3.5	1196	6-26-2019
Shorting block	SPEAG	DAK-3.5 Short	SM DAK 200 BA	N/A
Thermometer	LKM	DTM3000	3424	8-9-2019

System Check

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145882	8-7-2019
Power Sensor	Agilent	U2000A	MY54260010	8-7-2019
Power Sensor	Agilent	U2000A	MY54260007	8-7-2019
Power Amplifier	EXODUS	1410025-AMP2027-10003	10003	8-8-2019
Directional Coupler	Agilent	772D	MY52180193	8-7-2019
Low Pass Filter	FILTRON	L14012FL	1410003S	8-7-2019
Attenuator	Agilent	8491B/003	MY39269292	8-7-2019
Attenuator	Agilent	8491B/010	MY39269315	8-7-2019
Attenuator	Agilent	8491B/020	MY39269298	8-7-2019
E-Field Probe (SAR4)	SPEAG	EX3DV4	3991	5-24-2019
Data Acquisition Electronics (SAR4)	SPEAG	DAE4	1259	7-26-2019
System Validation Dipole	SPEAG	D2450V2	960	3-20-2019
Thermometer (SAR4)	Lutron	MHB-382SD	AH.91478	8-8-2019

Others

Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Wireless Connectivity Tester	R & S	CMW270	100982	8-8-2019

5. Measurement Uncertainty

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

6. Device Under Test (DUT) Information

6.1. DUT Description

Device Dimension	Overall (Length x Width): 43.8 mm x 39.5 mm Display Diagonal: 28.08 mm												
Back Cover	<input checked="" type="checkbox"/> The Back Cover is not removable.												
Battery Options	<input checked="" type="checkbox"/> The rechargeable battery is not user accessible												
Wireless Router (Hotspot)	<input checked="" type="checkbox"/> Mobile Hotspot is not supported												
Wi-Fi Direct	Wi-Fi Direct enabled devices transfer data directly between each other <input checked="" type="checkbox"/> Wi-Fi Direct (Wi-Fi 2.4 GHz)												
Test Sample Information	<table border="1"> <thead> <tr> <th>No.</th> <th>S/N</th> <th>Notes</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>R3AKC0086EY</td> <td>SAR</td> </tr> <tr> <td>2</td> <td>R3AK4005HZR</td> <td>Wi-Fi conduction</td> </tr> <tr> <td>3</td> <td>R32K400E4CK</td> <td>BT conduction</td> </tr> </tbody> </table>	No.	S/N	Notes	1	R3AKC0086EY	SAR	2	R3AK4005HZR	Wi-Fi conduction	3	R32K400E4CK	BT conduction
No.	S/N	Notes											
1	R3AKC0086EY	SAR											
2	R3AK4005HZR	Wi-Fi conduction											
3	R32K400E4CK	BT conduction											

6.2. Wireless Technologies

Wireless technologies	Frequency bands	Operating mode	Duty Cycle used for SAR testing
Wi-Fi	2.4 GHz	802.11b 802.11g 802.11n (HT20)	99.5% (802.11b) 96.7% (802.11g) 96.4% (802.11n HT20)
Bluetooth	2.4 GHz	Version 4.2 LE	76.9% (DH5)

Notes:

- The Bluetooth protocol is considered source-based averaging. Bluetooth GFSK (DH5) was verified to have the highest duty cycle of 76.9% and was considered and used for SAR Testing.
- Duty cycle for Wi-Fi is referenced from the DTS report.

6.3. Nominal and Maximum Output Power

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

RF Air interface	Mode	Max. RF Output Power (dBm)
WiFi 2.4 GHz (Ch. 1~Ch. 11)	802.11b	18.0
	802.11g	16.0
	802.11n HT20	15.0
WiFi 2.4 GHz (Ch. 12)	802.11b	12.0
	802.11g	
	802.11n HT20	
WiFi 2.4 GHz (Ch. 13)	802.11b	7.0
	802.11g	8.0
	802.11n HT20	
Bluetooth		16.0
Bluetooth LE		8.0

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 / Bluetooth	Extremity	0 mm	Rear	N/A	Yes
	Next-to-Mouth	10 mm	Front	N/A	Yes

Notes:

This device does not support voice communication function, but SAR testing in Next-to-Mouth condition was performed for the voice activated transmission capabilities.

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 $\pm 2^\circ\text{C}$ 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.

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 1 Room

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit \pm (%)	
01-17-2019	Head 2450	e'	38.6600	Relative Permittivity (ϵ_r):	38.66	39.20	-1.38	5
		e"	13.5700	Conductivity (σ):	1.85	1.80	2.70	5
	Head 2400	e'	38.8100	Relative Permittivity (ϵ_r):	38.81	39.30	-1.24	5
		e"	13.4800	Conductivity (σ):	1.80	1.75	2.70	5
	Head 2480	e'	38.5500	Relative Permittivity (ϵ_r):	38.55	39.16	-1.56	5
		e"	13.6400	Conductivity (σ):	1.88	1.83	2.64	5

SAR 4 Room

Date	Freq. (MHz)	Liquid Parameters		Measured	Target	Delta (%)	Limit \pm (%)	
01-02-2019	Body 2450	e'	51.6400	Relative Permittivity (ϵ_r):	51.64	52.70	-2.01	5
		e"	14.5900	Conductivity (σ):	1.99	1.95	1.93	5
	Body 2400	e'	51.7800	Relative Permittivity (ϵ_r):	51.78	52.77	-1.88	5
		e"	14.4700	Conductivity (σ):	1.93	1.90	1.74	5
	Body 2480	e'	51.5500	Relative Permittivity (ϵ_r):	51.55	52.66	-2.11	5
		e"	14.6900	Conductivity (σ):	2.03	1.99	1.68	5

8.2. System Check

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

System Performance Check Measurement Conditions:

- The measurements were performed in the flat section of the TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.
- The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.
- The DASY system with an E-Field Probe was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (below 3 GHz) and/or 8x8x7 (above 3 GHz) fine cube was chosen for the cube.
- Distance between probe sensors and phantom surface was set to 2.5 mm.
For 5 GHz band - Distance between probe sensors and phantom surface was set to 1.4 mm
- The dipole input power (forward power) was 100 mW.
- The results are normalized to 1 W input power.

Reference Target SAR Values

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

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)	
				1g/10g	Body
D2450V2	960	3-20-2018	2450	1g	49.80
				10g	23.50

System Check Results

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

SAR 1 Room

Date Tested	System Dipole		T.S. Liquid	Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.	
	Type	Serial #		Zoom Scan to 100 mW	Normalize to 1 W				
1-17-2019	D2450V2	960	Head	1g	5.58	55.80	53.60	4.10	1,2
				10g	2.51	25.10	25.10	0.00	

SAR 4 Room

Date Tested	System Dipole		T.S. Liquid	Measured Results		Target (Ref. Value)	Delta $\pm 10\%$	Plot No.	
	Type	Serial #		Zoom Scan to 100 mW	Normalize to 1 W				
1-2-2019	D2450V2	960	Body	1g	5.12	51.20	49.80	2.81	3,4
				10g	2.33	23.30	23.50	-0.85	

9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4 GHz (DTS Band)

Measured Results

Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Max Output Power (dBm)	SAR Test (Yes/No)
802.11b	1 Mbps	1	2412	17.7	18.0	Yes
		6	2437	17.4		
		11	2462	17.3		
		12	2467	10.8	12.0	No
		13	2472	5.7	7.0	
802.11g	6 Mbps	1	2412	Not Require	16.0	No
		6	2437			
		10	2457			
		11	2462			
		12	2467	11.7	12.0	
		13	2472	6.9	8.0	
802.11n (HT20)	6.5 Mbps	1	2412	Not Require	15.0	No
		6	2437			
		10	2457			
		11	2462			
		12	2467	11.5	12.0	
		13	2472	6.8	8.0	

Note(s):

- SAR is not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 1.2 W/kg.
- 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.
- Additionally, SAR is not required for Channels 12 and 13 because the tune-up limit and the measured output power for these two channels are no greater than those for the default test channels. Refer to §6.3.

9.2. Bluetooth

Average Power Measured Results

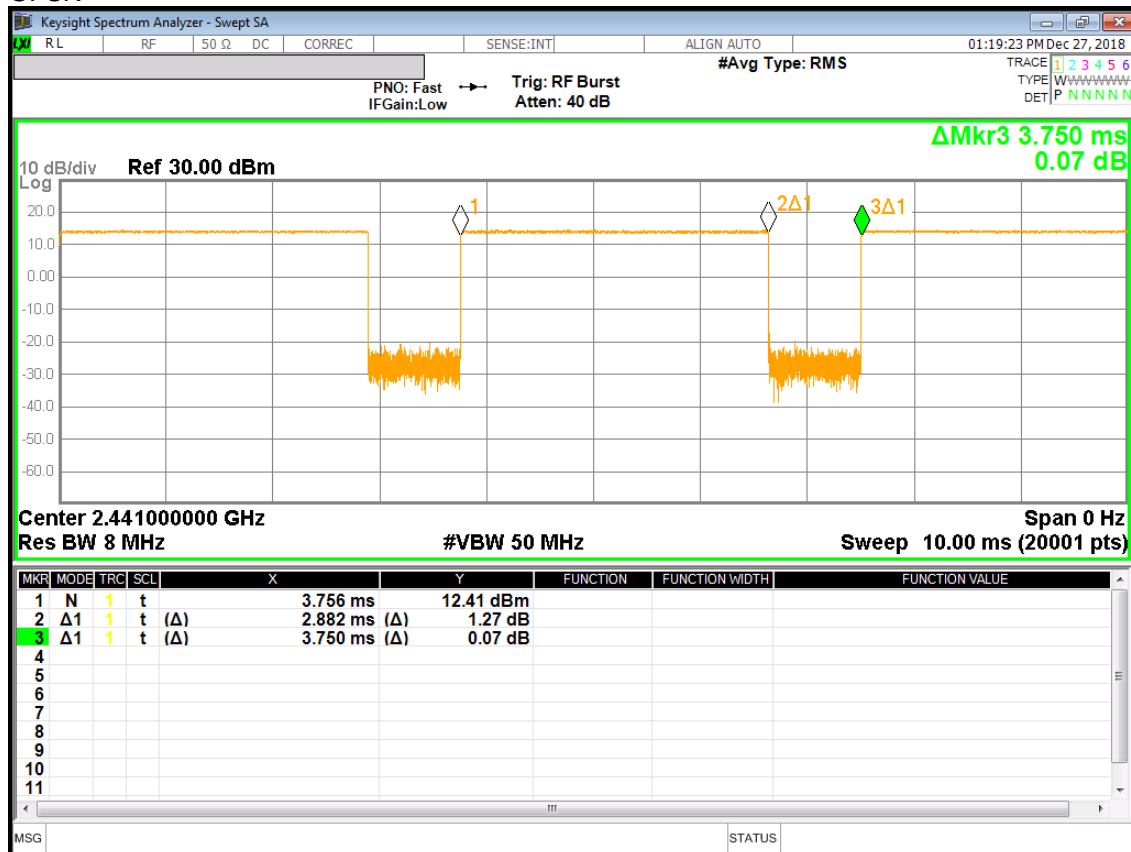
Band (GHz)	Mode	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)
2.4	GFSK	0	2402	15.5
		39	2441	14.2
		78	2480	14.8
	EDR, $\pi/4$ DQPSK	0	2402	8.6
		39	2441	6.9
		78	2480	6.3
	EDR, 8-DPSK	0	2402	8.6
		39	2441	6.9
		78	2480	6.3
	LE, GFSK	0	2402	6.3
		19	2440	6.5
		39	2480	7.6

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	2.882	3.750	76.9%	1.30

Duty Cycle plots

GFSK



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 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 (DTS Band)

Frequency Band	Mode	RF Exposure Conditions	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Area Scan Max. SAR (W/kg)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
									Tune-up limit	Meas.	Meas.	Scaled	Meas.	Scaled	
2.4GHz	802.11b 1 Mbps	Next-to-Mouth	10	Flat / Front	1	2412.0	0.375	99.5%	18.0	17.7	0.289	0.315			
					6	2437.0	0.415	99.5%	18.0	17.4	0.320	0.368			
					11	2462.0	0.475	99.5%	18.0	17.3	0.342	0.409			1
		Extremity	0	Flat / Rear	1	2412.0	1.170	99.5%	18.0	17.7			0.434	0.473	
					6	2437.0	1.359	99.5%	18.0	17.4			0.533	0.612	
					11	2462.0	1.661	99.5%	18.0	17.3			0.612	0.731	2

Note(s):

- When the 802.11b reported SAR of the highest measured maximum output power channel is ≤ 0.8 W/kg, no further SAR testing is required. If SAR is > 0.8 W/kg and ≤ 1.2 W/kg, SAR is required for the next highest measured output power channel. Finally, if SAR is > 1.2 W/kg, SAR is required for the third channel.
- SAR testing is not required for OFDM mode(s) when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

10.2. Bluetooth

Frequency Band	Mode	RF Exposure Conditions	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle (%)	Power (dBm)		1-g SAR (W/kg)		10-g SAR (W/kg)		Plot No.
								Tune-up limit	Meas.	Meas.	Scaled	Meas.	Scaled	
2.4GHz	GFSK	Next-to-Mouth	10	Flat / Front	0	2402.0	76.9%	16.0	15.5	0.147	0.217			3
		Extremity	0	Flat / Rear	0	2402.0	76.9%	16.0	15.5			0.280	0.413	4

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

Peak spatial-average (Next to Mouth, 1g of tissue)

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
2400	Wi-Fi 802.11b/g/n	Next to Mouth	Front	No	0.342	N/A	N/A
	Bluetooth	Next to Mouth	Front	No	0.147	N/A	N/A

Peak spatial-average (Extremity, 10g of tissue)

Frequency Band (MHz)	Air Interface	RF Exposure Conditions	Test Position	Repeated SAR (Yes/No)	Highest Measured SAR (W/kg)	Repeated Measured SAR (W/kg)	Largest to Smallest SAR Ratio
2400	Wi-Fi 802.11b/g/n	Extremity	Rear	No	0.612	N/A	N/A
	Bluetooth	Extremity	Rear	No	0.280	N/A	N/A

Note(s):

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

12. Simultaneous Transmission SAR Analysis

N/A.

Wi-Fi 2.4 GHz Radio can't transmit simultaneously with Bluetooth Radio.

Appendixes

Refer to separated files for the following appendixes.

4788805488-S1V4 FCC Report SAR_App A_Photos & Ant. Locations

4788805488-S1V4 FCC Report SAR_App B_Highest SAR Test Plots

4788805488-S1V4 FCC Report SAR_App C_System Check Plots

4788805488-S1V4 FCC Report SAR_App D_SAR Tissue Ingredients

4788805488-S1V4 FCC Report SAR_App E_Probe Cal. Certificates

4788805488-S1V4 FCC Report SAR_App F_Dipole Cal. Certificates

END OF REPORT