



SAR EVALUATION REPORT

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

For
BT/BLE, DTS/UNII a/b/g/n and ANT+ Tablet

**FCC ID: A3LSMT333
Model Name: SM-T333**

**Report Number: 15119760-S1B
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| Rev. | Date | Revisions | Revised By |
|------|-----------|---|-----------------|
| -- | 1/26/2015 | Initial Issue | -- |
| A | 1/28/2015 | Section 7: Removed Power Reduction Information | Coltyce Sanders |
| B | 2/2/2015 | Cover Page and Section 1: Removed Model SM-T333NU | AJ Newcomer |
| | | | |

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1. Attestation of Test Results

| | | | | |
|--|---|--|--------------|------------|
| Applicant Name | SAMSUNG ELECTRONICS CO., LTD. | | | |
| FCC ID | A3LSMT333 | | | |
| Model Name | SM-T333 | | | |
| Applicable Standards | FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013 | | | |
| SAR Limits (W/Kg) | | | | |
| Exposure Category | Peak spatial-average(1g of tissue) | | | |
| General population / Uncontrolled exposure | 1.6 | | | |
| The Highest Reported SAR (W/kg) | | | | |
| RF Exposure Conditions | Equipment Class | | | |
| | Licensed | DTS | U-NII | DSS |
| Standalone | N/A | 0.489 | 0.556 | <0.001 |
| Simultaneous Tx | Simultaneous Transmission is not supported. | | | |
| Date Tested | 1/12/2015 to 1/21/2015 | | | |
| Test Results | Pass | | | |
| <p>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.</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 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.</p> | | | | |
| Approved & Released By: | | Prepared By: | | |
|  | |  | | |
| Devin Chang Senior Engineer UL Verification Services Inc. | | Coltyce Sanders Laboratory 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 SAR meas for 802.11 v02
- 447498 D01 General RF Exposure Guidance v05r02
- 447498 D03 Supplement C Cross-Reference
- 616217 D04 SAR for laptop and tablets v01r01
- 690783 D01 SAR Listings on Grants v01r03
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03
- 865664 D02 RF Exposure Reporting v01r01

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.

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 area scan based <i>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 | E753ES | MY40000980 | 4/7/2015 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 | 1082 | 9/16/2015 |
| Dielectronic Probe kit | SPEAG | DAK-3.5 Short | SM DAK 200 BA | N/A |
| Thermometer | Control Company | Traceable | 122529163 | 10/8/2015 |

System Check

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|--------------------------------------|-----------------|------------------------|-------------|---------------|
| HP Signal Generator | HP | 8665B | 3546A00784 | 6/23/2015 |
| Power Meter | HP | 437B | 3125U09516 | 10/6/2015 |
| Power Meter | Agilent | N1911A | MY53060016 | 8/7/2015 |
| Power Sensor | Agilent | E9323A | MY53070003 | 5/1/2015 |
| Power Sensor | Agilent | 8481A | 3318A95392 | 10/6/2015 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1622052 | N/A |
| Bi-directional coupler | Werlatone, Inc. | C8060-102 | 2711 | N/A |
| DC Power Supply | Sorensen Ametek | XT20-3 | 1318A00530 | N/A |
| Synthesized Signal Generator | Agilent | 8665B | 3438A00633 | 7/10/2015 |
| Power Meter | HP | 437B | 3125U11347 | 8/27/2015 |
| Power Meter | HP | 437B | 3125U16345 | 6/16/2015 |
| Power Sensor | HP | 8481A | 2702A60780 | 6/16/2015 |
| Power Sensor | HP | 8481A | 1926A16917 | 10/10/2015 |
| Amplifier | MITEQ | AMF-4D-00400600-50-30P | 1808938 | N/A |
| Bi-directional coupler | Werlatone, Inc. | C8060-102 | 2710 | N/A |
| DC Power Supply | HP | 6296A | 2841A-05955 | N/A |
| E-Field Probe (SAR 1) | SPEAG | EX3DV4 | 3902 | 5/19/2015 |
| Data Acquisition Electronics (SAR 1) | SPEAG | DAE4 | 1352 | 11/7/2015 |
| System Validation Dipole | SPEAG | D2450V2 | 748 | 2/18/2015 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1003 | 2/26/2015 |
| Thermometer (SAR Lab 1) | EXTECH | 445703 | CCS-205 | 3/24/2015 |

Others

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|-------------------|--------------|------------|------------|---------------|
| Power Meter | Agilent | N1912A | MY53040015 | 7/10/2015 |
| Power Sensor | Agilent | N1921A | MY52020011 | 5/6/2015 |

5. Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

6. Device Under Test (DUT) Information

6.1. DUT Description

| | |
|--------------------|---|
| Device Dimension | Overall (Length x Width): 209.8 mm x 123.8 mm Overall Diagonal: 233.64 mm Display Diagonal: 205 mm |
| Battery Back Cover | The rechargeable battery is not user accessible. |
| Battery Options | The rechargeable battery is not user accessible. |
| 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) <input type="checkbox"/> Wi-Fi Direct (Wi-Fi 5 GHz) |

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) | 100% |
| | 5 GHz | 802.11a 802.11n (HT20) 802.11n (HT40) | 100% |
| | TDWR (Terminal Doppler Weather Radar): Not Supported. | | |
| | Band gap channel : Not supported | | |
| Bluetooth | 2.4 GHz | Version 4.0 LE | 77.5% (DH5) |

6.3. Nominal and Maximum Output Power

KDB 447498 sec.4.1.(3) 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

| Upper limit (dB): | | RF Output Power (dBm) | |
|-------------------|--------------|-----------------------|------------------------------|
| RF Air interface | Mode | Target | Max. tune-up tolerance limit |
| WiFi 2.4 GHz | 802.11b | 15.0 | 15.5 |
| | 802.11g | 13.0 | 13.5 |
| | 802.11n HT20 | 11.0 | 11.5 |
| WiFi 5 GHz | 802.11a | 10.0 | 10.5 |
| | 802.11n HT20 | 10.0 | 10.5 |
| | 802.11n HT40 | 10.0 | 10.5 |
| Bluetooth | | 9.5 | 10.0 |
| Bluetooth LE | | 2.0 | 2.5 |

7. RF Exposure Conditions (Test Configurations)

Refer to “SAR Photos and Ant locations” Appendix for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

7.1. Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 § 4.3.1 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

SAR Test Exclusion Calculations for WLAN

Antennas < 50mm to adjacent edges

| Tx Interface | Frequency (MHz) | Output Power | | Separation Distances (mm) | | | | | | Calculated Threshold Value | | | | | |
|----------------------|-----------------|--------------|----|---------------------------|--------|--------|--------|--------|-------|----------------------------|--------|---------|---------|--------|-------|
| | | dBm | mW | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front |
| Wi-Fi Antenna | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 15.50 | 35 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 11 | 11 | > 50 mm | > 50 mm | 5 | |
| Wi-Fi 5.2 GHz | 5240 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 5 | 5 | > 50 mm | > 50 mm | 2.3 | |
| Wi-Fi 5.3 GHz | 5320 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 5.1 | 5.1 | > 50 mm | > 50 mm | 2.3 | |
| Wi-Fi 5.5 GHz | 5700 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 5.3 | 5.3 | > 50 mm | > 50 mm | 2.4 | |
| Wi-Fi 5.8 GHz | 5825 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 5.3 | 5.3 | > 50 mm | > 50 mm | 2.4 | |
| Bluetooth | 2480 | 10.00 | 10 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | 3.1 | 3.1 | > 50 mm | > 50 mm | 1.4 | |

Note(s):

1. According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.

Antennas > 50mm to adjacent edges

| Tx Interface | Frequency (MHz) | Output Power | | Separation Distances (mm) | | | | | | Calculated Threshold Value | | | | | |
|----------------------|-----------------|--------------|----|---------------------------|--------|--------|--------|--------|-------|----------------------------|---------|----------|-----------|---------|-------|
| | | dBm | mW | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 | Front |
| Wi-Fi Antenna | | | | | | | | | | | | | | | |
| Wi-Fi 2.4 GHz | 2462 | 15.50 | 35 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 398.3 mW | 1547.8 mW | < 50 mm | |
| Wi-Fi 5.2 GHz | 5240 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 368.2 mW | 1517.7 mW | < 50 mm | |
| Wi-Fi 5.3 GHz | 5320 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 367.7 mW | 1517.2 mW | < 50 mm | |
| Wi-Fi 5.5 GHz | 5700 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 365.5 mW | 1515 mW | < 50 mm | |
| Wi-Fi 5.8 GHz | 5825 | 10.50 | 11 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 364.9 mW | 1514.4 mW | < 50 mm | |
| Bluetooth | 2480 | 10.00 | 10 | 0.6 | 5.32 | 80.27 | 195.22 | 10.87 | | < 50 mm | < 50 mm | 398 mW | 1547.5 mW | < 50 mm | |

Note(s):

1. According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

7.2. Required Test Configurations

The table below identifies the standalone test configurations required for this device according to the findings in Section 7.1:

| Test Configurations | Rear | Edge 1 | Edge 2 | Edge 3 | Edge 4 |
|---------------------|------|------------|---------------|---------------|-------------|
| | | (Top Edge) | (Right Edge) | (Bottom Edge) | (Left Edge) |
| Wi-Fi 2.4 GHz | Yes | Yes | No | No | Yes |
| Wi-Fi 5 GHz | Yes | Yes | No | No | No |
| Bluetooth | Yes | Yes | No | No | No |

Note(s):

1. Yes = Testing is required.
2. No = Testing is not required.

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 Standard 1528-2013

Refer to Table 3 within the IEEE Standard 1528-2013

Dielectric Property Measurements Results:

SAR Lab 1

| Date | Freq. (MHz) | Liquid Parameters | | Measured | Target | Delta (%) | Limit ±(%) | |
|-----------|-------------|-------------------|---------|---|--------|-----------|------------|---|
| 1/12/2015 | Body 2450 | e' | 51.3800 | Relative Permittivity (ϵ_r): | 51.38 | 52.70 | -2.50 | 5 |
| | | e" | 14.8200 | Conductivity (σ): | 2.02 | 1.95 | 3.53 | 5 |
| | Body 2410 | e' | 51.5100 | Relative Permittivity (ϵ_r): | 51.51 | 52.76 | -2.37 | 5 |
| | | e" | 14.6900 | Conductivity (σ): | 1.97 | 1.91 | 3.20 | 5 |
| | Body 2475 | e' | 51.2600 | Relative Permittivity (ϵ_r): | 51.26 | 52.67 | -2.67 | 5 |
| | | e" | 14.9500 | Conductivity (σ): | 2.06 | 1.99 | 3.64 | 5 |
| 1/20/2015 | Body 2450 | e' | 50.3600 | Relative Permittivity (ϵ_r): | 50.36 | 52.70 | -4.44 | 5 |
| | | e" | 14.6600 | Conductivity (σ): | 2.00 | 1.95 | 2.42 | 5 |
| | Body 2410 | e' | 50.5200 | Relative Permittivity (ϵ_r): | 50.52 | 52.76 | -4.24 | 5 |
| | | e" | 14.5000 | Conductivity (σ): | 1.94 | 1.91 | 1.87 | 5 |
| | Body 2475 | e' | 50.2700 | Relative Permittivity (ϵ_r): | 50.27 | 52.67 | -4.55 | 5 |
| | | e" | 14.7500 | Conductivity (σ): | 2.03 | 1.99 | 2.25 | 5 |
| 1/15/2015 | Body 5180 | e' | 48.9600 | Relative Permittivity (ϵ_r): | 48.96 | 49.05 | -0.18 | 5 |
| | | e" | 18.7100 | Conductivity (σ): | 5.39 | 5.27 | 2.23 | 5 |
| | Body 5200 | e' | 48.9300 | Relative Permittivity (ϵ_r): | 48.93 | 49.02 | -0.18 | 5 |
| | | e" | 18.8100 | Conductivity (σ): | 5.44 | 5.29 | 2.72 | 5 |
| | Body 5600 | e' | 48.2500 | Relative Permittivity (ϵ_r): | 48.25 | 48.48 | -0.47 | 5 |
| | | e" | 19.2400 | Conductivity (σ): | 5.99 | 5.76 | 3.99 | 5 |
| | Body 5800 | e' | 47.9100 | Relative Permittivity (ϵ_r): | 47.91 | 48.20 | -0.60 | 5 |
| | | e" | 19.4200 | Conductivity (σ): | 6.26 | 6.00 | 4.38 | 5 |
| | Body 5825 | e' | 47.8200 | Relative Permittivity (ϵ_r): | 47.82 | 48.20 | -0.79 | 5 |
| | | e" | 19.4400 | Conductivity (σ): | 6.30 | 6.00 | 4.94 | 5 |
| 1/20/2014 | Body 5180 | e' | 46.9500 | Relative Permittivity (ϵ_r): | 46.95 | 49.05 | -4.27 | 5 |
| | | e" | 18.9500 | Conductivity (σ): | 5.46 | 5.27 | 3.54 | 5 |
| | Body 5200 | e' | 46.9500 | Relative Permittivity (ϵ_r): | 46.95 | 49.02 | -4.22 | 5 |
| | | e" | 19.0000 | Conductivity (σ): | 5.49 | 5.29 | 3.76 | 5 |
| | Body 5600 | e' | 46.2200 | Relative Permittivity (ϵ_r): | 46.22 | 48.48 | -4.66 | 5 |
| | | e" | 19.1800 | Conductivity (σ): | 5.97 | 5.76 | 3.67 | 5 |
| | Body 5800 | e' | 45.9700 | Relative Permittivity (ϵ_r): | 45.97 | 48.20 | -4.63 | 5 |
| | | e" | 19.4200 | Conductivity (σ): | 6.26 | 6.00 | 4.38 | 5 |
| | Body 5825 | e' | 45.9700 | Relative Permittivity (ϵ_r): | 45.97 | 48.20 | -4.63 | 5 |
| | | e" | 19.3700 | Conductivity (σ): | 6.27 | 6.00 | 4.56 | 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 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.

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 |
| D2450V2 | 748 | 2/18/2014 | 2450 | 1g | 51.6 | 50.7 |
| | | | | 10g | 24.0 | 23.7 |
| D5GHzV2 | 1003 | 2/26/2014 | 5200 | 1g | 77.7 | 73.5 |
| | | | | 10g | 22.2 | 20.5 |
| | | | 5600 | 1g | 81.8 | 79.6 |
| | | | | 10g | 23.2 | 22.1 |
| | | | 5800 | 1g | 78.3 | 73.8 |
| | | | | 10g | 22.1 | 20.4 |

System Check Results

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

SAR Lab 1

| Date Tested | System Dipole | | T.S. Liquid | Measured Results | | Target (Ref. Value) | Delta ±10 % | Plot No. | |
|-------------|-------------------|----------|-------------|---------------------|------------------|---------------------|-------------|----------|-----|
| | Type | Serial # | | Zoom Scan to 100 mW | Normalize to 1 W | | | | |
| 1/12/2015 | D2450V2 | 748 | Body | 1g | 5.40 | 54.0 | 50.7 | 6.51 | 1,2 |
| | | | | 10g | 2.48 | 24.8 | 23.7 | 4.64 | |
| 1/20/2015 | D2450V2 | 748 | Body | 1g | 5.03 | 50.3 | 50.7 | -0.79 | |
| | | | | 10g | 2.31 | 23.1 | 23.7 | -2.53 | |
| 1/15/2015 | D5GHzV2 (5.2 GHz) | 1003 | Body | 1g | 6.97 | 69.7 | 73.5 | -5.17 | |
| | | | | 10g | 1.99 | 19.9 | 20.5 | -2.93 | |
| 1/15/2015 | D5GHzV2 (5.6 GHz) | 1003 | Body | 1g | 8.47 | 84.7 | 79.6 | 6.41 | 3,4 |
| | | | | 10g | 2.39 | 23.9 | 22.1 | 8.14 | |
| 1/15/2015 | D5GHzV2 (5.8 GHz) | 1003 | Body | 1g | 7.35 | 73.5 | 73.8 | -0.41 | |
| | | | | 10g | 2.08 | 20.8 | 20.4 | 1.96 | |
| 1/20/2015 | D5GHzV2 (5.2 GHz) | 1003 | Body | 1g | 7.40 | 74.0 | 73.5 | 0.68 | |
| | | | | 10g | 2.11 | 21.1 | 20.5 | 2.93 | |
| 1/20/2015 | D5GHzV2 (5.6 GHz) | 1003 | Body | 1g | 7.71 | 77.1 | 79.6 | -3.14 | |
| | | | | 10g | 2.17 | 21.7 | 22.1 | -1.81 | |
| 1/20/2015 | D5GHzV2 (5.8 GHz) | 1003 | Body | 1g | 7.36 | 73.6 | 73.8 | -0.27 | |
| | | | | 10g | 2.07 | 20.7 | 20.4 | 1.47 | |

9. Conducted Output Power Measurements

9.1. Wi-Fi 2.4GHz (DTS Band)

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) | Note(s) |
|------------|----------------|-----------|------|-------------|---------------|------------------------|-------------------|---------|
| 2.4 | 802.11b | 1 Mbps | 1 | 2412 | 15.3 | 15.5 | Yes | |
| | | | 6 | 2437 | 15.3 | | | |
| | | | 11 | 2462 | 15.1 | | | |
| | 802.11g | 6 Mbps | 1 | 2412 | Not Required | 13.5 | No | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |
| | 802.11n (HT20) | MCS0 | 1 | 2412 | Not Required | 11.5 | Yes | 1 |
| | | | 6 | 2437 | | | | |
| | | | 11 | 2462 | | | | |

Note(s):

- Output Power and SAR measurement is not required for 802.11g/n HT20 channels when the specified tune-up tolerances for 802.11g/n HT20 are lower than 802.11b by more than 1 dB and the measured SAR is ≤ 1.2 W/Kg.

9.2. Wi-Fi 5GHz (U-NII)

| Band (GHz) | Mode | Data Rate | Ch # | Freq. (MHz) | Avg Pwr (dBm) | Max Output Power (dBm) | SAR Test (Yes/No) | Note(s) |
|-------------------------|----------------|-----------|--------------------------|-----------------------------|-----------------------------|------------------------|-------------------|---------|
| 5.2 (U-NII 1) | 802.11a | 6 Mbps | 36 ~ 48 | 5180 ~ 5240 | Not required | 10.5 | No | 1 |
| | 802.11n (HT20) | 6.5 Mbps | 36 ~ 48 | 5180 ~ 5240 | | 10.5 | No | 1 |
| | 802.11n (HT40) | 13.5 Mbps | 38 46 | 5190 5230 | 10.2 10.5 | 10.5 | No | 2 |
| 5.3 (U-NII 2A) | 802.11a | 6 Mbps | 52 ~ 64 | 5260 ~ 5320 | Not required | 10.5 | No | 1 |
| | 802.11n (HT20) | 6.5 Mbps | 52 ~ 64 | 5260 ~ 5320 | | 10.5 | No | 1 |
| | 802.11n (HT40) | 13.5 Mbps | 54 62 | 5270 5310 | 10.5 10.5 | 10.5 | Yes | |
| 5.5 (U-NII 2C) | 802.11a | 6 Mbps | 100 ~ 140 | 5500 ~ 5700 | Not required | 10.5 | No | 1 |
| | 802.11n (HT20) | 6.5 Mbps | 100 ~ 140 | 5500 ~ 5700 | | 10.5 | No | 1 |
| | 802.11n (HT40) | 13.5 Mbps | 102 118 134 | 5510 5590 5630 | 10.3 10.2 10.5 | 10.5 | Yes | |
| 5.8 (UNII-3 or §15.247) | 802.11a | 6 Mbps | 149 ~ 165 | 5745 ~ 5825 | Not required | 10.5 | No | 1 |
| | 802.11n (HT20) | 6.5 Mbps | 149 ~ 165 | 5745 ~ 5825 | | 10.5 | No | 1 |
| | 802.11n (HT40) | 13.5 Mbps | 151 159 | 5755 5795 | 10.3 10.5 | 10.5 | Yes | |

Note(s):

- Output Power and SAR measurement is not required for 802.11a and 802.11n HT20 channels because the specified tune-up tolerances for 802.11a and 802.11n HT20 are lower than or equal to 802.11n HT40 and the measured SAR is ≤ 1.2 W/Kg.
- 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.

9.3. Bluetooth

| Band (GHz) | Mode | Ch # | Freq. (MHz) | Avg Pwr (dBm) | SAR Test (Yes/No) |
|------------|---------------------------|------|-------------|---------------|-------------------|
| 2.4 | V3.0 + EDR, GFSK | 0 | 2402 | 9.3 | Yes |
| | | 39 | 2441 | 9.7 | |
| | | 78 | 2480 | 10.0 | |
| | V3.0 + EDR, $\pi/4$ DQPSK | 0 | 2402 | 7.1 | No |
| | | 39 | 2441 | 7.5 | |
| | | 78 | 2480 | 7.8 | |
| | V3.0 + EDR, 8-DPSK | 0 | 2402 | 7.1 | No |
| | | 39 | 2441 | 7.5 | |
| | | 78 | 2480 | 7.8 | |
| | V4.0 LE, GFSK | 0 | 2402 | 1.7 | No |
| | | 19 | 2440 | 1.8 | |
| | | 39 | 2480 | 1.9 | |

10. 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 248227 D01 SAR meas for 802.11 v02:

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 2.4 GHz (DTS)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Notes | Plot No. |
|----------------|-------------------|------------|---------------|-------|-------------|---------------------------|---------------|-------|----------------|--------------|-------|----------|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | | |
| 2.4GHz | 802.11b 1 Mbps | 0 | Rear | 6 | 2437.0 | 0.562 | 15.5 | 15.3 | 0.467 | 0.489 | 1 | 1 |
| | | | Edge 1 | 6 | 2437.0 | 0.157 | 15.5 | 15.3 | 0.13 | 0.136 | | |
| | | | Edge 4 | 6 | 2437.0 | 0.198 | 15.5 | 15.3 | 0.147 | 0.154 | | |

Note(s):

- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions were evaluated until a SAR ≤ 0.8 W/kg was reported.

10.2. Wi-Fi 5 GHz (U-NII)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Area Scan Max. SAR (W/kg) | Power (dBm) | | 1-g SAR (W/kg) | | Notes | Plot No. |
|---------------------|-----------------------------|------------|---------------|-------|-------------|---------------------------|---------------|-------|----------------|--------------|-------|----------|
| | | | | | | | Tune-up limit | Meas. | Meas. | Scaled | | |
| 5.3 GHz U-NII 2A | 802.11n HT40 13.5Mbps | 0 | Rear | 62 | 5310.0 | 0.907 | 10.5 | 10.5 | 0.556 | 0.556 | 1 | 2 |
| | | | Edge 1 | 62 | 5310.0 | 0.291 | 10.5 | 10.5 | 0.123 | 0.123 | | |
| 5.5 GHz U-NII 2C | 802.11n HT40 13.5Mbps | 0 | Rear | 134 | 5670.0 | 0.764 | 10.5 | 10.5 | 0.356 | 0.356 | 1 | 3 |
| | | | Edge 1 | 134 | 5670.0 | 0.384 | 10.5 | 10.5 | 0.225 | 0.225 | | |
| 5.8 GHz U-NII 3 | 802.11n HT40 13.5Mbps | 0 | Rear | 159 | 5795.0 | 1.300 | 10.5 | 10.5 | 0.546 | 0.546 | 1 | 4 |
| | | | Edge 1 | 159 | 5795.0 | 0.688 | 10.5 | 10.5 | 0.407 | 0.407 | | |

Note(s):

- Highest reported SAR is > 0.4 W/kg. Due to the highest reported SAR for this test position, other test positions were evaluated until a SAR ≤ 0.8 W/kg was reported.

10.3. Bluetooth

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Power (dBm) | | 1-g SAR (W/kg) | | Plot No. |
|----------------|------|------------|---------------|-------|-------------|---------------|-------|----------------|--------|----------|
| | | | | | | Tune-up limit | Meas. | Meas. | Scaled | |
| 2.4 GHz | GFSK | 0 | Rear | 78 | 2480.0 | 10.0 | 10.0 | <0.001 | <0.001 | |
| | | | Edge 1 | 78 | 2480.0 | 10.0 | 10.0 | <0.001 | <0.001 | |

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 < 0.80 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.

| 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 | Standline | Rear | No | 0.467 | N/A | N/A |
| | Bluetooth | Standline | Rear | No | 0.001 | N/A | N/A |
| 5300 | Wi-Fi 802.11a/n | Standline | Rear | No | 0.556 | N/A | N/A |
| 5500 | Wi-Fi 802.11a/n | Standline | Rear | No | 0.356 | N/A | N/A |
| 5800 | Wi-Fi 802.11a/n | Standline | Rear | No | 0.547 | 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

There are no simultaneous transmission capabilities on this device; therefore no simultaneous transmission was required to be evaluated.

Appendixes

Refer to separated files for the following appendixes.

A_15I19760v0 SAR Photos & Ant. Locations

B_15I19760v0 SAR Highest Test Plots

C_15I19760v0 SAR System Check Plots

D_15I19760v0 SAR Tissue Ingredients

E_15I19760v0 SAR Probe Cal. Certificates

F_15I19760v0 SAR Dipole Cal. Certificates

END OF REPORT