# SAR EVALUATION REPORT

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

*For*
**Digital Image Receptor**

**FCC ID: ZZ6-WUBT-236ACN**
**Model Name: 4343W**

**Report Number: 4789136426-US-S0-V0**
**Issue Date: 1/31/2020**

*Prepared for*
**Varex Imaging Corporation**
**1678 South Pioneer Road, Salt Lake City, Utah 84104, USA**

*Prepared by*
**Underwriters Laboratories Taiwan Co., Ltd.,**
**Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd.,**
**Zhudong Township, Hsinchu County, Taiwan**
**TEL: +886-2-7737-3000**
**FAX: +886-3-583-7948**
**Website: www.ul.com**

Testing Laboratory
3398

**Revision History**

| Rev. | Date | Revisions | Revised By |
|---|---|---|---|
| V0 | 1/31/2020 | Initial Issue | Cindy Hsin |
| | | | |
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# 1. Attestation of Test Results

| | | |
|---|---|---|
| Applicant Name | Varex Imaging Corporation | |
| FCC ID | ZZ6-WUBT-236ACN | |
| Model Name | 4343W | |
| Applicable Standards | FCC 47 CFR § 2.1093<br>Published RF exposure KDB procedures<br>IEEE Std 1528-2013 | |
| Exposure Category | SAR Limits (W/Kg) | |
| | Peak spatial-average(1g of tissue) | |
| General population | 1.6 | |
| RF Exposure Conditions | Equipment Class - Highest Reported SAR (W/kg) | |
| | NII | |
| Standalone | 1.172 | |
| Date Tested | 9/16/2019 to 9/17/2019 | |
| Test Results | Pass | |

Underwriters Laboratories Taiwan Co., 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 Underwriters Laboratories Taiwan Co., Ltd., based on interpretations and/or observations of test results. 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 Underwriters Laboratories Taiwan Co., Ltd., and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., 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 TAF or any agency of any government. This report is written to support regulatory compliance of the applicable standards stated above.

| Approved and Authorized By: | Prepared By: |
|---|---|
| Stanley Wu<br>Senior Project Engineer<br>Underwriters Laboratories Taiwan Co., Ltd. | Cindy Hsin<br>Project Handler<br>Underwriters Laboratories Taiwan Co., Ltd. |

# 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
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02
- 941225 D05 SAR for LTE Devices v02r05

# 3. Facilities and Accreditation

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

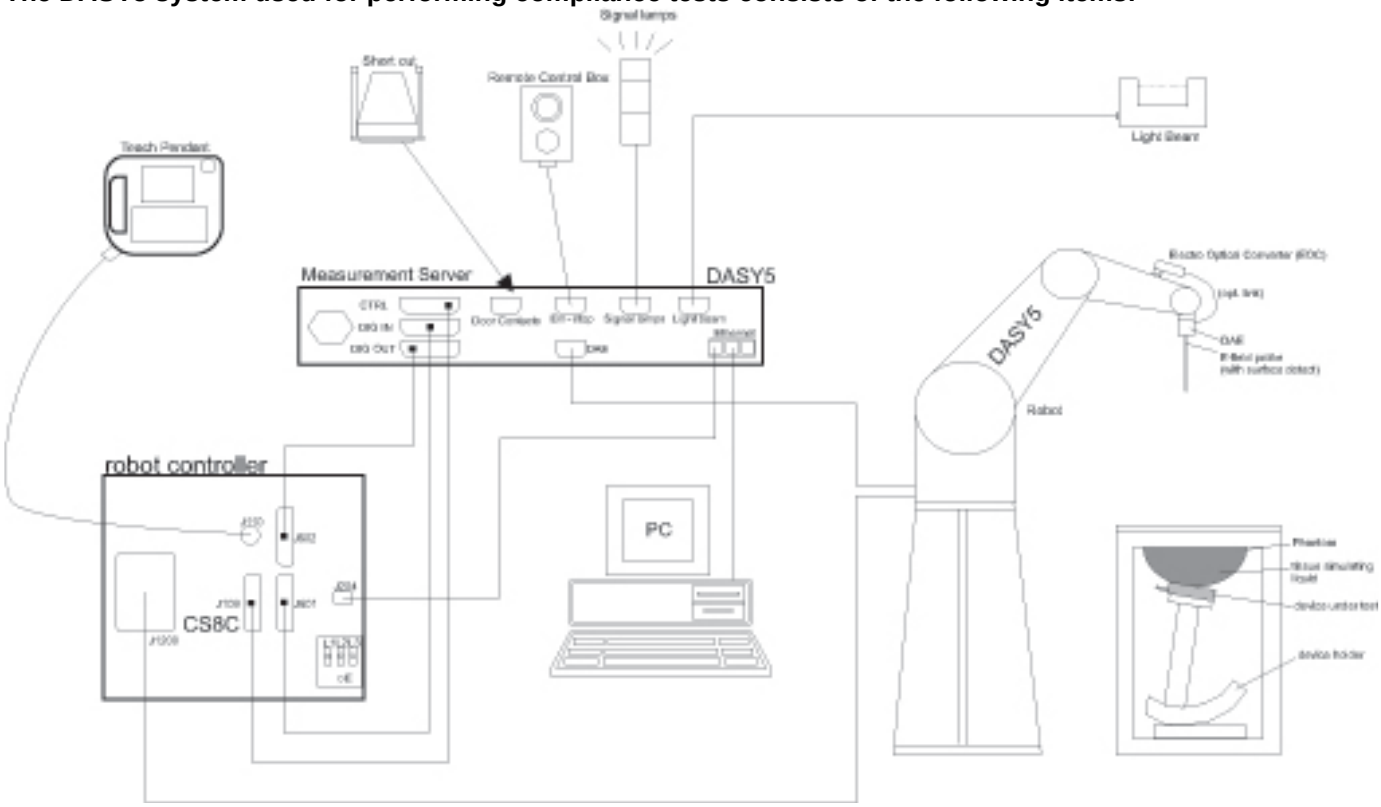
| **Underwriters Laboratories Taiwan Co., Ltd., Building B & E, No. 372-7, Sec. 4, Zhong-xing Rd., Zhudong Township, Hsinchu County, Taiwan** |
|---|
| SAR Room |

Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398.

# 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: $\Delta x_{Area}$, $\Delta y_{Area}$ | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>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: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>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<br>4 – 5 GHz: ≤ 3 mm<br>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<br>4 – 5 GHz: ≤ 2.5 mm<br>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<br>4 – 5 GHz: ≥ 25 mm<br>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 | MS46322B | 1740002 | 2019/12/25 |
| Dielectric Probe kit | SPEAG | DAK-3.5 | 1250 | 2019/9/18 |
| Shorting block | SPEAG | DAK-3.5 Short | SM DAK 200 CB | 2019/9/18 |
| Thermometer | DER EE | DE-3003 | P0006880 | 2020/1/3 |

**System Check**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| EXG-B RF Vector Signal Generator | Keysight Technologies | N5182B | MY56200244 | 2020/1/3 |
| Power Meter | Keysight | N1914A | MY56360007 | 2019/12/13 |
| Power Meter | ANRITSU | ML2495A | 1645002 | 2019/12/16 |
| Power Sensor | Keysight | N8481H | MY56350009 | 2019/12/13 |
| Power Sensor | ANRITSU | MA2411B | 1531202 | 2019/12/16 |
| Amplifier | Mini-Circuits | ZHL-42W+ | 51701624 | N/A |
| Amplifier | Mini-Circuits | ZVE-8G+ | 88201629 | N/A |
| 20dB Directional Coupler | N/A | N/A | 150820087 | N/A |
| DC Power Supply | GW Insrek | GPD-2303S | GEQ902177 | N/A |

**Lab Equipment**

| Name of Equipment | Manufacturer | Type/Model | Serial No. | Cal. Due Date |
|---|---|---|---|---|
| Dosimetric E-Field Probe | SPEAG | EX3DV4 | 3901 | 2020/8/28 |
| Data Acquisition Electronics | SPEAG | DAE4 | 1360 | 2019/12/17 |
| System Validation Dipole | SPEAG | D5GHzV2 | 1244 | 2019/12/13 |

Test Software

| Software Version |
|---|
| DASY NEO52 D10.1 S14.6.11 |
| SEMCAD-X-PostPro |

# 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

| | |
|---|---|
| Product Name | Digital Image Receptor |
| Model Name | 4343W |
| Device Dimension | Overall (Length x Width x Hight): 460 mm x 460 mm x 20 mm<br>Overall Diagonal: 460 mm |
| Back Cover | ☒ Normal Battery Cover |
| Battery Options | ☒ Standard – Lithium-ion battery, Rating 15.4Vdc, 52.8Wh<br>☐ Extended (large capacity)<br>☐ The rechargeable battery is not user accessible. |
| Hardware Version | N/A |
| Software Version | M01 |
| Sample Stage | Production equivalent |

## 6.2. Wireless Technologies

| Wireless technologies | Frequency bands | Operating mode | Duty Cycle used for SAR testing |
|---|---|---|---|
| Wi-Fi | 5 GHz | 802.11a<br>802.11n (HT20)<br>802.11n (HT40)<br>802.11ac (VHT20)<br>802.11ac (VHT40)<br>802.11ac (VHT80) | 98% (802.11a HT20 BW)<br>98% (802.11n HT20 BW)<br>98% (802.11n HT40 BW)<br>98% (802.11ac VHT20 BW)<br>98% (802.11ac VHT40 BW)<br>98% (802.11ac VHT80 BW) |

## 6.3. Nominal and Maximum Output Power

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.

| Band/ Mode | | Tune up Power (dBm) | |
|---|---|---|---|
| | | Chain 0 | Chain 1 |
| 5 GHz | 802.11a | 15.5 | - |
| | 802.11n HT20 (5180MHz~5240 MHz) | 14.5 | 14.5 |
| | 802.11n HT20 (5745MHz~5825 MHz) | 14 | 14 |
| | 802.11n HT40 (5190 MHz) | 12 | 12 |
| | 802.11n HT40 (5230 MHz) | 14.5 | 14.5 |
| | 802.11n HT40 (5755MHz) | 14 | 14 |
| | 802.11n HT40 (5795MHz) | 12 | 12 |
| | 802.11ac VHT80 | 11.5 | 11.5 |

# 7. RF Exposure Conditions (Test Configurations)

Refer to Appendix A for the specific details of the 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 SISO (Chain 0) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 15.50 | 35 | | 360 | 5 | 56 | 448 | 5 | | > 50 mm | 16 -MEASURE- | > 50 mm | > 50 mm | 16 -MEASURE- |
| Wi-Fi 5.8 GHz | 5825 | 15.50 | 35 | | 360 | 5 | 56 | 448 | 5 | | > 50 mm | 16.9 -MEASURE- | > 50 mm | > 50 mm | 16.9 -MEASURE- |
| **Wi-Fi MIMO (Chain 0) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 14.50 | 28 | | 360 | 5 | 56 | 448 | 5 | | *> 50 mm* | 12.8 -MEASURE- | *> 50 mm* | *> 50 mm* | 12.8 -MEASURE- |
| Wi-Fi 5.8 GHz | 5825 | 14.00 | 25 | | 360 | 5 | 56 | 448 | 5 | | *> 50 mm* | 12.1 -MEASURE- | *> 50 mm* | *> 50 mm* | 12.1 -MEASURE- |
| **Wi-Fi MIMO (Chain 1) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 14.50 | 28 | | 448 | 56 | 5 | 360 | 5 | | *> 50 mm* | *> 50 mm* | 12.8 -MEASURE- | *> 50 mm* | 12.8 -MEASURE- |
| Wi-Fi 5.8 GHz | 5825 | 14.00 | 25 | | 448 | 56 | 5 | 360 | 5 | | *> 50 mm* | *> 50 mm* | 12.1 -MEASURE- | *> 50 mm* | 12.1 -MEASURE- |

**Note(s):**

1. **According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.**
2. **The device is placed or fixed on a flat surface and user is not near the rear of the device, therefore not need to evaluate the rear.**

## 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 SISO (Chain 0) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 15.50 | 35 | | 360 | 5 | 56 | 448 | 5 | | 3165.5 mW -EXEMPT- | < 50 mm | 125.5 mW -EXEMPT- | 4045.5 mW -EXEMPT- | < 50 mm |
| Wi-Fi 5.8 GHz | 5825 | 15.50 | 35 | | 360 | 5 | 56 | 448 | 5 | | 3162.2 mW -EXEMPT- | < 50 mm | 122.2 mW -EXEMPT- | 4042.2 mW -EXEMPT- | < 50 mm |
| **Wi-Fi MIMO (Chain 0) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 14.50 | 28 | | 360 | 5 | 56 | 448 | 5 | | 3165.5 mW -EXEMPT- | < 50 mm | 125.5 mW -EXEMPT- | 4045.5 mW -EXEMPT- | < 50 mm |
| Wi-Fi 5.8 GHz | 5825 | 14.00 | 25 | | 360 | 5 | 56 | 448 | 5 | | 3162.2 mW -EXEMPT- | < 50 mm | 122.2 mW -EXEMPT- | 4042.2 mW -EXEMPT- | < 50 mm |
| **Wi-Fi MIMO (Chain 1) Antenna** | | | | | | | | | | | | | | | |
| Wi-Fi 5.2 GHz | 5240 | 14.50 | 28 | | 448 | 56 | 5 | 360 | 5 | | 4045.5 mW -EXEMPT- | 125.5 mW -EXEMPT- | < 50 mm | 3165.5 mW -EXEMPT- | < 50 mm |
| Wi-Fi 5.8 GHz | 5825 | 14.00 | 25 | | 448 | 56 | 5 | 360 | 5 | | 4042.2 mW -EXEMPT- | 122.2 mW -EXEMPT- | < 50 mm | 3162.2 mW -EXEMPT- | < 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.**
2. **The device is placed or fixed on a flat surface and user is not near the rear of the device, therefore not need to evaluate the rear.**

## 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 | Edge 1 (Top Edge) | Edge 2 (Right Edge ) | Edge 3 (Bottom Edge) | Edge 4 (Left Edge) | Front |
|---|---|---|---|---|---|
| Wi-Fi 5.2 GHz SISO (Chain 0) Antenna | No | Yes | No | No | Yes |
| Wi-Fi 5.8 GHz SISO (Chain 0) Antenna | No | Yes | No | No | Yes |
| Wi-Fi 5.2 GHz MIMO (Chain 0) Antenna | No | Yes | No | No | Yes |
| Wi-Fi 5.8 GHz MIMO (Chain 0) Antenna | No | Yes | No | No | Yes |
| Wi-Fi 5.2 GHz MIMO (Chain 1) Antenna | No | No | Yes | No | Yes |
| Wi-Fi 5.8 GHz MIMO (Chain 1) Antenna | No | No | Yes | No | Yes |

**Note(s):**

Yes = Testing is required.

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 ± 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 | |
|---|---|---|---|---|
| | $\varepsilon_r$ | σ (S/m) | $\varepsilon_r$ | 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:**

| Date | Tissue Type | Frequency (MHz) | Relative Permittivity (εr) | | | Conductivity (σ) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Measured | Target | Delta (%) | Measured | Target | Delta (%) |
| 2019/9/16 | Head | 5200 | 36.93 | 36.00 | 2.58 | 4.51 | 4.66 | -3.15 |
| | | 5250 | 36.78 | 35.95 | 2.31 | 4.57 | 4.71 | -3.00 |
| | | 5300 | 36.77 | 35.90 | 2.42 | 4.62 | 4.76 | -2.99 |
| 2019/9/17 | Head | 5750 | 35.60 | 35.35 | 0.71 | 5.24 | 5.22 | 0.33 |
| | | 5800 | 35.46 | 35.30 | 0.45 | 5.28 | 5.27 | 0.18 |
| | | 5850 | 35.41 | 35.25 | 0.45 | 5.35 | 5.32 | 0.53 |

## 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 250 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.

| 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 % | |
| 2019/9/16 | Head | D5250V2_1244 | 2019/12/13 | 8.02 | 80.2 | 78.30 | 2.43 | 2.33 | 23.3 | 22.40 | 4.02 | 1 |
| 2019/9/17 | Head | D5250V2_1244 | 2019/12/13 | 7.91 | 79.1 | 78.30 | 1.02 | 2.28 | 22.8 | 22.40 | 1.79 | 2 |
| 2019/9/17 | Head | D5800V2_1244 | 2019/12/13 | 8.47 | 84.7 | 78.70 | 7.62 | 2.42 | 24.2 | 22.50 | 7.56 | 3 |

# 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) | | Max Output Power (dBm) | | SAR Test (Yes/No) |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Chain 0 | Chain 1 | Chain 0 | Chain 1 | |
| 5.2 (U-NII 1) | 802.11a | 6 Mbps | 36 | 5180 | 14.61 | - | 15.5 | - | Yes |
| | | | 40 | 5200 | 14.78 | - | | | |
| | | | 44 | 5220 | 14.82 | - | | | |
| | | | 48 | 5240 | 14.89 | - | | | |
| | 802.11n (HT20) | MCS0 | 36 | 5180 | 13.93 | 13.82 | 14.5 | 14.5 | No |
| | | | 40 | 5200 | 13.6 | 13.79 | | | |
| | | | 44 | 5220 | 13.63 | 13.87 | | | |
| | | | 48 | 5240 | 13.61 | 13.56 | | | |
| | 802.11n (HT40) | MCS0 | 38 | 5190 | 11.15 | 11.22 | 12 | 12 | Yes |
| | | | 46 | 5230 | 13.92 | 13.98 | 14.5 | 14.5 | |
| | 802.11ac (VHT80) | MCS0 | 42 | 5210 | 9.07 | 8.85 | 11.5 | 11.5 | No |
| 5.8 (U-NII 3) | 802.11a | 6 Mbps | 149 | 5745 | 14.72 | - | 15.5 | - | Yes |
| | | | 153 | 5765 | 14.69 | - | | | |
| | | | 157 | 5785 | 14.79 | - | | | |
| | | | 161 | 5805 | 14.71 | - | | | |
| | | | 165 | 5825 | 14.76 | - | | | |
| | 802.11n (HT20) | MCS0 | 149 | 5745 | 13.51 | 13.66 | 14 | 14 | No |
| | | | 153 | 5765 | 13.47 | 13.59 | | | |
| | | | 157 | 5785 | 13.49 | 13.61 | | | |
| | | | 161 | 5805 | 13.45 | 13.56 | | | |
| | | | 165 | 5825 | 13.73 | 13.64 | | | |
| | 802.11n (HT40) | MCS0 | 151 | 5755 | 13.23 | 13.46 | 14 | 14 | Yes |
| | | | 159 | 5795 | 13.25 | 13.62 | 12 | 12 | |
| | 802.11ac (VHT80) | MCS0 | 155 | 5775 | 10.59 | 11.02 | 9.5 | 9.5 | 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.

# 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:**

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 Body (U-NII Band)

5.2GHz SISO Antenna (Chain 0)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 1 | 802.11a 6Mbps | 0 | Front | 48 | 5240.0 | 100.0% | 15.5 | 14.89 | 0.203 | 0.234 | 0.075 | 0.086 | |
| | | | Edge 2 | 36 | 5270.0 | 100.0% | 15.5 | 14.61 | 0.615 | **0.755** | 0.171 | 0.210 | |
| | | | | 44 | 5220.0 | 100.0% | 15.5 | 14.82 | 0.632 | 0.739 | 0.176 | 0.206 | |
| | | | | 48 | 5240.0 | 100.0% | 15.5 | 14.89 | 0.652 | 0.750 | 0.181 | 0.208 | |

5.2GHz MIMO Antenna (Chain 0)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 1 | 802.11n 40 MCS0 | 0 | Front | 46 | 5230.0 | 100.0% | 14.5 | 13.9 | 0.245 | 0.280 | 0.091 | 0.104 | |
| | | | Edge 2 | 38 | 5190.0 | 100.0% | 12.0 | 11.2 | 0.397 | 0.483 | 0.108 | 0.131 | |
| | | | | 46 | 5230.0 | 100.0% | 14.5 | 13.9 | 0.848 | 0.969 | 0.239 | 0.273 | |

5.2GHz MIMO Antenna (Chain 1)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 1 | 802.11n 40 MCS0 | 0 | Front | 46 | 5230.0 | 100.0% | 14.5 | 13.98 | 0.417 | 0.470 | 0.160 | 0.180 | |
| | | | Edge 3 | 38 | 5190.0 | 100.0% | 12.0 | 11.22 | 0.904 | 1.082 | 0.251 | 0.300 | |
| | | | | 46 | 5230.0 | 100.0% | 14.5 | 13.98 | 1.040 | **1.172** | 0.287 | 0.324 | 1 |

5.8GHz SISO Antenna (Chain 0)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 3 | 802.11a 6Mbps | 0 | Front | 157 | 5785.0 | 100.0% | 15.5 | 14.79 | 0.327 | 0.385 | 0.124 | 0.146 | |
| | | | Edge 2 | 149 | 5745.0 | 100.0% | 15.5 | 14.72 | 0.888 | 1.063 | 0.227 | 0.272 | |
| | | | | 157 | 5785.0 | 100.0% | 15.5 | 14.79 | 0.874 | 1.029 | 0.222 | 0.261 | |
| | | | | 165 | 5825.0 | 100.0% | 15.5 | 14.76 | 0.980 | **1.162** | 0.250 | 0.296 | 2 |

5.8GHz MIMO Antenna (Chain 0)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 3 | 802.11n 40 MCS0 | 0 | Front | 159 | 5795.0 | 100.0% | 14.0 | 13.25 | 0.298 | 0.354 | 0.112 | 0.133 | |
| | | | Edge 2 | 151 | 5755.0 | 100.0% | 14.0 | 13.23 | 0.896 | **1.070** | 0.229 | 0.273 | 3 |
| | | | | 159 | 5795.0 | 100.0% | 14.0 | 13.25 | 0.825 | 0.981 | 0.211 | 0.251 | |

5.8GHz MIMO Antenna (Chain 1)

| Frequency Band | Mode | 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 | |
| 5.2 GHz U-NII 3 | 802.11n 40 MCS0 | 0 | Front | 159 | 5795.0 | 100.0% | 14.0 | 13.62 | 0.094 | 0.103 | 0.035 | 0.038 | |
| | | | Edge 3 | 151 | 5755.0 | 100.0% | 14.0 | 13.46 | 0.457 | 0.518 | 0.111 | 0.126 | |
| | | | | 159 | 5795.0 | 100.0% | 14.0 | 13.62 | 0.541 | 0.590 | 0.130 | 0.142 | |

# 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.

5.2GHz MIMO Antenna (Chain 0)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Reported SAR (W/kg) | | Largest to Smallest SAR Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Original | Repeated | |
| 5GHz | 802.11n 40 MCS0s | 0 | Edge 2 | 46 | 5230 | 100.0% | 0.848 | 0.833 | 1.02 |

5.2GHz MIMO Antenna (Chain 1)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Reported SAR (W/kg) | | Largest to Smallest SAR Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Original | Repeated | |
| 5GHz | 802.11n 40 MCS0s | 0 | Edge 3 | 46 | 5230 | 100.0% | 1.040 | 1.030 | 1.01 |

5.8GHz SISO Antenna (Chain 0)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Reported SAR (W/kg) | | Largest to Smallest SAR Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Original | Repeated | |
| 5GHz | 802.11a 6Mbps | 0 | Edge 2 | 149 | 5745 | 100.0% | 0.980 | 0.952 | 1.03 |

5.8GHz MIMO Antenna (Chain 0)

| Frequency Band | Mode | Dist. (mm) | Test Position | Ch #. | Freq. (MHz) | Duty Cycle | Reported SAR (W/kg) | | Largest to Smallest SAR Ratio |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Original | Repeated | |
| 5GHz | 802.11n 40 MCS0s | 0 | Edge 2 | 149 | 5745 | 100.0% | 0.896 | 0.896 | 1.00 |

**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

## 12.1. Sum of the SAR (MIMO) for Wi-Fi Chain 0 & Wi-Fi Chain 1

| Test Position | Standalone SAR (W/kg) | | ∑ 1-g SAR (W/kg) |
|---|---|---|---|
| | WiFi Chain 0 ① | WiFi Chain 1 ② | WiFi Chain 0 + WiFi Chain 1 ① + ② |
| Front | 0.280 | 0.470 | 0.750 |
| Edge 1 | 0.400 | 0.400 | 0.800 |
| Edge 2 | 1.070 | 0.400 | 1.470 |
| Edge 3 | 0.400 | 1.172 | 1.572 |
| Edge 4 | 0.400 | 0.400 | 0.800 |

**Conclusion:**

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 10-g SAR is < 4 W/kg or the SPLSR is < 0.1 for all circumstances that require SPLSR calculation.

# Appendixes

**Refer to separated files for the following appendixes.**

**4789136426-US-S0-V0 Appendix A: Antenna Dimensions and Separation Distances**

**4789136426-US-S0-V0 Appendix B: SAR System Check Plots**

**4789136426-US-S0-V0 Appendix C: Highest SAR Test Plots**

**4789136426-US-S0-V0 Appendix D: SAR Liquid Tissue Ingredients**

**4789136426-US-S0-V0 Appendix E: SAR Probe and Dipole Calibration Certificates**

**END OF REPORT**