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# SAR EVALUATION REPORT

**Applicant Name:**
Apple Inc.
One Apple Park Way
Cupertino, CA 95014 USA

**Date of Testing:**
07/23/2024 – 08/19/2024
**Test Report Issue Date:**
08/20/2024
**Test Site/Location:**
Element, Morgan Hill, CA, USA
**Document Serial No.:**
1C2405230025-01.BCG-R1

| | |
|---|---|
| **FCC ID:** | **BCG-A3055** |
| **APPLICANT:** | **APPLE, INC.** |

**DUT Type:** Wireless Earbud
**Application Type:** Certification
**FCC Rule Part(s):** CFR §2.1093
**Model:** A3055

| Equipment Class | Band & Mode | Tx Frequency | SAR | |
|---|---|---|---|---|
| | | | 1g Head (W/kg) | 1g Body-Worn (W/kg) |
| DSS/DTS | 2.4 GHz Bluetooth | 2402 - 2480 MHz | 0.13 | 0.73 |
| NII | NB U-NII 1 | 5157 - 5245 MHz | <0.1 | 1.18 |
| NII | NB U-NII 3 | 5731 - 5844 MHz | <0.1 | 1.06 |
| 6VL | NB U-NII 5 | 6108 - 6420 MHz | <0.1 | 0.34 |
| Equipment Class | Band & Mode | Tx Frequency | APD (W/m^2) | APD (W/m^2) |
| 6VL | NB U-NII 5 | 6108 - 6420 MHz | 0.15 | 1.16 |
| Equipment Class | Band & Mode | Tx Frequency | Reported PD (W/m^2) | Reported PD (W/m^2) |
| 6VL | NB U-NII 5 | 6108 - 6420 MHz | 0.32 | 1.49 |

Note: This revised Test Report supersedes and replaces the previously issued test report on the same subject device for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.6 of this report; for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

RJ Ortanez
Executive Vice President

CERT #2041.02

The SAR Tick is an initiative of the Mobile & Wireless Forum (MWF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MWF. Further details can be obtained by emailing: sartick@mwfai.info.

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# 1 DEVICE UNDER TEST

## 1.1 Device Overview

| Band & Mode | Operating Modes | Tx Frequency |
|---|---|---|
| 2.4 GHz Bluetooth | Data | 2402 - 2480 MHz |
| NB U-NII 1 | Data | 5157 - 5245 MHz |
| NB U-NII 3 | Data | 5731 - 5844 MHz |
| NB U-NII 5 | Data | 6108 - 6420 MHz |

## 1.2 Power Reduction for SAR

There is no power reduction used for any band/mode implemented in this device for SAR purposes.

## 1.3 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D04v01.

### 1.3.1 Maximum Output Power

| Mode / Band | Duty Cycle | Modulated Average (dBm) | |
|---|---|---|---|
| 2.4 GHz Bluetooth BDR | 34% | Maximum | **12.50** |
| | | Nominal | **11.50** |
| 2.4 GHz Bluetooth EDR | 77% | Maximum | **9.50** |
| | | Nominal | **8.50** |
| 2.4 GHz Bluetooth HDR4/8 | 77% | Maximum | **9.50** |
| | | Nominal | **8.50** |
| 2.4 GHz Bluetooth HDRp4/8 | 100% | Maximum | **9.50** |
| | | Nominal | **8.50** |
| 2.4 Bluetooth LE1M | 100% | Maximum | **10.50** |
| | | Nominal | **9.50** |
| 2.4 Bluetooth LE2M | 15% | Maximum | **10.50** |
| | | Nominal | **9.50** |

| Mode / Band | Duty Cycle | Modulated Average (dBm) | |
|---|---|---|---|
| NB UNII-1 BDR | 34% | Maximum | **9.00** |
| | | Nominal | **8.00** |
| NB UNII-1 HDR4/8 1-Slot | 34% | Maximum | **9.00** |
| | | Nominal | **8.00** |
| NB UNII-1 HDR4/8 3/5-Slot | 77% | Maximum | **6.00** |
| | | Nominal | **5.00** |
| NB UNII-1 HDRp4/8 | 100% | Maximum | **6.00** |
| | | Nominal | **5.00** |
| NB UNII-1 LE2M | 15% | Maximum | **10.00** |
| | | Nominal | **9.00** |

| Mode / Band | Duty Cycle | Modulated Average (dBm) | |
|---|---|---|---|
| NB UNII-3 BDR | 34% | Maximum | **10.00** |
| | | Nominal | **9.00** |
| NB UNII-3 HDR4/8 1-Slot | 34% | Maximum | **9.50** |
| | | Nominal | **8.50** |
| NB UNII-3 HDR4/8 3/5-Slot | 77% | Maximum | **6.50** |
| | | Nominal | **5.50** |
| NB UNII-3 HDRp4/8 | 100% | Maximum | **6.50** |
| | | Nominal | **5.50** |
| NB UNII-3 LE2M | 15% | Maximum | **11.00** |
| | | Nominal | **10.00** |

| Mode / Band | Duty Cycle | Modulated Average (dBm) | |
|---|---|---|---|
| NB UNII-5 BDR | 34% | Maximum | **-3.00** |
| | | Nominal | **-4.00** |
| NB UNII-5 HDR4 1-Slot | 34% | Maximum | **-0.50** |
| | | Nominal | **-1.50** |
| NB UNII-5 HDR8 1-Slot | 34% | Maximum | **2.00** |
| | | Nominal | **1.00** |
| NB UNII-5 HDR4 3/5-Slot | 77% | Maximum | **-0.50** |
| | | Nominal | **-1.50** |
| NB UNII-5 HDR8 3/5-Slot | 77% | Maximum | **2.00** |
| | | Nominal | **1.00** |
| NB UNII-5 HDRp4 | 100% | Maximum | **-0.50** |
| | | Nominal | **-1.50** |
| NB UNII-5 HDRp8 | 100% | Maximum | **2.00** |
| | | Nominal | **1.00** |
| NB UNII-5 LE2M | 15% | Maximum | **-3.00** |
| | | Nominal | **-4.00** |

## 1.4 DUT Antenna Locations

Based on the expected use conditions, Head SAR was evaluated. Per manufacturer request, Body-Worn SAR was evaluated as an additional conservative SAR test condition. The antenna is located inside BCG-A3055 – which is a wireless Bluetooth earbud for the Right ear. A diagram showing the location of the device antenna can be found in the DUT Antenna Diagram & SAR Test Setup Photographs Appendix. More information about the configurations evaluated for SAR can be found in Section 4.2 and Section 4.3.

## 1.5 Simultaneous Transmission Capabilities

This Device does not support any Simultaneous transmission Scenarios.

## 1.6 Guidance Applied

- FCC KDB Publication 447498 D04v01 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)

## 1.7 Device Serial Numbers

Several samples with identical hardware were used to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics and are within operational tolerances expected for production units. The serial numbers used for each test are indicated alongside the results in Section 9.

# 2 INTRODUCTION

The FCC and Innovation, Science, and Economic Development Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996, and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

## 2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 2-1).

**Equation 2-1**
**SAR Mathematical Equation**

$$\boxed{SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{\rho dv}\right)}$$

**SAR is expressed in units of Watts per Kilogram (W/kg).**

$$SAR = \frac{\sigma \cdot E^2}{\rho}$$

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m$^3$)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

# 3 DOSIMETRIC ASSESSMENT

## 3.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04 and IEEE 1528-2013:

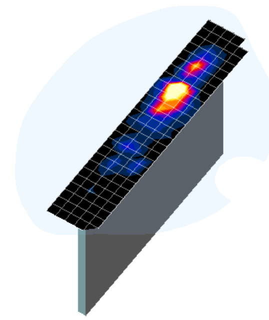


**Figure 3-1**
**Sample SAR Area Scan**

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface, and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01r04 (See Table 3-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01r04 (See Table 3-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the cDASY6 manual online for more details):
    a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 3-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
    b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

**Table 3-1**
**Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01r04***

| Frequency | Maximum Area Scan Resolution (mm) ($\Delta x_{area}$, $\Delta y_{area}$) | Maximum Zoom Scan Resolution (mm) ($\Delta x_{zoom}$, $\Delta y_{zoom}$) | Maximum Zoom Scan Spatial Resolution (mm) | | | Minimum Zoom Scan Volume (mm) (x,y,z) |
|---|---|---|---|---|---|---|
| | | | Uniform Grid | Graded Grid | | |
| | | | $\Delta z_{zoom}(n)$ | $\Delta z_{zoom}(1)$* | $\Delta z_{zoom}(n>1)$* | |
| ≤ 2 GHz | ≤ 15 | ≤ 8 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 2-3 GHz | ≤ 12 | ≤ 5 | ≤ 5 | ≤ 4 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 30 |
| 3-4 GHz | ≤ 12 | ≤ 5 | ≤ 4 | ≤ 3 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 28 |
| 4-5 GHz | ≤ 10 | ≤ 4 | ≤ 3 | ≤ 2.5 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 25 |
| 5-6 GHz | ≤ 10 | ≤ 4 | ≤ 2 | ≤ 2 | ≤ 1.5*$\Delta z_{zoom}(n-1)$ | ≥ 22 |

*Also compliant to IEEE 1528-2013 Table 6

# 4 TEST CONFIGURATION POSITIONS

## 4.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

## 4.2 Positioning for Head

This device is a wireless Bluetooth earbud for the right ear which is designed to be used in the ear canal. The antenna is located inside the earbud. SAR was evaluated with a separation distance of 0 mm between the earbud (the ear tip facing the phantom) and the flat phantom. The phantom is filled with head tissue equivalent medium.

## 4.3 Body-Worn Exposure Conditions

Per manufacturer request, Body-Worn SAR was evaluated as an additional conservative SAR test condition for the right earbud. The DUT was evaluated with a separation distance of 0 mm between the back side of the earbud and the flat phantom. The button side and antenna touching were additionally evaluated. The phantom is filled with head tissue equivalent medium.

# 5 RF EXPOSURE LIMITS

## 5.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## 5.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e., as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 5-1**
**SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6**

| HUMAN EXPOSURE LIMITS | | |
|---|---|---|
| | UNCONTROLLED ENVIRONMENT<br>*General Population*<br>(W/kg) or (mW/g) | CONTROLLED ENVIRONMENT<br>*Occupational*<br>(W/kg) or (mW/g) |
| **Peak Spatial Average SAR**<br>Head | 1.6 | 8.0 |
| **Whole Body SAR** | 0.08 | 0.4 |
| **Peak Spatial Average SAR**<br>Hands, Feet, Ankle, Wrists, etc. | 4.0 | 20 |

1. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
2. The Spatial Average value of the SAR averaged over the whole body.
3. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

## 5.3 RF Exposure Limits for Frequencies Above 6 GHz

Per §1.1310 (d)(3), the MPE limits are applied for frequencies above 6 GHz. Power Density is expressed in units of W/m$^2$ or mW/cm$^2$.

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm$^2$ per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes.

**Table 6-2**
**Human Exposure Limits Specified in FCC 47 CFR §1.1310**

| **Human Exposure to Radiofrequency (RF) Radiation Limits** | | |
|---|---|---|
| **Frequency Range** [MHz] | **Power Density** [mW/cm$^2$] | **Average Time** [Minutes] |
| (A) Limits For Occupational / Controlled Environments | | |
| 1,500 – 100,000 | 5.0 | 6 |
| (B) Limits For General Population / Uncontrolled Environments | | |
| 1,500 – 100,000 | 1.0 | 30 |

Note: 1.0 mW/cm$^2$ is 10 W/m$^2$

# 6 FCC MEASUREMENT PROCEDURES

## 6.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D04v01, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

# 7 RF CONDUCTED POWERS

## 7.1 Bluetooth/NB UNII Conducted Powers

**Table 7-1**
**Bluetooth Average RF Power**

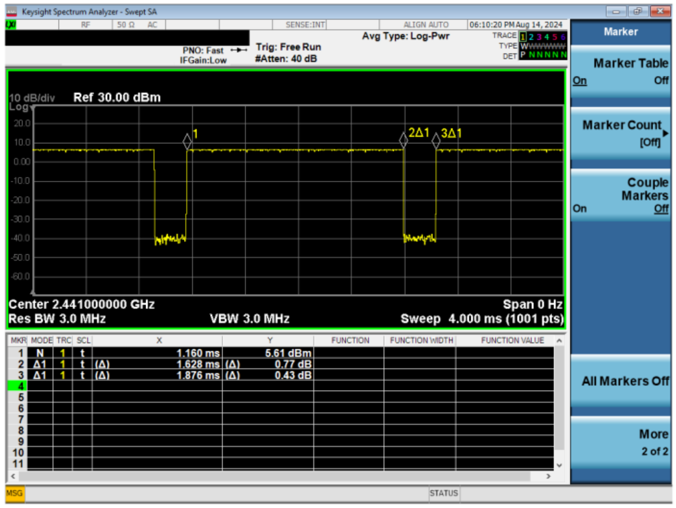
| Frequency [MHz] | Modulation | Data Rate [Mbps] | Channel No. | Avg Conducted Power | |
|---|---|---|---|---|---|
| | | | | [dBm] | [mW] |
| 2402 | LE1M | 1.0 | 0 | 9.81 | 9.572 |
| 2441 | LE1M | 1.0 | 39 | 9.70 | 9.333 |
| 2480 | LE1M | 1.0 | 78 | 9.75 | 9.441 |

**Table 7-2**
**NB UNII Average RF Power**

| Type | Band | Frequency | Channel | Average |
|---|---|---|---|---|
| HDRp4 | U-NII 1 | 5157 | Low | 5.68 |
| | | 5201 | Mid | 5.62 |
| | | 5245 | High | 5.32 |
| HDRp4 | U-NII 3 | 5731 | Low | 5.04 |
| | | 5788 | Mid | 5.00 |
| | | 5844 | High | 5.02 |
| HDRp8 | U-NII 5 | 6108 | Low | 1.42 |
| | | 6185 | Low-Mid | 1.58 |
| | | 6264 | Mid | 1.51 |
| | | 6342 | Mid-High | 1.66 |
| | | 6420 | High | 1.86 |

## 7.2 Bluetooth/NB UNII Duty Cycle Plots

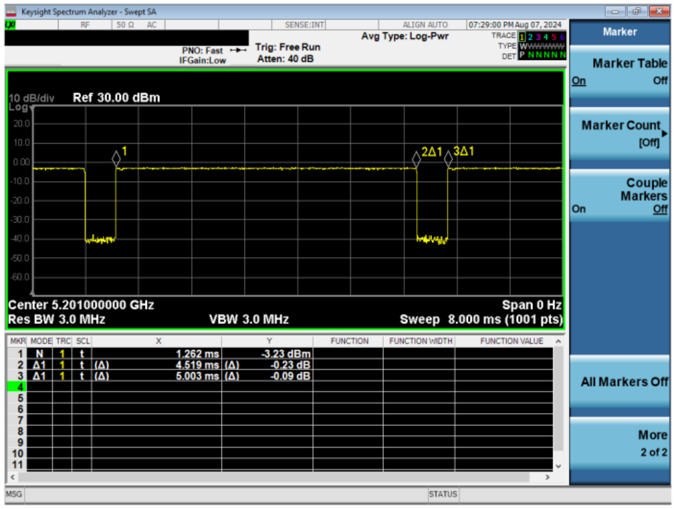
**Figure 7-1**
**2.4 GHz Bluetooth Transmission Plot**




**Equation 7-1**
**2.4 GHz Bluetooth Duty Cycle Calculation**

$$\boldsymbol{Duty\ Cycle} = \frac{\boldsymbol{Pulse\ Width}}{\boldsymbol{Period}} * \mathbf{100\%} = \frac{\mathbf{1.628}\ \boldsymbol{ms}}{\mathbf{1.876}\ \boldsymbol{ms}} * \mathbf{100\%} = \mathbf{86.78\%}$$

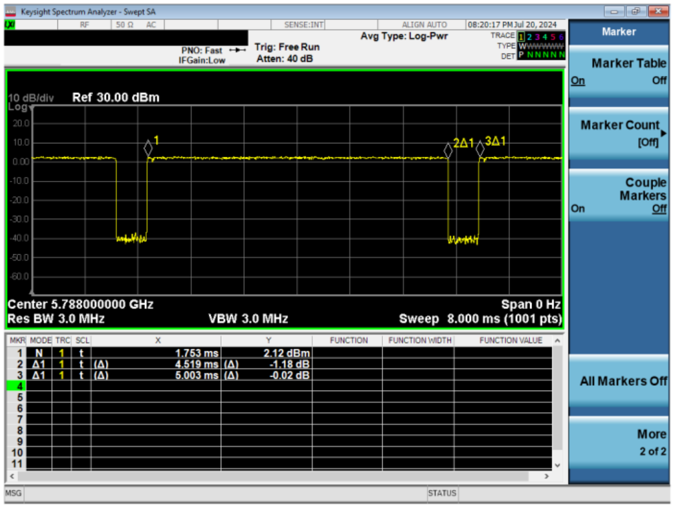
## Figure 7-2
## NB UNII-1 Transmission Plot




## Equation 7-2
## NB UNII-1 Duty Cycle Calculation

$$\textbf{\textit{Duty Cycle}} = \frac{\textbf{\textit{Pulse Width}}}{\textbf{\textit{Period}}} * 100\% = \frac{\mathbf{4.519}\ \textbf{\textit{ms}}}{\mathbf{5.003}\ \textbf{\textit{ms}}} * 100\% = \mathbf{90.33}\%$$

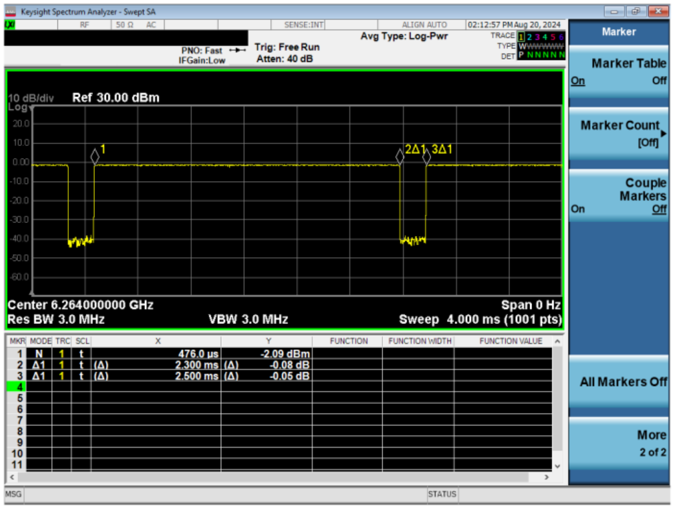
## Figure 7-3
## NB UNII-3 Transmission Plot




## Equation 7-3
## NB UNII-3 Duty Cycle Calculation

$$\boldsymbol{Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{4.519\ ms}{5.003\ ms} * 100\% = 90.33\%}$$

**Figure 7-4**
**NB UNII-5 Transmission Plot**




**Equation 7-4**
**NB UNII-5 Duty Cycle Calculation**

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.300\ ms}{2.500\ ms} * 100\% = 92.00\%$$

## 7.3 Notes for Bluetooth/NB UNII

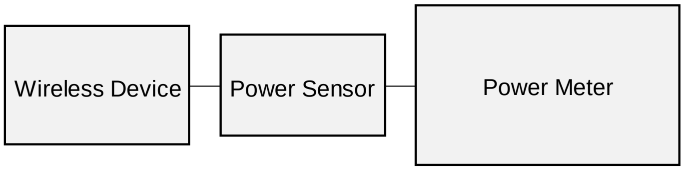



**Figure 7-5**
**Power Measurement Setup**

# 8 SYSTEM VERIFICATION

## 8.1 Tissue Verification

**Table 8-1**
**Measured Head Tissue Properties**

| Calibrated for Tests Performed on: | Tissue Type | Tissue Temp During Calibration (˚C) | Measured Frequency (MHz) | Measured Conductivity, σ (S/m) | Measured Dielectric Constant, ε | TARGET Conductivity, σ (S/m) | TARGET Dielectric Constant, ε | % dev σ | % dev ε |
|---|---|---|---|---|---|---|---|---|---|
| 08/15/2024 | 2450 Head | 23.7 | 2300 | 1.653 | 38.617 | 1.670 | 39.500 | -1.02% | -2.24% |
| | | | 2310 | 1.663 | 38.575 | 1.679 | 39.480 | -0.95% | -2.29% |
| | | | 2320 | 1.673 | 38.531 | 1.687 | 39.460 | -0.83% | -2.35% |
| | | | 2400 | 1.763 | 38.216 | 1.756 | 39.289 | 0.40% | -2.73% |
| | | | 2450 | 1.817 | 38.012 | 1.800 | 39.200 | 0.94% | -3.03% |
| | | | 2480 | 1.852 | 37.897 | 1.833 | 39.162 | 1.04% | -3.23% |
| | | | 2500 | 1.873 | 37.823 | 1.855 | 39.136 | 0.97% | -3.35% |
| | | | 2510 | 1.882 | 37.785 | 1.866 | 39.123 | 0.86% | -3.42% |
| | | | 2535 | 1.909 | 37.676 | 1.893 | 39.092 | 0.85% | -3.62% |
| | | | 2550 | 1.928 | 37.609 | 1.909 | 39.073 | 1.00% | -3.75% |
| | | | 2560 | 1.941 | 37.569 | 1.920 | 39.060 | 1.09% | -3.82% |
| | | | 2600 | 1.984 | 37.425 | 1.964 | 39.009 | 1.02% | -4.06% |
| | | | 2650 | 2.042 | 37.214 | 2.018 | 38.945 | 1.19% | -4.44% |
| | | | 2680 | 2.077 | 37.103 | 2.051 | 38.907 | 1.27% | -4.64% |
| | | | 2700 | 2.096 | 37.033 | 2.073 | 38.882 | 1.11% | -4.76% |
| 08/19/2024 | 2450 Head | 23.8 | 2300 | 1.692 | 39.381 | 1.670 | 39.500 | 1.32% | -0.30% |
| | | | 2310 | 1.704 | 39.339 | 1.679 | 39.480 | 1.49% | -0.36% |
| | | | 2320 | 1.715 | 39.299 | 1.687 | 39.460 | 1.66% | -0.41% |
| | | | 2400 | 1.804 | 38.983 | 1.756 | 39.289 | 2.73% | -0.78% |
| | | | 2450 | 1.864 | 38.812 | 1.800 | 39.200 | 3.56% | -0.99% |
| | | | 2480 | 1.897 | 38.686 | 1.833 | 39.162 | 3.49% | -1.22% |
| | | | 2500 | 1.919 | 38.600 | 1.855 | 39.136 | 3.45% | -1.37% |
| | | | 2510 | 1.931 | 38.563 | 1.866 | 39.123 | 3.48% | -1.43% |
| | | | 2535 | 1.962 | 38.473 | 1.893 | 39.092 | 3.65% | -1.58% |
| | | | 2550 | 1.980 | 38.416 | 1.909 | 39.073 | 3.72% | -1.68% |
| | | | 2560 | 1.991 | 38.376 | 1.920 | 39.060 | 3.70% | -1.75% |
| | | | 2600 | 2.038 | 38.202 | 1.964 | 39.009 | 3.77% | -2.07% |
| | | | 2650 | 2.102 | 38.011 | 2.018 | 38.945 | 4.16% | -2.40% |
| | | | 2680 | 2.135 | 37.874 | 2.051 | 38.907 | 4.10% | -2.66% |
| | | | 2700 | 2.157 | 37.795 | 2.073 | 38.882 | 4.05% | -2.80% |
| 07/23/2024 | 5200-5800 Head | 21.0 | 5150 | 4.383 | 34.616 | 4.604 | 36.043 | -4.80% | -3.96% |
| | | | 5160 | 4.393 | 34.591 | 4.614 | 36.031 | -4.79% | -4.00% |
| | | | 5170 | 4.405 | 34.566 | 4.624 | 36.020 | -4.74% | -4.04% |
| | | | 5180 | 4.417 | 34.545 | 4.635 | 36.009 | -4.70% | -4.07% |
| | | | 5190 | 4.429 | 34.530 | 4.645 | 35.998 | -4.65% | -4.08% |
| | | | 5200 | 4.441 | 34.522 | 4.655 | 35.986 | -4.60% | -4.07% |
| | | | 5210 | 4.452 | 34.512 | 4.666 | 35.975 | -4.59% | -4.07% |
| | | | 5220 | 4.462 | 34.502 | 4.676 | 35.963 | -4.58% | -4.06% |
| | | | 5240 | 4.476 | 34.472 | 4.696 | 35.940 | -4.68% | -4.08% |
| | | | 5250 | 4.484 | 34.454 | 4.706 | 35.929 | -4.72% | -4.11% |
| | | | 5260 | 4.493 | 34.435 | 4.717 | 35.917 | -4.75% | -4.13% |
| | | | 5270 | 4.502 | 34.416 | 4.727 | 35.906 | -4.76% | -4.15% |
| | | | 5280 | 4.512 | 34.397 | 4.737 | 35.894 | -4.75% | -4.17% |
| | | | 5290 | 4.523 | 34.378 | 4.748 | 35.883 | -4.74% | -4.19% |
| | | | 5300 | 4.534 | 34.361 | 4.758 | 35.871 | -4.71% | -4.21% |
| | | | 5310 | 4.547 | 34.350 | 4.768 | 35.860 | -4.64% | -4.21% |
| | | | 5320 | 4.560 | 34.340 | 4.778 | 35.849 | -4.56% | -4.21% |
| | | | 5500 | 4.742 | 34.051 | 4.963 | 35.643 | -4.45% | -4.47% |
| | | | 5510 | 4.754 | 34.040 | 4.973 | 35.632 | -4.40% | -4.47% |
| | | | 5520 | 4.766 | 34.028 | 4.983 | 35.620 | -4.35% | -4.47% |
| | | | 5530 | 4.778 | 34.014 | 4.994 | 35.609 | -4.33% | -4.48% |
| | | | 5540 | 4.791 | 33.999 | 5.004 | 35.597 | -4.26% | -4.49% |
| | | | 5550 | 4.802 | 33.982 | 5.014 | 35.586 | -4.23% | -4.51% |
| | | | 5560 | 4.813 | 33.961 | 5.024 | 35.574 | -4.20% | -4.53% |
| | | | 5580 | 4.838 | 33.926 | 5.045 | 35.551 | -4.10% | -4.57% |
| | | | 5600 | 4.860 | 33.908 | 5.065 | 35.529 | -4.05% | -4.56% |
| | | | 5610 | 4.870 | 33.898 | 5.076 | 35.518 | -4.06% | -4.56% |
| | | | 5620 | 4.879 | 33.886 | 5.086 | 35.506 | -4.07% | -4.56% |
| | | | 5640 | 4.899 | 33.855 | 5.106 | 35.483 | -4.05% | -4.59% |
| | | | 5660 | 4.920 | 33.823 | 5.127 | 35.460 | -4.04% | -4.62% |
| | | | 5670 | 4.931 | 33.804 | 5.137 | 35.449 | -4.01% | -4.64% |
| | | | 5680 | 4.941 | 33.784 | 5.147 | 35.437 | -4.00% | -4.66% |
| | | | 5690 | 4.951 | 33.764 | 5.158 | 35.426 | -4.01% | -4.69% |
| | | | 5700 | 4.963 | 33.746 | 5.168 | 35.414 | -3.97% | -4.71% |
| | | | 5710 | 4.974 | 33.739 | 5.178 | 35.403 | -3.94% | -4.70% |
| | | | 5720 | 4.983 | 33.733 | 5.188 | 35.391 | -3.95% | -4.68% |
| | | | 5745 | 5.002 | 33.714 | 5.214 | 35.363 | -4.07% | -4.66% |
| | | | 5750 | 5.006 | 33.705 | 5.219 | 35.357 | -4.08% | -4.67% |
| | | | 5755 | 5.010 | 33.695 | 5.224 | 35.351 | -4.10% | -4.68% |
| | | | 5765 | 5.019 | 33.671 | 5.234 | 35.340 | -4.11% | -4.72% |
| | | | 5775 | 5.031 | 33.648 | 5.245 | 35.329 | -4.08% | -4.76% |
| | | | 5785 | 5.044 | 33.626 | 5.255 | 35.317 | -4.02% | -4.79% |
| | | | 5795 | 5.056 | 33.605 | 5.265 | 35.305 | -3.97% | -4.82% |
| | | | 5800 | 5.062 | 33.597 | 5.270 | 35.300 | -3.95% | -4.82% |
| | | | 5805 | 5.067 | 33.590 | 5.275 | 35.294 | -3.94% | -4.83% |
| | | | 5825 | 5.088 | 33.566 | 5.296 | 35.271 | -3.93% | -4.83% |
| | | | 5835 | 5.098 | 33.559 | 5.305 | 35.230 | -3.90% | -4.74% |
| | | | 5845 | 5.107 | 33.551 | 5.315 | 35.210 | -3.91% | -4.71% |
| | | | 5850 | 5.111 | 33.548 | 5.320 | 35.200 | -3.93% | -4.69% |
| | | | 5855 | 5.114 | 33.542 | 5.325 | 35.197 | -3.96% | -4.70% |
| | | | 5865 | 5.120 | 33.524 | 5.336 | 35.190 | -4.05% | -4.73% |
| | | | 5875 | 5.127 | 33.504 | 5.347 | 35.183 | -4.11% | -4.77% |
| | | | 5885 | 5.136 | 33.480 | 5.357 | 35.177 | -4.13% | -4.82% |
| | | | 5905 | 5.159 | 33.431 | 5.379 | 35.163 | -4.09% | -4.93% |
| | | | 5935 | 5.230 | 35.905 | 5.411 | 35.143 | -3.35% | 2.17% |

| Calibrated for Tests Performed on: | Tissue Type | Tissue Temp During Calibration (˚C) | Measured Frequency (MHz) | Measured Conductivity, σ (S/m) | Measured Dielectric Constant, ε | TARGET Conductivity, σ (S/m) | TARGET Dielectric Constant, ε | % dev σ | % dev ε |
|---|---|---|---|---|---|---|---|---|---|
| 08/14/2024 | 6500 Head | 20.0 | 5935 | 5.230 | 35.905 | 5.411 | 35.143 | -3.35% | 2.17% |
| | | | 5970 | 5.271 | 35.856 | 5.448 | 35.120 | -3.25% | 2.10% |
| | | | 5985 | 5.290 | 35.818 | 5.464 | 35.110 | -3.18% | 2.02% |
| | | | 6000 | 5.306 | 35.786 | 5.480 | 35.100 | -3.18% | 1.95% |
| | | | 6025 | 5.331 | 35.751 | 5.510 | 35.070 | -3.25% | 1.94% |
| | | | 6065 | 5.378 | 35.693 | 5.557 | 35.022 | -3.22% | 1.92% |
| | | | 6075 | 5.392 | 35.677 | 5.569 | 35.010 | -3.18% | 1.91% |
| | | | 6085 | 5.404 | 35.656 | 5.580 | 34.998 | -3.15% | 1.88% |
| | | | 6275 | 5.651 | 35.294 | 5.805 | 34.770 | -2.65% | 1.51% |
| | | | 6285 | 5.664 | 35.270 | 5.816 | 34.758 | -2.61% | 1.47% |
| | | | 6305 | 5.681 | 35.224 | 5.840 | 34.734 | -2.72% | 1.41% |
| | | | 6345 | 5.733 | 35.168 | 5.887 | 34.686 | -2.62% | 1.39% |
| | | | 6475 | 5.881 | 34.969 | 6.041 | 34.530 | -2.65% | 1.27% |
| | | | 6485 | 5.891 | 34.961 | 6.052 | 34.518 | -2.66% | 1.28% |
| | | | 6500 | 5.908 | 34.932 | 6.070 | 34.500 | -2.67% | 1.25% |
| | | | 6505 | 5.913 | 34.917 | 6.076 | 34.494 | -2.68% | 1.23% |
| | | | 6545 | 5.967 | 34.856 | 6.122 | 34.446 | -2.53% | 1.19% |
| | | | 6675 | 6.127 | 34.646 | 6.273 | 34.290 | -2.33% | 1.04% |
| | | | 6685 | 6.141 | 34.617 | 6.285 | 34.278 | -2.29% | 0.99% |
| | | | 6715 | 6.180 | 34.532 | 6.319 | 34.242 | -2.20% | 0.85% |
| | | | 6785 | 6.257 | 34.399 | 6.400 | 34.158 | -2.23% | 0.71% |
| | | | 6825 | 6.315 | 34.350 | 6.447 | 34.110 | -2.05% | 0.70% |
| | | | 6985 | 6.491 | 34.093 | 6.633 | 33.918 | -2.14% | 0.52% |
| | | | 6995 | 6.503 | 34.067 | 6.644 | 33.906 | -2.12% | 0.47% |
| | | | 7000 | 6.510 | 34.054 | 6.650 | 33.900 | -2.11% | 0.45% |
| | | | 7005 | 6.518 | 34.044 | 6.656 | 33.894 | -2.07% | 0.44% |

The above measured tissue parameters were used in the cDASY6 software. The cDASY6 software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 D01v01r04 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

Per April 2019 TCG Workshop Notes, single head-tissue simulating liquid specified in IEC 62209-1 is permitted to use for all SAR tests.

## 8.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in the SAR System Validation Appendix.

**Table 8-2**
**System Verification Results – 1g**

| System Verification TARGET & MEASURED | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SAR System | Tissue Frequency (MHz) | Tissue Type | Date | Amb. Temp. (C) | Liquid Temp. (C) | Input Power (W) | Source SN | Probe SN | DAE | Measured SAR 1g (W/kg) | 1W Target SAR 1g (W/kg) | 1W Normalized SAR 1g (W/kg) | Deviation 1g (%) | Measured SAR 10g (W/kg) | 1W Target SAR 10g (W/kg) | 1W Normalized SAR 10g (W/kg) | Deviation 10g (%) | Measured 4cm$^2$ APD (W/m$^2$) | 1W Target 4cm$^2$ APD (W/m$^2$) | 1W Normalized 4cm$^2$ APD (W/m$^2$) | Deviation 4cm$^2$ APD (%) |
| AM6 | 2450 | HEAD | 08/15/2024 | 22.5 | 22.6 | 0.10 | 750 | 7499 | 1644 | 5.290 | 52.600 | 52.900 | 0.57% | 2.340 | 24.500 | 23.400 | -4.49% | | | | |
| AM6 | 2450 | HEAD | 08/19/2024 | 20.1 | 24.0 | 0.10 | 750 | 7499 | 1644 | 5.060 | 52.600 | 50.600 | -3.80% | 2.280 | 24.500 | 22.800 | -6.94% | | | | |
| AM8 | 5250 | HEAD | 07/23/2024 | 23.2 | 21.0 | 0.05 | 1163 | 7427 | 467 | 3.910 | 79.600 | 78.200 | -1.76% | 1.120 | 22.600 | 22.400 | -0.88% | | | | |
| AM8 | 5600 | HEAD | 07/23/2024 | 23.2 | 21.0 | 0.05 | 1163 | 7427 | 467 | 4.180 | 82.800 | 83.600 | 0.97% | 1.180 | 23.400 | 23.600 | 0.85% | | | | |
| AM8 | 5750 | HEAD | 07/23/2024 | 23.2 | 21.0 | 0.05 | 1163 | 7427 | 467 | 3.820 | 81.100 | 76.400 | -5.80% | 1.090 | 23.000 | 21.800 | -5.22% | | | | |
| AM8 | 5850 | HEAD | 07/23/2024 | 23.2 | 21.0 | 0.05 | 1163 | 7427 | 467 | 4.030 | 79.000 | 80.600 | 2.03% | 1.130 | 22.200 | 22.600 | 1.80% | | | | |
| AM2 | 6500 | HEAD | 08/14/2024 | 21.2 | 20.3 | 0.025 | 1019 | 7420 | 1333 | 7.320 | 293.000 | 292.800 | -0.07% | 1.340 | 54.100 | 53.600 | -0.92% | 32.8 | 1320 | 1312 | -0.61% |

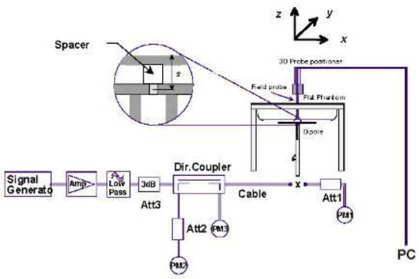



**Figure 8-1**
**System Verification Setup Diagram**

**Figure 8-2**
**System Verification Setup Photo**

## 8.3 Power Density Test System Verification

The system was verified to be within ±0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user's manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG's mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check.

The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

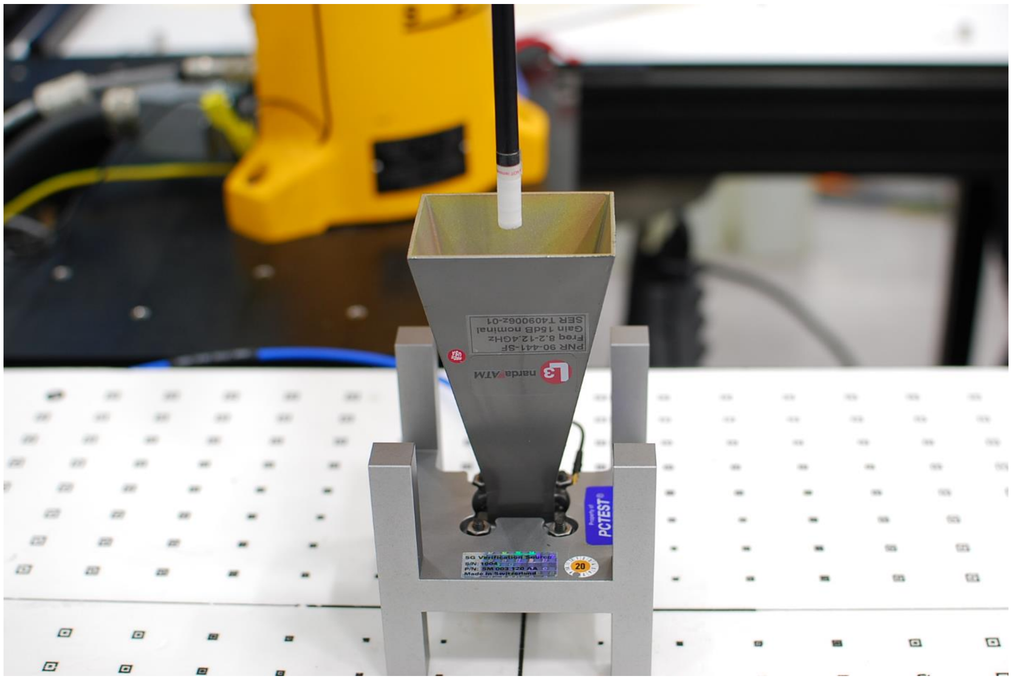



**Figure 8-3**
**System Verification Setup Photo**

**Table 8-3**
**10 GHz Verification Results**

| System Verification | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| System | Frequency (GHz) | Date | Source S/N | Probe S/N | Prad (mW) | Normal psPD (W/m² over 4 cm²) | | Deviation (dB) | Total psPD (W/m² over 4 cm²) | | Deviation (dB) |
| | | | | | | Measured | Target | | Measured | Target | |
| AM5 | 10 | 08/09/2024 | 1006 | 9487 | 93.3 | 50.80 | 58.50 | -0.61 | 51.00 | 58.90 | -0.63 |

Note: A **10 mm distance spacing** was used from the reference horn antenna aperture to the probe element.

# 9 SAR DATA SUMMARY

## 9.1 2.4 GHz Bluetooth SISO Standalone Head SAR

**Table 9-1**

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | 0.01 | 2402 | 0 | 1 | 10.50 | 9.81 | Front | 0 | 0.081 | 1.172 | 1.152 | 0.109 | |
| Head | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.01 | 2441 | 39 | 1 | 10.50 | 9.70 | Front | 0 | 0.096 | 1.202 | 1.152 | 0.133 | A1 |
| Head | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.06 | 2480 | 78 | 1 | 10.50 | 9.75 | Front | 0 | 0.083 | 1.189 | 1.152 | 0.114 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.2 5 GHz NB U-NII 1 Standalone Head SAR

**Table 9-2**

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | 0.08 | 5245 | High | 4 | 6.00 | 5.32 | Front | 0 | 0.027 | 1.169 | 1.107 | 0.035 | |
| Head | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.16 | 5157 | Low | 4 | 6.00 | 5.68 | Front | 0 | 0.034 | 1.076 | 1.107 | 0.041 | A2 |
| Head | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | 0.15 | 5201 | Mid | 4 | 6.00 | 5.62 | Front | 0 | 0.029 | 1.091 | 1.107 | 0.035 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.3 5 GHz NB U-NII 3 Standalone Head SAR

**Table 9-3**

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | 0.05 | 5844 | High | 4 | 6.50 | 5.02 | Front | 0 | 0.020 | 1.406 | 1.107 | 0.031 | |
| Head | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | 0.05 | 5731 | Low | 4 | 6.50 | 5.04 | Front | 0 | 0.009 | 1.400 | 1.107 | 0.014 | |
| Head | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | 0.04 | 5788 | Mid | 4 | 6.50 | 5.00 | Front | 0 | 0.015 | 1.413 | 1.107 | 0.023 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.4 6 GHz NB U-NII 5 Standalone Head SAR

**Table 9-4**

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.02 | 6420 | High | 8 | 2.00 | 1.86 | Front | 0 | 0.023 | 1.033 | 1.087 | 0.026 | A3 |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.01 | 6108 | Low | 8 | 2.00 | 1.42 | Front | 0 | 0.008 | 1.143 | 1.087 | 0.010 | |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.04 | 6186 | Low-Mid | 8 | 2.00 | 1.58 | Front | 0 | 0.009 | 1.102 | 1.087 | 0.011 | |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.05 | 6264 | Mid | 8 | 2.00 | 1.51 | Front | 0 | 0.019 | 1.119 | 1.087 | 0.023 | |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.19 | 6342 | Mid-High | 8 | 2.00 | 1.66 | Front | 0 | 0.018 | 1.081 | 1.087 | 0.021 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Head<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

| Exposure | Band/ Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured APD [W/m² (4cm²)] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported APD [W/m² (4cm²)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.02 | 6420 | High | 8 | 2.00 | 1.86 | Front | 0 | 0.131 | 1.033 | 1.087 | 0.147 |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.01 | 6108 | Low | 8 | 2.00 | 1.42 | Front | 0 | 0.053 | 1.143 | 1.087 | 0.066 |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.04 | 6186 | Low-Mid | 8 | 2.00 | 1.58 | Front | 0 | 0.061 | 1.102 | 1.087 | 0.073 |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.05 | 6264 | Mid | 8 | 2.00 | 1.51 | Front | 0 | 0.094 | 1.119 | 1.087 | 0.114 |
| Head | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.19 | 6342 | Mid-High | 8 | 2.00 | 1.66 | Front | 0 | 0.090 | 1.081 | 1.087 | 0.106 |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.5 2.4 GHz Bluetooth SISO Standalone Body-Worn SAR

### Table 9-5

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Body-worn | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | 0.05 | 2402 | 0 | 1 | 10.50 | 9.81 | Back | 0 | 0.415 | 1.172 | 1.152 | 0.560 | |
| Body-worn | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.06 | 2402 | 0 | 1 | 10.50 | 9.81 | Antenna Touching | 0 | 0.539 | 1.172 | 1.152 | 0.728 | A4 |
| Body-worn | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.01 | 2402 | 0 | 1 | 10.50 | 9.81 | Button | 0 | 0.445 | 1.172 | 1.152 | 0.601 | |
| Body-worn | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.09 | 2441 | 39 | 1 | 10.50 | 9.70 | Antenna Touching | 0 | 0.499 | 1.202 | 1.152 | 0.691 | |
| Body-worn | 2.4 GHz Bluetooth | Right | H5RH730027X0000B2Z | 86.78 | -0.12 | 2480 | 78 | 1 | 10.50 | 9.75 | Antenna Touching | 0 | 0.449 | 1.189 | 1.152 | 0.615 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.6 5 GHz NB U-NII 1 Standalone Body-Worn SAR

### Table 9-6

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.10 | 5245 | High | 4 | 6.00 | 5.32 | Back | 0 | 0.914 | 1.169 | 1.107 | 1.183 | |
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.09 | 5157 | Low | 4 | 6.00 | 5.68 | Back | 0 | 0.910 | 1.076 | 1.107 | 1.084 | |
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.01 | 5201 | Mid | 4 | 6.00 | 5.62 | Back | 0 | 0.973 | 1.091 | 1.107 | 1.175 | A5 |
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.03 | 5201 | Mid | 4 | 6.00 | 5.62 | Back | 0 | 0.916 | 1.091 | 1.107 | 1.106 | |
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | 0.03 | 5157 | Low | 4 | 6.00 | 5.68 | Button | 0 | 0.667 | 1.076 | 1.107 | 0.795 | |
| Body-worn | NB U-NII 1 | Right | H5RH730027X0000B2Z | 90.33 | -0.06 | 5157 | Low | 4 | 6.00 | 5.68 | Antenna Touching | 0 | 0.617 | 1.076 | 1.107 | 0.735 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: Blue entry represents variability measurement

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.7 5 GHz NB U-NII 3 Standalone Body-Worn SAR

### Table 9-7

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Body-worn | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | -0.03 | 5844 | High | 4 | 6.50 | 5.02 | Back | 0 | 0.680 | 1.406 | 1.107 | 1.058 | |
| Body-worn | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | -0.14 | 5731 | Low | 4 | 6.50 | 5.04 | Back | 0 | 0.474 | 1.400 | 1.107 | 0.735 | |
| Body-worn | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | -0.03 | 5788 | Mid | 4 | 6.50 | 5.00 | Back | 0 | 0.596 | 1.413 | 1.107 | 0.932 | |
| Body-worn | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | -0.12 | 5731 | Low | 4 | 6.50 | 5.04 | Antenna Touching | 0 | 0.281 | 1.400 | 1.107 | 0.436 | |
| Body-worn | NB U-NII 3 | Right | H5RH730027X0000B2Z | 90.33 | 0.04 | 5731 | Low | 4 | 6.50 | 5.04 | Button | 0 | 0.294 | 1.400 | 1.107 | 0.456 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.8 6 GHz NB U-NII 5 Standalone Body-Worn SAR

### Table 9-8

| Exposure | Band / Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured 1g SAR [W/kg] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported 1g SAR [W/kg] | Plot # |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.03 | 6420 | High | 8 | 2.00 | 1.86 | Back | 0 | 0.296 | 1.033 | 1.087 | 0.332 | A6 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.06 | 6108 | Low | 8 | 2.00 | 1.42 | Back | 0 | 0.276 | 1.143 | 1.087 | 0.343 | |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.05 | 6186 | Low-Mid | 8 | 2.00 | 1.58 | Back | 0 | 0.272 | 1.102 | 1.087 | 0.326 | |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.03 | 6264 | Mid | 8 | 2.00 | 1.51 | Back | 0 | 0.235 | 1.119 | 1.087 | 0.286 | |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.06 | 6342 | Mid-High | 8 | 2.00 | 1.66 | Back | 0 | 0.271 | 1.081 | 1.087 | 0.318 | |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.11 | 6420 | High | 8 | 2.00 | 1.86 | Antenna Touching | 0 | 0.201 | 1.033 | 1.087 | 0.226 | |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.02 | 6420 | High | 8 | 2.00 | 1.86 | Button | 0 | 0.109 | 1.033 | 1.087 | 0.122 | |
| ANSI/IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | |

| Exposure | Band/ Mode | Earbud | Serial Number | Duty Cycle [%] | Power Drift [dB] | Frequency [MHz] | Channel # | Data Rate [Mbps] | Max Allowed Power [dBm] | Conducted Power [dBm] | Test Position | Spacing [mm] | Measured APD [W/m² (4cm²)] | Power Scaling Factor | Duty Cycle Scaling Factor | Reported APD [W/m² (4cm²)] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | 0.03 | 6420 | High | 8 | 2.00 | 1.86 | Back | 0 | 0.961 | 1.033 | 1.087 | 1.079 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.06 | 6108 | Low | 8 | 2.00 | 1.42 | Back | 0 | 0.933 | 1.143 | 1.087 | 1.159 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.05 | 6186 | Low-Mid | 8 | 2.00 | 1.58 | Back | 0 | 0.864 | 1.102 | 1.087 | 1.035 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.03 | 6264 | Mid | 8 | 2.00 | 1.51 | Back | 0 | 0.742 | 1.119 | 1.087 | 0.903 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.06 | 6342 | Mid-High | 8 | 2.00 | 1.66 | Back | 0 | 0.818 | 1.081 | 1.087 | 0.961 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.11 | 6420 | High | 8 | 2.00 | 1.86 | Antenna Touching | 0 | 0.683 | 1.033 | 1.087 | 0.767 |
| Body-worn | NB U-NII 5 | Right | H5RH730027X0000B2Z | 92.00 | -0.02 | 6420 | High | 8 | 2.00 | 1.86 | Button | 0 | 0.519 | 1.033 | 1.087 | 0.583 |

Note: The reported SAR was scaled to 100% transmission duty factor.

## 9.9 SAR Test Notes

General Notes:

1. Batteries are fully charged at the beginning of the SAR measurements.
2. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics and are within operational tolerances expected for production units.
4. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D04v01.
5. To demonstrate compliance for Head, SAR testing was performed on a flat phantom filled with head tissue equivalent medium.
6. Per manufacturer request, Body-Worn SAR was additionally evaluated as a conservative SAR test condition for the right earbud (BCG-A3055).
7. Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg and 2.0 W/kg for 10g SAR. Please see Section 10 for variability analysis.
8. The orange highlights throughout the report represents the highest scaled SAR per Equipment Class.

Bluetooth/NB UNII Notes

1. Bluetooth/NB UNII SAR was evaluated with a test mode with hopping disabled with DH5 operation. The reported SAR was scaled to the 100% transmission duty factor to determine compliance for a more conservative exposure analysis. See section 7.2 for the time domain plot and calculation for the duty factor of the device.

## 9.10 Power Density Data

| MEASUREMENT RESULTS | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | Mode | Maximum Allowed Power [dBm] | Conducted Power [dBm] | Power Drift (dB) | Spacing (mm) | Ant. | DUT Serial Number | Data Rate (Mbps) | Side | Duty Cycle (%) | Grid Step (λ) | iPD (W/m²) | Scaling Factor for Measurement Uncertainty per IEC 62479 | Scaling Factor (Power) | Scaling Factor (Duty Cycle) | Normal psPD (W/m²) | Scaled Normal psPD (W/m²) | Total psPD (W/m²) | Scaled Total psPD (W/m²) | Plot # |
| 6420 | High | NB U-NII 5 | 2.00 | 1.86 | -0.06 | 2 | Right | 00B31 | 8 | Front | 92.00 | 0.25 | 0.724 | 1.554 | 1.033 | 1.087 | 0.159 | 0.277 | 0.182 | 0.318 | |
| 6420 | High | NB U-NII 5 | 2.00 | 1.86 | 0.00 | 2 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 1.910 | 1.554 | 1.033 | 1.087 | 0.335 | 0.585 | 0.407 | 0.710 | |
| 6420 | High | NB U-NII 5 | 2.00 | 1.86 | -0.05 | 2 | Right | 00B31 | 8 | Antenna Touching | 92.00 | 0.25 | 1.680 | 1.554 | 1.033 | 1.087 | 0.338 | 0.590 | 0.354 | 0.618 | |
| 6420 | High | NB U-NII 5 | 2.00 | 1.86 | -0.12 | 2 | Right | 00B31 | 8 | Button | 92.00 | 0.25 | 1.710 | 1.554 | 1.033 | 1.087 | 0.362 | 0.632 | 0.373 | 0.651 | |
| 6108 | Low | NB U-NII 5 | 2.00 | 1.42 | -0.16 | 2 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 0.903 | 1.554 | 1.143 | 1.087 | 0.377 | 0.728 | 0.433 | 0.836 | |
| 6186 | Low-Mid | NB U-NII 5 | 2.00 | 1.58 | 0.04 | 2 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 4.830 | 1.554 | 1.102 | 1.087 | 0.772 | 1.437 | 0.801 | 1.491 | A7 |
| 6264 | Mid | NB U-NII 5 | 2.00 | 1.51 | -0.18 | 2 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 0.516 | 1.554 | 1.119 | 1.087 | 0.140 | 0.265 | 0.192 | 0.363 | |
| 6342 | Mid-High | NB U-NII 5 | 2.00 | 1.66 | -0.02 | 2 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 1.780 | 1.554 | 1.081 | 1.087 | 0.565 | 1.032 | 0.593 | 1.083 | |
| 6185 | Low-Mid | NB U-NII 5 | 2.00 | 1.58 | -0.02 | 9.69 | Right | 00B31 | 8 | Back | 92.00 | 0.25 | 0.824 | 1.554 | 1.102 | 1.087 | 0.223 | 0.415 | 0.178 | 0.331 | |

## 9.11 Power Density Notes

1. The manufacturer has confirmed that the devices tested have the same physical, mechanical, and thermal characteristics and are within operational tolerances expected for production units.
2. Batteries are fully charged at the beginning of the measurements. The DUT was connected to a wall charger for some measurements due to the test duration. It was confirmed that the charger plugged into this DUT did not impact the near-field PD test results.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by λ/4.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
5. Per FCC guidance and equipment manufacturer guidance, power density results were scaled according to IEC 62479:2010 for the portion of the measurement uncertainty > 30%. Total expanded uncertainty of 2.68 dB (85.4%) was used to determine the psPD measurement scaling factor.
6. Per equipment manufacturer guidance, power density was measured at d=2mm and d=λ/5mm using the same grid size and grid step size for some frequencies and surfaces. The integrated Power Density (iPD) was calculated based on these measurements. Since iPD ratio between the two distances is ≥ -1dB, the grid step was sufficient for determining compliance at d=2mm.
7. PD results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D04v01.
8. PTP-PR algorithm was used during psPD measurement and calculations.

# 10 SAR MEASUREMENT VARIABILITY

## 10.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg
5) When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

**Table 10-1**
**Body SAR Measurement Variability Results**

| BODY VARIABILITY RESULTS | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Band | FREQUENCY | | Mode | Service | Data Rate (Mbps) | Side | Spacing | Measured SAR (1g) | 1st Repeated SAR (1g) | Ratio | 2nd Repeated SAR (1g) | Ratio | 3rd Repeated SAR (1g) | Ratio |
| | MHz | Ch. | | | | | | (W/kg) | (W/kg) | | (W/kg) | | (W/kg) | |
| 5250 | 5201.00 | Mid | NB U-NII 1 | HDRp4 | 4 | Back | 0 mm | 0.973 | 0.916 | 1.06 | N/A | N/A | N/A | N/A |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | | | |

## 10.2 Measurement Uncertainty

The measured SAR was <1.5 W/kg for 1g and <3.75 W/kg for 10g for all frequency bands. Therefore, per KDB Publication 865664 D01v01r04, the extended measurement uncertainty analysis per IEEE 1528-2013 was not required.

# 11 EQUIPMENT LIST

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Agilent | E4404B | Spectrum Analyzer | N/A | N/A | N/A | MY45113242 |
| Agilent | E4438C | ESG Vector Signal Generator | 11/14/2023 | Annual | 11/14/2024 | MY45093852 |
| Agilent | E4438C | ESG Vector Signal Generator | 11/15/2023 | Annual | 11/15/2024 | MY45092078 |
| Agilent | N5182A | MXG Vector Signal Generator | 10/12/2023 | Annual | 10/12/2024 | MY47400015 |
| Agilent | N5182A | MXG Vector Signal Generator | 3/7/2024 | Annual | 3/7/2025 | MY47420603 |
| Agilent | 8753ES | S-Parameter Vector Network Analyzer | 1/10/2024 | Annual | 1/10/2025 | MY40001472 |
| Agilent | E5515C | Wireless Communications Test Set | CBT | N/A | CBT | GB46310798 |
| Agilent | E5515C | Wireless Communications Test Set | CBT | N/A | CBT | US41140256 |
| Agilent | N4010A | Wireless Connectivity Test Set | N/A | N/A | N/A | GB46170464 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 433973 |
| Amplifier Research | 15S1G6 | Amplifier | CBT | N/A | CBT | 433974 |
| Amplifier Research | 150A100C | Amplifier | CBT | N/A | CBT | 350132 |
| Anritsu | MN8110B | I/O Adaptor | CBT | N/A | CBT | 6261747881 |
| Anritsu | ML2496A | Power Meter | 6/24/2024 | Annual | 6/24/2025 | 1840005 |
| Anritsu | ML2495A | Power Meter | 7/8/2024 | Annual | 7/8/2025 | 1039008 |
| Anritsu | MA2411B | Pulse Power Sensor | 8/22/2023 | Annual | 8/22/2024 | 1726262 |
| Anritsu | MA2411B | Pulse Power Sensor | 11/8/2023 | Annual | 11/8/2024 | 1027293 |
| Anritsu | MA24106A | USB Power Sensor | 12/4/2023 | Annual | 12/4/2024 | 1520501 |
| Anritsu | MA24106A | USB Power Sensor | 4/15/2024 | Annual | 4/15/2025 | 1827528 |
| Mini-Circuits | PWR-4GHS | USB Power Sensor | 6/12/2024 | Annual | 6/12/2025 | 12001070013 |
| Control Company | 4052 | Long Stem Thermometer | 2/27/2024 | Biennial | 2/27/2026 | 240174346 |
| Control Company | 4052 | Long Stem Thermometer | 2/27/2024 | Biennial | 2/27/2026 | 240171096 |
| Control Company | 4052 | Long Stem Thermometer | 2/27/2024 | Biennial | 2/27/2026 | 240171059 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 4/15/2024 | Biennial | 4/15/2026 | 240310280 |
| Control Company | 4040 | Therm./ Clock/ Humidity Monitor | 4/15/2024 | Biennial | 4/15/2026 | 240310282 |
| Control Company | S66279 | Therm./ Clock/ Humidity Monitor | 2/16/2024 | Biennial | 2/16/2026 | 240140051 |
| Mitutoyo | 500-196-30 | CD-6"ASX 6Inch Digital Caliper | 2/16/2022 | Triennial | 2/16/2025 | A20238413 |
| Keysight Technologies | N9020A | MXA Signal Analyzer | 4/11/2024 | Annual | 4/11/2025 | MY54500644 |
| Agilent | N9020A | MXA Signal Analyzer | 6/14/2024 | Annual | 6/14/2025 | MY56470202 |
| MCL | BW-N6W5+ | 6dB Attenuator | CBT | N/A | CBT | 1139 |
| Mini-Circuits | VLF-6000+ | Low Pass Filter DC to 6000 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-1200+ | Low Pass Filter DC to 1000 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | CBT | N/A | CBT | N/A |
| Mini-Circuits | BW-N20W5 | Power Attenuator | CBT | N/A | CBT | 1226 |
| Mini-Circuits | ZUDC10-83-S+ | Directional Coupler | CBT | N/A | CBT | 2050 |
| Narda | 4772-3 | Attenuator (3dB) | CBT | N/A | CBT | 9406 |
| Narda | BW-S3W2 | Attenuator (3dB) | CBT | N/A | CBT | 120 |
| Seekonk | NC-100 | Torque Wrench | CBT | N/A | CBT | 22217 |
| Seekonk | NC-100 | Torque Wrench | 4/2/2024 | Biennial | 4/2/2026 | 1262 |
| SPEAG | DAK-3.5 | Dielectric Assessment Kit | 11/13/2023 | Annual | 11/13/2024 | 1277 |
| SPEAG | DAKS-3.5 | Portable Dielectric Assessment Kit | 8/14/2023 | Annual | 8/14/2024 | 1041 |
| SPEAG | MAIA | Modulation and Audio Interference Analyzer | N/A | N/A | N/A | 1237 |
| SPEAG | MAIA | Modulation and Audio Interference Analyzer | N/A | N/A | N/A | 1331 |
| SPEAG | MAIA | Modulation and Audio Interference Analyzer | N/A | N/A | N/A | 1390 |
| SPEAG | DAK-12 | Dielectric Assessment Kit (4MHz - 3GHz) | 3/11/2024 | Annual | 3/11/2025 | 1102 |
| SPEAG | 5G Verification Source 10GHz | 10GHz System Verification Antenna | 10/13/2023 | Annual | 10/13/2024 | 1006 |
| SPEAG | D2450V2 | 2450 MHz SAR Dipole | 5/11/2022 | Triennial | 5/11/2025 | 750 |
| SPEAG | D5GHzV2 | 5 GHz SAR Dipole | 6/12/2024 | Annual | 6/12/2025 | 1163 |
| SPEAG | D6.5GHzV2 | 6.5 GHz SAR Dipole | 10/11/2023 | Annual | 10/11/2024 | 1019 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 12/7/2023 | Annual | 12/7/2024 | 1644 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 2/9/2024 | Annual | 2/9/2025 | 467 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 4/9/2024 | Annual | 4/9/2025 | 1582 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 10/18/2023 | Annual | 10/18/2024 | 1333 |
| SPEAG | EUmmWV4 | mmWave Probe | 4/8/2024 | Annual | 4/8/2025 | 9487 |
| SPEAG | EX3DV4 | SAR Probe | 2/9/2024 | Annual | 2/9/2025 | 7427 |
| SPEAG | EX3DV4 | SAR Probe | 1/16/2024 | Annual | 1/16/2025 | 7499 |
| SPEAG | EX3DV4 | SAR Probe | 10/16/2023 | Annual | 10/16/2024 | 7420 |

All equipment was used solely within its respective calibration period.

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler, or filter were connected to a calibrated source (i.e., a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

Applicable for SAR measurements < 6 GHz:

| a | b | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | IEEE 1528 Sec. | Tol. (± %) | Prob. Dist. | Div. | $c_i$ 1gm | $c_i$ 10 gms | 1gm $u_i$ (± %) | 10gms $u_i$ (± %) | $v_i$ |
| **Measurement System** | | | | | | | | | |
| Probe Calibration | E2.1 | 7 | N | 1 | 1 | 1 | 7.0 | 7.0 | ∞ |
| Axial Isotropy | E2.2 | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | E2.2 | 1.3 | N | 1 | 0.7 | 0.7 | 0.9 | 0.9 | ∞ |
| Boundary Effect | E2.3 | 2 | R | 1.732 | 1 | 1 | 1.2 | 1.2 | ∞ |
| Linearity | E2.4 | 0.3 | N | 1 | 1 | 1 | 0.3 | 0.3 | ∞ |
| System Detection Limits | E2.4 | 0.25 | R | 1.732 | 1 | 1 | 0.1 | 0.1 | ∞ |
| Modulation Response | E2.5 | 4.8 | R | 1.732 | 1 | 1 | 2.8 | 2.8 | ∞ |
| Readout Electronics | E2.6 | 0.3 | N | 1 | 1 | 1 | 0.3 | 0.3 | ∞ |
| Response Time | E2.7 | 0.8 | R | 1.732 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Integration Time | E2.8 | 2.6 | R | 1.732 | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions - Noise | E6.1 | 3 | R | 1.732 | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | E6.1 | 3 | R | 1.732 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E6.2 | 0.8 | R | 1.732 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Probe Positioning w/ respect to Phantom | E6.3 | 6.7 | R | 1.732 | 1 | 1 | 3.9 | 3.9 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E5 | 4 | R | 1.732 | 1 | 1 | 2.3 | 2.3 | ∞ |
| **Test Sample Related** | | | | | | | | | |
| Test Sample Positioning | E4.2 | 3.12 | N | 1 | 1 | 1 | 3.1 | 3.1 | 35 |
| Device Holder Uncertainty | E4.1 | 1.67 | N | 1 | 1 | 1 | 1.7 | 1.7 | 5 |
| Output Power Variation - SAR drift measurement | E2.9 | 5 | R | 1.732 | 1 | 1 | 2.9 | 2.9 | ∞ |
| SAR Scaling | E6.5 | 0 | R | 1.732 | 1 | 1 | 0.0 | 0.0 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | E3.1 | 7.6 | R | 1.73 | 1.0 | 1.0 | 4.4 | 4.4 | ∞ |
| Liquid Conductivity - measurement uncertainty | E3.3 | 4.3 | N | 1 | 0.78 | 0.71 | 3.3 | 3.0 | 76 |
| Liquid Permittivity - measurement uncertainty | E3.3 | 4.2 | N | 1 | 0.23 | 0.26 | 1.0 | 1.1 | 75 |
| Liquid Conductivity - Temperature Uncertainty | E3.4 | 3.4 | R | 1.732 | 0.78 | 0.71 | 1.5 | 1.4 | ∞ |
| Liquid Permittivity - Temperature Unceritainty | E3.4 | 0.6 | R | 1.732 | 0.23 | 0.26 | 0.1 | 0.1 | ∞ |
| Liquid Conductivity - deviation from target values | E3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Permittivity - deviation from target values | E3.2 | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| **Combined Standard Uncertainty (k=1)** | | | RSS | | | | 12.2 | 12.0 | 191 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | | k=2 | | | | 24.4 | 24.0 | |

The above measurement uncertainties are according to IEEE Std. 1528-2013

Applicable for SAR measurements > 6 GHz:

| a | b | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | IEEE 1528 Sec. | Tol. (± %) | Prob. Dist. | Div. | $c_i$ 1gm | $c_i$ 10 gms | 1gm $u_i$ (± %) | 10gms $u_i$ (± %) | $v_i$ |
| **Measurement System** | | | | | | | | | |
| Probe Calibration | E2.1 | 9.3 | N | 1 | 1 | 1 | 9.3 | 9.3 | ∞ |
| Axial Isotropy | E2.2 | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | E2.2 | 1.3 | N | 1 | 0.7 | 0.7 | 0.9 | 0.9 | ∞ |
| Boundary Effect | E2.3 | 2 | R | 1.732 | 1 | 1 | 1.2 | 1.2 | ∞ |
| Linearity | E2.4 | 0.3 | N | 1 | 1 | 1 | 0.3 | 0.3 | ∞ |
| System Detection Limits | E2.4 | 0.25 | R | 1.732 | 1 | 1 | 0.1 | 0.1 | ∞ |
| Modulation Response | E2.5 | 4.8 | R | 1.732 | 1 | 1 | 2.8 | 2.8 | ∞ |
| Readout Electronics | E2.6 | 0.3 | N | 1 | 1 | 1 | 0.3 | 0.3 | ∞ |
| Response Time | E2.7 | 0.8 | R | 1.732 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Integration Time | E2.8 | 2.6 | R | 1.732 | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions - Noise | E6.1 | 3 | R | 1.732 | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | E6.1 | 3 | R | 1.732 | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E6.2 | 0.8 | R | 1.732 | 1 | 1 | 0.5 | 0.5 | ∞ |
| Probe Positioning w/ respect to Phantom | E6.3 | 6.7 | R | 1.732 | 1 | 1 | 3.9 | 3.9 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E5 | 4 | R | 1.732 | 1 | 1 | 2.3 | 2.3 | ∞ |
| **Test Sample Related** | | | | | | | | | |
| Test Sample Positioning | E4.2 | 3.12 | N | 1 | 1 | 1 | 3.1 | 3.1 | 35 |
| Device Holder Uncertainty | E4.1 | 1.67 | N | 1 | 1 | 1 | 1.7 | 1.7 | 5 |
| Output Power Variation - SAR drift measurement | E2.9 | 5 | R | 1.732 | 1 | 1 | 2.9 | 2.9 | ∞ |
| SAR Scaling | E6.5 | 0 | R | 1.732 | 1 | 1 | 0.0 | 0.0 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | E3.1 | 7.6 | R | 1.73 | 1.0 | 1.0 | 4.4 | 4.4 | ∞ |
| Liquid Conductivity - measurement uncertainty | E3.3 | 4.3 | N | 1 | 0.78 | 0.71 | 3.3 | 3.0 | 76 |
| Liquid Permittivity - measurement uncertainty | E3.3 | 4.2 | N | 1 | 0.23 | 0.26 | 1.0 | 1.1 | 75 |
| Liquid Conductivity - Temperature Uncertainty | E3.4 | 3.4 | R | 1.732 | 0.78 | 0.71 | 1.5 | 1.4 | ∞ |
| Liquid Permittivity - Temperature Unceritainty | E3.4 | 0.6 | R | 1.732 | 0.23 | 0.26 | 0.1 | 0.1 | ∞ |
| Liquid Conductivity - deviation from target values | E3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Permittivity - deviation from target values | E3.2 | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| **Combined Standard Uncertainty (k=1)** | | | RSS | | | | 13.8 | 13.6 | 191 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | | k=2 | | | | 27.6 | 27.1 | |

The above measurement uncertainties are according to IEEE Std. 1528-2013

Applicable for Power Density measurements:

| a | b | c | d | e | f = c x f/e | g |
|---|---|---|---|---|---|---|
| **Uncertainty Component** | Unc. (± dB) | Prob. Dist. | Div. | $c_i$ | $u_i$ (± dB) | $v_i$ |
| **Measurement System** | | | | | | |
| Calibration | 0.49 | N | 1 | 1 | 0.49 | ∞ |
| Probe Correction | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Frequency Response | 0.20 | R | 1.73 | 1 | 0.12 | ∞ |
| Sensor Cross Coupling | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Isotropy | 0.50 | R | 1.73 | 1 | 0.29 | ∞ |
| Linearity | 0.20 | R | 1.73 | 1 | 0.12 | ∞ |
| Probe Scattering | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Probe Positioning offset | 0.30 | R | 1.73 | 1 | 0.17 | ∞ |
| Probe Positioning Repeatability | 0.04 | R | 1.73 | 1 | 0.02 | ∞ |
| Sensor Mechanical Offset | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Probe Spatial Resolution | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Field Impedence Dependance | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Amplitude and Phase Drift | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Amplitude and Phase Noise | 0.04 | R | 1.73 | 1 | 0.02 | ∞ |
| Measurement Area Truncation | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Data Acquisition | 0.03 | N | 1 | 1 | 0.03 | ∞ |
| Sampling | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Field Reconstruction | 2.00 | R | 1.73 | 1 | 1.15 | ∞ |
| Forward Transformation | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Power Density Scaling | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Spatial Averaging | 0.10 | R | 1.73 | 1 | 0.06 | ∞ |
| System Detection Limit | 0.04 | R | 1.73 | 1 | 0.02 | ∞ |
| **Test Sample Related** | | | | | | |
| Probe Coupling with DUT | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Modulation Response | 0.40 | R | 1.73 | 1 | 0.23 | ∞ |
| Integration Time | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Response Time | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Device Holder Influence | 0.10 | R | 1.73 | 1 | 0.06 | ∞ |
| DUT alignment | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| RF Ambient Conditions | 0.04 | R | 1.73 | 1 | 0.02 | ∞ |
| Ambient Reflections | 0.04 | R | 1.73 | 1 | 0.02 | ∞ |
| Immunity/Secondary Reception | 0.00 | R | 1.73 | 1 | 0.00 | ∞ |
| Drift of DUT | 0.21 | R | 1.73 | 1 | 0.12 | ∞ |
| **Combined Standard Uncertainty (k=1)** | | RSS | | | 1.34 | ∞ |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | k=2 | | | 2.68 | |

# 13 CONCLUSION

## 13.1 Measurement Conclusion

The SAR evaluation indicates that the EUT complies with the RF radiation exposure limits of the FCC and Innovation, Science, and Economic Development Canada, with respect to all parameters subject to this test. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g., ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g., age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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