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SAR EVALUATION REPORT

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

Date of Testing:
07/02/2024 – 07/26/2024
Test Report Issue Date:
12/02/2024
Test Site/Location:
Element, Morgan Hill, CA, USA
Document Serial No.:
1C2405230027-01.BCG-R1

FCC ID: **BCGA3157**

APPLICANT: **APPLE, INC.**

DUT Type: Wireless Earbud
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: A3157

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	1.15
NII	NB U-NII 1	5157 - 5245 MHz	0.10	1.07
NII	NB U-NII 3	5731 - 5844 MHz	0.13	0.90
6VL	NB U-NII 5	6108 - 6420 MHz	N/A	N/A

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 1.8 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

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	**15.50**
		Nominal	**14.50**
2.4 GHz Bluetooth EDR	77%	Maximum	**11.00**
		Nominal	**10.00**
2.4 GHz Bluetooth HDR4/8	77%	Maximum	**11.00**
		Nominal	**10.00**
2.4 GHz Bluetooth HDRp4/8	100%	Maximum	**11.00**
		Nominal	**10.00**
2.4 GHz Bluetooth LE1M	100%	Maximum	**9.00**
		Nominal	**8.00**
2.4 GHz Bluetooth LE2M	15%	Maximum	**9.00**
		Nominal	**8.00**

Mode / Band	Duty Cycle	Modulated Average (dBm)	
NB UNII-1 BDR	34%	Maximum	**10.00**
		Nominal	**9.00**
NB UNII-1 HDR4/8 1-Slot	34%	Maximum	**10.50**
		Nominal	**9.50**
NB UNII-1 HDR4/8 3/5-Slot	77%	Maximum	**7.50**
		Nominal	**6.50**
NB UNII-1 HDRp4/8	100%	Maximum	**7.50**
		Nominal	**6.50**
NB UNII-1 LE2M	15%	Maximum	**11.00**
		Nominal	**10.00**

Mode / Band	Duty Cycle	Modulated Average (dBm)	
NB UNII-3 BDR	34%	Maximum	**11.50**
		Nominal	**10.50**
NB UNII-3 HDR4/8 1-Slot	34%	Maximum	**10.50**
		Nominal	**9.50**
NB UNII-3 HDR4/8 3/5-Slot	77%	Maximum	**7.00**
		Nominal	**6.00**
NB UNII-3 HDRp4/8	100%	Maximum	**7.00**
		Nominal	**6.00**
NB UNII-3 LE2M	15%	Maximum	**13.50**
		Nominal	**12.50**

Mode / Band	Duty Cycle	Modulated Average (dBm)	
NB UNII-5 BDR	34%	Maximum	**-6.00**
		Nominal	**-7.00**
NB UNII-5 HDRp4	100%	Maximum	**-3.50**
		Nominal	**-4.50**
NB UNII-5 HDRp8	100%	Maximum	**-1.00**
		Nominal	**-2.00**
NB UNII-5 HDR4 1-Slot	34%	Maximum	**-3.50**
		Nominal	**-4.50**
NB UNII-5 HDR4 3/5-Slot	77%	Maximum	**-3.50**
		Nominal	**-4.50**
NB UNII-5 HDR8 1-Slot	34%	Maximum	**-1.00**
		Nominal	**-2.00**
NB UNII-5 HDR8 3/5-Slot	77%	Maximum	**-1.00**
		Nominal	**-2.00**
NB UNII-5 LEM	100%	Maximum	**-6.00**
		Nominal	**-7.00**
NB UNII-5 LE2M	15%	Maximum	**-5.00**
		Nominal	**-6.00**

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 BCGA3157 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 Miscellaneous SAR Test Considerations

The Bluetooth/NB UNII chipset in this device is produced by two different suppliers. The electrically identical modules are manufactured with identical mechanical structures to meet the same specifications and functions. Two device variants are referenced as Variant 1 and Variant 2 in this report. Bluetooth/NB UNII SAR worst case configuration was spot checked on Variant 1 and Variant 2.

1.7 1-mW Test Exemption

Max Output Power= -1 dBm or 0.79 mW; Frequency Range= 6108-6420 MHz. This 2.1093 portable device under Part 15c Subpart E requires SAR head and body-worn testing with a test separation of 0 mm as allowed in KDB Pub. 447498.

Per FCC KDB 447498 D04v01 Section 2.1.2, if the available maximum time-averaged power is no more than 1 mW, then a single RF source is exempt from the requirement to show data demonstrating compliance to RF exposure limits. Since the maximum output power for NB UNII-5 is less than 1 mW and there are no simultaneous transmission scenarios supported for this device, then, it qualifies for the standalone test exemption.

1.8 Guidance Applied

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

1.9 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

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

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:

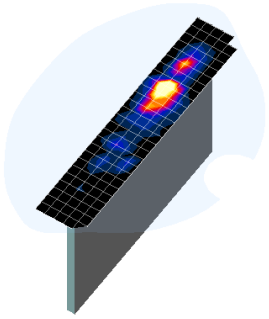

Figure 3-1
Sample SAR Area Scan

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

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{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 (logo) of the earbud and the flat phantom. The button side, non-button side and bottom side 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 *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR 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.

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 Maximum Average RF Power – Variant 1

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2404	HDRp4	4.0	1	10.96	12.474
2440	HDRp4	4.0	37	10.55	11.350
2476	HDRp4	4.0	73	10.47	11.143

Bluetooth Maximum Average RF Power – Variant 2

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2404	HDRp4	4.0	1	10.91	12.331
2440	HDRp4	4.0	37	10.67	11.668
2476	HDRp4	4.0	73	10.55	11.350

Table 7-2
NB UNII Maximum Average RF Power – Variant 1

Type	Band	Frequency	Channel	Average
HDRp4	U-NII 1	5157	Low	7.40
		5201	Mid	7.42
		5245	High	7.47
HDRp4	U-NII 3	5731	Low	6.60
		5788	Mid	6.91
		5844	High	6.92

NB UNII Maximum Average RF Power – Variant 2

Type	Band	Frequency	Channel	Average
HDRp4	U-NII 1	5157	Low	6.70
		5201	Mid	6.71
		5245	High	6.60
HDRp4	U-NII 3	5731	Low	6.58
		5788	Mid	6.41
		5844	High	6.29

7.2 Bluetooth/NB UNII Duty Cycle Plots

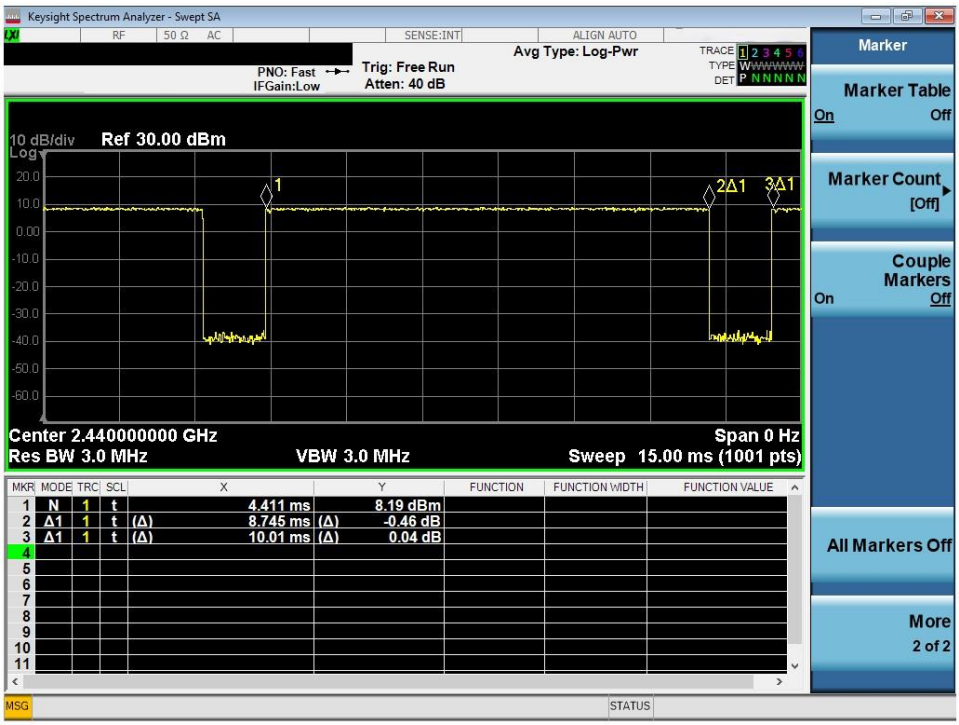

Figure 7-1
2.4 GHz Bluetooth Transmission Plot - Variant 1

Equation 7-1
2.4 GHz Bluetooth Duty Cycle Calculation

$$\textbf{Duty Cycle} = \frac{\textbf{Pulse Width}}{\textbf{Period}} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

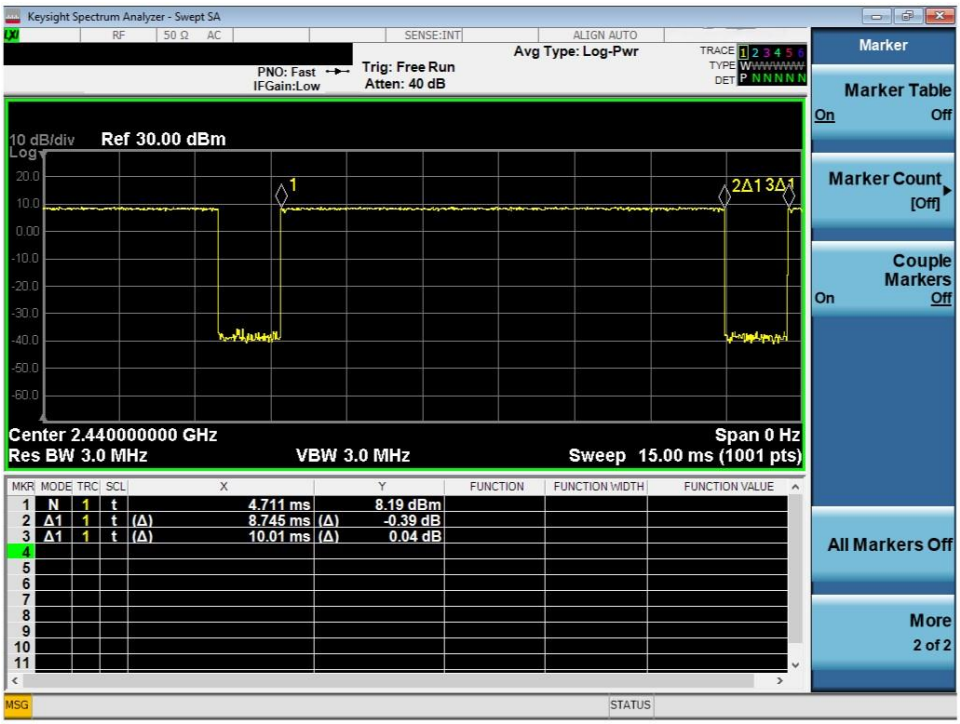

Figure 7-2
2.4 GHz Bluetooth Transmission Plot - Variant 2

Equation 7-2
2.4 GHz Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

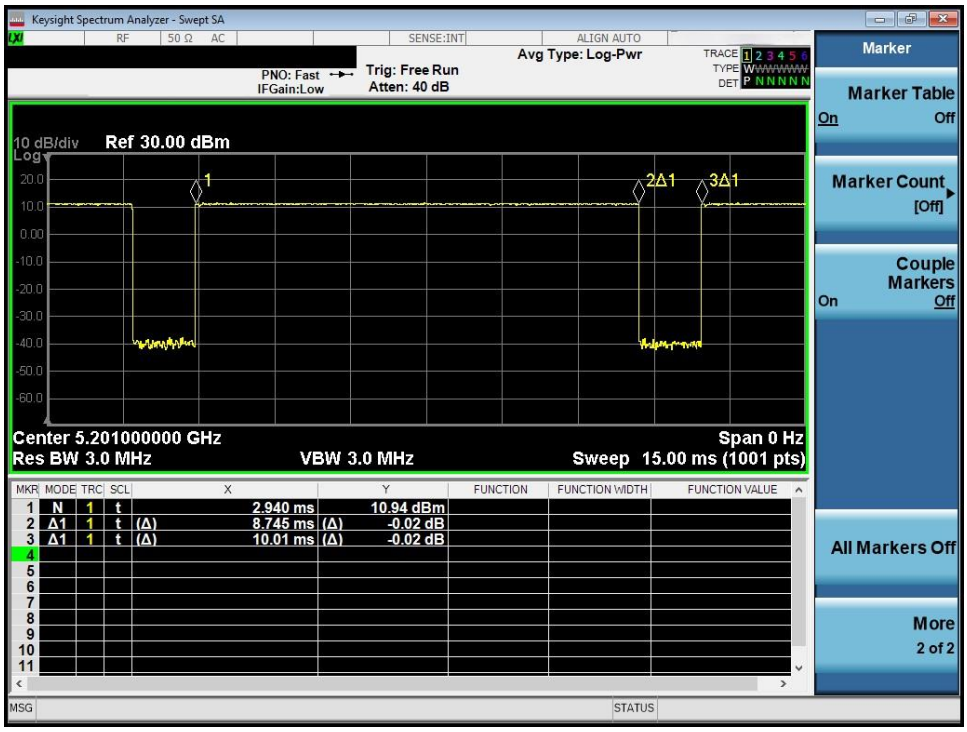

Figure 7-3
NB UNII-1 Transmission Plot - Variant 1

Equation 7-3
NB UNII-1 Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

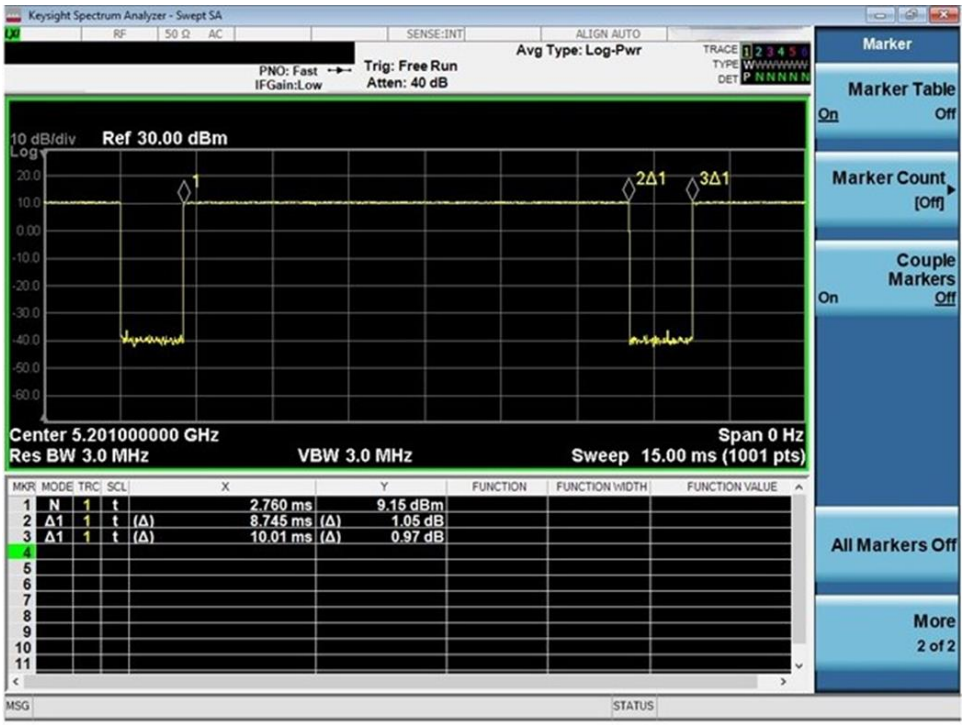

Figure 7-4
NB UNII-1 Transmission Plot - Variant 2

Equation 7-4
NB UNII-1 Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

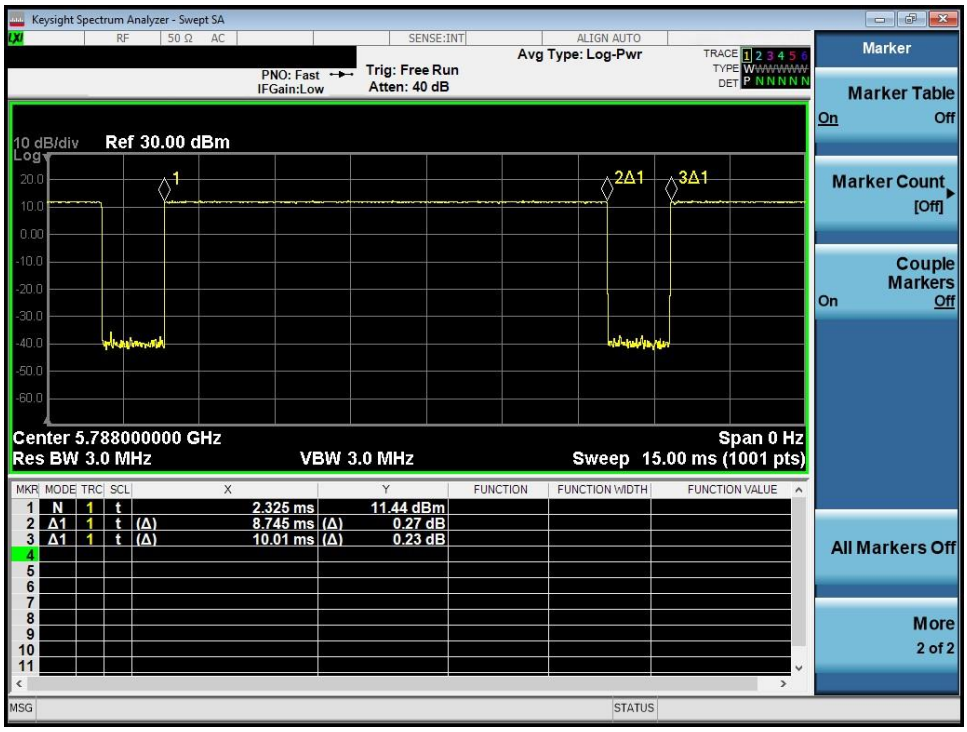

Figure 7-5
NB UNII-3 Transmission Plot - Variant 1

Equation 7-5
NB UNII-3 Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

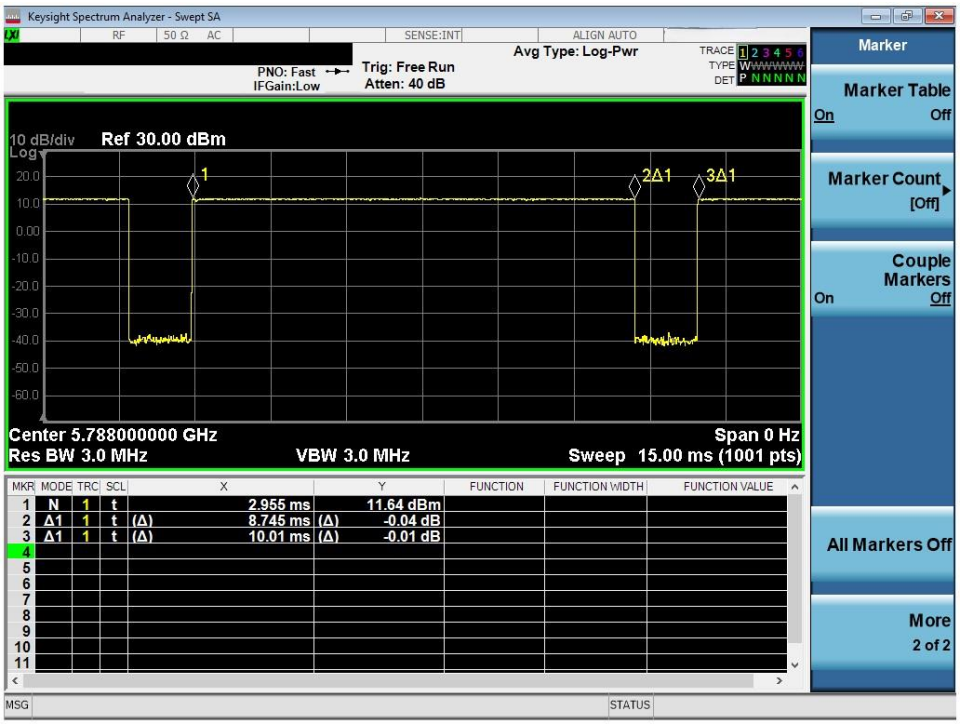

Figure 7-6
NB UNII-3 Transmission Plot - Variant 2

Equation 7-6
NB UNII-3 Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{8.745\ ms}{10.01\ ms} * 100\% = 87.36\%$$

7.7 Notes for Bluetooth/NB UNII

- The Bluetooth/NB UNII chipset in this device is produced by two different suppliers. The electrically identical modules are manufactured with identical mechanical structures to meet the same specifications and functions. Two device variants are referenced as Variant 1 and Variant 2 in this report.
- Bluetooth/NB UNII SAR worst case configuration was spot checked on Variant 1 and Variant 2.
- Full power measurements were performed for Variant 1 and Variant 2 per FCC KDB Procedures 248227.

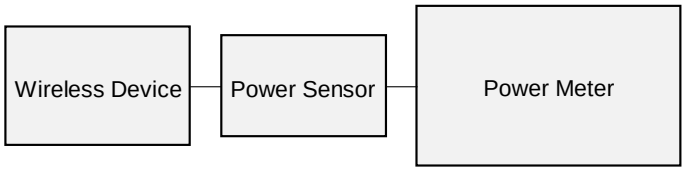

Figure 7-7
Power Measurement Setup

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
07/26/2024	2450 Head	24.4	2300	1.660	39.273	1.670	39.500	-0.60%	-0.57%
			2310	1.671	39.234	1.679	39.480	-0.48%	-0.62%
			2320	1.682	39.191	1.687	39.460	-0.30%	-0.68%
			2400	1.775	38.896	1.756	39.289	1.08%	-1.00%
			2450	1.831	38.688	1.800	39.200	1.72%	-1.31%
			2480	1.866	38.563	1.833	39.162	1.80%	-1.53%
			2500	1.891	38.490	1.855	39.136	1.94%	-1.65%
			2510	1.903	38.456	1.866	39.123	1.98%	-1.70%
			2535	1.932	38.362	1.893	39.092	2.06%	-1.87%
			2550	1.948	38.297	1.909	39.073	2.04%	-1.99%
			2560	1.959	38.252	1.920	39.060	2.03%	-2.07%
			2600	2.007	38.078	1.964	39.009	2.19%	-2.39%
			2650	2.066	37.891	2.018	38.945	2.38%	-2.71%
			2680	2.097	37.758	2.051	38.907	2.24%	-2.95%
			2700	2.120	37.660	2.073	38.882	2.27%	-3.14%
07/02/2024	5200-5800 Head	20.0	5150	4.530	35.395	4.604	36.043	-1.62%	-1.80%
			5160	4.541	35.382	4.614	36.031	-1.58%	-1.80%
			5170	4.552	35.366	4.624	36.020	-1.55%	-1.81%
			5180	4.564	35.354	4.635	36.009	-1.53%	-1.82%
			5190	4.574	35.331	4.645	35.998	-1.53%	-1.85%
			5200	4.584	35.306	4.655	35.986	-1.52%	-1.89%
			5210	4.596	35.283	4.666	35.975	-1.51%	-1.92%
			5220	4.607	35.263	4.676	35.963	-1.48%	-1.95%
			5240	4.625	35.224	4.696	35.940	-1.51%	-1.99%
			5250	4.635	35.207	4.706	35.929	-1.51%	-2.01%
			5260	4.648	35.194	4.717	35.917	-1.46%	-2.01%
			5270	4.660	35.182	4.727	35.906	-1.43%	-2.02%
			5280	4.672	35.176	4.737	35.894	-1.38%	-2.00%
			5290	4.684	35.159	4.748	35.883	-1.35%	-2.02%
			5300	4.692	35.136	4.758	35.871	-1.39%	-2.05%
			5310	4.699	35.118	4.768	35.860	-1.45%	-2.07%
			5320	4.707	35.105	4.778	35.849	-1.48%	-2.08%
			5500	4.898	34.813	4.963	35.643	-1.31%	-2.33%
			5510	4.911	34.801	4.973	35.632	-1.26%	-2.33%
			5520	4.923	34.787	4.983	35.620	-1.20%	-2.34%
			5530	4.935	34.768	4.994	35.609	-1.19%	-2.36%
			5540	4.947	34.749	5.004	35.597	-1.14%	-2.38%
			5550	4.957	34.731	5.014	35.586	-1.15%	-2.40%
			5560	4.965	34.719	5.024	35.574	-1.17%	-2.40%
			5580	4.984	34.677	5.045	35.551	-1.22%	-2.46%
			5600	5.009	34.639	5.065	35.529	-1.11%	-2.51%
			5610	5.020	34.628	5.076	35.518	-1.11%	-2.51%
			5620	5.032	34.612	5.086	35.506	-1.06%	-2.52%
			5640	5.059	34.579	5.106	35.483	-0.92%	-2.55%
			5660	5.082	34.555	5.127	35.460	-0.89%	-2.55%
			5670	5.090	34.544	5.137	35.449	-0.91%	-2.55%
			5680	5.098	34.524	5.147	35.437	-0.96%	-2.58%
			5690	5.107	34.505	5.158	35.426	-0.99%	-2.60%
			5700	5.120	34.484	5.168	35.414	-0.93%	-2.63%
			5710	5.132	34.465	5.178	35.403	-0.88%	-2.65%
			5720	5.144	34.443	5.188	35.391	-0.85%	-2.68%
			5745	5.177	34.396	5.214	35.363	-0.70%	-2.73%
			5750	5.184	34.389	5.219	35.357	-0.66%	-2.74%
			5755	5.190	34.383	5.224	35.351	-0.65%	-2.74%
			5765	5.199	34.371	5.234	35.340	-0.67%	-2.74%
			5775	5.207	34.362	5.245	35.329	-0.72%	-2.74%
			5785	5.215	34.355	5.255	35.317	-0.77%	-2.72%
			5795	5.223	34.338	5.265	35.305	-0.79%	-2.74%
			5800	5.228	34.323	5.270	35.300	-0.80%	-2.77%
			5805	5.233	34.304	5.275	35.294	-0.79%	-2.80%
			5825	5.256	34.249	5.296	35.271	-0.76%	-2.90%
			5835	5.269	34.238	5.305	35.230	-0.67%	-2.82%
			5845	5.286	34.224	5.315	35.210	-0.55%	-2.80%
			5855	5.299	34.204	5.325	35.197	-0.48%	-2.82%
			5865	5.309	34.191	5.336	35.190	-0.50%	-2.84%
			5875	5.317	34.185	5.347	35.183	-0.56%	-2.84%
			5885	5.326	34.174	5.357	35.177	-0.57%	-2.85%
			5905	5.346	34.126	5.379	35.163	-0.61%	-2.95%

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
07/13/2024	5200-5800 Head	20.0	5150	4.479	34.748	4.604	36.043	-2.71%	-3.59%
			5160	4.492	34.732	4.614	36.031	-2.64%	-3.61%
			5170	4.506	34.722	4.624	36.020	-2.56%	-3.60%
			5180	4.518	34.713	4.635	36.009	-2.52%	-3.60%
			5190	4.528	34.705	4.645	35.998	-2.52%	-3.59%
			5200	4.537	34.693	4.655	35.986	-2.53%	-3.59%
			5210	4.546	34.673	4.666	35.975	-2.57%	-3.62%
			5220	4.556	34.653	4.676	35.963	-2.57%	-3.64%
			5240	4.575	34.605	4.696	35.940	-2.58%	-3.72%
			5250	4.586	34.587	4.706	35.929	-2.55%	-3.74%
			5260	4.598	34.569	4.717	35.917	-2.52%	-3.75%
			5270	4.609	34.557	4.727	35.906	-2.49%	-3.76%
			5280	4.620	34.551	4.737	35.894	-2.47%	-3.74%
			5290	4.627	34.545	4.748	35.883	-2.55%	-3.73%
			5300	4.636	34.533	4.758	35.871	-2.56%	-3.73%
			5310	4.647	34.513	4.768	35.860	-2.54%	-3.76%
			5320	4.658	34.489	4.778	35.849	-2.50%	-3.80%
			5500	4.844	34.206	4.963	35.643	-2.39%	-4.03%
			5510	4.857	34.191	4.973	35.632	-2.33%	-4.04%
			5520	4.869	34.178	4.983	35.620	-2.29%	-4.05%
			5530	4.878	34.161	4.994	35.609	-2.32%	-4.07%
			5540	4.890	34.143	5.004	35.597	-2.28%	-4.08%
			5550	4.900	34.129	5.014	35.586	-2.27%	-4.09%
			5560	4.909	34.118	5.024	35.574	-2.29%	-4.09%
			5580	4.923	34.080	5.045	35.551	-2.41%	-4.14%
			5600	4.952	34.035	5.065	35.529	-2.23%	-4.20%
			5610	4.965	34.016	5.076	35.518	-2.20%	-4.23%
			5620	4.975	34.002	5.086	35.506	-2.18%	-4.24%
			5640	5.000	33.978	5.106	35.483	-2.08%	-4.24%
			5660	5.020	33.959	5.127	35.460	-2.08%	-4.23%
			5670	5.029	33.947	5.137	35.449	-2.09%	-4.24%
			5680	5.038	33.929	5.147	35.437	-2.12%	-4.25%
			5690	5.047	33.903	5.158	35.426	-2.15%	-4.30%
			5700	5.059	33.877	5.168	35.414	-2.11%	-4.34%
			5710	5.074	33.854	5.178	35.403	-2.01%	-4.38%
			5720	5.086	33.841	5.188	35.391	-1.97%	-4.38%
			5745	5.112	33.808	5.214	35.363	-1.95%	-4.40%
			5750	5.118	33.802	5.219	35.357	-1.93%	-4.40%
			5755	5.125	33.796	5.224	35.351	-1.90%	-4.40%
			5765	5.136	33.784	5.234	35.340	-1.86%	-4.40%
			5775	5.144	33.777	5.245	35.329	-1.93%	-4.39%
			5785	5.152	33.762	5.255	35.317	-1.97%	-4.40%
			5795	5.161	33.744	5.265	35.305	-1.97%	-4.42%
			5800	5.166	33.732	5.270	35.300	-1.97%	-4.44%
			5805	5.171	33.717	5.275	35.294	-1.97%	-4.47%
			5825	5.198	33.684	5.296	35.271	-1.86%	-4.50%
			5835	5.209	33.673	5.305	35.230	-1.80%	-4.42%
			5845	5.220	33.654	5.315	35.210	-1.78%	-4.42%
			5855	5.232	33.631	5.325	35.197	-1.75%	-4.45%
			5865	5.242	33.619	5.336	35.190	-1.77%	-4.46%
			5875	5.252	33.613	5.347	35.183	-1.77%	-4.46%
			5885	5.259	33.601	5.357	35.177	-1.82%	-4.48%
			5905	5.280	33.556	5.379	35.163	-1.84%	-4.57%

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.

8.1 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 (%)
AM6	2450	HEAD	07/26/2024	21.9	23.1	0.10	750	7499	1644	5.580	52.600	55.800	6.08%
AM8	5250	HEAD	07/02/2024	21.2	20.0	0.05	1123	7427	467	3.820	79.400	76.400	-3.78%
AM8	5250	HEAD	07/13/2024	20.9	20.0	0.05	1163	7427	467	3.860	79.600	77.200	-3.02%
AM8	5600	HEAD	07/02/2024	21.2	20.0	0.05	1123	7427	467	4.080	82.500	81.600	-1.09%
AM8	5600	HEAD	07/13/2024	20.9	20.0	0.05	1163	7427	467	4.220	82.800	84.400	1.93%
AM8	5750	HEAD	07/02/2024	21.2	20.0	0.05	1123	7427	467	3.690	79.400	73.800	-7.05%
AM8	5750	HEAD	07/13/2024	20.9	20.0	0.05	1163	7427	467	3.770	81.100	75.400	-7.03%
AM8	5850	HEAD	07/02/2024	21.2	20.0	0.05	1163	7427	467	4.090	79.000	81.800	3.54%
AM8	5850	HEAD	07/13/2024	20.9	20.0	0.05	1163	7427	467	3.960	79.000	79.200	0.25%

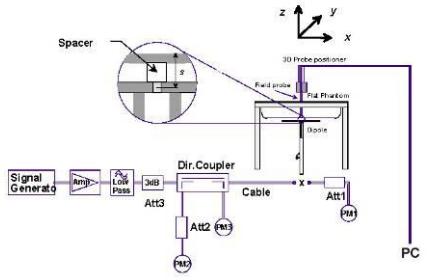

Figure 8-1
System Verification Setup Diagram

Figure 8-2
System Verification Setup Photo

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]	Add'l Info	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.01	2404	1	4	11.00	10.96	Front	0	V1	0.059	1.009	1.145	0.068	
Head	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.18	2440	37	4	11.00	10.55	Front	0	V1	0.083	1.109	1.145	0.105	
Head	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.05	2476	73	4	11.00	10.47	Front	0	V1	0.097	1.130	1.145	0.125	
Head	2.4 GHz Bluetooth	Right	HJ4H720000R0000UEA	87.36	0.18	2476	73	4	11.00	10.55	Front	0	V2	0.102	1.109	1.145	0.129	A1
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Head 1.6 W/kg (mW/g) 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]	Add'l Info	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	0.08	5245	High	4	7.50	7.47	Front	0	V1	0.081	1.007	1.145	0.093	
Head	NB U-NII 1	Right	HJ4H720000R0000UEA	87.36	0.02	5245	High	4	7.50	6.60	Front	0	V2	0.069	1.230	1.145	0.097	
Head	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.14	5157	Low	4	7.50	7.40	Front	0	V1	0.064	1.023	1.145	0.075	
Head	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.17	5201	Mid	4	7.50	7.42	Front	0	V1	0.068	1.019	1.145	0.079	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Head 1.6 W/kg (mW/g) 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]	Add'l Info	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	NB U-NII 3	Right	HJ4H6Z0000E0000UEA	87.36	-0.12	5844	High	4	7.00	6.92	Front	0	V1	0.081	1.019	1.145	0.094	
Head	NB U-NII 3	Right	HJ4H6Z0000E0000UEA	87.36	0.19	5731	Low	4	7.00	6.60	Front	0	V1	0.106	1.096	1.145	0.133	
Head	NB U-NII 3	Right	HJ4H720000R0000UEA	87.36	0.20	5731	Low	4	7.00	6.58	Front	0	V2	0.106	1.102	1.145	0.134	A2
Head	NB U-NII 3	Right	HJ4H6Z0000E0000UEA	87.36	0.07	5788	Mid	4	7.00	6.91	Front	0	V1	0.096	1.021	1.145	0.112	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Head 1.6 W/kg (mW/g) averaged over 1 gram							

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

9.4 2.4 GHz Bluetooth SISO Standalone Body-Worn 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]	Add'l Info	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	HJ4H6Z000090000UEA	87.36	0.00	2404	1	4	11.00	10.96	Bottom	0	V1	0.043	1.009	1.145	0.050	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H720000R0000UEA	87.36	0.02	2404	1	4	11.00	10.91	Logo	0	V2	0.982	1.021	1.145	1.148	A3
Body-worn	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.07	2404	1	4	11.00	10.96	Logo	0	V1	0.964	1.009	1.145	1.113	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.05	2404	1	4	11.00	10.96	Button	0	V1	0.691	1.009	1.145	0.798	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.04	2404	1	4	11.00	10.96	Non-Button	0	V1	0.640	1.009	1.145	0.739	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H720000R0000UEA	87.36	0.04	2404	1	4	11.00	10.91	Logo	0	V2	0.927	1.021	1.145	1.083	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	0.07	2440	37	4	11.00	10.55	Logo	0	V1	0.769	1.109	1.145	0.976	
Body-worn	2.4 GHz Bluetooth	Right	HJ4H6Z000090000UEA	87.36	-0.04	2476	73	4	11.00	10.47	Logo	0	V1	0.670	1.130	1.145	0.867	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note: Blue entry represents variability measurement

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

9.5 5 GHz NB U-NII 1 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]	Add'l Info	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	HJ4H6Z0000M0000UEA	87.36	0.04	5245	High	4	7.50	7.47	Bottom	0	V1	0.120	1.007	1.145	0.138	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.04	5245	High	4	7.50	7.47	Logo	0	V1	0.851	1.007	1.145	0.981	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.10	5245	High	4	7.50	7.47	Button	0	V1	0.672	1.007	1.145	0.775	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	0.05	5245	High	4	7.50	7.47	Non-Button	0	V1	0.266	1.007	1.145	0.307	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	0.01	5157	Low	4	7.50	7.40	Logo	0	V1	0.831	1.023	1.145	0.973	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.08	5201	Mid	4	7.50	7.42	Logo	0	V1	0.882	1.019	1.145	1.029	A4
Body-worn	NB U-NII 1	Right	HJ4H72000030000UEA	87.36	-0.01	5201	Mid	4	7.50	6.71	Logo	0	V2	0.779	1.199	1.145	1.069	
Body-worn	NB U-NII 1	Right	HJ4H6Z0000M0000UEA	87.36	-0.05	5201	Mid	4	7.50	7.42	Logo	0	V1	0.754	1.019	1.145	0.879	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Body 1.6 W/kg (mW/g) averaged over 1 gram							

Note: Blue entry represents variability measurement

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

9.6 5 GHz NB U-NII 3 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]	Add'l Info	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	HJ4H6V0013J0000UEA	87.36	0.13	5844	High	4	7.00	6.92	Bottom	0	V1	0.061	1.019	1.145	0.071	
Body-worn	NB U-NII 3	Right	HJ4H6V0013J0000UEA	87.36	0.02	5844	High	4	7.00	6.92	Logo	0	V1	0.525	1.019	1.145	0.612	
Body-worn	NB U-NII 3	Right	HJ4H6V0013J0000UEA	87.36	0.01	5844	High	4	7.00	6.92	Button	0	V1	0.647	1.019	1.145	0.755	
Body-worn	NB U-NII 3	Right	HJ4H6V0013J0000UEA	87.36	0.01	5844	High	4	7.00	6.92	Non-Button	0	V1	0.169	1.019	1.145	0.197	
Body-worn	NB U-NII 3	Right	HJ4H6V0013J0000UEA	87.36	0.00	5731	Low	4	7.00	6.60	Button	0	V1	0.716	1.096	1.145	0.898	
Body-worn	NB U-NII 3	Right	HJ4H72000030000UEA	87.36	-0.06	5731	Low	4	7.00	6.58	Button	0	V2	0.688	1.102	1.145	0.868	
Body-worn	NB U-NII 3	Right	HJ4H6V0013J0000UEA	87.36	-0.06	5788	Mid	4	7.00	6.91	Button	0	V1	0.623	1.021	1.145	0.728	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population											Body 1.6 W/kg (mW/g) averaged over 1 gram							

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

9.7 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 (BCGA3157).
7. Per FCC KDB 865664 D01v01r04, variability SAR tests were performed when the measured SAR results for a frequency band were greater than or equal to 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 10 for variability analysis.
8. The orange highlights throughout the report represent 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.

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	Earbud	Data Rate (Mbps)	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio
	MHz	Ch.							(W/kg)	(W/kg)	
2450	2404	1	2.4 GHz Bluetooth	HDRp4	Right	4	Logo	0 mm	0.982	0.927	1.06
5250	5201	Mid	NB U-NII 1	HDRp4	Right	4	Logo	0 mm	0.882	0.754	1.17
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) 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
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
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-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	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	D2450V2	2450 MHz SAR Dipole	5/11/2022	Triennial	5/11/2025	750
SPEAG	D5GHzV2	5 GHz SAR Dipole	3/12/2024	Annual	3/12/2025	1123
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	EX3DV4	SAR Probe	2/9/2024	Annual	2/9/2025	7427
SPEAG	EX3DV4	SAR Probe	1/16/2024	Annual	1/16/2025	7499
SPEAG	D5GHzV2	5 GHz SAR Dipole	6/12/2024	Annual	6/12/2025	1163

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.

12 MEASUREMENT UNCERTAINTIES

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	E.2.1	7	N	1	1	1	7.0	7.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	0.7	0.7	0.9	0.9	∞
Boundary Effect	E.2.3	2	R	1.732	1	1	1.2	1.2	∞
Linearity	E.2.4	0.3	N	1	1	1	0.3	0.3	∞
System Detection Limits	E.2.4	0.25	R	1.732	1	1	0.1	0.1	∞
Modulation Response	E.2.5	4.8	R	1.732	1	1	2.8	2.8	∞
Readout Electronics	E.2.6	0.3	N	1	1	1	0.3	0.3	∞
Response Time	E.2.7	0.8	R	1.732	1	1	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.732	1	1	1.5	1.5	∞
RF Ambient Conditions - Noise	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
RF Ambient Conditions - Reflections	E.6.1	3	R	1.732	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.8	R	1.732	1	1	0.5	0.5	∞
Probe Positioning w/ respect to Phantom	E.6.3	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	E.4.2	3.12	N	1	1	1	3.1	3.1	35
Device Holder Uncertainty	E.4.1	1.67	N	1	1	1	1.7	1.7	5
Output Power Variation - SAR drift measurement	E.2.9	5	R	1.732	1	1	2.9	2.9	∞
SAR Scaling	E.6.5	0	R	1.732	1	1	0.0	0.0	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	7.6	R	1.73	1.0	1.0	4.4	4.4	∞
Liquid Conductivity - measurement uncertainty	E.3.3	4.3	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.2	N	1	0.23	0.26	1.0	1.1	75
Liquid Conductivity - Temperature Uncertainty	E.3.4	3.4	R	1.732	0.78	0.71	1.5	1.4	∞
Liquid Permittivity - Temperature Unceritainty	E.3.4	0.6	R	1.732	0.23	0.26	0.1	0.1	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Permittivity - deviation from target values	E.3.2	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

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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