



ELEMENT MATERIALS TECHNOLOGY

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RF EXPOSURE EVALUATION REPORT

Applicant Name:

Apple Inc.
One Apple Park Way
Cupertino, CA 95014 USA

Date of Testing:

06/10/2025

Test Report Issue Date:

07/28/2025

Test Site/Location:

Element, Morgan Hill, CA, USA

Document Serial No.:

1C2504170047-03.BCG-R1

FCC ID:

BCGA3477

APPLICANT:

APPLE, INC.

DUT Type:

Wireless Earbud

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model:

A3477

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	0.07	0.15

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



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@mwfa.info.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 1 of 21

REV 24.0
05/06/2025

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TABLE OF CONTENTS

1	DEVICE UNDER TEST	3
2	INTRODUCTION	5
3	DOSIMETRIC ASSESSMENT	6
4	TEST CONFIGURATION POSITIONS.....	7
5	RF EXPOSURE LIMITS	8
6	FCC MEASUREMENT PROCEDURES	10
7	RF CONDUCTED POWERS	11
8	SYSTEM VERIFICATION.....	13
9	SAR DATA SUMMARY	15
10	SAR MEASUREMENT VARIABILITY	16
11	EQUIPMENT LIST	17
12	MEASUREMENT UNCERTAINTIES.....	18
13	CONCLUSION.....	19
14	REFERENCES	20
APPENDIX A: SAR TEST PLOTS		
APPENDIX B: SAR DIPOLE VERIFICATION PLOTS		
APPENDIX C: PROBE AND DIPOLE CALIBRATION CERTIFICATES		
APPENDIX D: SAR TISSUE SPECIFICATIONS		
APPENDIX E: SAR SYSTEM VALIDATION		
APPENDIX F: DUT ANTENNA DIAGRAM & SAR TEST SETUP PHOTOGRAPHS		

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 2 of 21

REV 24.0
05/06/2025

1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
2.4 GHz Bluetooth	Data	2402 - 2480 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	Modulated Average (dBm)	
2.4 GHz Bluetooth BDR	Maximum	12.50
	Nominal	11.50
2.4 GHz Bluetooth EDR	Maximum	12.50
	Nominal	11.50
2.4 GHz Bluetooth LE ADV	Maximum	9.00
	Nominal	8.00

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 BCGA3477 – which is a wireless Bluetooth earbud for the left 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.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 3 of 21

REV 24.0
05/06/2025

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1.5 Simultaneous Transmission Capabilities

This Device does not support any Simultaneous transmission Scenarios.

1.6 Guidance Applied

- FCC KDB Publication 447498 D04v01 (Interim General RF Exposure 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.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 4 of 21

REV 24.0
05/06/2025

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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/m³)
- 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]

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 5 of 21

REV 24.0
05/06/2025

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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:

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 completed to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

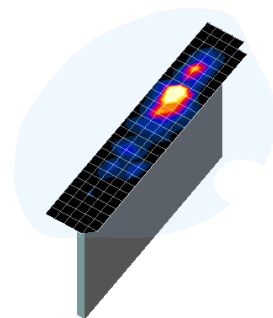


Figure 3-1
Sample SAR Area
Scan

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

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

*Also compliant to IEEE 1528-2013 Table 6

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 6 of 21

REV 24.0
05/06/2025

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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 $\epsilon = 3$ and loss tangent $\delta = 0.02$.

4.2 Positioning for Head

This device is a wireless Bluetooth earbud for the left 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 5 mm between the front of the earbud (the ear tip facing the phantom) and the flat phantom. Additional test positions were evaluated for a more conservative analysis. The test positions for the different orientations are labeled as follows: P3, P4, and P6. 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 left earbud. The DUT was evaluated with a separation distance of 5 mm between the back side of the earbud and the flat phantom. Additional test positions were evaluated for a more conservative analysis. The test positions for the different orientations are labeled as follows: P1, P2, and P5. The phantom is filled with head tissue equivalent medium.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 7 of 21

REV 24.0
05/06/2025

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.

5.3 RF Exposure Limits for Frequencies Below 6 GHz

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

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (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.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 8 of 21

REV 24.0
05/06/2025

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5.4 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/m² or mW/cm².

Peak Spatially Averaged Power Density was evaluated over a circular area of 4 cm² 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/cm² is 10 W/m²

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 9 of 21

REV 24.0
05/06/2025

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.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 10 of 21

REV 24.0
05/06/2025

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7 RF CONDUCTED POWERS

7.1 Bluetooth Conducted Powers

Table 7-1
Bluetooth Average RF Power

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	11.51	14.158
2441	GFSK	1.0	39	11.44	13.932
2480	GFSK	1.0	78	11.42	13.868

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 11 of 21

REV 24.0
05/06/2025

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7.2 Bluetooth Duty Cycle Plots

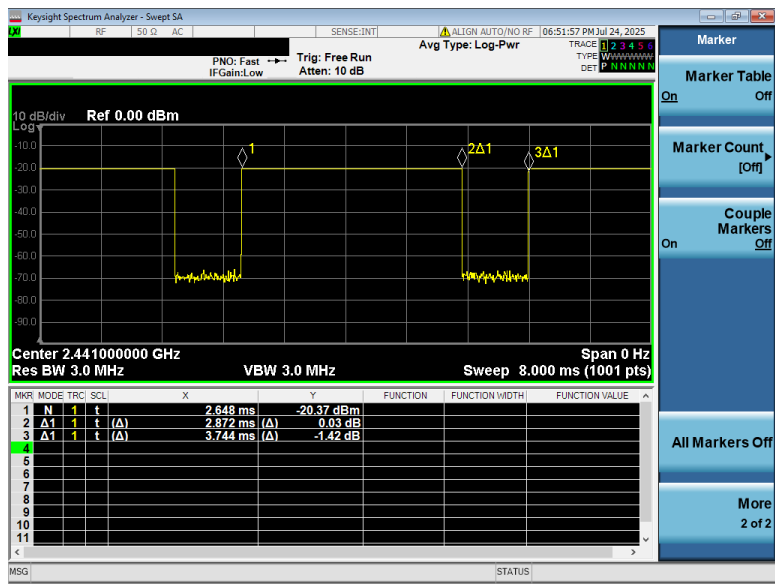


Figure 7-1
2.4 GHz Bluetooth Transmission Plot

Equation 7-1
2.4 GHz Bluetooth Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{2.872\ ms}{3.744\ ms} * 100\% = 76.71\%$$

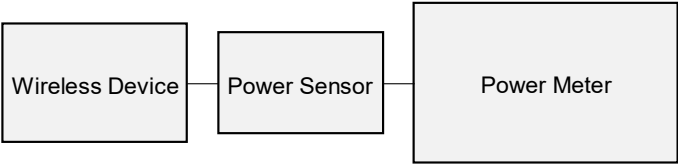


Figure 7-2
Power Measurement Setup

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 12 of 21

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
06/10/2025	2450 Head	24.6	2300	1.664	38.949	1.670	39.500	-0.36%	-1.39%
			2310	1.675	38.918	1.679	39.480	-0.24%	-1.42%
			2320	1.687	38.888	1.687	39.460	0.00%	-1.45%
			2400	1.778	38.562	1.756	39.289	1.25%	-1.85%
			2450	1.837	38.377	1.800	39.200	2.06%	-2.10%
			2480	1.870	38.248	1.833	39.162	2.02%	-2.33%
			2500	1.893	38.165	1.855	39.136	2.05%	-2.48%
			2510	1.905	38.126	1.866	39.123	2.09%	-2.55%
			2535	1.935	38.029	1.893	39.092	2.22%	-2.72%
			2550	1.952	37.971	1.909	39.073	2.25%	-2.82%
			2560	1.964	37.927	1.920	39.060	2.29%	-2.90%
			2600	2.009	37.755	1.964	39.009	2.29%	-3.21%
			2650	2.069	37.555	2.018	38.945	2.53%	-3.57%
			2680	2.102	37.423	2.051	38.907	2.49%	-3.81%
			2700	2.124	37.344	2.073	38.882	2.46%	-3.96%

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.

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

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 13 of 14

REV 24.0
05/06/2025

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8.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ 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 4cm2 APD (W/m2)	1W Target 4cm2 APD (W/m2)	1W Normalized 4cm2 APD (W/m2)	Deviation 4cm2 APD (%)
AM16	2450	HEAD	06/10/2025	22.0	23.1	0.10	750	7532	501	5.250	53.300	52.500	-1.50%	2.370	25.100	23.700	-5.58%				

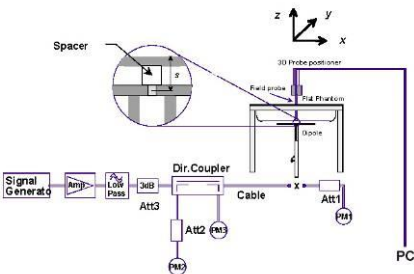


Figure 8-1
System Verification Setup Diagram



Figure 8-2
System Verification Setup Photo

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 14 of 15

9

SAR DATA SUMMARY

9.1 2.4 GHz Bluetooth SISO Standalone Head SAR

Exposure	Band / Mode	Service / Modulation	Ant.	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]	Measured 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Reported 10g SAR [W/kg]	Plot #
Head	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	-0.17	2402.00	0	1	12.50	11.51	Front P3	5	0.024	0.010	1.256	1.010	0.030	0.013	
Head	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	-0.20	2402.00	0	1	12.50	11.51	Front P4	5	0.012	0.006	1.256	1.010	0.015	0.008	
Head	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	0.01	2402.00	0	1	12.50	11.51	Front P6	5	0.053	0.024	1.256	1.010	0.067	0.030	A1
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 the 77.5% transmission duty factor to determine compliance since the duty factor of the device is permanently limited to 77.5% per manufacturer.

9.2 2.4 GHz Bluetooth SISO Standalone Body-Worn SAR

Exposure	Band / Mode	Service / Modulation	Ant.	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]	Measured 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Reported 10g SAR [W/kg]	Plot #
Body-worn	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	0.05	2402.00	0	1	12.50	11.51	Back P1	5	0.033	0.014	1.256	1.010	0.042	0.018	
Body-worn	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	-0.06	2402.00	0	1	12.50	11.51	Back P2	5	0.038	0.015	1.256	1.010	0.048	0.019	
Body-worn	2.4 GHz Bluetooth	FHSS	1	Left	HQCHG40002L00012YF	76.71	0.00	2402.00	0	1	12.50	11.51	Back P5	5	0.121	0.045	1.256	1.010	0.154	0.057	A2
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 the 77.5% transmission duty factor to determine compliance since the duty factor of the device is permanently limited to 77.5% per manufacturer.

9.3 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 left earbud (BCGA3477).
7. The orange highlights throughout the report represent the highest scaled SAR per Equipment Class.

Bluetooth Notes

1. Bluetooth SAR was evaluated with a test mode with hopping disabled with DH5 operation. The reported SAR was scaled to the 77.5% 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.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 15 of 16

REV 24.0
05/06/2025

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10 SAR MEASUREMENT VARIABILITY

10.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01r04, SAR measurement variability was not assessed since all measured SAR values are $<0.8\text{W/kg}$ for 1g and $<0.2\text{ W/kg}$ for 10g SAR.

10.2 Measurement Uncertainty

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

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 16 of 17

REV 24.0
05/06/2025

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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	10/23/2024	Annual	10/23/2025	MY45093852
Agilent	E4438C	ESG Vector Signal Generator	11/15/2024	Annual	11/15/2025	MY45092078
Agilent	N5182A	MXG Vector Signal Generator	5/30/2025	Annual	5/30/2026	MY48180366
Agilent	N5182A	MXG Vector Signal Generator	12/5/2024	Annual	12/5/2025	US46240505
Agilent	8753ES	S-Parameter Vector Network Analyzer	1/6/2025	Annual	1/6/2026	MY40001472
Agilent	8753ES	S-Parameter Vector Network Analyzer	9/25/2024	Annual	9/25/2025	MY40003841
Agilent	E5515C	Wireless Communications Test Set	CBT	N/A	CBT	GB46310798
Agilent	E5515C	Wireless Communications Test Set	CBT	N/A	CBT	GB41450275
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433973
Amplifier Research	1551G6	Amplifier	CBT	N/A	CBT	433974
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	ML2496A	Power Meter	7/15/2024	Annual	7/15/2025	1138001
Anritsu	MA2411B	Pulse Power Sensor	9/5/2024	Annual	9/5/2025	1726262
Anritsu	MA2411B	Pulse Power Sensor	10/21/2024	Annual	10/21/2025	1027293
Anritsu	MA24106A	USB Power Sensor	7/10/2024	Annual	7/10/2025	1827530
Anritsu	MA24106A	USB Power Sensor	5/29/2025	Annual	5/29/2026	1344554
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	10/15/2024	Biennial	10/15/2026	240763503
Control Company	4040	Therm./ Clock/ Humidity Monitor	4/15/2024	Biennial	4/15/2026	240310282
Control Company	1235C55	Digital Caliper	2/25/2025	Biennial	2/25/2027	711245294
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	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	11/5/2024	Annual	11/5/2025	1277
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/7/2024	Annual	8/7/2025	1041
SPEAG	DAK-12	Dielectric Assessment Kit (4MHz - 3GHz)	3/10/2025	Annual	3/10/2026	1102
SPEAG	D2450V2	2450 MHz SAR Dipole	5/13/2025	Annual	5/13/2026	750
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/9/2025	Annual	4/9/2026	501
SPEAG	EX3DV4	SAR Probe	4/16/2025	Annual	4/16/2026	7532

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. Each equipment item was used solely within its respective calibration period.

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 17 of 18

REV 24.0
05/06/2025

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12 MEASUREMENT UNCERTAINTIES

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 Uncertainty	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
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.4	24.0

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

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 18 of 19

REV 24.0
05/06/2025

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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]

FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 19 of 20

REV 24.0
05/06/2025

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FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 20 of 21

REV 24.0
05/06/2025

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FCC ID: BCGA3477	RF EXPOSURE EVALUATION REPORT	Approved by: Technical Manager
DUT Type: Wireless Earbud		Page 21 of 21

REV 24.0
05/06/2025