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SAR EVALUATION REPORT

Applicant Name:
BRINC
1055 N. 38th St.
Seattle, WA
United States, 98103

Date of Testing:
08/26/2024
Test Site/Location:
Element Washington DC LLC,
Columbia, MD, USA
FCC Test Site: US1113
Document Serial No.:
1M2406100047-01.2BHDH

FCC ID: **2BHDHBR00004**

APPLICANT: **BRINC**

DUT Type: Portable Drone Controller
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model(s): LEMUR2

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1g Body-Worn (W/kg)	10g Extremity (W/kg)
TNB	2.4 GHz Mesh Radio	2455.0 - 2479.0 MHz	**0.31**	**1.60**
Simultaneous SAR per KDB 690783 D01v01r03:			**0.57**	**3.10**

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 3.1 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
2.4GHz - Mesh Radio	COFDM	2455.0 - 2479.0 MHz

The DUT is tested using software provided by the manufacturer to activate a testing signal transmitting from the DUT without any other auxiliary needed. Test channels and maximum output power were set to the highest possible output power level.

1.2 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 D01v06.

1.2.1 ISM Mesh Radio Maximum Output Power

Mode	Band	SISO		SISO		MIMO	
		Antenna 1		Antenna 2			
Maximum / Nominal Power		Max	Nom.	Max	Nom.	Max	Nom.
2.4 GHz Mesh Radio	2.4 GHz	22.5	21.5	22.5	21.5	25.5	24.5

1.3 DUT Antenna Locations

A diagram showing the location of the device antennas can be found in Appendix F.

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. **Table 1-1**
Device Edges/Sides for SAR testing

Antenna	Back	Front	Top	Bottom	Right	Left
2.4 GHz Ant A	Yes	No	Yes	No	Yes	Yes
2.4 GHz Ant B	Yes	No	Yes	No	Yes	Yes

Note: Particular DUT edges were not required to be evaluated for wireless router SAR or phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 447498 D01v06 Section 4.3.

1.4 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D01v06, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v06 4.3.2 procedures.

Table 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body-Worn Accessory	Extremity
1	2.4 GHz Mesh Radio Ant A + 2.4 GHz Mesh Radio Ant B	Yes	Yes

1.5 Guidance Applied

- IEEE 1528:2013
- FCC KDB Publication 447498 D01v06 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04 (SAR Measurement 100 MHz to 6 GHz)
- FCC KDB Publication 865664 D02 RF Exposure Reporting v01r02
- FCC KDB Publication 941225 D07 UMPC Mini Tablet v01r02
- FCC KDB Publication 616217 D04 SAR for laptop and tablets v01r02

1.6 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:

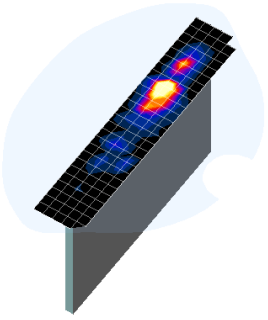

Figure 3-1
Sample SAR Area Scan

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 3-1) 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 DASY 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) (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*Δz_{zoom}(n-1)	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*Δz_{zoom}(n-1)	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*Δz_{zoom}(n-1)	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*Δz_{zoom}(n-1)	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*Δz_{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.
right while placed in this inclined position to the flat phantom.

4.1 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

4.2 SAR Test Positioning Based on Form Factor

This device has antennas located in an extended housing that is angled. During 10g extremity testing for top edge the controller was tilted at an angle so that antenna A and B were flush to the bottom of the phantom, as this is a more conservative measurement. Please see Appendix F for photos of the device during testing.

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 D01v06, 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 2.4 GHz - Mesh Radio

Table 7-1
2.4 GHz - Mesh Radio Maximum Average RF Power

Frequency [MHz]	BW [MHz]	Ant1 Cond. Power [dBm]	Ant2 Cond. Power [dBm]	MIMO Cond. Power [dBm]
2455	7.0	21.64	21.75	24.71
2467	7.0	21.46	21.68	24.58
2479	7.0	21.25	21.22	24.25

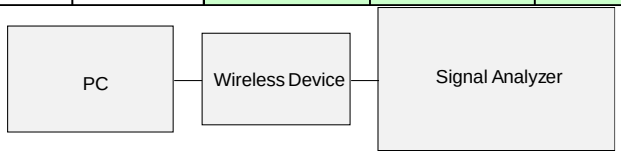

Figure 7-1
Power Measurement Setup

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
08/26/2024	2450 Head	21.9	2300	1.673	39.417	1.670	39.500	0.18%	-0.21%
			2310	1.681	39.403	1.679	39.480	0.12%	-0.20%
			2320	1.688	39.384	1.687	39.460	0.06%	-0.19%
			2400	1.750	39.262	1.756	39.289	-0.34%	-0.07%
			2450	1.788	39.159	1.800	39.200	-0.67%	-0.10%
			2480	1.811	39.114	1.833	39.162	-1.20%	-0.12%
			2500	1.826	39.082	1.855	39.136	-1.56%	-0.14%
			2510	1.834	39.067	1.866	39.123	-1.71%	-0.14%
			2535	1.853	39.023	1.893	39.092	-2.11%	-0.18%
			2550	1.866	38.999	1.909	39.073	-2.25%	-0.19%
			2560	1.874	38.986	1.920	39.060	-2.40%	-0.19%
			2600	1.905	38.921	1.964	39.009	-3.00%	-0.23%
			2650	1.946	38.833	2.018	38.945	-3.57%	-0.29%
			2680	1.971	38.779	2.051	38.907	-3.90%	-0.33%
			2700	1.986	38.740	2.073	38.882	-4.20%	-0.37%

The above measured tissue parameters were used in the DASY software. The DASY 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.

8.2 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 E.

Table 8-2
System Verification Results

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)
O	2450	HEAD	08/26/2024	22.3	20.9	0.10	981	3914	728	5.42	53.90	54.20	0.56%	2.54	25.40	25.40

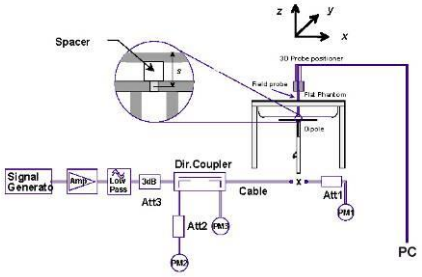

Figure 8-1
System Verification Setup Diagram

Figure 8-2
System Verification Setup Photo

9 SAR DATA SUMMARY

9.1 Standalone Body-Worn/Extremity SAR Data

Table 9-1

Exposure	Band / Mode	Bandwidth [MHz]	Service / Modulation	Ant.	Serial Number	Duty Cycle	Power Drift [dB]	Frequency [MHz]	Channel #	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/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	0.01	2455.00	Low	22.5	21.64	Back	0	1.020	0.572	1.219	0.250	0.311	0.174	A1
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	0.01	2455.00	Low	22.5	21.64	Back	0	0.885	0.496	1.219	0.250	0.270	0.151	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	-0.01	2455.00	Low	22.5	21.64	Front	0	0.737	0.412	1.219	0.250	0.225	0.126	
Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	-0.04	2455.00	Low	22.5	21.64	Top	0	N/A	4.930	1.219	0.250	N/A	1.502	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	0.07	2455.00	Low	22.5	21.64	Right	0	0.025	0.016	1.219	0.250	0.008	0.005	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	A	00009	0.25	0.05	2455.00	Low	22.5	21.64	Left	0	0.111	0.069	1.219	0.250	0.034	0.021	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.01	2455.00	Low	22.5	21.75	Back	0	0.880	0.479	1.189	0.250	0.261	0.142	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.00	2455.00	Low	22.5	21.75	Front	0	0.857	0.478	1.189	0.250	0.255	0.142	
Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.03	2455.00	Low	22.5	21.75	Top	0	N/A	5.380	1.189	0.250	N/A	1.599	A2
Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.03	2455.00	Low	22.5	21.75	Top	0	N/A	5.100	1.189	0.250	N/A	1.515	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.06	2455.00	Low	22.5	21.75	Right	0	0.136	0.084	1.189	0.250	0.040	0.025	
Body/Extremity	2.4GHz - Mesh Radio	7	COFDM - 16QAM-BPSK	B	00009	0.25	0.03	2455.00	Low	22.5	21.75	Left	0	0.024	0.015	1.189	0.250	0.007	0.004	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population												Body/Extremity 1.6 W/kg (mW/g)/4.0 W/kg (mW/g) averaged over 1 gram/averaged over 10 grams								

Note: Blue entries represent variability measurements.

9.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, and FCC KDB Publication 447498 D01v06
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. 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.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. The device was tested using a fixed spacing for body-worn and extremity testing. A separation distance of 0 mm was considered. The body-worn testing distance of 0 mm was chosen for conservative testing.
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 11 for variability analysis.
8. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.
9. Due to the SW limitations for transmission only SISO transmissions were captured. For MIMO considerations see section 10 for simultaneous transmission and evaluation of MIMO SAR by summation.
10. Per the manufacturer the maximum possible duty cycle under normal use conditions is 25%. The DUT was tested for SAR at 100% duty cycle and scaled to the 25% normal use case.

10 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

10.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v06 are applicable to devices with built-in unlicensed transmitters such as Bluetooth devices which may simultaneously transmit with the licensed transmitter.

10.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D01v06 4.3.2 and IEEE 1528-2013 Section 6.3.4.1.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤1.6 W/kg for 1 g SAR and ≤ 4.0 W/kg for 10 g SAR. The different test positions in an exposure condition may be considered collectively to determine SAR test exclusion according to the sum of 1g or 10g SAR.

10.3 Body/Extremity SAR Simultaneous Transmission Analysis

Table 10-1
Simultaneous Transmission Scenario with 2.4 GHz ISM Body 1g SAR

Simult Tx	Configuration	2.4 GHz Ant A SAR (W/kg)	2.4 GHz Ant B SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Body SAR	Back	0.311	0.261	0.572
	Right	0.008	0.040	0.048
	Left	0.034	0.007	0.041

Table 10-2
Simultaneous Transmission Scenario with 2.4 GHz ISM Extremity 10g SAR

Simult Tx	Configuration	2.4 GHz Ant A SAR (W/kg)	2.4 GHz Ant B SAR (W/kg)	Σ SAR (W/kg)
		1	2	1+2
Extremity SAR	Back	0.174	0.142	0.316
	Top	1.502	1.599	3.101
	Right	0.005	0.025	0.030
	Left	0.021	0.004	0.025

10.4 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06.

11 SAR MEASUREMENT VARIABILITY

11.1 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 11-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS														
Band	FREQUENCY		Mode	Service	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)	
2450	2455.00	Low	2.4 GHz Mesh Radio	COFDM	back	0 mm	1.020	0.885	1.15	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Body 1.6 W/kg (mW/g) averaged over 1 gram						

Table 11-2
Extremity SAR Measurement Variability Results

PHABLET VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (10g)	1st Repeated SAR (10g)	Ratio	2nd Repeated SAR (10g)	Ratio	3rd Repeated SAR (10g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
2450	2455.00	Low	2.4 GHz Mesh Radio	COFDM	Top	0 mm	5.380	5.100	1.05	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population							Extremity 4.0 W/kg (mW/g) averaged over 10 grams						

11.2 Measurement Uncertainty

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

12 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	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	150A100C	Amplifier	CBT	N/A	CBT	350132
Mini-Circuits	PWR-4GHS	USB Power Sensor	6/12/2024	Annual	6/12/2025	12001070013
Control Company	4040	Therm./ Clock/ Humidity Monitor	1/15/2024	Annual	1/15/2025	160574418
Mitutoyo	500-196-30	CD-6"ASX 6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
Agilent	N9020A	MXA Signal Analyzer	6/14/2024	Annual	6/14/2025	MY56470202
Mini-Circuits	VLF-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
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	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1379
SPEAG	D2450V2	2450 MHz SAR Dipole	11/25/2021	Triennial	11/25/2024	981
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/8/2024	Annual	5/8/2025	728
SPEAG	EX3DV4	SAR Probe	5/10/2024	Annual	5/10/2025	3914

Note: 1) All equipment was used solely within its respective calibration period. 2) 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.

13 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	E.5	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

14 CONCLUSION

14.1 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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