ELEMENT MATERIALS TECHNOLOGY
(formerly PCTEST)
18855 Adams Court, Morgan Hill, CA 95037 USA
Tel. 408.538.5600
http://www.element.com

SAR EVALUATION REPORT

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

Date of Testing:
06/17/2024 – 07/10/2024
Test Report Issue Date:
08/06/2024
Test Site/Location:
Element, Morgan Hill, CA, USA
Document Serial No.:
1C2405230020-01.BCG (Rev 1)

FCC ID: **BCG-A2999**

APPLICANT: **APPLE, INC.**

DUT Type: Watch
Application Type: Certification
FCC Rule Part(s): CFR §2.1093
Model: A2999, A3000

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1g Head (W/kg)	10g Extremity (W/kg)
DTS	2.4 GHz WIFI	2412 - 2472 MHz	0.39	<0.1
NII	5 GHz WIFI	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz	0.29	<0.1
DSS/DTS	2.4 GHz Bluetooth	2402 - 2480 MHz	0.23	<0.1
NII	802.15.4 ab-NB	5728.75 - 5846.25 MHz	<0.1	<0.1
DXX	NFC	13.56 MHz	N/A	<0.1
UWB	UWB	6489.6 - 7987.2 MHz	N/A	<0.1
Simultaneous SAR per KDB 690783 D01v01r03:			**0.52**	**0.10**
Equipment Class	Band & Mode	Tx Frequency	APD (W/m^2)	
UWB	UWB	6489.6 - 7987.2 MHz	N/A	0.05
Equipment Class	Band & Mode	Tx Frequency	Reported PD (W/m^2)	Reported PD (W/m^2)
UWB	UWB	6489.6 - 7987.2 MHz	N/A	1.55

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 issues test report(s) and dispose of it accordingly.

This watch 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 WLAN	Voice/Data	2412 - 2472 MHz
5 GHz WIFI	Voice/Data	U-NII-1: 5180 - 5240 MHz U-NII-2A: 5260 - 5320 MHz U-NII-2C: 5500 - 5720 MHz U-NII-3: 5745 - 5825 MHz
Bluetooth	Data	2402 - 2480 MHz
802.15.4 ab-NB	Data	5728.75 - 5846.25 MHz
UWB	Data	6489.6 - 7987.2 MHz
NFC	Data	13.56 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 – WiFi Mode

Mode/ Band			IEEE 802.11b (2.4 GHz)		IEEE 802.11g (2.4 GHz)		IEEE 802.11n (2.4 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm)	20 MHz Bandwidth	1	20.00	19.00	17.00	16.00	17.00	16.00
		2	20.00	19.00	19.00	18.00	19.00	18.00
		3	20.00	19.00	19.00	18.00	19.00	18.00
		4	20.00	19.00	19.00	18.00	19.00	18.00
		5	20.00	19.00	19.00	18.00	19.00	18.00
		6	20.00	19.00	19.00	18.00	19.00	18.00
		7	20.00	19.00	19.00	18.00	19.00	18.00
		8	20.00	19.00	19.00	18.00	19.00	18.00
		9	20.00	19.00	19.00	18.00	19.00	18.00
		10	20.00	19.00	19.00	18.00	19.00	18.00
		11	20.00	19.00	17.00	16.00	17.00	16.00
		12	20.00	19.00	14.50	13.50	14.50	13.50
		13	18.00	17.00	2.50	1.50	2.50	1.50

Mode/ Band			IEEE 802.11a (5 GHz)		IEEE 802.11n (5 GHz)	
		Channel	Maximum	Nominal	Maximum	Nominal
Modulated Average - Single Tx Chain (dBm)	20 MHz Bandwidth	36	17.00	16.00	17.00	16.00
		40	17.00	16.00	17.00	16.00
		44	17.00	16.00	17.00	16.00
		48	17.00	16.00	17.00	16.00
		52	17.00	16.00	17.00	16.00
		56	17.00	16.00	17.00	16.00
		60	17.00	16.00	17.00	16.00
		64	17.00	16.00	17.00	16.00
		100	17.00	16.00	17.00	16.00
		104	17.00	16.00	17.00	16.00
		108	17.00	16.00	17.00	16.00
		112	17.00	16.00	17.00	16.00
		116	17.00	16.00	17.00	16.00
		120	17.00	16.00	17.00	16.00
		124	17.00	16.00	17.00	16.00
		128	17.00	16.00	17.00	16.00
		132	17.00	16.00	17.00	16.00
		136	15.00	14.00	15.00	14.00
		140	12.50	11.50	12.50	11.50
		144	17.00	16.00	17.00	16.00
		149	17.00	16.00	17.00	16.00
		153	17.00	16.00	17.00	16.00
		157	17.00	16.00	17.00	16.00
		161	17.00	16.00	17.00	16.00
		165	17.00	16.00	17.00	16.00

1.3.2 Maximum Output Power – Bluetooth Mode

Mode / Band		Modulated Average - Single Tx Chain (dBm)
Bluetooth BDR/LE	Maximum	**19.00**
	Nominal	**18.00**
Bluetooth EDR	Maximum	**14.50**
	Nominal	**13.50**
Bluetooth HDR	Maximum	**14.50**
	Nominal	**13.50**

1.3.3 Maximum Output Power – 802.15.4 ab-NB

Mode / Band		Modulated Average - Single Tx Chain (dBm)
802.15.4 ab-NB	Maximum	**16.00**
	Nominal	**14.00**

1.4 DUT Antenna Locations

A diagram showing the location of the device antennas can be found in the DUT Antenna Diagram & SAR Test Setup Photographs Appendix**.**

1.5 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the device for this model. Therefore, all SAR tests were performed with the device which already incorporates the NFC antenna. A diagram showing the location of the NFC antenna can be found in the DUT Antenna Diagram & SAR Test Setup Photographs Appendix**.**

1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D04v01, 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 D04v01 4.3.2 procedures.

Table 1
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Head	Extremity
1	2.4 GHz WI-FI + 802.15.4 ab-NB + NFC	Yes*	Yes
2	2.4 GHz WI-FI + UWB + NFC	Yes*	Yes
3	2.4 GHz Bluetooth + 5 GHz WI-FI + NFC	Yes*	Yes
4	2.4 GHz Bluetooth + 802.15.4 ab-NB + NFC	Yes*	Yes
5	2.4 GHz Bluetooth + UWB + NFC	Yes*	Yes

1. 2.4 GHz WLAN and 2.4 GHz Bluetooth cannot transmit simultaneously.
2. 2.4 GHz WLAN and 5 GHz WLAN cannot transmit simultaneously.
3. 802.15.4 ab-NB, 5 GHz WLAN and UWB cannot transmit simultaneously.
4. This device supports VoWIFI.
5. *UWB and NFC were evaluated for extremity based on expected usage conditions.

1.7 Miscellaneous SAR Test Considerations

(A) WIFI/BT

This device supports channel 1-13 for 2.4 GHz WLAN. However, because channel 12/13 targets are not higher than that of channels 1-11, channels 1, 6, and 11 were considered for SAR testing per FCC KDB 248227 D01V02r02.

Since U-NII-1 and U-NII-2A bands have the same maximum output power and the highest reported SAR for U-NII-2A is less than 1.2 W/kg, SAR is not required for U-NII-1 band according to FCC KDB Publication 248227 D01v02r02.

Per FCC guidance, SAR was performed using 8 GHz SAR probe calibration factors for UWB. Absorbed power density (APD) using a 4cm^2 averaging area is reported based on SAR measurements. Incident power density is evaluated at 2mm ensuring that the resolution is sufficient such that integrated power density (iPD) between d=2mm and d=λ/5mm is $\geq$ -1dB per equipment manufacturer guidance. Power density results are scaled up for uncertainty above 30%.

1.8 Guidance Applied

- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance, Wrist-worn Device Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)
- IEEE 1528-2013
- November 2017, October 2018, April 2019, November 2019, October 2020 TCBC Workshop Notes
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedures for Devices Operating at 6-10 GHz) (Nov 2021)
- IEC 62479:2010

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.

1.10 Device Housing Types and Wrist Band Types

This device has one housing type that were evaluated independently for SAR: Aluminum. The device can also be used with different wristband accessories. The non-metallic wrist accessory, sport band, was evaluated for all exposure conditions. The available metallic wrist accessories, metal links band and metal loop band, were additionally evaluated.

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:

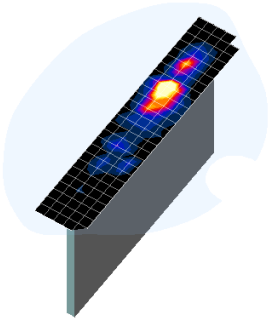

Figure 3-1
Sample SAR Area Scan

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).
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). 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. Additionally, a manufacturer provided low-loss foam was used to position the device for head SAR evaluations.

4.2 Positioning for Head

Devices that are designed to be worn on the wrist may operate in speaker mode for voice communication, with the device worn on the wrist and positioned next to the mouth. When next-to-mouth SAR evaluation is required, the device is positioned at 10 mm from a flat phantom filled with head tissue-equivalent medium. The device is evaluated with wrist bands strapped together to represent normal use conditions.

4.3 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. When extremity SAR evaluation is required, the device is evaluated with the back of the device touching the flat phantom, which is filled with head tissue-equivalent medium. The device was evaluated with Sport wristband unstrapped and touching the phantom. For Metal Loop and Metal Links wristbands, the device was evaluated with wristbands strapped and the distance between wristbands and the phantom was minimized to represent the spacing created by actual use conditions.

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 *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.

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/m^2 or mW/cm^2.

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

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

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

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

6 FCC MEASUREMENT PROCEDURES

Power measurements for licensed transmitters are performed using a base station simulator under digital average power.

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.

6.2 SAR Testing with 802.11 Transmitters

The normal network operating configurations of 802.11 transmitters are not suitable for SAR measurements. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset-based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 D01v02r02 for more details.

6.2.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters.

A periodic duty factor is required for current generation SAR systems to measure SAR. When 802.11 frame gaps are accounted for in the transmission, a maximum transmission duty factor of 92 - 96% is typically achievable in most test mode configurations. A minimum transmission duty factor of 85% is required to avoid certain hardware and device implementation issues related to wide range SAR scaling. The reported SAR is scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit.

6.2.2 U-NII-1 and U-NII-2A

For devices that operate in both U-NII-1 and U-NII-2A bands, when the same maximum output power is specified for both bands, SAR measurement using OFDM SAR test procedures is not required for U-NII-1 unless the highest reported SAR for U-NII-2A is > 1.2 W/kg. When different maximum output powers are specified for the bands, SAR measurement for the U-NII band with the lower maximum output power is not required unless the highest reported SAR for the U-NII band with the higher maximum output power, adjusted by the ratio of lower to higher specified maximum output power for the two bands, is > 1.2 W/kg. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

6.2.3 U-NII-2C and U-NII-3

The frequency range covered by U-NII-2C and U-NII-3 is 380 MHz (5.47 – 5.85 GHz), which requires a minimum of at least two SAR probe calibration frequency points to support SAR measurements. When Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification. Unless band gap channels are permanently disabled, SAR must be considered for these channels. Each band is

tested independently according to the normally required OFDM SAR measurement and probe calibration frequency points requirements.

6.2.4 2.4 GHz SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either the fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

1) When the reported SAR of the highest measured maximum output power channel for the exposure configuration is ≤ 0.8 W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.

2) When the reported SAR is > 0.8 W/kg, SAR is required for that position using the next highest measured output power channel. When any reported SAR is > 1.2 W/kg, SAR is required for the third channel, i.e., all channels require testing.

2.4 GHz 802.11 g/n OFDM are additionally evaluated for SAR if the highest reported SAR for 802.11b, adjusted by the ratio of the OFDM to DSSS specified maximum output power, is > 1.2 W/kg. When SAR is required for OFDM modes in 2.4 GHz band, the Initial Test Configuration Procedures should be followed. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

6.2.5 OFDM Transmission Mode and SAR Test Channel Selection

When the same maximum output power was specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration with the largest channel bandwidth, lowest order modulation and lowest data rate. When the maximum output power of a channel is the same for equivalent OFDM configurations; for example, 802.11a, and 802.11n or 802.11g and 802.11n with the same channel bandwidth, modulation, and data rate etc., the lower order 802.11 mode i.e., 802.11a, then 802.11n or 802.11g then 802.11n, is used for SAR measurement. When the maximum output power are the same for multiple test channels, either according to the default or additional power measurement requirements, SAR is measured using the channel closest to the middle of the frequency band or aggregated band. When there are multiple channels with the same maximum output power, SAR is measured using the higher number channel.

6.2.6 Initial Test Configuration Procedure

For OFDM, an initial test configuration is determined for each frequency band and aggregated band, according to the transmission mode with the highest maximum output power specified for SAR measurements. When the same maximum output power is specified for multiple OFDM transmission mode configurations in a frequency band or aggregated band, SAR is measured using the configuration(s) with the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order IEEE 802.11 mode. The channel of the transmission mode with the highest average RF output conducted power will be the initial test configuration.

When the reported SAR is ≤ 0.8 W/kg, no additional measurements on other test channels are required. Otherwise, SAR is evaluated using the subsequent highest average RF output channel until the reported SAR result is ≤ 1.2 W/kg or all channels are measured. When there are multiple untested channels having the same subsequent highest average RF output power, the channel with higher frequency from the lowest 802.11 mode is considered for SAR measurements (See Section 6.2.5). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

6.2.7 Subsequent Test Configuration Procedures

For OFDM configurations in each frequency band and aggregated band, SAR is evaluated for initial test configuration using the fixed test position or the initial test position procedure. When the highest reported SAR (for the initial test configuration), adjusted by the ratio of the specified maximum output power of the subsequent test configuration to initial test configuration, is ≤ 1.2 W/kg, no additional SAR tests for the subsequent test configurations are required. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

7 RF CONDUCTED POWERS

7.1 WLAN Conducted Powers

Table 7-1
2.4 GHz WLAN Maximum Average RF Power

2.4GHz WIFI (20MHz 802.11b SISO)		
Freq. [MHz]	**Channel**	**Conducted Power [dBm]**
2412	1	19.41
2437	6	19.07
2462	11	18.93
2.4GHz WIFI (20MHz 802.11g SISO)		
Freq. [MHz]	**Channel**	**Conducted Power [dBm]**
2412	1	16.26
2437	6	17.16
2462	11	15.99
2.4GHz WIFI (20MHz 802.11n SISO)		
Freq. [MHz]	**Channel**	**Conducted Power [dBm]**
2412	1	16.29
2437	6	17.14
2462	11	16.03

Table 7-2
5 GHz WLAN Maximum Average RF Power

5GHz WIFI (20MHz 802.11a SISO)			
Band	**Freq. [MHz]**	**Channel**	**Avg. Conducted Power [dBm]**
UNII-1	5180	36	15.54
	5200	40	15.60
	5220	44	15.55
	5240	48	15.46
UNII-2A	5260	52	15.71
	5280	56	15.66
	5300	60	15.85
	5320	64	15.83
UNII-2C	5500	100	15.78
	5600	120	15.79
	5620	124	15.71
	5720	144	15.87
UNII-3	5745	149	15.83
	5785	157	15.80
	5825	165	15.96

5GHz WIFI (20MHz 802.11n SISO)			
Band	**Freq. [MHz]**	**Channel**	**Avg. Conducted Power [dBm]**
UNII-1	5180	36	16.01
	5200	40	15.94
	5220	44	15.89
	5240	48	15.87
UNII-2A	5260	52	16.03
	5280	56	15.98
	5300	60	16.19
	5320	64	16.14
UNII-2C	5500	100	16.05
	5600	120	16.20
	5620	124	15.95
	5720	144	16.32
UNII-3	5745	149	16.17
	5785	157	16.16
	5825	165	16.15

Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02:

- Power measurements were performed for the transmission mode configuration with the highest maximum output power specified for production units.
- For transmission modes with the same maximum output power specification, powers were measured for the largest channel bandwidth, lowest order modulation and lowest data rate.
- For transmission modes with identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- For each transmission mode configuration, powers were measured for the highest and lowest channels; and at the mid-band channel(s) when there were at least 3 channels supported. For configurations with multiple mid-band channels, due to an even number of channels, both channels were measured.

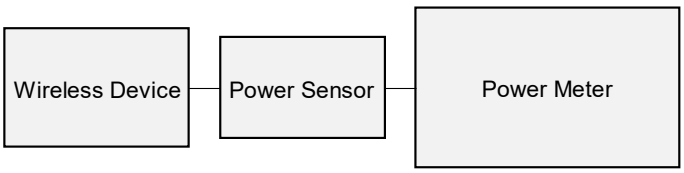

Figure 7-1
Power Measurement Setup

7.2 Bluetooth Conducted Powers

Table 7-3
Bluetooth Average RF Power

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel No.	Avg Conducted Power	
				[dBm]	[mW]
2402	GFSK	1.0	0	18.21	66.222
2441	GFSK	1.0	39	18.05	63.826
2480	GFSK	1.0	78	17.98	62.806

Note 1: Bluetooth was evaluated with a test mode with 100% transmission duty factor.

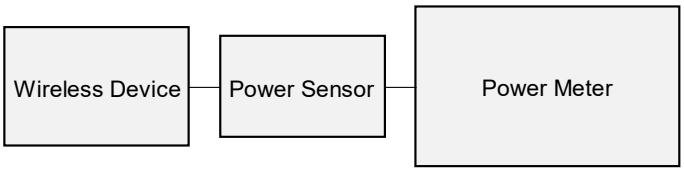

Figure 7-2
Power Measurement Setup

7.3 802.15.4 ab-NB Conducted Powers

Table 7-4
802.15.4 ab-NB Average RF Power

Frequency [MHz]	Modulation	Data Rate [Mbps]	Channel	Avg Conducted Power	
				[dBm]	[mW]
5728.75	O-QPSK	1.00	Low	15.15	32.734
5786.25	O-QPSK	1.00	Mid	15.05	31.989
5846.25	O-QPSK	1.00	High	14.97	31.405

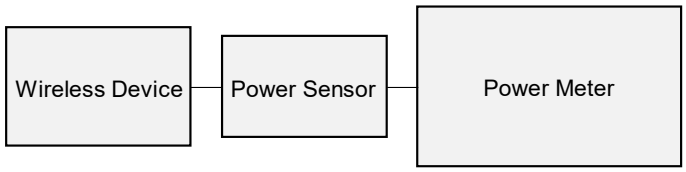

Figure 7-3
Power Measurement Setup

7.4 802.15.4 ab-NB Duty Cycle

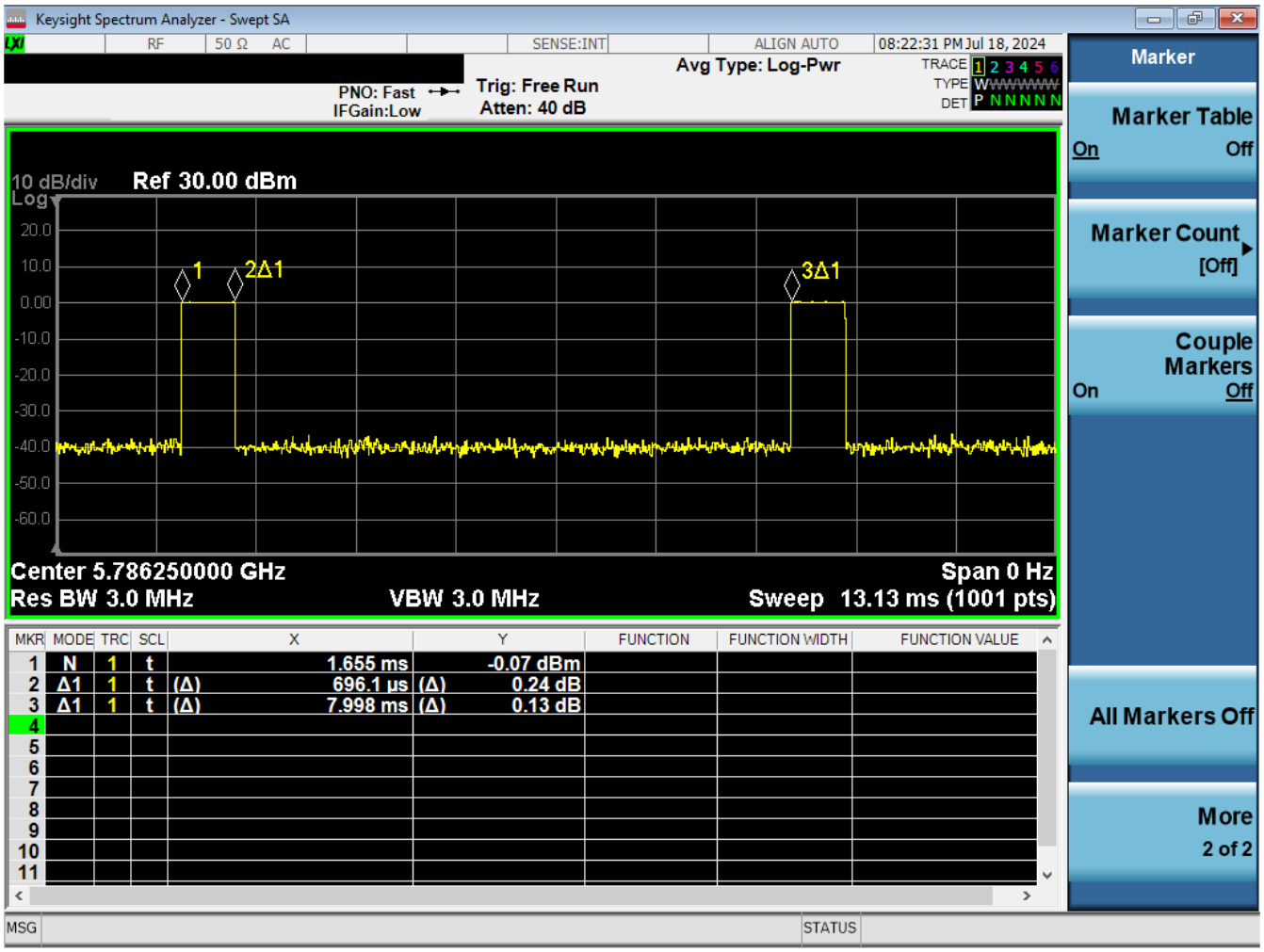

Figure 7-4
802.15.4 ab-NB Transmission Plot

Equation 7-1
802.15.4 ab-NB Duty Cycle Calculation

$$Duty\ Cycle = \frac{Pulse\ Width}{Period} * 100\% = \frac{.696}{7.998} * 100\% = 8.70\%$$

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
07/01/2024	30 Head	23.5	4	0.756	54.013	0.750	55.000	0.80%	-1.79%
			12	0.757	53.627	0.750	55.000	0.93%	-2.50%
			13	0.757	53.554	0.750	55.000	0.93%	-2.63%
			14	0.757	53.529	0.750	55.000	0.93%	-2.67%
			30	0.759	53.005	0.750	55.000	1.20%	-3.63%
			60	0.765	52.483	0.753	54.325	1.59%	-3.39%
			65	0.766	52.395	0.753	54.213	1.73%	-3.35%
			150	0.794	50.913	0.760	52.300	4.47%	-2.65%
07/08/2024	2450 Head	19.0	2300	1.638	40.049	1.670	39.500	-1.92%	1.39%
			2310	1.645	40.029	1.679	39.480	-2.03%	1.39%
			2320	1.653	40.010	1.687	39.460	-2.02%	1.39%
			2400	1.714	39.899	1.756	39.289	-2.39%	1.55%
			2450	1.755	39.819	1.800	39.200	-2.50%	1.58%
			2480	1.778	39.780	1.833	39.162	-3.00%	1.58%
			2500	1.793	39.745	1.855	39.136	-3.34%	1.56%
			2510	1.801	39.727	1.866	39.123	-3.48%	1.54%
			2535	1.822	39.688	1.893	39.092	-3.75%	1.52%
			2550	1.835	39.667	1.909	39.073	-3.88%	1.52%
			2560	1.843	39.653	1.920	39.060	-4.01%	1.52%
			2600	1.876	39.583	1.964	39.009	-4.48%	1.47%
			2650	1.921	39.505	2.018	38.945	-4.81%	1.44%
07/10/2024	2450 Head	24.0	2300	1.649	39.393	1.670	39.500	-1.26%	-0.27%
			2310	1.656	39.383	1.679	39.480	-1.37%	-0.25%
			2320	1.663	39.370	1.687	39.460	-1.42%	-0.23%
			2400	1.721	39.238	1.756	39.289	-1.99%	-0.13%
			2450	1.756	39.165	1.800	39.200	-2.44%	-0.09%
			2480	1.777	39.099	1.833	39.162	-3.06%	-0.16%
			2500	1.794	39.077	1.855	39.136	-3.29%	-0.15%
			2510	1.802	39.065	1.866	39.123	-3.43%	-0.15%
			2535	1.819	39.031	1.893	39.092	-3.91%	-0.16%
			2550	1.828	39.005	1.909	39.073	-4.24%	-0.17%
			2560	1.834	38.982	1.920	39.060	-4.48%	-0.20%
			2600	1.867	38.909	1.964	39.009	-4.94%	-0.26%
06/17/2024	5200-5800 Head	20.2	5180	4.571	35.664	4.635	36.009	-1.38%	-0.96%
			5190	4.580	35.658	4.645	35.998	-1.40%	-0.94%
			5200	4.587	35.650	4.655	35.986	-1.46%	-0.93%
			5210	4.597	35.639	4.666	35.975	-1.48%	-0.93%
			5220	4.608	35.608	4.676	35.963	-1.45%	-0.99%
			5240	4.630	35.568	4.696	35.940	-1.41%	-1.04%
			5250	4.638	35.559	4.706	35.929	-1.44%	-1.03%
			5260	4.652	35.549	4.717	35.917	-1.38%	-1.02%
			5270	4.664	35.527	4.727	35.906	-1.33%	-1.06%
			5280	4.677	35.507	4.737	35.894	-1.27%	-1.08%
			5290	4.684	35.504	4.748	35.883	-1.35%	-1.06%
			5300	4.689	35.503	4.758	35.871	-1.45%	-1.03%
			5310	4.697	35.490	4.768	35.860	-1.49%	-1.03%
			5320	4.709	35.459	4.778	35.849	-1.44%	-1.09%
			5500	4.905	35.158	4.963	35.643	-1.17%	-1.36%
			5510	4.914	35.129	4.973	35.632	-1.19%	-1.41%
			5520	4.926	35.104	4.983	35.620	-1.14%	-1.45%
			5530	4.940	35.087	4.994	35.609	-1.08%	-1.47%
			5540	4.954	35.075	5.004	35.597	-1.00%	-1.47%
			5550	4.966	35.068	5.014	35.586	-0.96%	-1.46%
			5560	4.975	35.058	5.024	35.574	-0.98%	-1.45%
			5580	4.999	35.024	5.045	35.551	-0.91%	-1.48%
			5600	5.020	34.995	5.065	35.529	-0.89%	-1.50%
			5610	5.028	34.972	5.076	35.518	-0.95%	-1.54%
			5620	5.039	34.942	5.086	35.506	-0.92%	-1.59%
			5640	5.062	34.918	5.106	35.483	-0.86%	-1.59%
			5660	5.085	34.897	5.127	35.460	-0.82%	-1.59%
			5670	5.096	34.871	5.137	35.449	-0.80%	-1.63%
			5680	5.110	34.848	5.147	35.437	-0.72%	-1.66%
			5690	5.118	34.838	5.158	35.426	-0.78%	-1.66%
			5700	5.131	34.824	5.168	35.414	-0.72%	-1.67%
			5710	5.141	34.801	5.178	35.403	-0.71%	-1.70%
			5720	5.152	34.779	5.188	35.391	-0.69%	-1.73%
			5745	5.182	34.754	5.214	35.363	-0.61%	-1.72%
			5750	5.191	34.751	5.219	35.357	-0.54%	-1.71%
			5755	5.200	34.748	5.224	35.351	-0.46%	-1.71%
			5765	5.211	34.735	5.234	35.340	-0.44%	-1.71%
			5775	5.219	34.706	5.245	35.329	-0.50%	-1.76%
			5785	5.225	34.668	5.255	35.317	-0.57%	-1.84%
			5795	5.229	34.645	5.265	35.305	-0.68%	-1.87%
			5800	5.235	34.636	5.270	35.300	-0.66%	-1.88%
			5805	5.244	34.631	5.275	35.294	-0.59%	-1.88%
			5825	5.268	34.611	5.296	35.271	-0.53%	-1.87%
			5835	5.279	34.602	5.305	35.230	-0.49%	-1.78%
			5845	5.291	34.602	5.315	35.210	-0.45%	-1.73%
			5850	5.297	34.601	5.320	35.200	-0.43%	-1.70%
			5855	5.302	34.592	5.325	35.197	-0.43%	-1.72%
			5865	5.315	34.572	5.336	35.190	-0.39%	-1.76%
			5875	5.325	34.550	5.347	35.183	-0.41%	-1.80%
			5885	5.333	34.517	5.357	35.177	-0.45%	-1.88%
			5905	5.349	34.469	5.379	35.163	-0.56%	-1.97%

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
			5180	4.431	37.564	4.635	36.009	-4.40%	4.32%
			5190	4.442	37.545	4.645	35.998	-4.37%	4.30%
			5200	4.453	37.524	4.655	35.986	-4.34%	4.27%
			5210	4.464	37.495	4.666	35.975	-4.33%	4.23%
			5220	4.475	37.469	4.676	35.963	-4.30%	4.19%
			5240	4.502	37.429	4.696	35.940	-4.13%	4.14%
			5250	4.514	37.410	4.706	35.929	-4.08%	4.12%
			5260	4.524	37.388	4.717	35.917	-4.09%	4.10%
			5270	4.535	37.373	4.727	35.906	-4.06%	4.09%
			5280	4.550	37.363	4.737	35.894	-3.95%	4.09%
			5290	4.563	37.356	4.748	35.883	-3.90%	4.11%
			5300	4.572	37.337	4.758	35.871	-3.91%	4.09%
			5310	4.576	37.313	4.768	35.860	-4.03%	4.05%
			5320	4.586	37.292	4.778	35.849	-4.02%	4.03%
			5500	4.797	36.980	4.963	35.643	-3.34%	3.75%
			5510	4.808	36.973	4.973	35.632	-3.32%	3.76%
			5520	4.817	36.951	4.983	35.620	-3.33%	3.74%
			5530	4.826	36.923	4.994	35.609	-3.36%	3.69%
			5540	4.838	36.889	5.004	35.597	-3.32%	3.63%
			5550	4.851	36.864	5.014	35.586	-3.25%	3.59%
			5560	4.865	36.850	5.024	35.574	-3.16%	3.59%
			5580	4.892	36.815	5.045	35.551	-3.03%	3.56%
			5600	4.918	36.793	5.065	35.529	-2.90%	3.56%
			5610	4.930	36.785	5.076	35.518	-2.88%	3.57%
			5620	4.939	36.771	5.086	35.506	-2.89%	3.56%
06/18/2024	5200-5800 Head	19.0	5640	4.959	36.725	5.106	35.483	-2.88%	3.50%
			5660	4.984	36.682	5.127	35.460	-2.79%	3.45%
			5670	4.997	36.656	5.137	35.449	-2.73%	3.40%
			5680	5.008	36.632	5.147	35.437	-2.70%	3.37%
			5690	5.020	36.621	5.158	35.426	-2.68%	3.37%
			5700	5.035	36.613	5.168	35.414	-2.57%	3.39%
			5710	5.050	36.591	5.178	35.403	-2.47%	3.36%
			5720	5.060	36.579	5.188	35.391	-2.47%	3.36%
			5745	5.087	36.547	5.214	35.363	-2.44%	3.35%
			5750	5.092	36.532	5.219	35.357	-2.43%	3.32%
			5755	5.096	36.517	5.224	35.351	-2.45%	3.30%
			5765	5.105	36.492	5.234	35.340	-2.46%	3.26%
			5775	5.117	36.472	5.245	35.329	-2.44%	3.24%
			5785	5.131	36.451	5.255	35.317	-2.36%	3.21%
			5795	5.146	36.436	5.265	35.305	-2.26%	3.20%
			5800	5.153	36.427	5.270	35.300	-2.22%	3.19%
			5805	5.160	36.421	5.275	35.294	-2.18%	3.19%
			5825	5.182	36.392	5.296	35.271	-2.15%	3.18%
			5835	5.193	36.382	5.305	35.230	-2.11%	3.27%
			5845	5.203	36.372	5.315	35.210	-2.11%	3.30%
			5850	5.210	36.361	5.320	35.200	-2.07%	3.30%
			5855	5.216	36.351	5.325	35.197	-2.05%	3.28%
			5865	5.223	36.324	5.336	35.190	-2.12%	3.22%
			5875	5.232	36.300	5.347	35.183	-2.15%	3.17%
			5885	5.247	36.281	5.357	35.177	-2.05%	3.14%
			5905	5.278	36.230	5.379	35.163	-1.88%	3.03%
			5180	4.534	34.774	4.635	36.009	-2.18%	-3.43%
			5190	4.544	34.758	4.645	35.998	-2.17%	-3.44%
			5200	4.556	34.755	4.655	35.986	-2.13%	-3.42%
			5210	4.564	34.743	4.666	35.975	-2.19%	-3.42%
			5220	4.575	34.721	4.676	35.963	-2.16%	-3.45%
			5240	4.600	34.684	4.696	35.940	-2.04%	-3.49%
			5250	4.610	34.681	4.706	35.929	-2.04%	-3.47%
			5260	4.620	34.659	4.717	35.917	-2.06%	-3.50%
			5270	4.633	34.639	4.727	35.906	-1.99%	-3.53%
			5280	4.641	34.612	4.737	35.894	-2.03%	-3.57%
			5290	4.642	34.606	4.748	35.883	-2.23%	-3.56%
			5300	4.650	34.591	4.758	35.871	-2.27%	-3.57%
			5310	4.663	34.580	4.768	35.860	-2.20%	-3.57%
			5320	4.680	34.565	4.778	35.849	-2.05%	-3.58%
			5500	4.863	34.250	4.963	35.643	-2.01%	-3.91%
			5510	4.871	34.232	4.973	35.632	-2.05%	-3.93%
			5520	4.883	34.209	4.983	35.620	-2.01%	-3.96%
			5530	4.895	34.182	4.994	35.609	-1.98%	-4.01%
			5540	4.905	34.175	5.004	35.597	-1.98%	-3.99%
			5550	4.914	34.171	5.014	35.586	-1.99%	-3.98%
			5560	4.922	34.157	5.024	35.574	-2.03%	-3.98%
			5580	4.952	34.107	5.045	35.551	-1.84%	-4.06%
			5600	4.977	34.075	5.065	35.529	-1.74%	-4.09%
			5610	4.989	34.060	5.076	35.518	-1.71%	-4.10%
			5620	5.000	34.049	5.086	35.506	-1.69%	-4.10%
06/22/2024	5200-5800 Head	20.7	5640	5.018	34.036	5.106	35.483	-1.72%	-4.08%
			5660	5.042	34.012	5.127	35.460	-1.66%	-4.08%
			5670	5.060	33.990	5.137	35.449	-1.50%	-4.12%
			5680	5.077	33.963	5.147	35.437	-1.36%	-4.16%
			5690	5.090	33.949	5.158	35.426	-1.32%	-4.17%
			5700	5.098	33.934	5.168	35.414	-1.35%	-4.18%
			5710	5.105	33.919	5.178	35.403	-1.41%	-4.19%
			5720	5.115	33.900	5.188	35.391	-1.41%	-4.21%
			5745	5.138	33.883	5.214	35.363	-1.46%	-4.19%
			5750	5.144	33.871	5.219	35.357	-1.44%	-4.20%
			5755	5.150	33.859	5.224	35.351	-1.42%	-4.22%
			5765	5.164	33.828	5.234	35.340	-1.34%	-4.28%
			5775	5.176	33.803	5.245	35.329	-1.32%	-4.32%
			5785	5.187	33.786	5.255	35.317	-1.29%	-4.34%
			5795	5.194	33.777	5.265	35.305	-1.35%	-4.33%
			5800	5.201	33.773	5.270	35.300	-1.31%	-4.33%
			5805	5.204	33.763	5.275	35.294	-1.35%	-4.34%
			5825	5.215	33.733	5.296	35.271	-1.53%	-4.36%
			5835	5.227	33.720	5.305	35.230	-1.47%	-4.29%
			5845	5.243	33.705	5.315	35.210	-1.35%	-4.27%
			5850	5.250	33.700	5.320	35.200	-1.32%	-4.26%
			5855	5.258	33.691	5.325	35.197	-1.26%	-4.28%
			5865	5.267	33.662	5.336	35.190	-1.29%	-4.34%
			5875	5.276	33.639	5.347	35.183	-1.33%	-4.39%
			5885	5.286	33.618	5.357	35.177	-1.33%	-4.43%
			5905	5.298	33.578	5.379	35.163	-1.51%	-4.51%

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
07/10/2024	5200-5800 Head	19.3	5180	4.543	34.779	4.635	36.009	-1.98%	-3.42%
			5190	4.554	34.765	4.645	35.998	-1.96%	-3.43%
			5200	4.563	34.743	4.655	35.986	-1.98%	-3.45%
			5210	4.574	34.721	4.666	35.975	-1.97%	-3.49%
			5220	4.587	34.705	4.676	35.963	-1.90%	-3.50%
			5240	4.607	34.678	4.696	35.940	-1.90%	-3.51%
			5250	4.618	34.665	4.706	35.929	-1.87%	-3.52%
			5260	4.630	34.647	4.717	35.917	-1.84%	-3.54%
			5270	4.641	34.622	4.727	35.906	-1.82%	-3.58%
			5280	4.650	34.600	4.737	35.894	-1.84%	-3.61%
			5290	4.659	34.582	4.748	35.883	-1.87%	-3.63%
			5300	4.670	34.566	4.758	35.871	-1.85%	-3.64%
			5310	4.683	34.541	4.768	35.860	-1.78%	-3.68%
			5320	4.696	34.512	4.778	35.849	-1.72%	-3.73%
			5500	4.891	34.216	4.963	35.643	-1.45%	-4.00%
			5510	4.900	34.196	4.973	35.632	-1.47%	-4.03%
			5520	4.912	34.172	4.983	35.620	-1.42%	-4.07%
			5530	4.926	34.146	4.994	35.609	-1.36%	-4.11%
			5540	4.939	34.123	5.004	35.597	-1.30%	-4.14%
			5550	4.951	34.106	5.014	35.586	-1.26%	-4.16%
			5560	4.963	34.102	5.024	35.574	-1.21%	-4.14%
			5580	4.986	34.072	5.045	35.551	-1.17%	-4.16%
			5600	5.010	34.029	5.065	35.529	-1.09%	-4.22%
			5610	5.019	34.010	5.076	35.518	-1.12%	-4.25%
			5620	5.030	33.988	5.086	35.506	-1.10%	-4.28%
			5640	5.053	33.933	5.106	35.483	-1.04%	-4.37%
			5660	5.079	33.894	5.127	35.460	-0.94%	-4.42%
			5670	5.093	33.886	5.137	35.449	-0.86%	-4.41%
			5680	5.103	33.876	5.147	35.437	-0.85%	-4.41%
			5690	5.112	33.862	5.158	35.426	-0.89%	-4.41%
			5700	5.125	33.846	5.168	35.414	-0.83%	-4.43%
			5710	5.137	33.825	5.178	35.403	-0.79%	-4.46%
			5720	5.148	33.802	5.188	35.391	-0.77%	-4.49%
			5745	5.177	33.741	5.214	35.363	-0.71%	-4.59%
			5750	5.182	33.731	5.219	35.357	-0.71%	-4.60%
			5755	5.186	33.721	5.224	35.351	-0.73%	-4.61%
			5765	5.197	33.702	5.234	35.340	-0.71%	-4.63%
			5775	5.209	33.691	5.245	35.329	-0.69%	-4.64%
			5785	5.223	33.683	5.255	35.317	-0.61%	-4.63%
			5795	5.235	33.674	5.265	35.305	-0.57%	-4.62%
			5800	5.240	33.665	5.270	35.300	-0.57%	-4.63%
			5805	5.245	33.657	5.275	35.294	-0.57%	-4.64%
			5825	5.267	33.615	5.296	35.271	-0.55%	-4.70%
			5835	5.282	33.595	5.305	35.230	-0.43%	-4.64%
			5845	5.292	33.578	5.315	35.210	-0.43%	-4.64%
			5850	5.296	33.568	5.320	35.200	-0.45%	-4.64%
			5855	5.300	33.554	5.325	35.197	-0.47%	-4.67%
			5865	5.308	33.528	5.336	35.190	-0.52%	-4.72%
			5875	5.317	33.502	5.347	35.183	-0.56%	-4.78%
			5885	5.329	33.481	5.357	35.177	-0.52%	-4.82%
			5905	5.359	33.461	5.379	35.163	-0.37%	-4.84%
07/01/2024	6000 Head	20.5	5935	5.453	34.936	5.411	35.143	0.78%	-0.59%
			5970	5.494	34.881	5.448	35.120	0.84%	-0.68%
			5985	5.513	34.862	5.464	35.110	0.90%	-0.71%
			6000	5.532	34.843	5.480	35.100	0.95%	-0.73%
			6025	5.559	34.800	5.510	35.070	0.89%	-0.77%
			6065	5.605	34.714	5.557	35.022	0.86%	-0.88%
			6075	5.620	34.697	5.569	35.010	0.92%	-0.89%
			6085	5.635	34.679	5.580	34.998	0.99%	-0.91%
			6185	5.768	34.497	5.698	34.878	1.23%	-1.09%
			6275	5.884	34.316	5.805	34.770	1.36%	-1.31%
			6285	5.896	34.299	5.816	34.758	1.38%	-1.32%
			6305	5.920	34.259	5.840	34.734	1.37%	-1.37%
			6345	5.959	34.203	5.887	34.686	1.22%	-1.39%
			6475	6.101	34.022	6.041	34.530	0.99%	-1.47%
			6485	6.109	34.013	6.052	34.518	0.94%	-1.46%
			6500	6.119	33.992	6.070	34.500	0.81%	-1.47%
			6505	6.122	33.984	6.076	34.494	0.76%	-1.48%
			6545	6.165	33.895	6.122	34.446	0.70%	-1.60%
			6665	6.355	33.684	6.265	34.302	1.44%	-1.80%
			6675	6.366	33.670	6.273	34.290	1.48%	-1.81%
			6685	6.376	33.658	6.285	34.278	1.45%	-1.81%
			6715	6.403	33.607	6.319	34.242	1.33%	-1.85%
			6785	6.498	33.461	6.400	34.158	1.53%	-2.04%
			6825	6.515	33.405	6.447	34.110	1.05%	-2.07%
			6985	6.677	33.152	6.633	33.918	0.66%	-2.26%
			6995	6.684	33.138	6.644	33.906	0.60%	-2.27%
			7000	6.690	33.127	6.650	33.900	0.60%	-2.28%
			7005	6.695	33.114	6.656	33.894	0.59%	-2.30%
			7025	6.733	33.069	6.680	33.870	0.79%	-2.36%
			7500	7.330	32.233	7.240	33.300	1.24%	-3.20%
			7980	7.855	31.465	7.816	32.724	0.50%	-3.85%
			8000	7.892	31.407	7.840	32.700	0.66%	-3.95%

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.

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

8.2 Test System Verification

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

Table 8-2
System Verification Results – 1g

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 (%)
AM13	2450	HEAD	07/08/2024	21.4	20.4	0.10	921	7682	1683	5.260	54.200	52.600	-2.95%
AM13	2450	HEAD	07/10/2024	21.5	23.3	0.10	921	7682	1683	5.100	54.200	51.000	-5.90%
AM8	5250	HEAD	06/17/2024	21.2	20.4	0.05	1066	7427	467	3.860	80.300	77.200	-3.86%
AM8	5250	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	3.770	80.300	75.400	-6.10%
AM8	5600	HEAD	06/17/2024	21.2	20.4	0.05	1066	7427	467	4.210	83.900	84.200	0.36%
AM8	5600	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	4.160	83.900	83.200	-0.83%
AM8	5750	HEAD	06/17/2024	21.2	20.4	0.05	1066	7427	467	3.810	79.500	76.200	-4.15%
AM8	5750	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	3.950	79.500	79.000	-0.63%
AM8	5850	HEAD	06/17/2024	21.2	20.4	0.05	1066	7427	467	4.070	82.200	81.400	-0.97%
AM8	5850	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	4.160	82.200	83.200	1.22%

Table 8-3
System Verification Results – 10g

SAR System	Tissue Frequency (MHz)	Tissue Type	Date	Amb. Temp. (C)	Liquid Temp. (C)	Input Power (W)	Source SN	Probe SN	DAE	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 (%)
AM14	13	HEAD	07/09/2024	22.0	22.5	1.00	1004	3746	1237	0.368	0.356	0.368	3.37%				
AM13	2450	HEAD	07/08/2024	21.4	20.4	0.10	921	7682	1683	2.520	25.500	25.200	-1.18%				
AM8	5250	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	1.080	23.100	21.600	-6.49%				
AM8	5600	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	1.180	24.100	23.600	-2.07%				
AM8	5750	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	1.130	22.600	22.600	0.00%				
AM8	5800	HEAD	06/22/2024	21.5	19.6	0.05	1066	7427	467	1.170	23.400	23.400	0.00%				
AM7	6500	HEAD	07/01/2024	20.3	20.1	0.025	1019	7421	604	1.270	54.100	56.800	-6.10%	31.1	1320	1244	-5.76%
AM7	8000	HEAD	07/01/2024	20.3	20.1	0.025	1006	7421	604	1.070	45.400	42.800	-5.73%	26.1	1110	1044	-5.95%

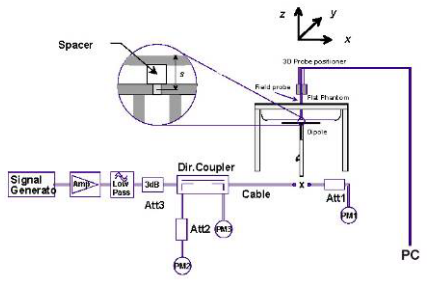

Figure 8-1
System Verification Setup Diagram

Figure 8-2
System Verification Setup Photo

8.3 Power Density Test System Verification

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

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

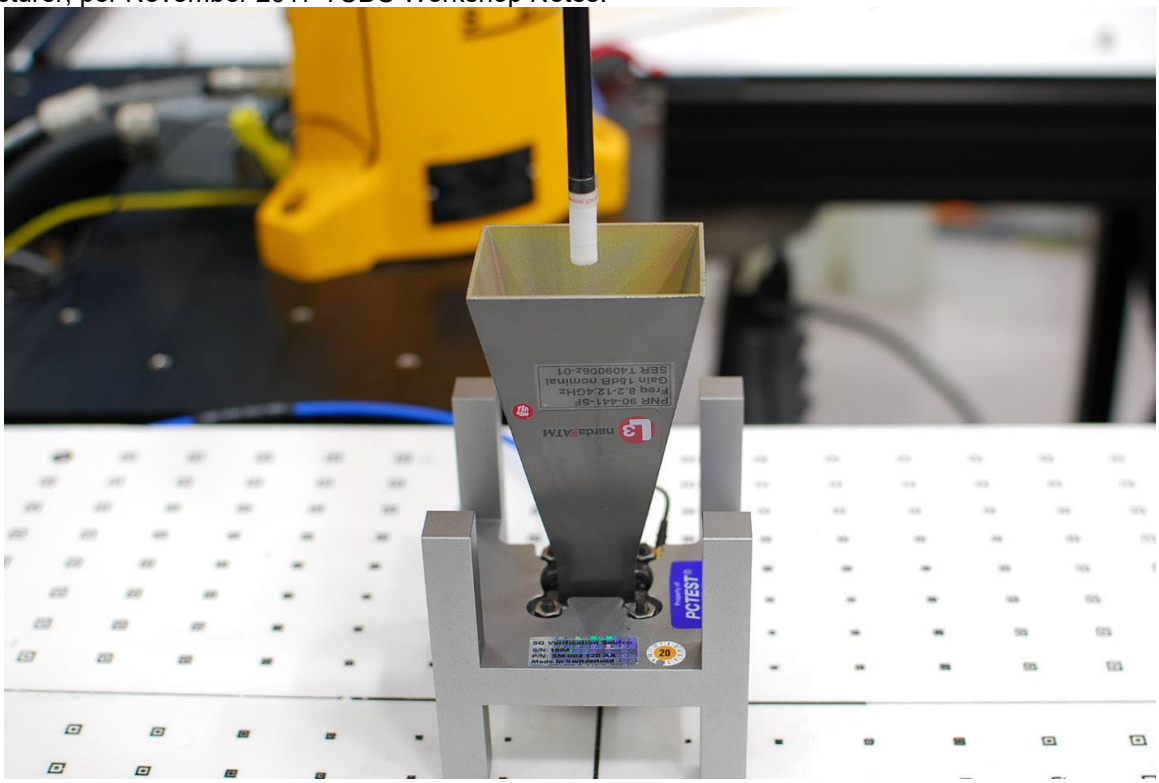

Figure 8-3
System Verification Setup Photo

Table 8-4
10 GHz Verification Results

System Verification												
System	Frequency (GHz)	Date	Source S/N	DAE S/N	Probe S/N	Prad (mW)	Normal psPD (W/m² over 4 cm²)		Deviation (dB)	Total psPD (W/m² over 4 cm²)		Deviation (dB)
							Measured	Target		Measured	Target	
AM12	10	07/01/2024	1006	1408	9487	93.3	57.80	58.50	-0.0523	58.10	58.90	-0.0594

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

9 SAR DATA SUMMARY

9.1 2.4 GHz WIFI SISO Standalone Head SAR

Table 9-1

Exposure	Band / Mode	Bandwidth [MHz]	Service / Modulation	Housing Type	Wristband Type	Serial Number	Duty Cycle [%]	Power Drift [dB]	Frequency [MHz]	Channel #	Data Rate [Mbps]	Max Allowed Power [dBm]	Conducted Power [dBm]	Test Position	Spacing [mm]	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Sport	K92F1	99.76	-0.05	2412	1	1	20.00	19.41	Front	10	0.327	1.146	1.002	0.375	A1
Head	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Sport	K92F1	99.76	-0.14	2437	6	1	20.00	19.07	Front	10	0.316	1.239	1.002	0.392	
Head	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Sport	K92F1	99.76	-0.10	2462	11	1	20.00	18.93	Front	10	0.302	1.279	1.002	0.387	
Head	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Loop	K92F1	99.76	0.02	2412	1	1	20.00	19.41	Front	10	0.206	1.146	1.002	0.237	
Head	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Links	K92F1	99.76	0.02	2412	1	1	20.00	19.41	Front	10	0.231	1.146	1.002	0.265	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population														Head 1.6 W/kg (mW/g) averaged over 1 gram						

9.2 5 GHz WIFI SISO Standalone Head SAR

Table 9-2

Exposure	Band / Mode	Bandwidth [MHz]	Service / Modulation	Housing Type	Wristband Type	Serial Number	Duty Cycle [%]	Power Drift [dB]	Frequency [MHz]	Channel #	U-NII band	Data Rate [Mbps]	Max Allowed Power [dBm]	Conducted Power [dBm]	Test Position	Spacing [mm]	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.06	5300	60	U-NII-2A	6.5	17.00	15.85	Front	10	0.159	1.303	1.015	0.210	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	-0.05	5300	60	U-NII-2A	6.5	17.00	15.85	Front	10	0.150	1.303	1.015	0.198	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.11	5300	60	U-NII-2A	6.5	17.00	15.85	Front	10	0.162	1.303	1.015	0.214	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.16	5720	144	U-NII-2C	6.5	17.00	15.87	Front	10	0.181	1.297	1.015	0.238	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	0.02	5720	144	U-NII-2C	6.5	17.00	15.87	Front	10	0.184	1.297	1.015	0.242	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	-0.16	5500	100	U-NII-2C	6.5	17.00	15.78	Front	10	0.207	1.324	1.015	0.278	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.01	5600	120	U-NII-2C	6.5	17.00	15.79	Front	10	0.215	1.321	1.015	0.288	A2
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	-0.20	5620	124	U-NII-2C	6.5	17.00	15.71	Front	10	0.210	1.346	1.015	0.287	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	-0.09	5720	144	U-NII-2C	6.5	17.00	15.87	Front	10	0.194	1.297	1.015	0.255	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.20	5825	165	U-NII-3	6.5	17.00	15.96	Front	10	0.155	1.271	1.015	0.200	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	-0.02	5825	165	U-NII-3	6.5	17.00	15.96	Front	10	0.160	1.271	1.015	0.206	
Head	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.03	5825	165	U-NII-3	6.5	17.00	15.96	Front	10	0.173	1.271	1.015	0.223	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population															Head 1.6 W/kg (mW/g) averaged over 1 gram						

9.3 2.4 GHz Bluetooth SISO Standalone Head SAR

Table 9-3

Exposure	Band / Mode	Service / Modulation	Housing Type	Wristband Type	Serial Number	Duty Cycle [%]	Power Drift [dB]	Frequency [MHz]	Channel #	Data Rate [Mbps]	Max Allowed Power [dBm]	Conducted Power [dBm]	Test Position	Spacing [mm]	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	2.4 GHz Bluetooth	FHSS	Aluminum	Sport	JC076	100.0	-0.07	2402	0	1	19.00	18.21	Front	10	0.192	1.199	1.000	0.230	A3
Head	2.4 GHz Bluetooth	FHSS	Aluminum	Sport	JC076	100.0	0.06	2441	39	1	19.00	18.05	Front	10	0.171	1.245	1.000	0.213	
Head	2.4 GHz Bluetooth	FHSS	Aluminum	Sport	JC076	100.0	-0.01	2480	78	1	19.00	17.98	Front	10	0.175	1.265	1.000	0.221	
Head	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Loop	JC076	100.0	-0.03	2402	0	1	19.00	18.21	Front	10	0.118	1.199	1.000	0.141	
Head	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Links	JC076	100.0	-0.05	2402	0	1	19.00	18.21	Front	10	0.105	1.199	1.000	0.126	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population													Head 1.6 W/kg (mW/g) averaged over 1 gram						

9.4 5 GHz 802.15.4 ab-NB SISO Standalone Head SAR

Table 9-4

Exposure	Band / Mode	Housing Type	Wristband Type	Serial Number	Duty Cycle [%]	Power Drift [dB]	Frequency [MHz]	Channel #	Data Rate [Mbps]	Max Allowed Power [dBm]	Conducted Power [dBm]	Test Position	Spacing [mm]	Measured 1g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 1g SAR [W/kg]	Plot #
Head	802.15.4 ab-NB	Aluminum	Sport	39N5H	8.70	0.06	5846.25	High	1	16.00	14.97	Front	10	0.009	1.268	1.023	0.012	
Head	802.15.4 ab-NB	Aluminum	Sport	39N5H	8.70	0.08	5728.75	Low	1	16.00	15.15	Front	10	0.012	1.216	1.023	0.015	A4
Head	802.15.4 ab-NB	Aluminum	Sport	39N5H	8.70	0.07	5786.25	Mid	1	16.00	15.05	Front	10	0.008	1.245	1.023	0.010	
Head	802.15.4 ab-NB	Aluminum	Metal Loops	39N5H	8.70	0.02	5728.75	Low	1	16.00	15.15	Front	10	0.010	1.216	1.023	0.012	
Head	802.15.4 ab-NB	Aluminum	Metal Links	39N5H	8.70	0.05	5728.75	Low	1	16.00	15.15	Front	10	0.012	1.216	1.023	0.015	
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 the 8.9% transmission duty factor.

9.5 2.4 GHz WIFI SISO Standalone Extremity SAR

Table 9-5

Exposure	Band / Mode	Bandwidth [MHz]	Service / Modulation	Housing Type	Wristband Type	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 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 10g SAR [W/kg]	Plot #
Extremity	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Sport	JC076	99.76	0.09	2412	1	1	20.00	19.41	Back	0	0.047	1.146	1.002	0.054	
Extremity	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Loop	JC076	99.76	0.08	2412	1	1	20.00	19.41	Back	0	0.049	1.146	1.002	0.056	
Extremity	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Links	JC076	99.76	-0.06	2412	1	1	20.00	19.41	Back	0	0.051	1.146	1.002	0.059	
Extremity	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Links	JC076	99.76	0.02	2437	6	1	20.00	19.07	Back	0	0.051	1.239	1.002	0.063	A5
Extremity	2.4 GHz WIFI/ IEEE 802.11b	22	DSSS	Aluminum	Metal Links	JC076	99.76	0.08	2462	11	1	20.00	18.93	Back	0	0.051	1.279	1.002	0.065	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population														Extremity 4.0 W/kg (mW/g) averaged over 10 grams						

9.6 5 GHz WIFI SISO Standalone Extremity SAR

Table 9-6

Exposure	Band / Mode	Bandwidth [MHz]	Service / Modulation	Housing Type	Wristband Type	Serial Number	Duty Cycle [%]	Power Drift [dB]	Frequency [MHz]	Channel #	U-NII band	Data Rate [Mbps]	Max Allowed Power [dBm]	Conducted Power [dBm]	Test Position	Spacing [mm]	Measured 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 10g SAR [W/kg]	Plot #
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.03	5300	60	U-NII-2A	6.5	17.00	15.85	Back	0	0.008	1.303	1.015	0.011	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	0.08	5300	60	U-NII-2A	6.5	17.00	15.85	Back	0	0.012	1.303	1.015	0.016	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.06	5300	60	U-NII-2A	6.5	17.00	15.85	Back	0	0.016	1.303	1.015	0.021	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.03	5500	100	U-NII-2C	6.5	17.00	15.78	Back	0	0.022	1.324	1.015	0.030	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.08	5600	120	U-NII-2C	6.5	17.00	15.79	Back	0	0.032	1.321	1.015	0.043	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.01	5620	124	U-NII-2C	6.5	17.00	15.71	Back	0	0.026	1.349	1.015	0.036	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.02	5720	144	U-NII-2C	6.5	17.00	15.87	Back	0	0.032	1.297	1.015	0.042	A6
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	0.04	5720	144	U-NII-2C	6.5	17.00	15.87	Back	0	0.016	1.297	1.015	0.021	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.01	5720	144	U-NII-2C	6.5	17.00	15.87	Back	0	0.030	1.297	1.015	0.039	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Sport	03J2X	98.57	0.06	5825	165	U-NII-3	6.5	17.00	15.96	Back	0	0.012	1.271	1.015	0.015	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Loop	03J2X	98.57	0.04	5825	165	U-NII-3	6.5	17.00	15.96	Back	0	0.014	1.271	1.015	0.018	
Extremity	5 GHz WIFI/ IEEE 802.11a	20	OFDM	Aluminum	Metal Links	03J2X	98.57	0.05	5825	165	U-NII-3	6.5	17.00	15.96	Back	0	0.022	1.271	1.015	0.028	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population															Extremity 4.0 W/kg (mW/g) averaged over 10 grams						

9.7 2.4 GHz Bluetooth SISO Standalone Extremity SAR

Table 9-7

Exposure	Band / Mode	Service / Modulation	Housing Type	Wristband Type	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 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 10g SAR [W/kg]	Plot #
Extremity	2.4 GHz Bluetooth	FHSS	Aluminum	Sport	JC076	100.0	-0.02	2402	0	1	19.00	18.21	Back	0	0.031	1.199	1.000	0.037	
Extremity	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Loop	JC076	100.0	0.03	2402	0	1	19.00	18.21	Back	0	0.035	1.199	1.000	0.042	
Extremity	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Links	JC076	100.0	0.00	2402	0	1	19.00	18.21	Back	0	0.040	1.199	1.000	0.048	
Extremity	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Links	JC076	100.0	0.01	2441	39	1	19.00	18.05	Back	0	0.043	1.245	1.000	0.054	A7
Extremity	2.4 GHz Bluetooth	FHSS	Aluminum	Metal Links	JC076	100.0	0.05	2480	78	1	19.00	17.98	Back	0	0.037	1.265	1.000	0.047	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population														Extremity 4.0 W/kg (mW/g) averaged over 10 grams					

9.8 5 GHz 802.15.4 ab-NB SISO Standalone Extremity SAR

Table 9-8

Exposure	Band / Mode	Housing Type	Wristband Type	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 10g SAR [W/kg]	Power Scaling Factor	Duty Cycle Scaling Factor	Reported 10g SAR [W/kg]	Plot #
Extremity	802.15.4 ab-NB	Aluminum	Sport	39N5H	8.70	0.01	5728.75	Low	1	16.00	15.15	Back	0	0.000	1.216	1.023	0.000	
Extremity	802.15.4 ab-NB	Aluminum	Metal Loops	39N5H	8.70	0.09	5728.75	Low	1	16.00	15.15	Back	0	0.000	1.216	1.023	0.000	
Extremity	802.15.4 ab-NB	Aluminum	Metal Links	39N5H	8.70	0.02	5846.25	High	1	16.00	14.97	Back	0	0.000	1.268	1.023	0.000	
Extremity	802.15.4 ab-NB	Aluminum	Metal Links	39N5H	8.70	0.01	5728.75	Low	1	16.00	15.15	Back	0	0.000	1.216	1.023	0.000	A8
Extremity	802.15.4 ab-NB	Aluminum	Metal Links	39N5H	8.70	0.08	5786.25	Mid	1	16.00	15.05	Back	0	0.000	1.245	1.023	0.000	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population												Extremity 4.0 W/kg (mW/g) averaged over 10 grams						

Note: The reported SAR was scaled to the 8.9% transmission duty factor.

9.9 UWB Standalone Extremity SAR

Table 9-9

Exposure	Band / Mode	Service / Modulation	Housing Type	Wristband Type	Serial Number	Duty Cycle	Power Drift [dB]	Frequency [MHz]	Channel #	Test Position	Spacing [mm]	Measured 10g SAR [W/kg]	Plot #
Extremity	UWB	CW	Aluminum	Sport	G59TW	1:1	0.04	6489.60	5	Back	0	0.000	
Extremity	UWB	CW	Aluminum	Sport	G59TW	1:1	0.04	7987.20	9	Back	0	0.000	
Extremity	UWB	CW	Aluminum	Metal Loop	G59TW	1:1	0.05	6489.60	5	Back	0	0.000	
Extremity	UWB	CW	Aluminum	Metal Loop	G59TW	1:1	0.07	7987.20	9	Back	0	0.002	
Extremity	UWB	CW	Aluminum	Metal Links	G59TW	1:1	0.05	6489.60	5	Back	0	0.002	
Extremity	UWB	CW	Aluminum	Metal Links	G59TW	1:1	0.06	7987.20	9	Back	0	0.002	A9
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Extremity 4.0 W/kg (mW/g) averaged over 10 grams			

Exposure	Band/ Mode	Service/ Modulation	Housing Type	Form Factor	Serial Number	Duty Cycle	Power Drift [dB]	Frequency [MHz]	Channel #	Test Position	Spacing [mm]	Measured APD [W/m² (4cm²)]	Plot #
Extremity	UWB	CW	Aluminum	Sport	G59TW	1:1	0.04	6489.60	5	Back	0	0.022	
Extremity	UWB	CW	Aluminum	Sport	G59TW	1:1	0.04	7987.20	9	Back	0	0.017	
Extremity	UWB	CW	Aluminum	Metal Loop	G59TW	1:1	0.05	6489.60	5	Back	0	0.024	
Extremity	UWB	CW	Aluminum	Metal Loop	G59TW	1:1	0.07	7987.20	9	Back	0	0.040	
Extremity	UWB	CW	Aluminum	Metal Links	G59TW	1:1	0.05	6489.60	5	Back	0	0.041	
Extremity	UWB	CW	Aluminum	Metal Links	G59TW	1:1	0.06	7987.20	9	Back	0	0.045	

9.10 NFC Standalone Extremity SAR

Table 9-10

Exposure	Band / Mode	Signal Type	Housing Type	Wristband Type	Serial Number	Power Drift [dB]	Frequency [MHz]	Data Rate (Kbps)	Test Position	Spacing [mm]	Measured 10g SAR [W/kg]	Plot #
Extremity	NFC	A	Aluminum	Sport	1G2F5	0.01	13.65	848	Back	0	0.000	A10
Extremity	NFC	A	Aluminum	Metal Loop	1G2F5	0.09	13.65	848	Back	0	0.000	
Extremity	NFC	A	Aluminum	Metal Links	1G2F5	0.08	13.65	848	Back	0	0.000	
ANSI/IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Extremity 4.0 W/kg (mW/g) averaged over 10 grams			

9.11 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 447498 D04v01.
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 D04v01.
6. Per FCC KDB Publication 865664 D01v01r04, variability SAR tests were not required since measured SAR results for all frequency bands were less than 0.8 W/kg and 2.0 W/kg for 10g SAR.
7. This device has three housing types: Aluminum. The non-metallic wrist accessory, sport band, was evaluated for all exposure conditions. The available metallic wrist accessories, metal links band and metal loop band, were additionally evaluated.
8. This device is a portable wrist-worn device and does not support any other use conditions. Therefore, the procedures in FCC KDB Publication 447498 D04v01 Section 6.2 have been applied for extremity and next to mouth (head) conditions.
9. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.

WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR. See Section 6.2.4 for more information.
2. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 5 GHz WIFI single transmission chain operations, the initial test configuration was selected according to the transmission mode with the highest maximum allowed powers. Other transmission modes were not investigated since the highest reported SAR for initial test configuration adjusted by the ratio of maximum output powers is less than 1.2 W/kg for 1g evaluations. See Section 6.2.5 for more information.
3. When the maximum reported 1g averaged SAR is ≤0.8 W/kg, SAR testing on additional channels was not required. Otherwise, SAR for the next highest output power channel was required until the reported SAR result was ≤ 1.20 W/kg for 1g evaluations or all test channels were measured. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools. The reported SAR was scaled to the 100% transmission duty factor to determine compliance.

Bluetooth Notes

1. To determine compliance, Bluetooth SAR was measured with the maximum power condition. Bluetooth was evaluated with a test mode with 100% transmission duty factor.

802.15.4 ab-Nb Notes

1. 802.15.4 ab-NB SAR was scaled to the 8.9% transmission duty factor to determine compliance since the duty factor of the device is limited to 8.9% per manufacturer. See Section 7.4 for the time domain plot and calculation for the duty factor of the device.

9.12 Power Density Data

MEASUREMENT RESULTS																			
Frequency (MHz)	Channel	Mode	Service	Wristband Type	Power Drift (dB)	Spacing (mm)	Housing Type	DUT Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Grid Step (λ)	iPD (W/m²)	Scaling Factor for Measurement Uncertainty per IEC 62479	Normal psPD (W/m²)	Scaled Normal psPD (W/m²)	Total psPD (W/m²)	Scaled Total psPD (W/m²)	Plot #
6489.60	5	UWB	CW	Sport	-0.07	2	Aluminum	P4DNF	1000	Back	100	0.25	3.000	1.554	0.344	0.535	0.381	0.592	
7987.20	9	UWB	CW	Sport	0.09	2	Aluminum	P4DNF	1000	Back	100	0.25	3.040	1.554	0.522	0.811	0.563	0.875	
6489.60	5	UWB	CW	Metal Loop	-0.07	2	Aluminum	P4DNF	1000	Back	100	0.25	5.240	1.554	0.792	1.231	0.814	1.265	
7987.20	9	UWB	CW	Metal Loop	-0.08	2	Aluminum	P4DNF	1000	Back	100	0.25	4.940	1.554	0.950	1.476	0.997	1.549	A11
7987.20	9	UWB	CW	Metal Loop	0.00	7.5	Aluminum	P4DNF	1000	Back	100	0.25	0.144	1.554	0.045	0.070	0.095	0.148	
6489.60	5	UWB	CW	Metal Links	-0.03	2	Aluminum	P4DNF	1000	Back	100	0.25	2.360	1.554	0.305	0.474	0.310	0.482	
7987.20	9	UWB	CW	Metal Links	0.18	2	Aluminum	P4DNF	1000	Back	100	0.25	4.210	1.554	0.629	0.977	0.767	1.192	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population								Power Density 10 W/m² averaged over 4 cm²											

9.13 Power Density Notes

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

10 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

10.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D04v01 are applicable to devices with built in unlicensed transmitters such as 802.11 and Bluetooth devices which may simultaneously transmit.

10.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore, simultaneous transmission analysis is required. Per FCC KDB Publication 447498 D04v01 4.3.2, simultaneous transmission SAR test exclusion may be applied when the sum of the 1g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤1.6 W/kg. 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.

Note: In cases where simultaneous transmission scenarios overlap with the same power level (for example, cellular band + 2.4 GHz WIFI and cellular band + 2.4 GHz WIFI + 802.15.4 ab-NB), the most conservative SAR summation scenario was evaluated.

10.3 Head SAR Simultaneous Transmission Analysis

For SAR summation, the highest reported SAR across all housing and wristband types was used as a conservative evaluation for simultaneous transmission analysis.

Table 10-1
Simultaneous Transmission Scenario with 2.4 GHz WIFI and 802.15.4 ab-NB (Head at 1.0 cm)

Exposure Condition	2.4 GHz WIFI SAR (W/kg)	802.15.4 ab-NB SAR (W/kg)	∑ SAR (W/kg)
	1	2	1+2
Head SAR	0.392	0.015	0.407

Table 10-2
Simultaneous Transmission Scenario with 2.5 GHz Bluetooth and 5 GHz WIFI (Head at 1.0 cm)

Exposure Condition	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WIFI SAR (W/kg)	∑ SAR (W/kg)
	1	2	1+2
Head SAR	0.230	0.288	0.518

Table 10-3
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth and 802.15.4 ab-NB (Head at 1.0 cm)

Exposure Condition	2.4 GHz Bluetooth SAR (W/kg)	802.15.4 ab-NB SAR (W/kg)	∑ SAR (W/kg)
	1	2	1+2
Head SAR	0.230	0.015	0.245

10.4 Extremity SAR Simultaneous Transmission Analysis

For SAR summation, the highest reported SAR across all housing and wristband types was used as a conservative evaluation for simultaneous transmission analysis.

Table 10-4
Simultaneous Transmission Scenario with 2.4 GHz WIFI, 802.15.4 ab-NB and NFC (Extremity at 0.0 cm)

Exposure Condition	2.4 GHz WIFI SAR (W/kg)	802.15.4 ab-NB SAR (W/kg)	NFC SAR (W/kg)	∑ SAR (W/kg)
	1	2	3	1+2+3
Extremity SAR	0.065	0.000	0.000	0.065

Table 10-5
Simultaneous Transmission Scenario with 2.4 GHz WIFI, UWB and NFC (Extremity at 0.0 cm)

Exposure Condition	2.4 GHz WIFI SAR (W/kg)	UWB SAR (W/kg)	NFC SAR (W/kg)	∑ SAR (W/kg)
	1	2	3	1+2+3
Extremity SAR	0.065	0.002	0.000	0.067

Table 10-6
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth, 5 GHz WIFI and NFC (Extremity at 0.0 cm)

Exposure Condition	2.4 GHz Bluetooth SAR (W/kg)	5 GHz WIFI SAR (W/kg)	NFC SAR (W/kg)	∑ SAR (W/kg)
	1	2	3	1+2+3
Extremity SAR	0.054	0.043	0.000	0.097

Table 10-7
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth, 802.15.4 ab-NB and NFC (Extremity at 0.0 cm)

Exposure Condition	2.4 GHz Bluetooth SAR (W/kg)	802.15.4 ab-NB SAR (W/kg)	NFC SAR (W/kg)	∑ SAR (W/kg)
	1	2	3	1+2+3
Extremity SAR	0.054	0.000	0.000	0.054

Table 10-8
Simultaneous Transmission Scenario with 2.4 GHz Bluetooth, UWB and NFC (Extremity at 0.0 cm)

Exposure Condition	2.4 GHz Bluetooth SAR (W/kg)	UWB SAR (W/kg)	NFC SAR (W/kg)	∑ SAR (W/kg)
	1	2	3	1+2+3
Extremity SAR	0.054	0.002	0.000	0.056

10.5 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 D04v01.

11 SAR MEASUREMENT VARIABILITY

11.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was not assessed for each frequency band since all measured SAR values are < 0.8 W/kg for 1g SAR and < 2.0 W/kg for 10g SAR.

11.2 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 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	E4438C	ESG Vector Signal Generator	11/14/2023	Annual	11/14/2024	MY45093852
Agilent	E4438C	ESG Vector Signal Generator	11/15/2023	Annual	11/15/2024	MY45092078
Agilent	N5182A	MXG Vector Signal Generator	10/12/2023	Annual	10/12/2024	MY47400015
Agilent	N5182A	MXG Vector Signal Generator	3/7/2024	Annual	3/7/2025	MY47420603
Agilent	8753ES	S-Parameter Vector Network Analyzer	1/10/2024	Annual	1/10/2025	MY40001472
Agilent	8753ES	S-Parameter Vector Network Analyzer	7/21/2023	Annual	7/21/2024	US39170118
Agilent	N4010A	Wireless Connectivity Test Set	N/A	N/A	N/A	GB46170464
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433973
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433974
Amplifier Research	150A100C	Amplifier	CBT	N/A	CBT	350132
Anritsu	MN8110B	I/O Adaptor	CBT	N/A	CBT	6261747881
Anritsu	ML2496A	Power Meter	11/6/2023	Annual	11/6/2024	2002005
Anritsu	ML2495A	Power Meter	3/14/2024	Annual	3/14/2025	1349513
Anritsu	MA2411B	Pulse Power Sensor	8/22/2023	Annual	8/22/2024	1726262
Anritsu	MA2411B	Pulse Power Sensor	11/8/2023	Annual	11/8/2024	1027293
Anritsu	MA24106A	USB Power Sensor	12/4/2023	Annual	12/4/2024	1520501
Anritsu	MA24106A	USB Power Sensor	4/15/2024	Annual	4/15/2025	1827528
Mini-Circuits	PWR-4GHS	USB Power Sensor	6/12/2024	Annual	6/12/2025	12001070013
Control Company	4052	Long Stem Thermometer	2/27/2024	Biennial	2/27/2026	240174346
Control Company	4052	Long Stem Thermometer	2/27/2024	Biennial	2/27/2026	240171096
Control Company	4052	Long Stem Thermometer	2/27/2024	Biennial	2/27/2026	240171059
Control Company	4040	Therm./ Clock/ Humidity Monitor	4/15/2024	Biennial	4/15/2026	240310280
Control Company	4040	Therm./ Clock/ Humidity Monitor	4/15/2024	Biennial	4/15/2026	240310282
Control Company	S66279	Therm./ Clock/ Humidity Monitor	2/16/2024	Biennial	2/16/2026	240140051
Mitutoyo	500-196-30	CD-6"ASX 6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
Keysight Technologies	N9020A	MXA Signal Analyzer	4/11/2024	Annual	4/11/2025	MY54500644
Agilent	N9020A	MXA Signal Analyzer	6/14/2024	Annual	6/14/2025	MY56470202
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Mini-Circuits	VLF-6000+	Low Pass Filter DC to 6000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	ZUDC10-83-S+	Directional Coupler	CBT	N/A	CBT	2050
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Seekonk	NC-100	Torque Wrench	CBT	N/A	CBT	22217
Seekonk	NC-100	Torque Wrench	4/2/2024	Biennial	4/2/2026	1262
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2023	Annual	11/13/2024	1277
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/14/2023	Annual	8/14/2024	1041
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1237
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1331
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1390
SPEAG	DAK-12	Dielectric Assessment Kit (4MHz - 3GHz)	3/11/2024	Annual	3/11/2025	1102
SPEAG	CLA-13	Confined Loop Antenna	11/9/2023	Annual	11/9/2024	1004
SPEAG	D2450V2	2450 MHz SAR Dipole	11/9/2021	Triennial	11/9/2024	921
SPEAG	D5GHzV2	5 GHz SAR Dipole	3/12/2024	Annual	3/12/2025	1123
SPEAG	D5GHzV2	5 GHz SAR Dipole	11/17/2022	Biennial	11/17/2024	1066
SPEAG	D6.5GHzV2	6.5 GHz SAR Dipole	10/11/2023	Annual	10/11/2024	1019
SPEAG	D8GHzV2	8 GHz SAR Dipole	5/8/2024	Annual	5/8/2025	1006
SPEAG	D10GHzV2	10GHz System Verification Antenna	10/13/2023	Annual	10/13/2024	1006
SPEAG	DAE4	Dasy Data Acquisition Electronics	10/18/2023	Annual	10/18/2024	1237
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/8/2024	Annual	5/8/2025	1683
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/9/2024	Annual	4/9/2025	501
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/9/2024	Annual	2/9/2025	467
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/12/2023	Annual	9/12/2024	1684
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/6/2024	Annual	3/6/2025	1408
SPEAG	EX3DV4	SAR Probe	5/13/2024	Annual	5/13/2025	7682
SPEAG	EX3DV4	SAR Probe	2/9/2024	Annual	2/9/2025	7427
SPEAG	EX3DV4	SAR Probe	10/16/2023	Annual	10/16/2024	3746
SPEAG	EX3DV4	SAR Probe	4/16/2024	Annual	4/16/2025	7532
SPEAG	EX3DV4	SAR Probe	10/2/2023	Annual	10/2/2024	3949
SPEAG	EUmmWV4	mmWV4 Probe	4/8/2024	Annual	4/8/2025	9487

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.

13 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	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

Applicable for SAR measurements > 6 GHz:

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

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

Applicable for Power Density measurements:

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

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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