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WIFI 6 GHZ RF EXPOSURE EVALUATION

Applicant Name
Sony Corporation
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Tokyo, 108-0075, Japan
Sony Corporation

Date of Testing
02/28/2023 – 03/02/2023
Test Site/Location
Element, Columbia, MD, USA
Document Serial No:
1M2302060006-20.PY7

FCC ID: **PY7-84558E**

APPLICANT: **SONY CORPORATION**

DUT Type: Portable Device
Application Type: Certification
FCC Rule Part(s): CFR §2.1093

Band & Mode	Tx Frequency	SAR			APD			PD
	MHz	1g Head (W/kg)	1g Body-worn (W/kg)	10g Phablet (W/kg)	Head (W/m^2)	Body-worn (W/m^2)	Phablet (W/m^2)	psPD (W/m^2)
WIFI 6 GHz	5955-7115	<0.1	<0.1	0.251	0.24	0.14	5.99	3.493

Values above represent RF exposure evaluations during MIMO operations.

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

RJ Ortanez
Executive Vice President

CERT #2041.01

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	Tx Frequency
U-NII-5	5955 - 6415 MHz
U-NII-6	6435 - 6515 MHz
U-NII-7	6535 - 6875 MHz
U-NII-8	6895 - 7115 MHz

1.2 Nominal and Maximum Output Power Specifications

The 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.

Please see 802.11ax RU SAR Exclusion Appendix from measurement report SN 1M2302060006-19.PY7 for 802.11ax RU target powers.

1.2.1 Maximum SISO in MIMO mode WLAN Output Power

Mode	IEEE 802.11 (in dBm)	
	SISO in MIMO mode	
	a (CDD + STBC)	ax (SU) (CDD + STBC, SDM)
	Maximum	Maximum
6 GHz WIFI (20MHz BW)	5925-6875 MHz: 5.0 6875-7125 MHz: 5.5	5925-6875 MHz: 5.0 6875-7125 MHz: 6.5
6 GHz WIFI (40MHz BW)	[redacted]	5925-6875 MHz: 8.0 6875-7125 MHz: 9.5
6 GHz WIFI (80MHz BW)	[redacted]	11.5
6 GHz WIFI (160MHz BW)	[redacted]	11.5

1.2.2 Reduced SISO in MIMO mode WLAN Output Power

Mode	IEEE 802.11 (in dBm)	
	SISO in MIMO mode	
	a (CDD + STBC)	ax (SU) (CDD + STBC, SDM)
	Maximum	Maximum
6 GHz WIFI (20MHz BW)	5925-6875 MHz: 5.0 6875-7125 MHz: 5.5	5925-6875 MHz: 5.0 6875-7125 MHz: 6.5
6 GHz WIFI (40MHz BW)	[redacted]	5925-6875 MHz: 8.0 6875-7125 MHz: 9.5
6 GHz WIFI (80MHz BW)	[redacted]	9.5
6 GHz WIFI (160MHz BW)	[redacted]	9.5

1.3 DUT Antenna Locations

The overall dimensions of this device are > 9 x 5 cm. A diagram showing the location of the device antennas can be found in SAR Part 1 Report DUT Antenna Diagram & SAR Test Setup Photographs Appendix. Since the diagonal dimension of the display is > 150 mm and <200 mm, it is considered a “phablet.” Exact antenna dimensions and separation distances are shown in the Technical Descriptions in the FCC filing

Table 1-1
Device Surfaces

Device Sides/Edges for Testing						
Mode	Back	Front	Top	Bottom	Right	Left
6 GHz WLAN MIMO	Yes	Yes	Yes	Yes	No	Yes

Note: Particular DUT edges were not required to be evaluated for phablet SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 648474 D04v01r03. The distances between the transmit antennas and the edges of the device are included in the filing. Wireless router mode is disabled for all 6 GHz WLAN operations.

1.4 Miscellaneous Testing Considerations

Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors. FCC KDB 648474 and FCC KDB 248227 were followed for test positions, distances, and modes. Per TCB workshop October 2020 notes, 5 channels were tested. 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 ≥ -1dB per equipment manufacturer guidance. Power density results are scaled up for uncertainty above 30%.

Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension of the display is greater than 150mm and less than 200mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.

6 GHz WIFI SAR results are used for simultaneous transmission analysis with the other transmitters. Analysis can be found in SAR report.

To make the most efficient use of the additional available subcarriers (data tones), IEEE 802.11ax can utilize Orthogonal Frequency-Division Multiple Access (OFDMA) which divides the existing 802.11 channels into smaller subchannels called Resource Units (RUs). Possible RU sizes are: 26T, 52T, 106T, 242T, 484T, 996T, and 996T*2.

Per FCC Guidance, 802.11ax RU was considered a higher order 802.11 mode when compared to a/b/g/n/ac to apply KDB Publication 248227 D01v02r02 for OFDM mode selection. Therefore, SAR tests were not required for 802.11ax RU based on the maximum allowed output powers of OFDM modes and the reported SAR values. Per FCC Guidance, maximum conducted powers were performed for each RU size to demonstrate that the output powers would not be higher than the other OFDM 802.11 modes. Please see Measurement Report SN 1M2302060006-19.PY7 for 802.11ax RU output powers.

1.5 Guidance Applied

- 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)
- IEEE 1528-2013
- IEC/IEEE 63195-1:2022
- IEC 62479:2010
- FCC KDB 865664 D02 v01r02
- FCC KDB 648474 D04 v01r03
- FCC KDB 248227 D01 v02r02
- FCC KDB 447498 D01 v06
- FCC KDB 865664 D01 v01r04
- April 2019 TCB Workshop Notes (IEEE 802.11ax)

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 10.

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. [15]

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 [44] and Health Canada RF Exposure Guidelines Safety Code 6 [35]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [17] 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.[20]

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:

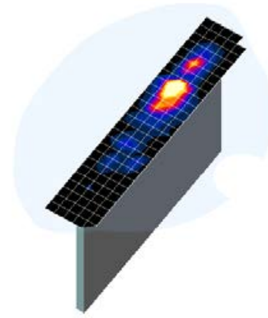

Figure 3-1
Sample SAR Area Scan

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*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

4 DEFINITION OF REFERENCE POINTS

4.1 EAR REFERENCE POINT

Figure 4-2 shows the front, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point (ERP), and "RE" is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 4-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 4-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning **[18]**.

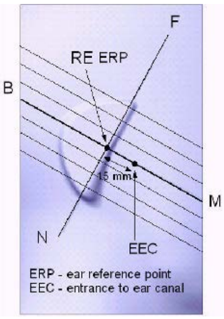

Figure 4-1
Close-Up Side view of ERP

4.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 4-3). The acoustic output was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 4-2
Front, back and side view of SAM Twin Phantom

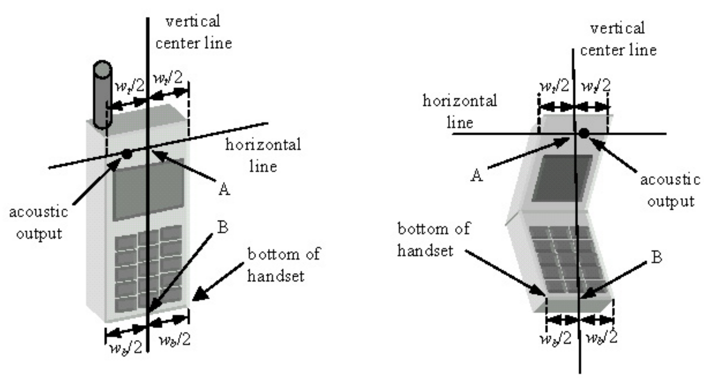

Figure 4-3
Handset Vertical Center & Horizontal Line Reference Points

5 TEST CONFIGURATION POSITIONS

5.1 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.

5.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 5-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

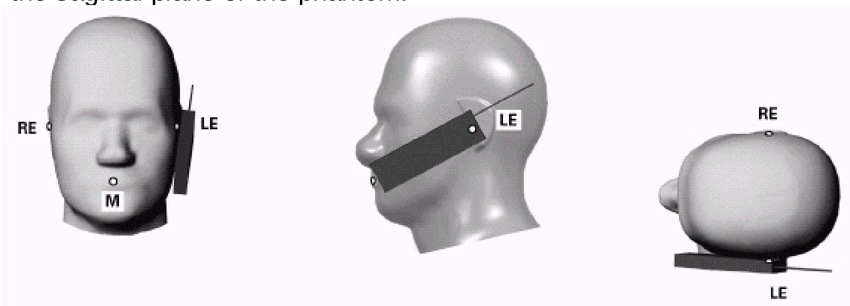

Figure 5-1 Front, Side and Top View of Cheek Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the pinna.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the reference plane.
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the device contact with the ear, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 5-2).

5.3 Positioning for Ear / 15º Tilt

With the test device aligned in the “Cheek Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 5-2).

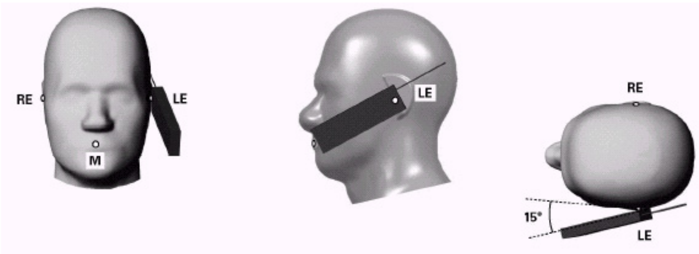

Figure 5-2 Front, Side and Top View of Ear/15º Tilt Position

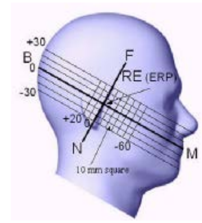

Figure 5-3
Side view w/ relevant markings

5.4 Body-Worn Accessory Configurations

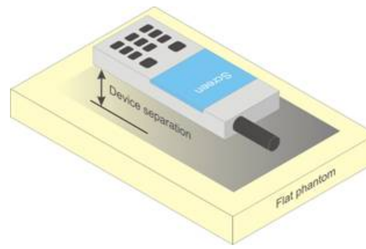

Figure 5-4
Sample Body-Worn Diagram

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 5-4). Per FCC KDB Publication 648474 D04v01r03, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v06 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented.
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device, and positioned against a flat phantom in a normal use configuration.

5.5 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 1g body and 10g extremity SAR Exclusion Thresholds found in KDB Publication 447498 D01v06 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v06, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

5.6 Phablet Configurations

For smart phones with a display diagonal dimension > 150 mm or an overall diagonal dimension > 160 mm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the phablets procedures outlined in KDB Publication 648474 D04v01r03 should be applied to evaluate SAR compliance. A device marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance. In addition to the normally required head and body-worn accessory SAR test procedures required for handsets, the UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna <=25 mm from that surface or edge, in direct contact with the phantom, for 10g SAR. The UMPC mini-tablet 1g SAR at 5 mm is not required. When hotspot mode applies, 10g SAR is required only for the surfaces and edges with hotspot mode 1g SAR > 1.2 W/kg.

6 RF EXPOSURE LIMITS

6.1 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.

6.2 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.

6.3 RF Exposure Limits for Frequencies Below 6 GHz

Table 6-1
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.

6.4 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

7 MEASUREMENT PROCEDURES

7.1 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.

7.2 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.

7.3 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.

7.4 Initial Test Position Procedure

For exposure conditions with multiple test positions, such as handset operating next to the ear, devices with hotspot mode or UMPC mini-tablet, procedures for initial test position can be applied. Using the transmission mode determined by the DSSS procedure or initial test configuration, area scans are measured for all positions in an exposure condition. The test position with the highest extrapolated (peak) SAR is used as the initial test position. When reported SAR for the initial test position is ≤ 0.4 W/kg, no additional testing for the remaining test positions is required. Otherwise, SAR is evaluated at the subsequent highest peak SAR positions until the reported SAR result is ≤ 0.8 W/kg or all test positions are measured. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

7.5 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, 802.11n and 802.11ac 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 and 802.11ac or 802.11g then 802.11n, is used for SAR measurement. Per April 2019 TCB Workshop guidance, 802.11ax was considered the highest order 802.11 mode. 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.

7.6 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 7.5). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

7.7 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.

7.8 MIMO SAR Considerations

Per KDB Publication 248227 D01v02r02, the simultaneous SAR provisions in KDB Publication 447498 D01v06 should be applied to determine simultaneous transmission SAR test exclusion for WIFI MIMO. If the sum of 1g single transmission chain SAR measurements is <1.6 W/kg, no additional SAR measurements for MIMO are required. Alternatively, SAR for MIMO can be measured with all antennas transmitting simultaneously at the specified maximum output power of MIMO operation. When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

8 RF CONDUCTED POWERS

Table 8-1
6 GHz WLAN Maximum Average RF Power – 802.11ax 80 MHz BW

6GHz (80MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
5985	7	11.04	11.48	14.28
6305	71	11.21	11.33	14.28
6545	119	10.23	11.48	13.91
6785	167	10.69	11.23	13.98
7025	215	10.48	11.42	13.99

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 identical maximum specified output power, channel bandwidth, modulation and data rates, power measurements were required for all identical configurations.
- 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.

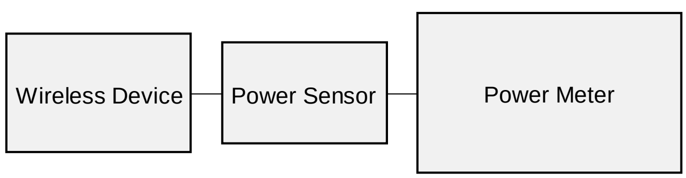

Figure 8-1
Power Measurement Setup

9 SYSTEM VERIFICATION

9.1 SAR Test System Verification

Table 9-1
Measured 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
03/01/2023	6500 Head	20.4	5935	5.572	34.406	5.411	35.143	2.98%	-2.10%
			5970	5.611	34.396	5.448	35.120	2.99%	-2.06%
			5985	5.616	34.356	5.464	35.110	2.78%	-2.15%
			6000	5.628	34.309	5.480	35.100	2.70%	-2.25%
			6025	5.673	34.221	5.510	35.070	2.96%	-2.42%
			6065	5.733	34.196	5.557	35.022	3.17%	-2.36%
			6075	5.735	34.182	5.569	35.010	2.98%	-2.37%
			6085	5.741	34.171	5.580	34.998	2.89%	-2.36%
			6185	5.865	33.984	5.698	34.878	2.93%	-2.56%
			6275	5.989	33.790	5.805	34.770	3.17%	-2.82%
			6285	5.993	33.780	5.816	34.758	3.04%	-2.81%
			6305	6.010	33.739	5.840	34.734	2.91%	-2.86%
			6345	6.089	33.625	5.887	34.686	3.43%	-3.06%
			6475	6.221	33.417	6.041	34.530	2.98%	-3.22%
			6500	6.228	33.343	6.070	34.500	2.60%	-3.35%
			6505	6.236	33.326	6.076	34.494	2.63%	-3.39%
			6545	6.341	33.273	6.122	34.446	3.58%	-3.41%
			6665	6.487	33.114	6.265	34.302	3.54%	-3.46%
			6675	6.493	33.094	6.273	34.290	3.51%	-3.49%
			6715	6.498	32.933	6.319	34.242	2.83%	-3.82%
			6785	6.619	32.909	6.400	34.158	3.42%	-3.66%
			6825	6.633	32.707	6.447	34.110	2.89%	-4.11%
			6985	6.862	32.617	6.633	33.918	3.45%	-3.84%
			7025	6.866	32.380	6.680	33.870	2.78%	-4.40%

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.

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 SAR System Validation Appendix.

Table 9-2
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	Measured SAR_{1g} (W/kg)	1 W Target SAR_{1g} (W/kg)	1 W Normalized SAR_{1g} (W/kg)	$Deviation_{1g}$ (%)	Measured SAR_{10g} (W/kg)	1 W Target SAR_{10g} (W/kg)	1 W Normalized SAR_{10g} (W/kg)	$Deviation_{10g}$ (%)	Measured $4cm^2$ APD (W/m^2)	1W Target $4cm^2$ APD (W/m^2)	1 W Normalized $4cm^2$ APD (W/m^2)	Deviation $4cm^2$ APD (%)
AM7	6500	Head	03/01/2023	22.5	20.8	0.025	1019	7416	7.550	295.000	302.000	2.37%	1.400	54.000	56.000	3.70%	34.1000	1310.0000	1364.000	4.12%

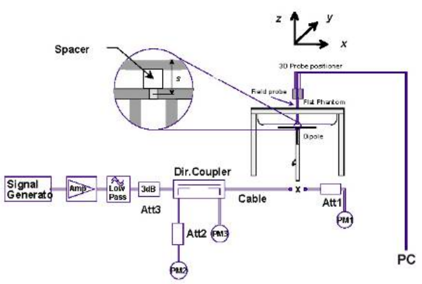

Figure 9-1
System Verification Setup Diagram

Figure 9-2
System Verification Setup Photo

9.2 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.

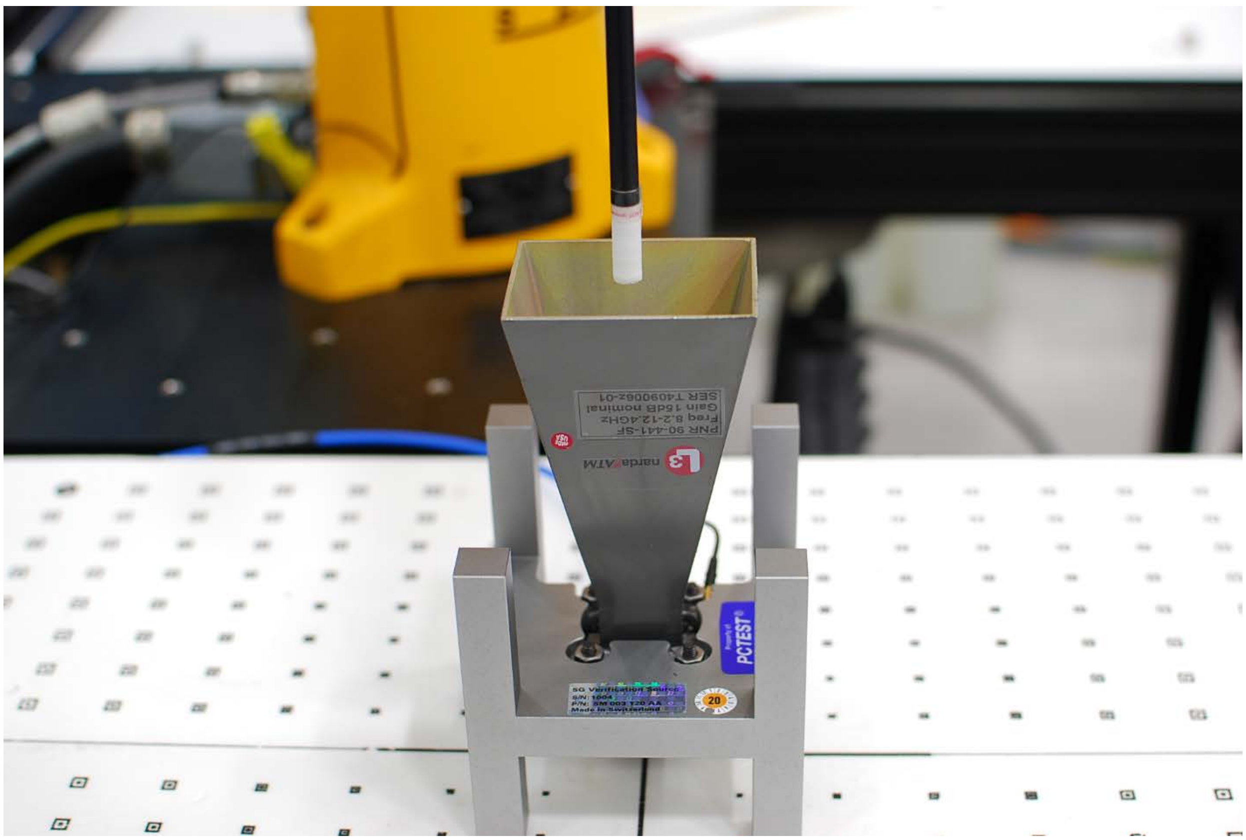

Figure 9-3
System Verification Setup Photo

Table 9-3
10 GHz Verifications

System Verification											
System	Frequency (GHz)	Date	Source S/N	Probe S/N	Prad (mW)	Normal psPD (W/m² over 4 cm²)		Deviation (dB)	Total psPD (W/m² over 4 cm²)		Deviation (dB)
						Measured	Target		Measured	Target	
Q	10	02/28/2023	1004	9407	86.1	47.50	49.40	-0.17	47.70	49.40	-0.15
Q	10	03/02/2023	1004	9407	86.1	47.40	49.40	-0.18	47.60	49.40	-0.16

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

10 DATA SUMMARY

10.1 SAR and Absorbed Power Density Results

Table 10-1
6 GHz WLAN Head MIMO SAR

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.															(W/kg)			(W/kg)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.06	Right	Cheek	MIMO	02862	68.1	99.73	0.025	1.069	1.003	0.027	
5985.00	7	802.11ax	OFDM	80	11.50	11.04	11.50	11.48	0.05	Right	Tilt	MIMO	02862	68.1	99.73	0.037	1.112	1.003	0.041	A1
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.03	Right	Tilt	MIMO	02862	68.1	99.73	0.030	1.069	1.003	0.032	
6545.00	119	802.11ax	OFDM	80	11.50	10.23	11.50	11.48	-0.06	Right	Tilt	MIMO	02862	68.1	99.73	0.001	1.340	1.003	0.001	
6785.00	167	802.11ax	OFDM	80	11.50	10.69	11.50	11.23	-0.03	Right	Tilt	MIMO	02862	68.1	99.73	0.030	1.205	1.003	0.036	
7025.00	215	802.11ax	OFDM	80	11.50	10.48	11.50	11.42	0.05	Right	Tilt	MIMO	02862	68.1	99.73	0.021	1.265	1.003	0.027	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.10	Left	Cheek	MIMO	02862	68.1	99.73	0.011	1.069	1.003	0.012	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.05	Left	Tilt	MIMO	02862	68.1	99.73	0.010	1.069	1.003	0.011	
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: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

Table 10-2
6 GHz WLAN Body-worn MIMO SAR

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Peak Number	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (1g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (1g)	Plot #
MHz	Ch.																(W/kg)			(W/kg)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.01	10	MIMO	1	02862	68.1	Back	99.73	0.015	1.069	1.003	0.016	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.08	10	MIMO	2	02862	68.1	Back	99.73	0.022	1.069	1.003	0.024	A2
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 gram											

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

Table 10-3
6 GHz WLAN Phablet MIMO SAR

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Peak Number	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	SAR (10g)	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Reported SAR (10g)	Plot #
MHz	Ch.																(W/kg)			(W/kg)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.03	0	MIMO	1	02862	68.1	Back	99.73	0.106	1.069	1.003	0.114	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.05	0	MIMO	2	02862	68.1	Back	99.73	0.065	1.069	1.003	0.070	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.20	0	MIMO	1	02862	68.1	Front	99.73	0.039	1.069	1.003	0.042	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.19	0	MIMO	2	02862	68.1	Front	99.73	0.013	1.069	1.003	0.014	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.04	0	MIMO	-	02862	68.1	Top	99.73	0.009	1.069	1.003	0.010	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.20	0	MIMO	-	02862	68.1	Bottom	99.73	0.002	1.069	1.003	0.002	
5985.00	7	802.11ax	OFDM	80	11.50	11.04	11.50	11.48	-0.07	0	MIMO	-	02862	68.1	Left	99.73	0.225	1.112	1.003	0.251	A3
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.12	0	MIMO	-	02862	68.1	Left	99.73	0.135	1.069	1.003	0.145	
6545.00	119	802.11ax	OFDM	80	11.50	10.23	11.50	11.48	-0.03	0	MIMO	-	02862	68.1	Left	99.73	0.114	1.340	1.003	0.153	
6785.00	167	802.11ax	OFDM	80	11.50	10.69	11.50	11.23	-0.18	0	MIMO	-	02862	68.1	Left	99.73	0.142	1.205	1.003	0.172	
7025.00	215	802.11ax	OFDM	80	11.50	10.48	11.50	11.42	0.00	0	MIMO	-	02862	68.1	Left	99.73	0.076	1.265	1.003	0.096	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Phablet 4 W/kg (mW/g) averaged over 10 gram											

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

element

Table 10-4
6 GHz WLAN Head MIMO Absorbed Power Density

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Side	Test Position	Antenna Config.	Device Serial Number	Data Rate (Mbps)	Duty Cycle (%)	Measured APD	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled APD	Plot #
MHz	Ch.															W/m^2 ($4cm^2$)			W/m^2 ($4cm^2$)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.06	Right	Cheek	MIMO	02862	68.1	99.73	0.139	1.069	1.003	0.149	
5985.00	7	802.11ax	OFDM	80	11.50	11.04	11.50	11.48	0.05	Right	Tilt	MIMO	02862	68.1	99.73	0.107	1.112	1.003	0.119	A1
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.03	Right	Tilt	MIMO	02862	68.1	99.73	0.120	1.069	1.003	0.129	
6545.00	119	802.11ax	OFDM	80	11.50	10.23	11.50	11.48	-0.06	Right	Tilt	MIMO	02862	68.1	99.73	0.035	1.340	1.003	0.047	
6785.00	167	802.11ax	OFDM	80	11.50	10.69	11.50	11.23	-0.03	Right	Tilt	MIMO	02862	68.1	99.73	0.201	1.205	1.003	0.243	
7025.00	215	802.11ax	OFDM	80	11.50	10.48	11.50	11.42	0.05	Right	Tilt	MIMO	02862	68.1	99.73	0.141	1.265	1.003	0.179	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.10	Left	Cheek	MIMO	02862	68.1	99.73	0.055	1.069	1.003	0.059	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.05	Left	Tilt	MIMO	02862	68.1	99.73	0.075	1.069	1.003	0.080	

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

Table 10-5
6 GHz WLAN Body-worn MIMO Absorbed Power Density

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Peak Number	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled APD	Plot #
MHz	Ch.																W/m^2 ($4cm^2$)			W/m^2 ($4cm^2$)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.01	10	MIMO	1	02862	68.1	Back	99.73	0.076	1.069	1.003	0.081	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.08	10	MIMO	2	02862	68.1	Back	99.73	0.127	1.069	1.003	0.136	A2

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

Table 10-6
6 GHz WLAN Phablet MIMO Absorbed Power Density

MEASUREMENT RESULTS																					
FREQUENCY		Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift [dB]	Spacing (mm)	Antenna Config.	Peak Number	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Scaled APD	Plot #
MHz	Ch.																W/m^2 ($4cm^2$)			W/m^2 ($4cm^2$)	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.03	0	MIMO	1	02862	68.1	Back	99.73	2.420	1.069	1.003	2.595	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.05	0	MIMO	2	02862	68.1	Back	99.73	1.530	1.069	1.003	1.640	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.20	0	MIMO	1	02862	68.1	Front	99.73	0.890	1.069	1.003	0.954	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.19	0	MIMO	2	02862	68.1	Front	99.73	0.303	1.069	1.003	0.325	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.04	0	MIMO	-	02862	68.1	Top	99.73	0.200	1.069	1.003	0.214	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.20	0	MIMO	-	02862	68.1	Bottom	99.73	0.049	1.069	1.003	0.053	
5985.00	7	802.11ax	OFDM	80	11.50	11.04	11.50	11.48	-0.07	0	MIMO	-	02862	68.1	Left	99.73	5.370	1.112	1.003	5.989	A3
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.12	0	MIMO	-	02862	68.1	Left	99.73	3.200	1.069	1.003	3.431	
6545.00	119	802.11ax	OFDM	80	11.50	10.23	11.50	11.48	-0.03	0	MIMO	-	02862	68.1	Left	99.73	2.720	1.340	1.003	3.656	
6785.00	167	802.11ax	OFDM	80	11.50	10.69	11.50	11.23	-0.18	0	MIMO	-	02862	68.1	Left	99.73	3.370	1.205	1.003	4.073	
7025.00	215	802.11ax	OFDM	80	11.50	10.48	11.50	11.42	0.00	0	MIMO	-	02862	68.1	Left	99.73	1.780	1.265	1.003	2.258	

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

SAR and Absorbed Power Density 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 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. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
7. Per FCC KDB Publication 648474 D04v01r03, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported body-worn SAR was ≤ 1.2 W/kg, no additional body-worn SAR evaluations using a headset cable were required.
8. Per FCC KDB Publication 648474 D04v01r03, this device is considered a "phablet" since the diagonal dimension is > 160 mm and < 200 mm. Therefore, phablet SAR tests are required when wireless router mode does not apply or if wireless router 1g SAR > 1.2 W/kg.
9. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds below.
10. Per October 2020 TCB Workshop notes, 5 channels were tested. Absorbed power density (APD) using a 4cm2 averaging area is reported based on SAR measurements.
11. 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 for 1g SAR and less than 2.0 W/kg for 10g SAR.

WLAN Notes:

1. Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D04v01 by making a SAR measurement with both antennas transmitting simultaneously.
2. 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.
3. 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. Procedures used to measure the duty factor are identical to that in the associated EMC test reports.
4. Per FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors. Per October 2020 TCB Workshop notes, 5 channels were tested.
5. Peak 1/2 correspond to hotspot location on top/bottom of the DUT respectively.

10.2 Power Density Results

Table 10-7
6 GHz WLAN MIMO Power Density

MEASUREMENT RESULTS																										
Frequency (MHz)	Channel	Mode	Service	Bandwidth [MHz]	Maximum Allowed Power (Ant 1) [dBm]	Conducted Power (Ant 1) [dBm]	Maximum Allowed Power (Ant 2) [dBm]	Conducted Power (Ant 2) [dBm]	Power Drift (dB)	Spacing (mm)	Antenna Config.	Peak Number	DUT Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Grid Step (λ)	iPD (W/m²)	Scaling Factor for Measurement Uncertainty per IEC 62479	Scaling Factor (Power)	Scaling Factor (Duty Cycle)	Normal psPD (W/m²)	Scaled Normal psPD (W/m²)	Total psPD (W/m²)	Scaled Total psPD (W/m²)	Plot #
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.06	2	MIMO	1	02847	68.1	Back	99.73	0.125	-	1.554	1.069	1.003	0.417	0.695	0.535	0.891	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.06	2	MIMO	2	02847	68.1	Back	99.73	0.125	-	1.554	1.069	1.003	0.538	0.896	0.624	1.040	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	-0.03	2	MIMO	1	02847	68.1	Front	99.73	0.125	-	1.554	1.069	1.003	0.253	0.422	0.304	0.507	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.04	2	MIMO	2	02847	68.1	Front	99.73	0.125	-	1.554	1.069	1.003	0.098	0.163	0.145	0.242	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.20	2	MIMO	-	02847	68.1	Top	99.73	0.125	-	1.554	1.069	1.003	0.224	0.373	0.251	0.418	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.07	2	MIMO	-	02847	68.1	Bottom	99.73	0.125	-	1.554	1.069	1.003	0.095	0.158	0.122	0.203	
5985.00	7	802.11ax	OFDM	80	11.50	11.04	11.50	11.48	-0.05	2	MIMO	-	02847	68.1	Left	99.73	0.125	-	1.554	1.112	1.003	0.941	1.631	1.420	2.461	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.12	2	MIMO	-	02847	68.1	Left	99.73	0.125	0.405	1.554	1.069	1.003	0.570	0.950	0.860	1.433	
6305.00	71	802.11ax	OFDM	80	11.50	11.21	11.50	11.33	0.01	9.51	MIMO	-	02847	68.1	Left	99.73	0.125	0.336	1.554	1.069	1.003	0.219	0.365	0.278	0.463	
6545.00	119	802.11ax	OFDM	80	11.50	10.23	11.50	11.48	-0.08	2	MIMO	-	02847	68.1	Left	99.73	0.125	-	1.554	1.340	1.003	1.070	2.235	1.290	2.694	
6785.00	167	802.11ax	OFDM	80	11.50	10.69	11.50	11.23	-0.06	2	MIMO	-	02847	68.1	Left	99.73	0.125	-	1.554	1.205	1.003	1.430	2.686	1.860	3.493	A4
7025.00	215	802.11ax	OFDM	80	11.50	10.48	11.50	11.42	-0.06	2	MIMO	-	02847	68.1	Left	99.73	0.125	-	1.554	1.265	1.003	0.971	1.915	1.160	2.287	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population													Power Density 10 W/m² averaged over 4 cm²													

Note: In MIMO operations, each antenna transmits at a maximum allowed power of 11.5 dBm.

Power Density General 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.
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. psPD for MIMO was evaluated by making a measurement with both antennas transmitting simultaneously.
8. PD results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
9. PTP-PR algorithm was used during psPD measurements and calculations.
10. Peak 1/2 correspond to hotspot location on top/bottom of the DUT respectively.

11 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
-	WL25-1	Conducted Cable Set (25GHz)	1/12/2023	Annual	1/12/2024	WL25-1
Agilent	N9038A	MXE EMI Receiver	N/A	N/A	N/A	MY51210133
Rohde & Schwarz	FSW67	Signal / Spectrum Analyzer	N/A	N/A	N/A	103200
Emco	3115	Horn Antenna (1-18GHz)	N/A	N/A	N/A	9704-5182
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433975
Keysight Technologies	N9030A	3Hz-44GHz PXA Signal Analyzer	8/18/2022	Annual	8/18/2023	MY49430494
SPEAG	EUmmWV3	EUmmWV3 Probe	10/17/2022	Annual	10/17/2023	9407
SPEAG	SM 003 100 AA	10 GHz System Verification Antenna	8/17/2022	Annual	8/17/2023	1004
SPEAG	DAE4ip	Dasy Data Acquisition Electronics	10/13/2022	Annual	10/13/2023	1638
SPEAG	EX3DV4	SAR Probe	5/18/2022	Annual	5/18/2023	7416
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/16/2022	Annual	5/16/2023	701
SPEAG	D6.5GHzV2	6.5GHz SAR Dipole	12/7/2022	Annual	12/7/2023	1019
Control Company	ML4052	Long Stem Thermometer	11/12/2021	Biennial	11/12/2023	210974908
Control Company	4040	Therm./Clock/Humidity Monitor	1/17/2023	Annual	1/17/2024	160574418
Agilent	SMF100A	Signal Generator	3/28/2022	Biennial	3/28/2024	101590
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/16/2022	Annual	5/16/2023	1070
Mitutoyo	500-196-30	CD-6"ASX 6Inch Digital Caliper	2/16/2022	Triennial	2/16/2025	A20238413
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE87FL1017	Low Pass Filter	CBT	N/A	CBT	N/A
MiniCircuits	ZUDC10-83-S+	Directional Coupler	7/4/2022	Annual	7/4/2023	2111
Seekonk	NC-100	Torque Wrench	11/28/2022	Biennial	11/28/2024	N/A
Anritsu	MA2411B	Pulse Power Sensor	10/21/2022	Annual	10/21/2023	1207364
Anritsu	MA2411B	Pulse Power Sensor	10/20/2022	Annual	10/20/2023	1339018
SPEAG	MAIA	Modulation and Audio Interference Analyzer	N/A	N/A	N/A	1520

Note:

1. Each equipment item 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.

12 MEASUREMENT UNCERTAINTIES

Applicable for SAR measurements:

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	9.3	N	1	1	1	9.3	9.3	∞
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				13.8	13.6	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				27.6	27.1	

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	

13 CONCLUSION

13.1 Measurement Conclusion

The SAR and power density measurements indicate that the DUT complies with the RF radiation exposure limits of the FCC, 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 RF Exposure 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.

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