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WIFI 6 GHZ RF EXPOSURE EVALUATION

Applicant Name
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Date of Testing
11/08/2021 – 12/08/2021
Test Site/Location
PCTEST, Columbia, MD, USA
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FCC ID:	**A3LSMS906E**
APPLICANT:	**SAMSUNG ELECTRONICS CO., LTD.**

DUT Type:	Portable Handset
Application Type:	Certification
FCC Rule Part(s):	CFR §2.1093
Model:	SM-S906E/DS
Additional Models:	SM-S906E

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	5935-7115	< 0.100	0.103	0.258	0.434	0.666	4.950	7.055

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.

Randy Ortanez
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	Tx Frequency
U-NII-5	5925 - 6425 MHz
U-NII-6	6425 - 6525 MHz
U-NII-7	6525 - 6875 MHz
U-NII-8	6875 - 7125 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.

1.2.1 Maximum MIMO WLAN Output Power

Mode	IEEE 802.11 (in dBm)			
	MIMO			
	a (CDD + STBC)		ax (SU) (CDD + STBC, SDM)	
	Nominal	Maximum	Nominal	Maximum
6 GHz WIFI (20MHz BW)	13.0	14.0	13.0	14.0
6 GHz WIFI (40MHz BW)			12.0	13.0
6 GHz WIFI (80MHz BW)			12.0	13.0
6 GHz WIFI (160MHz BW)			12.0	13.0

1.2.2 Reduced MIMO WLAN Output Power

The table below is applicable for the following conditions:

- Simultaneous conditions with 5G NR

Mode	IEEE 802.11 (in dBm)			
	MIMO			
	a (CDD + STBC)		ax (SU) (CDD + STBC, SDM)	
	Nominal	Maximum	Nominal	Maximum
6 GHz WIFI (20MHz BW)	11.0	12.0	11.0	12.0
6 GHz WIFI (40MHz BW)			11.0	12.0
6 GHz WIFI (80MHz BW)			11.0	12.0
6 GHz WIFI (160MHz BW)			11.0	12.0

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 Appendix C. Since the diagonal dimension of this device is > 160 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	No	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 941225 D06v02r01 Section III and 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 is greater than 160mm 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.

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 TR 63170:2018
- 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

2 RF EXPOSURE LIMITS

2.1 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.

2.2 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.

2.3 RF Exposure Limits for Frequencies Below 6 GHz

Table 2-1
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.

2.4 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 2-2
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

3 RF CONDUCTED POWERS

Table 3-1
6 GHz WLAN Maximum Average RF Power – 802.11a 20 MHz BW

6GHz (20MHz) 802.11a Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
5955	1	9.22	11.15	13.30
6075	25	9.57	11.63	13.73
6175	45	9.67	11.64	13.78
6275	65	9.8	11.5	13.74
6415	93	9.66	11.13	13.47
6435	97	9.93	10.38	13.17
6475	105	9.89	10.32	13.12
6515	113	9.78	10.33	13.07
6535	117	9.81	10.58	13.22
6675	145	10.02	10.61	13.34
6695	149	9.83	10.42	13.15
6875	185	9.54	11.17	13.44
6895	189	10.04	10.92	13.51
6995	209	10.03	11.04	13.57
7115	233	10.08	10.86	13.50

Table 3-2
6 GHz WLAN Maximum Average RF Power – 802.11ax 20 MHz BW

6GHz (20MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
5955	1	10.44	9.58	13.04
6075	25	10.42	10.10	13.27
6175	45	10.44	9.79	13.13
6275	65	10.87	10.21	13.56
6415	93	10.32	9.98	13.16
6435	97	10.63	10.23	13.44
6475	105	10.42	10.00	13.23
6515	113	10.50	9.88	13.21
6535	117	10.83	9.89	13.39
6675	145	10.64	10.00	13.34
6695	149	10.76	9.99	13.40
6875	185	10.84	9.86	13.39
6895	189	10.72	9.83	13.31
6995	209	10.88	9.91	13.43
7115	233	10.42	9.65	13.07

Table 3-3
6 GHz WLAN Maximum Average RF Power – 802.11ax 40 MHz BW

6GHz (40MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
5965	3	9.51	10.38	12.98
6085	27	8.90	9.70	12.33
6165	43	9.44	10.31	12.91
6285	67	9.89	9.99	12.95
6405	91	9.75	9.71	12.74
6445	99	10.41	9.11	12.82
6485	107	10.15	8.55	12.43
6525	115	10.24	8.99	12.67
6565	123	10.22	9.55	12.91
6685	147	9.71	9.21	12.48
6725	155	9.8	9.5	12.66
6845	179	9.65	9.01	12.35
6885	187	9.42	8.90	12.18
7005	211	10.6	9.13	12.94
7085	227	10.47	8.66	12.67

Table 3-4
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	9.28	10.14	12.74
6065	23	8.50	9.75	12.18
6145	39	9.07	10.31	12.75
6305	71	9.70	9.44	12.58
6385	87	9.91	9.47	12.71
6465	103	10.03	9.12	12.61
6545	119	9.88	8.94	12.45
6705	151	10.56	9.2	12.94
6785	167	10.21	9.42	12.84
6865	183	9.51	8.99	12.27
6945	199	10.6	9.11	12.93
7025	215	10.17	8.66	12.49

Table 3-5
6 GHz WLAN Maximum Average RF Power – 802.11ax 160 MHz BW

6GHz (160MHz) 802.11ax Conducted Power [dBm]				
Freq [MHz]	**Channel**	**ANT1**	**ANT2**	**MIMO**
6025	15	8.6	9.56	12.12
6185	47	8.9	10.32	12.68
6345	79	8.61	9.92	12.32
6505	111	10.09	8.99	12.59
6665	143	10.42	9.11	12.82
6825	175	10.01	8.96	12.53
6985	207	9.75	8.69	12.26

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.

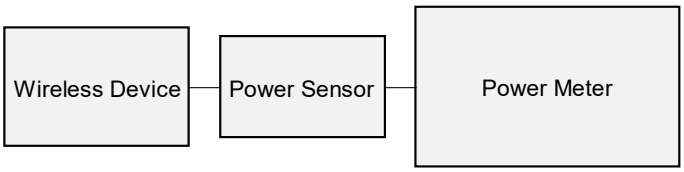

Figure 3-1
Power Measurement Setup

4 SYSTEM VERIFICATION

4.1 SAR Test System Verification

Table 4-1
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
12/08/2021	6500 Head	19.5	6000	5.567	33.567	5.480	35.100	*1.59%*	*-4.37%*
			6065	5.667	33.484	5.557	35.022	*1.98%*	*-4.39%*
			6075	5.686	33.432	5.569	35.010	*2.10%*	*-4.51%*
			6275	5.916	33.060	5.805	34.770	*1.91%*	*-4.92%*
			6305	5.941	33.050	5.840	34.734	*1.73%*	*-4.85%*
			6475	6.162	32.726	6.041	34.530	*2.00%*	*-5.22%*
			6500	6.166	32.708	6.070	34.500	*1.58%*	*-5.19%*
			6545	6.221	32.538	6.122	34.446	*1.62%*	*-5.54%*
			6675	6.407	32.376	6.273	34.290	*2.14%*	*-5.58%*
			6785	6.534	32.266	6.400	34.158	*2.09%*	*-5.54%*
			6995	6.753	31.747	6.644	33.906	*1.64%*	*-6.37%*
			7025	6.759	31.623	6.680	33.870	*1.18%*	*-6.63%*

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.

The SAR measurement systems have implemented the SAR error compensation algorithms documented in IEC 62209-2 to automatically compensate the measured SAR results for deviations between the measured and required tissue dielectric parameters for all frequencies. The test lab has verified that the required SAR error compensation algorithm has been correctly applied to only scale up the measured SAR, not downward.

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 Appendix F.

Table 4-2
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 4cm² APD (W/m²)	1W Target 4cm² APD (W/m²)	1 W Normalized 4cm² APD (W/m²)	Deviation 4cm² APD (%)
O	6500	Head	12/08/2021	20.0	19.5	0.050	1019	7659	14.700	293.000	294.000	0.34%	2.690	53.600	53.800	0.37%	65.7000	1340.0000	1314.000	-1.94%

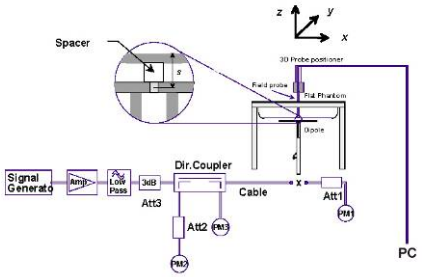

Figure 4-1
System Verification Setup Diagram

Figure 4-2
System Verification Setup Photo

4.2 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.

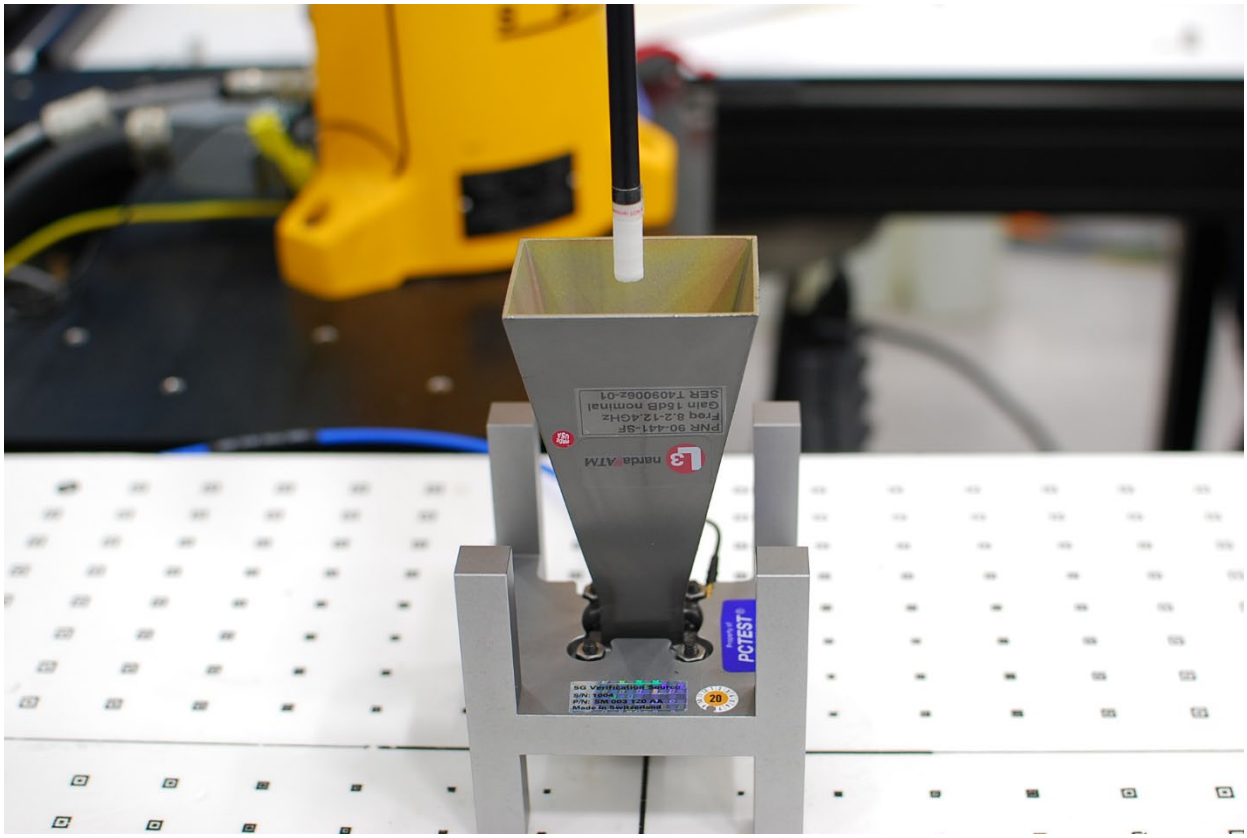

Figure 4-3
System Verification Setup Photo

Table 4-3
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	11/08/2021	1004	9364	86.1	50.80	50.70	0.01	51.00	50.70	0.03
Q	10	11/18/2021	1004	9364	86.1	51.90	50.70	0.10	52.20	50.70	0.13
Q	10	11/22/2021	1004	9364	86.1	49.80	50.70	-0.08	50.10	50.70	-0.05

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

5 DATA SUMMARY

5.1 SAR and Absorbed Power Density Results

Table 5-1
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)	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.00	Right	Cheek	MIMO	UIO1028M	17.2	96.5	0.052	1.199	1.036	0.065	A1
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.12	Right	Tilt	MIMO	UIO1028M	17.2	96.5	0.011	1.199	1.036	0.014	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.13	Left	Cheek	MIMO	UIO1028M	17.2	96.5	0.033	1.199	1.036	0.041	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.14	Left	Tilt	MIMO	UIO1028M	17.2	96.5	0.009	1.199	1.036	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: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 dBm.

Table 5-2
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.	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)	
6075.00	25	802.11ax	OFDM	20	11.0	10.42	11.0	10.10	-0.14	15	MIMO	UIO1028M	17.2	Back	96.5	0.029	1.231	1.036	0.037	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.15	15	MIMO	UIO1028M	17.2	Back	96.5	0.083	1.199	1.036	0.103	A2
6475.00	105	802.11ax	OFDM	20	11.0	10.42	11.0	10.00	-0.16	15	MIMO	UIO1028M	17.2	Back	96.5	0.054	1.259	1.036	0.070	
6675.00	145	802.11ax	OFDM	20	11.0	10.64	11.0	10.00	-0.14	15	MIMO	UIO1028M	17.2	Back	96.5	0.010	1.260	1.036	0.013	
6995.00	209	802.11ax	OFDM	20	11.0	10.88	11.0	9.91	0.16	15	MIMO	UIO1028M	17.2	Back	96.5	0.020	1.286	1.036	0.027	
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: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 dBm.

Table 5-3
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.	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)	
6075.00	25	802.11ax	OFDM	20	11.0	10.42	11.0	10.10	-0.04	0	MIMO	UIO1028M	17.2	Back	96.5	0.154	1.231	1.036	0.196	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.03	0	MIMO	UIO1028M	17.2	Back	96.5	0.208	1.199	1.036	0.258	A3
6475.00	105	802.11ax	OFDM	20	11.0	10.42	11.0	10.00	-0.13	0	MIMO	UIO1028M	17.2	Back	96.5	0.106	1.259	1.036	0.138	
6675.00	145	802.11ax	OFDM	20	11.0	10.64	11.0	10.00	-0.16	0	MIMO	UIO1028M	17.2	Back	96.5	0.060	1.260	1.036	0.078	
6995.00	209	802.11ax	OFDM	20	11.0	10.88	11.0	9.91	-0.13	0	MIMO	UIO1028M	17.2	Back	96.5	0.071	1.286	1.036	0.095	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.12	0	MIMO	UIO1028M	17.2	Front	96.5	0.059	1.199	1.036	0.073	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.16	0	MIMO	UIO1028M	17.2	Top	96.5	0.005	1.199	1.036	0.006	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.16	0	MIMO	UIO1028M	17.2	Left	96.5	0.053	1.199	1.036	0.066	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Phablet 4 W/kg (mW/g) averaged over 10 gram										

Note: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 dBm.

Table 5-4
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	Plot #
MHz	Ch.															W/m² (4cm²)	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.00	Right	Cheek	MIMO	UIO1028M	17.2	96.5	0.434	A1
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.12	Right	Tilt	MIMO	UIO1028M	17.2	96.5	0.067	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.13	Left	Cheek	MIMO	UIO1028M	17.2	96.5	0.191	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.14	Left	Tilt	MIMO	UIO1028M	17.2	96.5	0.045	

Note: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 dBm.

Table 5-5
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.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD	Plot #
MHz	Ch.															W/m² (4cm²)	
6075.00	25	802.11ax	OFDM	20	11.0	10.42	11.0	10.10	-0.14	15.0	MIMO	UIO1028M	17.2	Back	96.5	0.224	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.15	15.0	MIMO	UIO1028M	17.2	Back	96.5	0.666	A2
6475.00	105	802.11ax	OFDM	20	11.0	10.42	11.0	10.00	-0.16	15.0	MIMO	UIO1028M	17.2	Back	96.5	0.384	
6675.00	145	802.11ax	OFDM	20	11.0	10.64	11.0	10.00	-0.14	15.0	MIMO	UIO1028M	17.2	Back	96.5	0.051	
6995.00	209	802.11ax	OFDM	20	11.0	10.88	11.0	9.91	0.16	15.0	MIMO	UIO1028M	17.2	Back	96.5	0.133	

Note: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 dBm.

Table 5-6
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.	Device Serial Number	Data Rate (Mbps)	Side	Duty Cycle (%)	Measured APD	Plot #
MHz	Ch.															W/m² (4cm²)	
6075.00	25	802.11ax	OFDM	20	11.0	10.42	11.0	10.10	-0.04	0	MIMO	UIO1028M	17.2	Back	96.5	3.670	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.03	0	MIMO	UIO1028M	17.2	Back	96.5	4.950	A3
6475.00	105	802.11ax	OFDM	20	11.0	10.42	11.0	10.00	-0.13	0	MIMO	UIO1028M	17.2	Back	96.5	2.570	
6675.00	145	802.11ax	OFDM	20	11.0	10.64	11.0	10.00	-0.16	0	MIMO	UIO1028M	17.2	Back	96.5	1.440	
6995.00	209	802.11ax	OFDM	20	11.0	10.88	11.0	9.91	-0.13	0	MIMO	UIO1028M	17.2	Back	96.5	1.670	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	-0.12	0	MIMO	UIO1028M	17.2	Front	96.5	1.380	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.16	0	MIMO	UIO1028M	17.2	Top	96.5	0.127	
6275.00	65	802.11ax	OFDM	20	11.0	10.87	11.0	10.21	0.16	0	MIMO	UIO1028M	17.2	Left	96.5	1.220	

Note: To achieve the 14 dBm maximum allowed MIMO power shown in the documentation, each antenna transmits at a maximum allowed power of 11 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 D01v06.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical, and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v06.
6. Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 15 mm 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 FCC guidance, SAR was performed using 6.5 GHz SAR probe calibration factors. 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.

WLAN Notes:

1. WIFI 6 GHz operations are limited to MIMO operations only (does not support stand-alone mode). Per KDB Publication 248227 D01v02r02, SAR for MIMO was evaluated by following the simultaneous SAR provisions from KDB Publication 447498 D01v06 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.

5.2 Power Density Results

Table 5-7
6 GHz WLAN MIMO Power Density

MEASUREMENT RESULTS																			
Frequency (MHz)	Channel	Mode	Service	Bandwidth [MHz]	Power Drift (dB)	Spacing (mm)	Antenna Config.	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 #
6075.00	25	802.11ax	OFDM	20	-0.14	2	MIMO	UIO1028M	17.2	Back	96.5	0.05	-	1.554	3.160	4.911	3.550	5.517	
6275.00	65	802.11ax	OFDM	20	0.12	2	MIMO	UIO1028M	17.2	Back	96.5	0.05	2.17	1.554	3.660	5.688	4.540	7.055	A4
6275.00	65	802.11ax	OFDM	20	0.20	9.56	MIMO	UIO1028M	17.2	Back	96.5	0.05	2.15	1.554	1.770	2.751	1.930	2.999	
6475.00	105	802.11ax	OFDM	20	0.19	2	MIMO	UIO1028M	17.2	Back	96.5	0.05	-	1.554	2.730	4.242	3.130	4.864	
6675.00	145	802.11ax	OFDM	20	-0.14	2	MIMO	UIO1028M	17.2	Back	96.5	0.05	-	1.554	1.540	2.393	1.780	2.766	
6995.00	209	802.11ax	OFDM	20	-0.04	2	MIMO	UIO1028M	17.2	Back	96.5	0.05	-	1.554	1.460	2.269	1.770	2.751	
6275.00	65	802.11ax	OFDM	20	-0.12	2	MIMO	UIO1028M	17.2	Front	96.5	0.05	-	1.554	1.410	2.191	1.640	2.549	
6275.00	65	802.11ax	OFDM	20	0.05	2	MIMO	UIO1028M	17.2	Top	96.5	0.05	-	1.554	0.618	0.960	0.636	0.988	
6275.00	65	802.11ax	OFDM	20	0.12	2	MIMO	UIO1028M	17.2	Left	96.5	0.05	-	1.554	1.100	1.709	1.290	2.005	
47 CFR §1.1310 - SAFETY LIMIT Spatial Average Uncontrolled Exposure / General Population								Power Density 10 W/m² averaged over 4 cm²											

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. 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. WIFI 6 GHz operations are limited to MIMO operations only (does not support stand-alone mode). psPD for MIMO was evaluated by making a measurement with both antennas transmitting simultaneously.

6 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
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
Sunol	JB5	Bi-Log Antenna (30M - 5GHz)	N/A	N/A	N/A	A051107
Emco	3115	Horn Antenna (1-18GHz)	N/A	N/A	N/A	9704-5182
Amplifier Research	15S1G6	Amplifier	N/A	CBT	N/A	433975
SPEAG	EUmmWV3	EUmmWV3 Probe	6/21/2021	Annual	6/21/2022	9364
SPEAG	SM 003 100 AA	10 GHz System Verification Antenna	8/12/2021	Annual	8/12/2022	1004
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/7/2021	Annual	4/7/2022	1582
SPEAG	EX3DV4	SAR Probe	6/29/2021	Annual	6/29/2022	7659
SPEAG	DAE4	Dasy Data Acquisition Electronics	6/21/2021	Annual	6/21/2022	1678
SPEAG	D6.5GHzV2	6.5GHz SAR Dipole	1/12/2021	Annual	1/12/2022	1019
Control Company	4352	Long Stem Thermometer	1/24/2020	Biennial	1/24/2022	200043634
Agilent	SMF100A	Signal Generator	5/7/2020	Biennial	5/7/2022	101590
Rohde & Schwarz	SMU200A	Vector Signal Generator	5/12/2020	Biennial	5/12/2022	104145
Agilent	8753ES	S-Parameter Vector Network Analyzer	2/2/2021	Annual	2/2/2022	US39170122
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/12/2021	Annual	5/12/2022	1070

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.

7 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	∞
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	0.4	R	1.732	1	1	0.2	0.2	∞
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	2.70	N	1	1	1	2.7	2.7	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	4.2	N	1	0.78	0.71	3.3	3.0	76
Liquid Permittivity - measurement uncertainty	E.3.3	4.1	N	1	0.23	0.26	0.9	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				13.3	13.1	191
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				26.5	26.1	

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	

9 CONCLUSION

9.1 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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