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47CFR §2.1093 – FCC SAR REPORT

FCC ID:	**2BDTE-NUSHU1V1**
Model(s):	NUSHU, NUSHU X
Device Type:	Portable Transmitter in Shoe
Report Issue Date:	February 10, 2024

Magnes Inc.
2261 Market Street Ste 5508
San Francisco, CA 94114

Class II Permissive Change

FCC Equipment Class	**Extremity (Foot) SAR over 10g** [W/kg]
DTS	< 0.10
DSS	-
FCC Limit	**4.00**

The measurement evaluations presented in this report is based on the maximum performance of the tested device(s) which has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/ general population exposure federal limits in 47CFR § 1.1310 and has been tested in accordance with the measurement procedures specified within this report.

This report and data apply only for US operations only.

Steve Liu
President

Table of Contents

1. DUT Specifics

1.1. Device under Test

The device consists of an RF module integrated with a shoe (under the heel).

The manufacturer has confirmed that the device is within operational tolerances expected for production units and has the same physical, mechanical, and thermal characteristics expected for production units. The serial number of the device used for each test is indicated alongside the results.

1.2. Maximum SAR Detail

Table 1-1 Maximum SAR per Mode

Equipment Class	Band / Mode	Frequency	Extremity SAR (10g)
DTS	2.4 GHz WIFI	2412 - 2462 MHz	0.04
DTS	2.4 GHz Bluetooth LE	2402 - 2480 MHz	-
DSS	2.4 GHz Bluetooth EDR	2402 - 2480 MHz	-

1.3. Maximum Time-Averaged Power

This device follows the below maximum output power specifications and tolerances. SAR values were scaled to the maximum allowed power (including tolerance) to determine compliance per KDB Publication 447498 D04v01.

Table 1-2 Target Maximum RF Output Power (including tolerance)

Band / Mode	Target Power With Tolerance [dBm]	Exposure Condition
2.4 GHz WIFI	27.0	Extremity
2.4 GHz Bluetooth LE	7.0	Extremity
2.4 GHz Bluetooth BR/EDR	9.0	Extremity

Note: It is expected by the module manufacturer for the output powers to be as low as 5 dB from this upper tolerance.

1.4. Test Guidance Applied

- IEEE 1528-2013
- FCC KDB Publication 248227 D01v02r02 (SAR Considerations for 802.11 Devices)
- FCC KDB Publication 447498 D04v01 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r04, D02v01r02 (SAR Measurements up to 6 GHz)

2. DUT Conducted Powers

2.1. WIFI Conducted Powers

Table 2-1 RF Output Power – WIFI 802.11bgn*

Freq (MHz)	Channel	Mode	BW (MHz)	Measured Peak Power (dBm)	Target Peak Power with Tolerance (dBm)
2412	1	802.11b	20	26.24	27.0
2437	6	802.11b	20	26.62	27.0
2462	11	802.11b	20	26.00	27.0
2412	1	802.11g	20	25.06	26.0
2437	6	802.11g	20	25.91	26.0
2462	11	802.11g	20	25.38	26.0
2412	1	802.11n	20	25.21	26.0
2437	6	802.11n	20	25.89	26.0
2462	11	802.11n	20	25.45	26.0
2422	3	802.11n	40	23.87	27.0
2437	6	802.11n	40	26.51	27.0
2452	9	802.11n	40	23.85	27.0

2.2. Bluetooth Conducted Powers

Table 2-2 RF Output Power – Bluetooth LE*

Freq (MHz)	Channel	Mode	Measured Peak Power (dBm)	Target Power with Tolerance (dBm)
2402	0	GFSK	6.67	7.0
2440	38	GFSK	6.80	7.0
2480	78	GFSK	6.23	7.0

* Measurements performed for WLAN and Bluetooth LE is included as indicated in the Part 15C Test Report # RSHD200116001-00A. In this FCC file, the Part 15C report validates the radiated output power to be the same as that reported in the Test Report # RSHD200116001-00A.

Table 2-3 RF Output Power - Bluetooth BR/EDR**

Freq (MHz)	Channel	Mode	Measured Peak Power (dBm)	Target Power with Tolerance (dBm)
2402	0	BR (GFSK)	4.45	9.0
2441	39	BR (GFSK)	5.61	9.0
2480	78	BR (GFSK)	6.04	9.0
2402	0	EDR (π/4-DQPSK)	6.87	9.0
2441	39	EDR (π/4-DQPSK)	8.00	9.0
2480	78	EDR (π/4-DQPSK)	8.26	9.0
2402	0	EDR (8-DPSK)	7.24	9.0
2441	39	EDR (8-DPSK)	8.38	9.0
2480	78	EDR (8-DPSK)	8.51	9.0

** Measurements performed for Bluetooth BR/EDR is included as indicated in the Part 15C Test Report # RSHD200116001-00B. In this FCC file, the Part 15C report validates the radiated output power to be the same as that reported in the Test Report # RSHD200116001-00B.

3. DUT SAR Test Results

Table 3-1 2.4 GHz WIFI SAR Test Data

Exposure Condition	Band/Mode	DUT Serial No.	Power Drift [dB]	Max Duty Cycle [%]	Measured Duty Cycle [%]	Frequency [MHz]	Channel	Modulation/ Configuration	Data Rate (Mbps)	Maximum Allowed Power [dBm]	Measured Conducted Power [dBm]	Separation Distance [mm]	Measured 10g SAR [W/Kg]	Reported 10g SAR [W/Kg]	Test Plot
Extremity	2.4 GHz WIFI	999000092	0.21	100%	100%	2412	1	IEEE 802.11b	1	27.0	26.24	0	0.032	0.038	A1
Extremity	2.4 GHz WIFI	999000092	0.09	100%	100%	2437	6	IEEE 802.11b	1	27.0	26.62	0	0.023	0.025	-
Extremity	2.4 GHz WIFI	999000092	0.21	100%	100%	2462	11	IEEE 802.11b	1	27.0	26.00	0	0.030	0.038	-

3.1. General SAR Testing 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. Liquid tissue depth was at least 15.0 cm for all frequencies.
3. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D04v01.
4. Unless otherwise noted, when 10g SAR measurement is considered, a factor of 2.5 is applied to the 1g thresholds for the equivalent test cases.
5. Device was positioned at 0mm which includes the insole of the shoe.

3.2. WLAN Notes:

1. Justification for test configurations for WLAN per KDB Publication 248227 D01v02r02 for 2.4 GHz WIFI single transmission chain operations, the highest measured maximum output power channel for DSSS was selected for SAR measurement. SAR for OFDM modes (2.4 GHz 802.11g/n) was not required due to the maximum allowed powers and the highest reported DSSS SAR.
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 Part 15C test reports.

4. DUT SAR Test Exemption Assessment for Bluetooth

Per FCC KDB 447498 D01 v06 Section 4.3.1, For 100 MHz to 6 GHz "10-g extremity SAR evaluation for general population exposure conditions, by measurement or numerical simulation, is not required when… *test separation distances* **≤ 50 mm**, the **10-g *SAR*** *test exclusion "numeric thresholds*":

$$\frac{MaxPower}{Distance} \cdot \sqrt{f_{GHz}} \leq 7.5 \qquad \text{(for 10-g extremity SAR)}$$

Where:

f_{GHz}	= RF Channel frequency in GHz
$MaxPower$	= Power of channel, including tune-up tolerance, rounded to the nearest mW before calculation
$Distance$	= Min. Test Separation Distance in mm, rounded to the nearest mm before calculation

Per FCC KDB 447498 D01 4.3.1, "Power and distance are rounded to the nearest mW and mm before calculation." The result is rounded to one decimal place for comparison.

For Bluetooth, 9 dBm = 7.94 mW → 8 mW

For distances ≤ 5mm, per FCC policy the value of 5 shall be used for the distance component of the equation.

$$\frac{MaxPower}{Distance} \cdot \sqrt{f_{GHz}} = \frac{8}{5} \cdot \sqrt{2.48}$$

$$= 2.52 \leq 7.5$$

(**SAR Exempt** per FCC KDB 447498 v06)

5. DUT SAR Measurement Variability Requirement

For 10g SAR measurement, a factor of 2.5 is applied to the 1g SAR threshold of 0.8 W/kg required for the FCC variability requirement.

SAR Measurement Variability was not assessed since the highest measured 10g SAR is < 2 W/kg.

6. DUT Simultaneous Transmission Analysis

6.1. Scenarios

According to FCC KDB Publication 447498 D04v01, transmitters are considered to be operating simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds.

This device does not transmit simultaneously for WLAN and Bluetooth per the manufacturer.

7. General Introduction

Title 47 of the Code of Federal Regulations (CFR) pertains to United States Federal regulation for Telecommunications. The **Federal Communications Commission (FCC)** is the agency responsible for implementing and enforcing these regulations. The rules define a **radiofrequency device** as any device which in its operation is capable of emitting radiofrequency energy by radiation, conduction, or other means.

47CFR §2.1093(b) states, "A **portable device** is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that the RF source's radiating structure(s) **is/are within 20 centimeters of the body of the user**."

Also, 47CFR §2.1093(d)(6) states, that General population/uncontrolled exposure limits defined in §1.1310 "apply to portable devices intended for use by consumers or persons who are exposed as a consequence of their employment and may not be fully aware of the potential for exposure or cannot exercise control over their exposure."

47CFR §2.1093(d)(2) states that evaluation of compliance within FCC's SAR limits can be demonstrated by laboratory measurements. This test report serves this purpose.

8. Background on Radiofrequency (RF) Exposure Limits

8.1. Controlled Environment

Controlled environments are defined as locations where the RF field intensities have been adequately characterized by means of measurement or calculation and exposure is incurred by persons who are: aware of the potential for RF field exposure, cognizant of the intensity of the RF fields in their environment, aware of the potential health risks associated with RF field exposure and able to control their risk using mitigation strategies. 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.

8.2. Uncontrolled Environment

Uncontrolled environments are defined as locations where either insufficient assessment of RF fields have been conducted or where persons who are allowed access to these areas have not received proper RF field awareness/safety training and have no means to assess or, if required, to mitigate their exposure to RF fields. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed, or in which persons who may not be made fully aware of the potential for exposure, or cannot exercise control over their exposure. Members of the general public would fall under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

8.3. RF Exposure Limits for 100kHz – 6 GHz

Per FCC 47 CFR §1.1310, the SAR limits are applied for frequencies 100kHz ~ 6 GHz as shown below.

Table 8-1 Human Exposure to RF Radiation Limits in 47 CFR §1.1310 - SAR Basic Restrictions

Environment	Condition	**SAR**	Averaging volume
Uncontrolled / General Population	Head, Neck Trunk	**1.6 W/kg**	1g cube
	Extremity	**4.0 W/kg**	10g cube
Controlled	Head/Trunk	**8 W/kg**	1g cube
	Extremity / Limbs	**20 W/kg**	10g cube

8.4. General FCC Policy on Human Exposure to RF

Quoted from the FCC OET website:

The FCC is required by the National Environmental Policy Act of 1969, among other things, to evaluate the effect of emissions from FCC-regulated transmitters on the quality of the human environment. Several organizations, such as the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers, Inc. (IEEE) ,and the National Council on Radiation Protection and Measurements (NRCP) have issued recommendations for human exposure to RF electromagnetic fields.

On August 1, 1996, the Commission adopted the NCRP's recommended Maximum Permissible Exposure limits for field strength and power density for the transmitters operating at frequencies of 300 kHz to 100 GHz. In addition, the Commission adopted the specific absorption rate (SAR) limits for devices operating within close proximity to the body as specified within the ANSI/IEEE C95.1-1992 guidelines. (See Report and Order, FCC 96-326)

The Commission's requirements are detailed in Parts 1 and 2 of the FCC's Rules and Regulations [47 C.F.R. 1.1307(b), 1.1310, 2.1091, 2.1093]. The potential hazards associated with RF electromagnetic fields are discussed in the FCC's RF Safety FAQ.

9. RF Safety Laboratory SAR Measurement System

9.1. SAR Measurement Hardware and Software

Peak spatially averaged SAR (psSAR) measurements are performed using a DASY8 robot system with cDASY8 module SAR software. The DASY8 is made by SPEAG in Switzerland and consists of a 6-axis robot, robot controller, computer, dosimetric probe, probe alignment light beam unit, and various SAR phantoms.

9.2. E-Field Probe

Manufacturer	Schmid & Partner Engineering AG
Model	EX3DV4
Description	Smallest isotropic electric (E-) field probe for high precision specific absorption rate (SAR) measurements
Frequency Range	10 MHz - 10.0 GHz
Dynamic Range	10 µW/g – >100 mW/g
Overall Length (mm)	337
Body Diameter (mm)	12
Tip Length (mm)	337
Tip Diameter (mm)	2.5
Probe Tip to Sensor X Calibration Point (mm)	1
Probe Tip to Sensor Y Calibration Point (mm)	1
Applications	High precision dosimetric measurements in any exposure scenario (e.g. very strong gradient fields); the only probe that enables compliance testing for frequencies up to 6 GHz with precision of better than 30%
Compatibility	DASY8 robot + cDASY8 module SAR software

9.3. Peak Spatially Averaged SAR (psSAR) Measurements

SAR Evaluations are performed using the following procedure compliant to FCC KDB Publication 865664 D01v01r04, IEEE 1528:2013 and IEC/IEEE 62209-1528:

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, IEEE 1528:2013 and IEC/IEEE 62209-1528.

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, IEEE 1528:2013 and IEC/IEEE 62209-1528. 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 4-1. 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, to calculate the averaged SAR.
    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
    d. The zoom scan is confirmed to meet both of the following parameters if the result is > 0.1 W/kg. If the result does not meet the below parameters, it is re-measured with a finer resolution scan until the below parameters are met.
        (1) The smallest horizontal distance from the local SAR peaks to all points 3 dB below the SAR peak shall be larger than the horizontal grid steps in both x- and y-directions.
        (2) The ratio of the SAR at the second measured point (M2) to the SAR at the closest measured point (Ml) at the x-y location of the measured maximum SAR value shall be at least 30%
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.

9.4. Test Positions

9.4.1. Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

9.4.2. 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 D04v01 should be applied to determine SAR test requirements.

9.5. RF Safety Laboratory SAR System Measurement Uncertainty

SAR Uncertainty for DUTs According to 62209-1528										
Symbol	Input Quantity (Xi) (Source of Uncertainty)	62209-1528 Ref	Unc. (xi)	Prob. Dist. PDFi	Div(qi)	ci (1g)	ci (10g)	Std Unc (1g)	Std. Unc (10g)	vi
Measurement System Errors										
CF	Probe Calibration	8.4.1.1	13.1%	N (k=2)	2	1	1	6.55%	6.6%	∞
CFdrift	Probe Calibration Drift	8.4.1.2	1.7%	R	√3	1	1	1.0%	1.0%	∞
LIN	Probe Linearity and Detection Limit	8.4.1.3	4.7%	R	√3	1	1	2.7%	2.7%	∞
BBS	Broadband Signal	8.4.1.4	2.8%	R	√3	1	1	1.6%	1.6%	∞
ISO	Probe Isotropy	8.4.1.5	7.6%	R	√3	1	1	4.4%	4.4%	∞
DAE	Other probe and data acquisition errors	8.4.1.6	1.2%	N	1	1	1	1.2%	1.2%	∞
AMB	RF Ambient and Noise	8.4.1.7	1.8%	N	1	1	1	1.8%	1.8%	∞
Δxyz	Probe Positioning Errors	8.4.1.8	0.005 mm	N	1	0.29	0.29	0.2%	0.2%	
DAT	Data Processing Errors	8.4.1.9	2.3%	N	1	1	1	2.3%	2.3%	∞
Phantom and Device Errors										
LIQ(σ)	Measurement of Phantom Conductivity	8.4.2.1	2.5%	N	1	0.78	0.71	2.0%	1.8%	∞
LIQ(Tc)	Temperature Effects (Medium)	8.4.2.2	3.4%	R	√3	0.78	0.71	1.5%	1.4%	∞
EPS	Shell Permittivity	8.4.2.3	14.0%	R	√3	0.25	0.25	2.0%	2.0%	∞
DIS	Distance between the radiating element of the DUT and the phantom medium	8.4.2.4	2.0%	N	1	2	2	4.0%	4.0%	∞
Dxyz	Repeatability of Positioning the DUT or source against the phantom	8.4.2.5	1.0%	N	1	1	1	1.0%	1.0%	5
H	Device Holder Effects	8.4.2.6	3.6%	N	1	1	1	3.6%	3.6%	8
MOD	Effect of Operating mode on probe sensitivity	8.4.2.7	2.4%	R	√3	1	1	1.4%	1.4%	∞
RFdrift	Variation in SAR due to Drift in ouptput of DUT	8.4.2.9	2.5%	N	1	1	1	2.5%	2.5%	∞
VAL	Validation Antenna Uncertainty (Validation measurement only)	8.4.2.10	0.0%	N	1	1	1	0.0%	0.0%	∞
Pin	Uncertianty in Accepted Power (Validation Measurement only)	8.4.2.11	0.0%	N	1	1	1	0.0%	0.0%	∞
Correction to the SAR Results										
C(ε',σ)	Phantom Deviation from Target (ε',σ)	8.4.3.1	1.9%	N	1	1	0.84	1.9%	1.6%	∞
C(R)	SAR Scaling	8.4.3.2	0.0%	R	√3	1	1	0.0%	0.0%	∞
u(ΔS AR)	Combined Uncertainty							11.6%	11.5%	∞
U	Expanded Uncertainty and Effective Degrees of Freedom (k=2)							23.2%	23.1%	

10. SAR Measurement Procedures

10.1. Measured and Reported SAR

Per FCC KDB Publication 447498 D04v01, when SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r03.

10.2. 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.

10.2.1. General Device Setup

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

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

10.2.2. Initial Test Position Procedure

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.

10.2.3. 2.4 GHz SAR Test Requirements

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

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

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

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

10.2.4. 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 or 802.11g and 802.11n with the same channel bandwidth, modulation, and data rate etc., the lower order 802.11 mode i.e., then 802.11n or 802.11g then 802.11n, is used for SAR measurement.

10.2.5. 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 8.6.6). When 10g SAR measurement is considered, a factor of 2.5 is applied to the thresholds above.

10.2.6. 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.

11. SAR Testing Equipment List

Manufacturer	Model	Description	Serial Number	Calibration Date	Calibration Due
Amplifier Research	5S1G4	RF Broadband Amplifier (800 MHz - 4.2 GHz)	331258	*	*
Anritsu	S820E	Vector Network Analyzer	2348026	11/30/23	11/30/24
Anritsu	MA24118A	Microwave USB Power Sensor (10MHz - 18 GHz)	2123431	7/11/23	7/10/24
Anritsu	MA24118A	Microwave USB Power Sensor (10MHz - 18 GHz)	2123500	11/15/23	11/14/24
Control Company	4040	Ambient Thermometer	230581662	8/28/23	8/28/25
Control Company	4352	Long Stem Liquid Thermometer	230662212	9/28/23	9/28/25
Micro-Coax	UFB205A-0-0240-30x30	SMA M-F RF test Cable (DC - 18 GHz)	-	*	*
Mini-Circuits	NF-SF50+	RF Adapter N Male to SMA Female (DC - 18 GHz)	-	*	*
Mini-Circuits	CBL-6FT-SMNM+	Precision Test Cable SMA/N (DC - 18 GHz)	-	*	*
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-	*	*
Mini-Circuits	BW-N20W20+	20dB RF Fixed Attenuator (DC - 18 GHz)	-	*	*
Mini-Circuits	VLF-6000+	Coaxial Low Pass Filter (DC - 6 GHz)	-	*	*
Narda	24785-20	20 dB SMA Fixed Attenuator (DC - 4.0 GHz)	-	*	*
Narda	4226-20 (26733)	20 dB SMA Directional Coupler (0.5 - 18 GHz)	0201	*	*
SPEAG	DAK-3.5	DAK-3.5 Dielectric Probe	1349	10/5/23	10/5/24
SPEAG	D2450V2	2450 MHz System Validation Dipole	1112	10/9/23	10/9/24
SPEAG	DAE4ip	Data Acquisition Electrionics with Integ. Power	1844	11/2/23	11/2/24
SPEAG	EX3DV4	SAR Measurement Probe	7853	11/14/23	11/14/24
SPEAG	Powersource1	Signal Generator	4341	1/5/24	1/5/25
SPEAG	DASY8 Server	DASY8 Robot Measurement Server	10163	-	-
Staubli	TX2-60L	DASY8 Robot TX2-60L	F/23/0050942/A/005	-	-
Staubli	SCS9C	DASY8 Robot Controller CS9C	F/23/0050942/C/005	-	-

* Components calibrated before testing. Prior to testing, the measurement paths containing a cable, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator, power sensor, or VNA) 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. Conclusion

The SAR evaluation indicates that the DUT is capable of compliance 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 absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.