FCC TEST REPORT

FCC 47 CFR § 2.1093
IEEE Std 1528-2013

for

Medical Computer

Model Name.:
DMS-SA47,
DMS-SA47XXXXXXXXXXXXXXXX (where "X" may be any alphanumeric character , "-" or blank)

Issued to:

Advantech Co.Ltd.
No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District,
Taipei 114, Taiwan, R.O.C.

Issued by

Compliance Certification Services Inc.
Wugu Lab.
No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City, Taiwan. (R.O.C.)

Issued Date: 8/8/2023

Statements of Conformity
Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	8/8/2023	Initial Issue	ALL	Sky Zhou

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1 Attestation of Test Results

Applicant Name	Advantech Co., Ltd.		
Trade Name:	ADVANTECH		
Model Name	DMS-SA47 DMS-SA47XXXXXXXXXXXXXXX (where "X" may be any alphanumeric character , "-" or blank)		
Applicable Standards	FCC 47 CFR § 2.1093 Published RF exposure KDB procedures IEEE Std 1528-2013		
Exposure Category	SAR Limits (W/Kg)		
	Peak spatial-average(1g of tissue)		
General population / Uncontrolled exposure	1.6		
RF Exposure Conditions	Equipment Class - Highest Reported SAR (W/kg)		
	DTS	NII	DSS
Body-worn	0.55	1.51	0.00
Simultaneous TX	1.52		
Receive EUT Date:	4/19/2021		
Date Tested	5/4/2021 to 9/23/2021		
Device Category:	PORTABLE DEVICES		
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE		
Test Results	Pass		

The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:	Tested by:
	
Sky Zhou Asst. Section Manager Compliance Certification Services Inc.	WJ Lin Engineer Compliance Certification Services Inc.

2 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE STD 1528-2013, the following FCC Published RF exposure KDB procedures:

- 248227 D01 802.11 Wi-Fi SAR v02r02
- 447498 D01 General RF Exposure Guidance v06
- 616217 D04 SAR for laptop and tablets v01r02
- 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- 865664 D02 RF Exposure Reporting v01r02

In addition to the above, the following information was used:

- TCB workshop October, 2016; Page 7, RF Exposure Procedures (Bluetooth Duty Factor)

3 Device Under Test (DUT) Information

3.1 DUT Description

Applicant	Advantech Co., Ltd. No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District, Taipei 114, Taiwan, R.O.C.
Manufacturer	Advantech Co., Ltd. No. 1, Alley 20, Lane 26, Rueiguang Road, Neihu District, Taipei 114, Taiwan, R.O.C.
Product	Medical Computer
Trade Name	ADVANTECH
Model Discrepancy	DMS-SA47 DMS-SA47XXXXXXXXXXXXXXX (where "X" may be any alphanumeric character , "-" or blank)
Device Dimension	Overall (Length x Width): 225 mm x 197 mm Overall Diagonal: 285 mm Display Diagonal: 240 mm
Back Cover	☒ The Back Cover is not removable.
Battery Options	☒ Standard – Lithium-ion battery, Rating 10.8Vdc, 35.1Wh
Hardware Version	A01
Software Version	A01
Sample Stage	PVT

3.2 Wireless Technologies

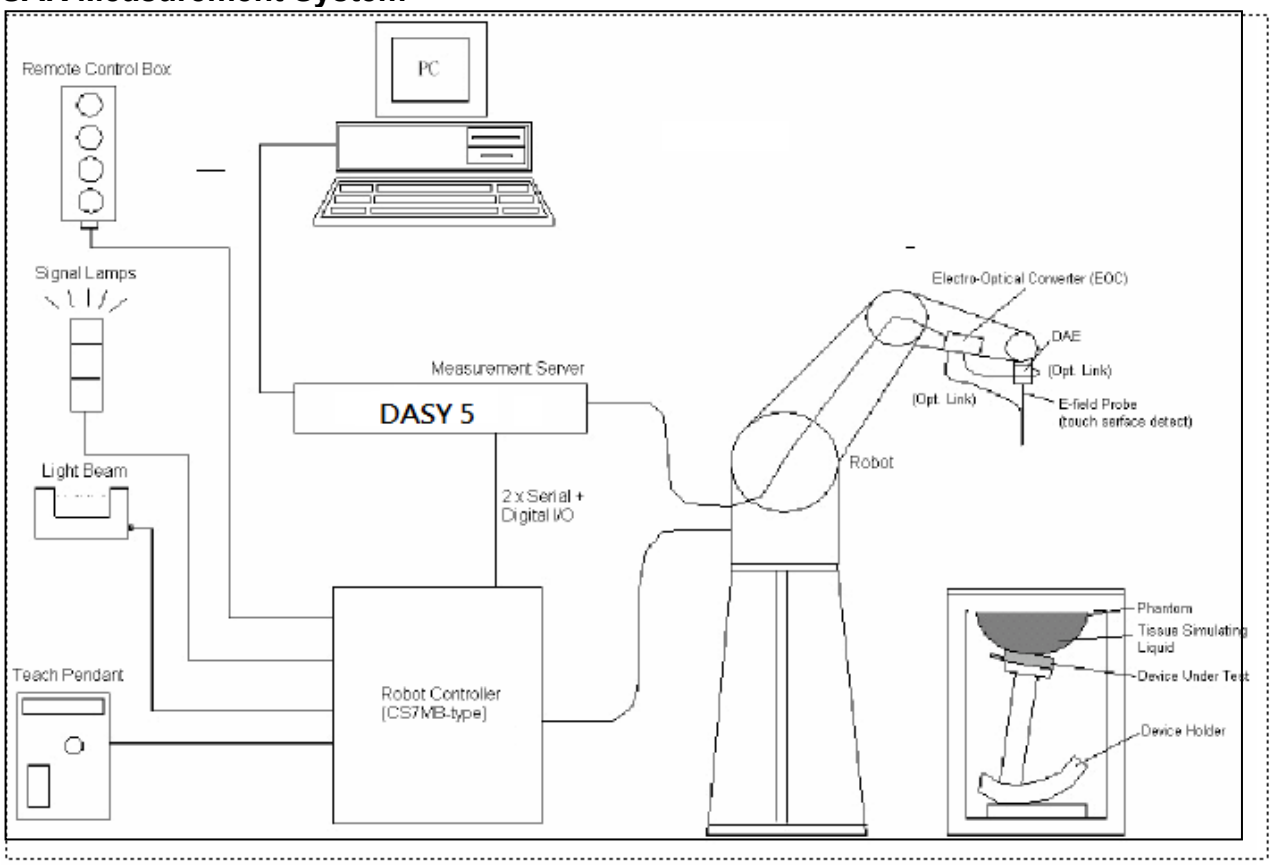
Wireless technologies	Frequency bands	Peak Antenna Gain (dBi)	Operating mode	Duty Cycle used for SAR testing
Wi-Fi Aux (Chain 1)	2.4 GHz	2.97	802.11b 802.11g 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40)	99.2% (802.11b) 95.12% (802.11g) 90.77% (802.11n/ac 20MHz BW) 83.22% (802.11n/ac 40MHz BW)
	5 GHz UNII-1	2.34	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	95% (802.11a) 91% (802.11n/ac 20MHz BW) 84% (802.11n/ac 40MHz BW) 82% (802.11ac 80MHz BW)
	5 GHz UNII-2a	2.48		
	5 GHz UNII-2c	2.61		
	5 GHz UNII-3	3.14		
Bluetooth	2.4 GHz	2.97	Version 2.1 LE	76.8%
WLAN Main Antenna Specification	Brand Name	Anjie		
	Type	PIFA		
	Parts Number	AJDP1J-C0045		
Wi-Fi Main (Chain 0)	2.4 GHz	2.78	802.11b 802.11g 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40)	99.2% (802.11b) 95.12% (802.11g) 90.77% (802.11n/ac 20MHz BW) 83.22% (802.11n/ac 40MHz BW)
	5 GHz UNII-1	2.48	802.11a 802.11n (HT20) 802.11n (HT40) 802.11ac (VHT20) 802.11ac (VHT40) 802.11ac (VHT80)	95% (802.11a) 91% (802.11n/ac 20MHz BW) 84% (802.11n/ac 40MHz BW) 82% (802.11ac 80MHz BW)
	5 GHz UNII-2a	2.48		
	5 GHz UNII-2c	3.46		
	5 GHz UNII-3	3.96		
WLAN Aux Antenna Specification	Brand Name	Anjie		
	Type	PIFA		
	Parts Number	AJDP1J-B0085		
NFC	13.56MHz	ISO 14443A/B and ISO 18092 Type y		NA[4]

Notes:

1. The sample selected for test was prototype that representative to production product and was provided by manufacturer
2. Variant information between/among model numbers / trademarks is provided by the applicant, test results of this report are applicable to the sample EUT received of main test model name.
3. Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received
4. Measured Duty Cycle is not required due to SAR test exemption.

3.3 SAR Measurement System & Test Equipment

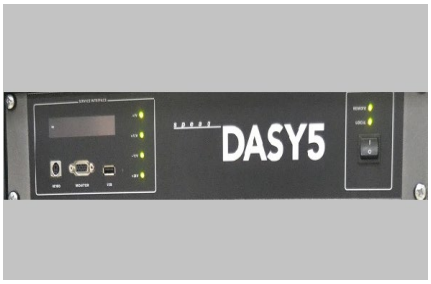
SAR Measurement System



The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (St¨aubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7 or Windows XP.
- DASY software version: NEO52 D10.3 S14.6.13.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.

3.4 System Components

DASY5 Measurement Server	
	The DASY5 measurement server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chip disk and 64MB RAM. The necessary circuits for communication with either the DAE4 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board. The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.
	The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

Data Acquisition Electronics (DAE)	
	The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements

Construction:	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration:	Basic Broad Band Calibration in air: 10-3000 MHz. Conversion Factors (CF) for HSL 900 and HSL 1800 CF-Calibration for other liquids and frequencies upon request.
Frequency:	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity:	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in HSL (rotation normal to probe axis)
Dynamic Range:	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions:	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1 mm
Application:	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

SAM Phantom

Construction:	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 2013, CENELEC 50361 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points with the robot.
Shell Thickness:	2 ±0.2 mm
Filling Volume:	Approx. 25 liters
Dimensions:	Height: 810mm; Length: 1000mm; Width: 500mm

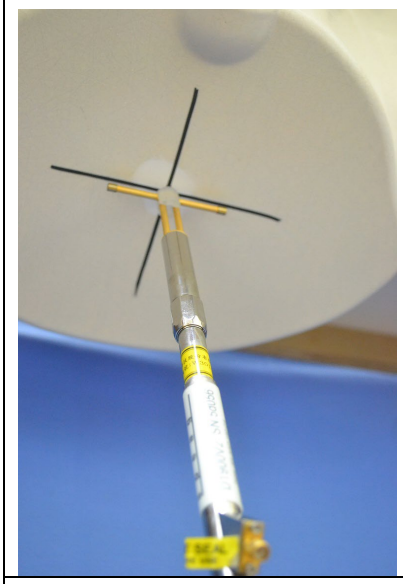
ELI Phantom

Construction:	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY5 and higher and is compatible with all SPEAG dosimetric probes and dipoles
Shell Thickness:	2.0 ± 0.2 mm (sagging: <1%)
Filling Volume:	Approx. 25 liters
Dimensions: **Minor axis:**	Major ellipse axis: 600 mm 400 mm 500mm

Device Holder for SAM Twin Phantom

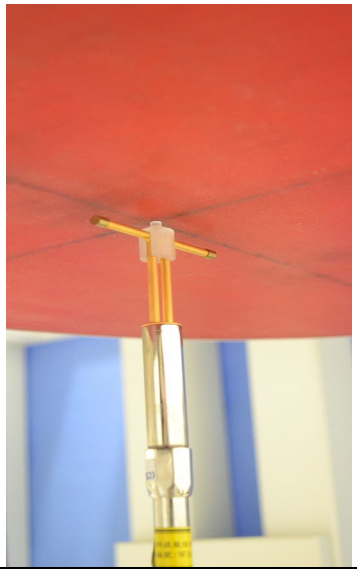
Construction: In combination with the Twin SAM Phantom V4.0 or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

System Validation Kits for SAM Phantom



Construction:	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.
Frequency:	2450, 5300, 5600, 5800 MHz
Return loss:	> 20 dB at specified validation position
Power capability:	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Dimensions:	D2450V2: dipole length: 51.5 mm; overall height: 290 mm D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm

System Validation Kits for ELI phantom



Construction:	Symmetrical dipole with l/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.
Frequency:	2450, 5300, 5600, 5800 MHz
Return loss:	> 20 dB at specified validation position
Power capability:	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Dimensions:	D2450V2: dipole length: 51.5 mm; overall height: 290 mm D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm

3.5 SAR Scan Procedures

Step 1: Power Reference Measurement

The reference and drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

<table>
<tr><th></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe abgle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: ΔxZoom, ΔyZoom</td><td>≤ 2 GHz: ≤ 15 mm
2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm
4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

Step 3: Zoom Scan

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

- Zoom Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}</td><td>≤ 2 GHz: ≤ 8 mm
2 – 3 GHz: ≤ 5 mm</td><td>3 – 4 GHz: ≤ 5 mm
4 – 6 GHz: ≤ 4 mm</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">Uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm
4 – 5 GHz: ≤ 3 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$:between 1st two points losest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm
4 – 5 GHz: ≤ 2.5 mm
5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Maximum zoom scan volume</td><td>x, y, z</td><td>≥ 30 mm</td><td colspan="2">3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
</table>

Step 4: Power drift measurement

The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1

Step 5: Z-Scan (FCC only)

The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation the extrapolated distance should not be larger than the step size in Z-direction

4 Measurement Uncertainty

Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg and the measured 10-g SAR within a frequency band is < 3.75 W/kg. The expanded SAR measurement uncertainty must be ≤ 30%, for a confidence interval of k = 2. If these conditions are met, extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

Therefore, the measurement uncertainty is not required.

5 RF Exposure Conditions (Test Configurations)

Refer to T210113D03-SF PHOTOs for the specific details of the antenna-to-antenna and antenna-to-edge(s) distances.

5.1 Standalone SAR Test Exclusion Considerations

Since the *Dedicated Host Approach* is applied, the standalone SAR test exclusion procedure in KDB 447498 is applied in conjunction with KDB 616217 § 4.3 to determine the minimum test separation distance:

- When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.
- When the separation distance from the antenna to an adjacent edge is > 5 mm, the actual antenna-to-edge separation distance is applied to determine SAR test exclusion.

SAR Test Exclusion Calculations for WLAN SISO

Antennas < 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Main Antenna (Chain 0)													
Wi-Fi 2.4 GHz	2462	18.00	63	21	41.87	170.26	136.5	20.42	4.7 -MEASURE-	2.4 -EXEMPT-	> 50 mm	> 50 mm	4.9 -MEASURE-
Wi-Fi 5.2 GHz	5240	15.00	32	21	41.87	170.26	136.5	20.42	3.5 -MEASURE-	1.7 -EXEMPT-	> 50 mm	> 50 mm	3.7 -MEASURE-
Wi-Fi 5.3 GHz	5320	16.00	40	21	41.87	170.26	136.5	20.42	4.4 -MEASURE-	2.2 -EXEMPT-	> 50 mm	> 50 mm	4.6 -MEASURE-
Wi-Fi 5.5 GHz	5700	17.00	50	21	41.87	170.26	136.5	20.42	5.7 -MEASURE-	2.8 -EXEMPT-	> 50 mm	> 50 mm	6 -MEASURE-
Wi-Fi 5.8 GHz	5825	17.00	50	21	41.87	170.26	136.5	20.42	5.7 -MEASURE-	2.9 -EXEMPT-	> 50 mm	> 50 mm	6 -MEASURE-
Aux Antenna (Chain 1)													
Wi-Fi 2.4 GHz	2462	18.00	63	21	117.37	206.69	40.27	5	4.7 -MEASURE-	> 50 mm	> 50 mm	2.5 -EXEMPT-	19.8 -MEASURE-
Wi-Fi 5.2 GHz	5240	15.50	35	21	117.37	206.69	40.27	5	3.8 -MEASURE-	> 50 mm	> 50 mm	2 -EXEMPT-	16 -MEASURE-
Wi-Fi 5.3 GHz	5320	17.00	50	21	117.37	206.69	40.27	5	5.5 -MEASURE-	> 50 mm	> 50 mm	2.9 -EXEMPT-	23.1 -MEASURE-
Wi-Fi 5.5 GHz	5700	17.00	50	21	117.37	206.69	40.27	5	5.7 -MEASURE-	> 50 mm	> 50 mm	3 -EXEMPT-	23.9 -MEASURE-
Wi-Fi 5.8 GHz	5825	17.00	50	21	117.37	206.69	40.27	5	5.7 -MEASURE-	> 50 mm	> 50 mm	3 -MEASURE-	24.1 -MEASURE-
Bluetooth	2480	4.00	3	21	81.6	206.69	40.27	5	0.2 -EXEMPT-	> 50 mm	> 50 mm	0.1 -EXEMPT-	0.9 -EXEMPT-

SAR Test Exclusion Calculations for WLAN MIMO

Antennas < 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Rear	Edge 1	Edge 2	Edge 3	Edge 4
MIMO													
Wi-Fi 2.4 GHz	2462	13.00	20	21	41.87	170.26	40.27	5	1.5 -EXEMPT-	0.7 -EXEMPT-	> 50 mm	0.8 -EXEMPT-	6.3 -MEASURE-
Wi-Fi 5.2 GHz	5240	16.00	40	21	41.87	170.26	40.27	5	4.4 -MEASURE-	2.2 -EXEMPT-	> 50 mm	2.3 -EXEMPT-	18.3 -MEASURE-
Wi-Fi 5.3 GHz	5320	16.00	40	21	41.87	170.26	40.27	5	4.4 -MEASURE-	2.2 -EXEMPT-	> 50 mm	2.3 -EXEMPT-	18.5 -MEASURE-
Wi-Fi 5.5 GHz	5700	16.50	45	21	41.87	170.26	40.27	5	5.1 -MEASURE-	2.6 -EXEMPT-	> 50 mm	2.7 -EXEMPT-	21.5 -MEASURE-
Wi-Fi 5.8 GHz	5825	16.00	40	21	41.87	170.26	40.27	5	4.6 -MEASURE-	2.3 -EXEMPT-	> 50 mm	2.4 -EXEMPT-	19.3 -MEASURE-

Note(s):

According to KDB 447498, if the calculated threshold value is >3 then SAR testing is required.

SAR Test Exclusion Calculations for WLAN SISO
Antennas > 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Main Antenna (Chain 0)													
Wi-Fi 2.4 GHz	2462	18.00	63	21	41.87	170.26	136.5	20.42	< 50 mm	< 50 mm	1298.2 mW -EXEMPT-	960.6 mW -EXEMPT-	< 50 mm
Wi-Fi 5.2 GHz	5240	15.00	32	21	41.87	170.26	136.5	20.42	< 50 mm	< 50 mm	1268.1 mW -EXEMPT-	930.5 mW -EXEMPT-	< 50 mm
Wi-Fi 5.3 GHz	5320	16.00	40	21	41.87	170.26	136.5	20.42	< 50 mm	< 50 mm	1267.6 mW -EXEMPT-	930 mW -EXEMPT-	< 50 mm
Wi-Fi 5.5 GHz	5700	17.00	50	21	41.87	170.26	136.5	20.42	< 50 mm	< 50 mm	1265.4 mW -EXEMPT-	927.8 mW -EXEMPT-	< 50 mm
Wi-Fi 5.8 GHz	5825	17.00	50	21	41.87	170.26	136.5	20.42	< 50 mm	< 50 mm	1264.8 mW -EXEMPT-	927.2 mW -EXEMPT-	< 50 mm
Aux Antenna (Chain 1)													
Wi-Fi 2.4 GHz	2462	18.00	63	21	117.37	206.69	40.27	5	< 50 mm	769.3 mW -EXEMPT-	1662.5 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.2 GHz	5240	15.50	35	21	117.37	206.69	40.27	5	< 50 mm	739.2 mW -EXEMPT-	1632.4 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.3 GHz	5320	17.00	50	21	117.37	206.69	40.27	5	< 50 mm	738.7 mW -EXEMPT-	1631.9 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.5 GHz	5700	17.00	50	21	117.37	206.69	40.27	5	< 50 mm	736.5 mW -EXEMPT-	1629.7 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.8 GHz	5825	17.00	50	21	117.37	206.69	40.27	5	< 50 mm	735.9 mW -EXEMPT-	1629.1 mW -EXEMPT-	< 50 mm	< 50 mm
Bluetooth	2480	4.00	3	21	81.6	206.69	40.27	5	< 50 mm	411.3 mW -EXEMPT-	1662.2 mW -EXEMPT-	< 50 mm	< 50 mm

SAR Test Exclusion Calculations for WLAN MIMO
Antennas > 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Rear	Edge 1	Edge 2	Edge 3	Edge 4
MIMO													
Wi-Fi 2.4 GHz	2462	13.00	20	21	41.87	170.26	40.27	5	< 50 mm	< 50 mm	1298.2 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.2 GHz	5240	16.00	40	21	41.87	170.26	40.27	5	< 50 mm	< 50 mm	1268.1 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.3 GHz	5320	16.00	40	21	41.87	170.26	40.27	5	< 50 mm	< 50 mm	1267.6 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.5 GHz	5700	16.50	45	21	41.87	170.26	40.27	5	< 50 mm	< 50 mm	1265.4 mW -EXEMPT-	< 50 mm	< 50 mm
Wi-Fi 5.8 GHz	5825	16.00	40	21	41.87	170.26	40.27	5	< 50 mm	< 50 mm	1264.8 mW -EXEMPT-	< 50 mm	< 50 mm

Note(s):

According to KDB 447498, if the calculated Power threshold is less than the output power then SAR testing is required.

5.2 Required Test Configurations

The table below identifies the standalone test configurations required for this device according to the findings in Section 6.1:

Main Antenna (Chain 0)					
Test Configurations	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi 2.4 GHz	Yes	No	No	No	Yes
Wi-Fi 5.2 GHz	Yes	No	No	No	Yes
Wi-Fi 5.3 GHz	Yes	No	No	No	Yes
Wi-Fi 5.5 GHz	Yes	No	No	No	Yes
Wi-Fi 5.8 GHz	Yes	No	No	No	Yes

Aux Antenna (Chain 1)					
Test Configurations	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi 2.4 GHz	Yes	No	No	No	Yes
Wi-Fi 5.2 GHz	Yes	No	No	No	Yes
Wi-Fi 5.3 GHz	Yes	No	No	No	Yes
Wi-Fi 5.5 GHz	Yes	No	No	No	Yes
Wi-Fi 5.8 GHz	Yes	No	No	Yes	Yes
Bluetooth	No	No	No	No	Yes

MIMO					
Test Configurations	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi 2.4 GHz	No	No	No	No	Yes
Wi-Fi 5.2 GHz	Yes	No	No	No	Yes
Wi-Fi 5.3 GHz	Yes	No	No	No	Yes
Wi-Fi 5.5 GHz	Yes	No	No	No	Yes
Wi-Fi 5.8 GHz	Yes	No	No	No	Yes

Note(s):

Yes = Testing is required.

No = Testing is not required.

6 Tissue Dielectric Properties

6.1 Test Liquid Confirmation

Simulating Liquids Parameter Check

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values

The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below 5% may not be easily achieved at certain frequencies.

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE 1528 2013 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head tissue parameters that have not been specified in IEEE 1528 2013 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE 1528 2013

Target Frequency (MHz)	Head	
	ε_r	σ (S/m)
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
835	41.5	0.90
900	41.5	0.97
915	41.5	0.98
1450	40.5	1.20
1610	40.3	1.29
1800 – 2000	40.0	1.40
2450	39.2	1.80
3000	38.5	2.40
5000	36.2	4.45
5100	36.1	4.55
5200	36.0	4.66
5300	35.9	4.76
5400	35.8	4.86
5500	35.6	4.96
5600	35.5	5.07
5700	35.4	5.17
5800	35.3	5.27

IEEE Std 1528-2013
Refer to Table 3 within the IEEE Std 1528-2013

6.2 Typical Composition of Ingredients for Liquid Tissue Phantoms

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

alt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxy thyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra-pure): Polyethylene glycol mono [4-(1, 1, 3, 3-tetramethylbutyl)phenyl]ether

Simulating Liquids for 5 GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	78
Mineral oil	11
Emulsifiers	9
Additives and Salt	2

6.3 Simulating Liquids Parameter Check Results

Date	Tissue Type	Frequency (MHz)	Relative Permittivity (εr)			Conductivity (σ)		
			Measured	Target	Delta (%)	Measured	Target	Delta (%)
2021/5/4	Head	2400	39.13	39.30	-0.43	1.76	1.76	0.23
		2450	38.95	39.20	-0.64	1.81	1.80	0.78
		2500	38.78	39.13	-0.89	1.87	1.85	1.03
2021/5/17	Head	5180	36.31	36.02	0.81	4.68	4.64	0.82
		5200	36.26	36.00	0.72	4.69	4.66	0.56
		5260	36.06	35.94	0.33	4.78	4.72	1.19
2021/9/22	Head	5150	36.10	36.05	0.14	4.73	4.61	2.71
		5200	35.89	36.00	-0.31	4.79	4.66	2.81
		5250	35.77	35.95	-0.50	4.83	4.71	2.57
2021/5/10	Head	5250	36.27	35.95	0.89	4.75	4.71	0.83
		5300	36.02	35.90	0.33	4.77	4.76	0.23
		5350	35.89	35.85	0.11	4.89	4.81	1.66
2021/9/23	Head	5250	35.68	35.95	-0.75	4.81	4.71	2.19
		5300	35.66	35.90	-0.67	4.93	4.76	3.63
		5350	35.63	35.85	-0.61	4.95	4.81	2.91
2021/5/6	Head	5550	34.86	35.58	-2.02	5.00	5.02	-0.44
		5600	34.69	35.50	-2.28	5.05	5.07	-0.34
		5650	34.55	35.45	-2.54	5.12	5.12	-0.06
2021/5/4	Head	5750	34.09	35.35	-3.56	5.17	5.22	-1.03
		5800	33.89	35.30	-3.99	5.25	5.27	-0.38
		5825	33.82	35.28	-4.14	5.29	5.30	-0.21
2021/5/5	Head	5750	34.47	35.35	-2.49	5.22	5.22	0.00
		5800	34.16	35.30	-3.23	5.30	5.27	0.59
		5825	34.11	35.28	-3.32	5.35	5.30	0.96

7 System Performance Check

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications. The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Head simulating liquid of the following parameters.
- The DASY5 system with an E-field probe EX3DV4 SN: 3665 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm (below 1 GHz) and 10 mm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration (dx=dy= 5 mm, dz= 5 mm).
- Distance between probe sensors and phantom surface was set to 3.0 mm.
- The dipole input power (forward power) was 250 mW±3% (below 2GHz) and 100 mW ±3%
- The results are normalized to 1 W input power.

7.1 Reference SAR Values for System Performance Check

The reference SAR values can be obtained from the calibration certificate of system validation dipoles

System Dipole	Serial No.	Cal. Date	Freq. (MHz)	Target SAR Values (W/kg)	
				1g/10g	Head
D2450V2	835	2020/6/15	2450	1g	51.5
				10g	23.7
D5GHzV2	1023	2021/1/26	5200	1g	77.9
				10g	22.2
D5GHzV2	1023	2021/1/26	5300	1g	80.4
				10g	22.8
D5GHzV2	1023	2021/1/26	5600	1g	83.9
				10g	23.6
D5GHzV2	1023	2021/1/26	5800	1g	80.9
				10g	22.6

7.2 System Performance Check Results

Date	Tissue Type	Dipole S/N	Input Power (mW)	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Delta 1g ±10 (%)	Measured 10g SAR (W/kg)	Targeted 10g SAR (W/kg)	Normalized 10g SAR (W/kg)	Delta 10g ±10 (%)	Plot No.
2021/5/4	Head	D2450V2-835	250	12.50	51.50	50	-2.91	6.08	23.70	24.32	2.62	1
2021/5/17	Head	D5GHzV2-1023-5200	100	7.71	77.90	77.1	-1.03	2.24	22.20	22.4	0.90	2
2021/9/22	Head	D5GHzV2-1023-5200	100	7.83	77.90	78.3	0.51	2.25	22.20	22.5	1.35	3
2021/5/10	Head	D5GHzV2-1023-5300	100	7.30	80.40	73	-9.20	2.10	22.80	21	-7.89	4
2021/9/23	Head	D5GHzV2-1023-5300	100	8.12	80.40	81.2	1.00	2.32	22.80	23.2	1.75	5
2021/5/6	Head	D5GHzV2-1023-5600	100	7.94	83.90	79.4	-5.36	2.27	23.60	22.7	-3.81	6
2021/5/4	Head	D5GHzV2-1023-5800	100	8.52	80.90	85.2	5.32	2.44	22.60	24.4	7.96	7
2021/5/5	Head	D5GHzV2-1023-5800	100	8.00	80.90	80	-1.11	2.28	22.60	22.8	0.88	8

8 Conducted Output Power Measurements

8.1 Wi-Fi 2.4GHz (DTS Band)

SISO Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)			Duty Cycle %	Tune-up Limit (dBm)			SAR Test (Yes/No)		
					Chain 0	Chain 1	Total		Chain 0	Chain 1	MIMO	Chain 0	Chain 1	MIMO
2.4GHz (DTS)	802.11b	1 Mbps	1	2412	17.78	17.62		99.2	18.0	18.0		Yes	Yes	
			6	2437	17.56	17.52								
			11	2462	17.92	17.72								
	802.11g	6 Mbps	1	2412	Not Required			95.12	18.0	18.0		No	No	
			6	2437										
			11	2462										
	802.11n (HT20)	MCS0	1	2412				90.77			13.0			No
			6	2437										
			11	2462										
	802.11n (HT40)	MCS0	3	2422	8.45	9.37	11.94	83.22			13.0			Yes
			6	2437	8.23	9.29	11.80							
			9	2452	8.13	9.45	11.85							
	802.11ac (VHT20)	MCS0	1	2412	Not Required			90.77			13.0			No
			6	2437										
			11	2462										
	802.11ac (VHT40)	MCS0	3	2422				83.22			13.0			No
			6	2437										
			9	2452										

Note(s):

1. SAR is not required for 802.11g/n modes when the adjusted SAR for 802.11b is < 1.2 W/kg.
2. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.

8.2 Wi-Fi 5GHz (U-NII Bands)

Measured Results

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)			Duty Cycle %		Tune-up Limit (dBm)			SAR Test (Yes/No)		
					Chain 0	Chain 1	Total	Chain 0	Chain 1	Chain 0	Chain 1	MIMO	Chain 0	Chain 1	MIMO
5.2GHz (U-NII 1)	802.11a	6 Mbps	36	5180	14.20	15.16		95		15.0	15.5		Yes	Yes	
			40	5200	14.17	14.67									
			44	5220	14.09	14.49									
			48	5240	14.39	14.75									
	802.11n (HT20)	MCS0	36	5180	Not Required			91				13.0			No
			40	5200											
			44	5220											
			48	5240											
	802.11n (HT40)	MCS0	38	5190				84				15.5			No
			46	5230											
	802.11ac (VHT20)	MCS0	36	5180				91				13.0			No
			40	5200											
			44	5220											
			48	5240											
	802.11ac (VHT40)	MCS0	38	5190				84				15.5			No
			46	5230											
	802.11ac (VHT80)	MCS0	42	5210	11.74	11.82	14.79	82				16.0			Yes
5.3GHz (U-NII 2A)	802.11a	6 Mbps	52	5260	15.35	16.40		95		16.0	17.0		Yes	Yes	
			56	5280	15.12	16.28									
			60	5300	15.42	16.15									
			64	5320	15.11	16.04									
	802.11n (HT20)	MCS0	52	5260	Not Required			91				13.0			No
			56	5280											
			60	5300											
			64	5320											
	802.11n (HT40)	MCS0	54	5270				84				13.3			No
			62	5310											
	802.11ac (VHT20)	MCS0	52	5260				91				13.0			No
			56	5280											
			60	5300											
			64	5320											
	802.11ac (VHT40)	MCS0	54	5270				84				13.3			No
			62	5310											
	802.11ac (VHT80)	MCS0	58	5290	11.58	11.96	14.78	82				16.0			Yes

Measured Results(continued)

Band	Mode	Data Rate	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)			Duty Cycle %	Tune-up Limit (dBm)			SAR Test (Yes/No)		
					Chain 0	Chain 1	Total		Chain 0	Chain 1	MIMO	Chain 0	Chain 1	MIMO
5.5GHz (U-NII 2C)	802.11a	6 Mbps	100	5500	16.76	16.69		95	17.0	17.0		Yes	Yes	
			116	5580	16.49	16.36								
			132	5660	16.73	16.31								
			140	5700	16.76	16.43								
			144	5720	16.53	16.40								
	802.11n (HT20)	MCS0	100	5500	Not Required			91			13.0			No
			116	5580										
			132	5660										
			140	5700										
			144	5720										
	802.11n (HT40)	MCS0	102	5510				84			13.3			No
			110	5550										
			134	5670										
			142	5710										
	802.11ac (VHT20)	MCS0	100	5500				91			13.0			No
			116	5580										
			132	5660										
			140	5700										
			144	5720										
	802.11ac (VHT40)	MCS0	102	5510				84			13.3			No
			110	5550										
			134	5670										
			142	5710										
	802.11ac (VHT80)	MCS0	106	5530	11.27	12.65	15.02	82			16.5			Yes
			122	5610	11.74	12.42	15.10							
			138	5690	11.68	12.55	15.15							
5.8GHz (U-NII 3)	802.11a	6 Mbps	149	5745	16.71	16.67		95	17.0	17.0		Yes	Yes	
			157	5785	16.59	16.56								
			165	5825	16.73	16.65								
	802.11n (HT20)	MCS0	149	5745	Not Required			91			13.5			No
			157	5785										
			165	5825										
	802.11n (HT40)	MCS0	151	5755				84			13.3			No
			159	5795										
	802.11ac (VHT20)	MCS0	149	5745				91			13.5			No
			157	5785										
			165	5825										
	802.11ac (VHT40)	MCS0	151	5755				84			13.3			No
			159	5795										
	802.11ac (VHT80)	MCS0	155	5775	11.43	11.76	14.61	82			16.0			Yes

Note(s):

1. For “Not required”, SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band. Additional output power measurements were not deemed necessary.
2. When the same transmission mode configurations have the same maximum output power on the same channel for the 802.11 a/g/n/ac modes, the channel in the lower order/sequence 802.11 mode (i.e. a, g, n then ac) is selected.
3. When the specified maximum output power is the same for both UNII band I and UNII band 2A, begin SAR measurement in UNII band 2A; and if the highest ***reported*** SAR for UNII band 2A is
   - ≤ 1.2 W/kg, SAR is not required for UNII band I
   - > 1.2 W/kg, both bands should be tested independently for SAR.

8.3 Bluetooth.

Average Power Measured Results

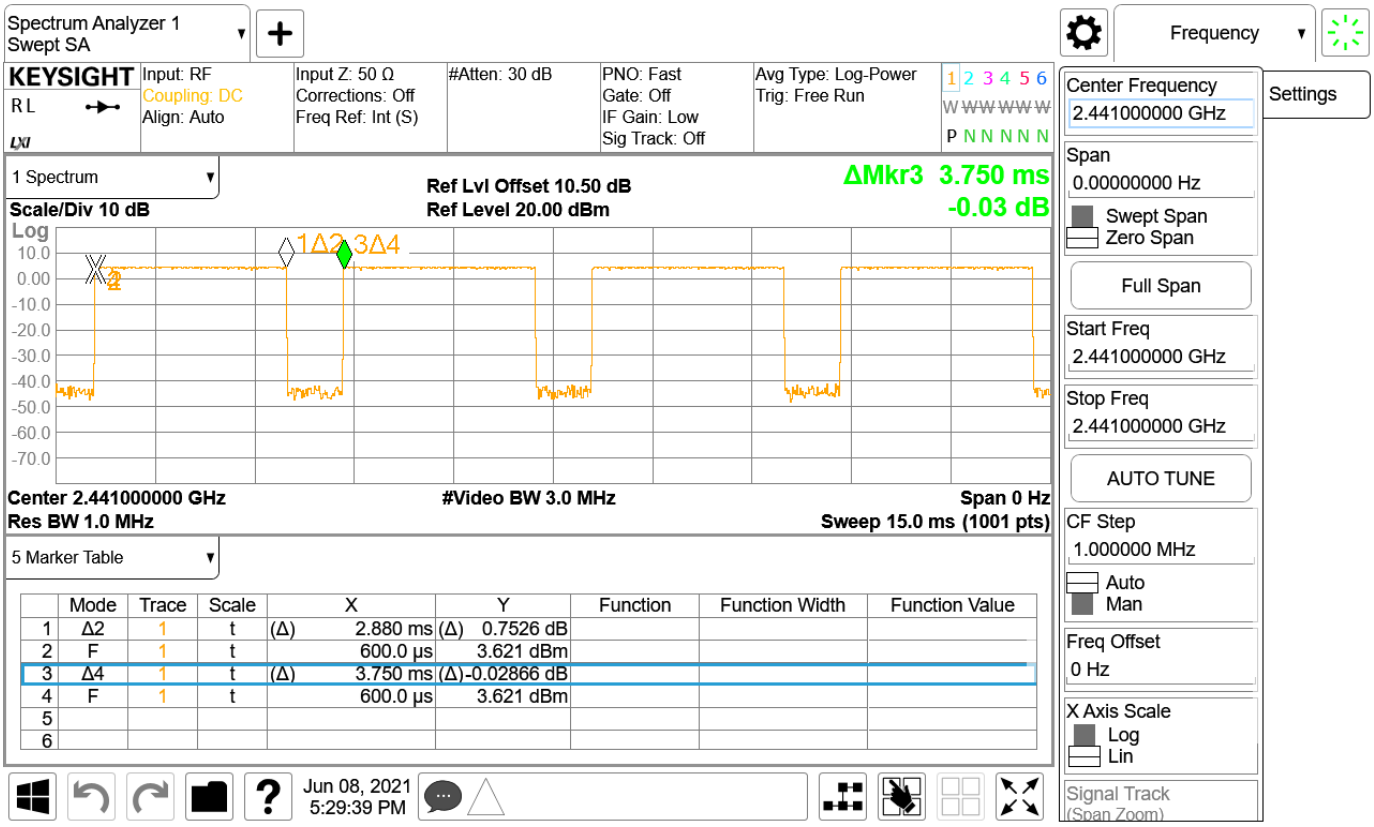
Band (GHz)	Mode	Ch #	Freq. (MHz)	Meas. Avg Pwr (dBm)	Meas. Avg Pwr (mW)	Duty Cycle %	Tune-up Limit (dBm)	SAR Test (Yes/No)
2.4	GFSK	0	2402	3.31	2.14	76.8	4.0	No
		39	2441	3.70	2.34			
		78	2480	3.69	2.34			
	EDR, π/4 DQPSK	0	2402	0.95	1.24	76.8	2.0	No
		39	2441	1.33	1.36			
		78	2480	1.32	1.36			
	EDR, 8-DPSK	0	2402	1.92	1.56	76.8	3.0	No
		39	2441	2.30	1.70			
		78	2480	2.26	1.68			
	LE, GFSK	0	2402	-4.51	0.35	66	-3.0	No
		19	2440	-4.15	0.38			
		39	2480	-4.09	0.39			

Duty Factor Measured Results

Mode	Type	T on (ms)	Period (ms)	Duty Cycle	Crest Factor (1/duty cycle)
GFSK	DH5	2.88	3.75	76.80%	1.30

Duty Cycle plots

GFSK



	Mode	Trace	Scale	X	Y	Function	Function Width	Function Value
1	Δ2	1	t	(Δ) 2.880 ms	(Δ) 0.7526 dB			
2	F	1	t	600.0 µs	3.621 dBm			
3	Δ4	1	t	(Δ) 3.750 ms	(Δ)-0.02866 dB			
4	F	1	t	600.0 µs	3.621 dBm			
5								
6								

9 Measured and Reported (Scaled) SAR Results

KDB 447498 D01 General RF Exposure Guidance:
Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

KDB 248227 D01 SAR meas for 802.11:
SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- > 0.4 W/kg, SAR is repeated using the same wireless mode test configuration tested in the *initial test position* to measure the subsequent next closet/smallest test separation distance and maximum coupling test position, on the highest maximum output power channel, until the *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
  - For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling condition should be tested.
  - When it is unclear, all equivalent conditions must be tested.
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.
- When the specified maximum output power is the same for both UNII 1 and UNII 2A, begin SAR measurements in UNII 2A with the channel with the highest measured output power. If the reported SAR for UNII 2A is ≤ 1.2 W/kg, SAR is not required for UNII 1; otherwise treat the remaining bands separately and test them independently for SAR.
- When the specified maximum output power is different between UNII 1 and UNII 2A, begin SAR with the band that has the higher specified maximum output. If the highest reported SAR for the band with the highest specified power is ≤ 1.2 W/kg, testing for the band with the lower specified output power is not required; otherwise test the remaining bands independently for SAR.

To determine the *initial test position*, Area Scans were performed to determine the position with the *Maximum Value of SAR (measured)*. The position that produced the highest *Maximum Value of SAR* is considered the worst case position; thus used as the *initial test position*.

9.1 Wi-Fi (DTS Band)

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Body	802.11b	Main Chain 0	0	Rear	11	2462	99.2%	18.0	17.92	0.193	0.198	
			0	Edge 4	11	2462	99.2%	18.0	17.92	0.532	**0.546**	1
	802.11b	Aux Chain 1	0	Rear	11	2462	99.2%	18.0	17.72	0.334	0.359	
			0	Edge 4	11	2462	99.2%	18.0	17.72	0.390	**0.419**	2
	802.11n40	MIMO 0 + 1	0	Edge 4	3	2422	83.2%	13.0	11.94	0.063	**0.097**	3

9.2 Wi-Fi (U-NII Band)

RF Exposure Conditions	Frequency Band	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Body	5.2GHz (U-NII 1)	802.11a	Main Chain 0	0	Rear	48	5240	95.0%	15.0	14.39	0.164	0.199	
					Edge 4	36	5180	95.0%	15.0	14.20	0.761	0.963	
					Edge 4	40	5200	95.0%	15.0	14.17	0.770	0.981	
					Edge 4	44	5220	95.0%	15.0	14.09	0.808	**1.049**	4
					Edge 4	48	5240	95.0%	15.0	14.39	0.837	1.014	
		802.11a	Aux Chain 1	0	Rear	36	5180	95.0%	15.5	15.16	0.280	**0.319**	5
					Edge 4	36	5180	95.0%	15.5	15.16	0.071	0.081	
		802.11ac80	MIMO	0	Rear	42	5210	82.0%	16.0	14.79	0.094	0.151	
					Edge 4	42	5210	82.0%	16.0	14.79	0.518	**0.835**	6

RF Exposure Conditions	Frequency Band	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Body	5.3GHz (U-NII 2A)	802.11a	Main Chain 0	0	Rear	60	5300	95.0%	16.0	15.42	0.245	0.295	
					Edge 4	52	5260	95.0%	16.0	15.35	1.080	1.320	
					Edge 4	56	5280	95.0%	16.0	15.12	1.050	1.354	
					Edge 4	60	5300	95.0%	16.0	15.42	1.120	1.347	
					Edge 4	64	5320	95.0%	16.0	15.11	1.100	**1.421**	7
		802.11a	Aux Chain 1	0	Rear	52	5260	95.0%	17.0	16.40	0.333	**0.402**	8
					Edge 4	52	5260	95.0%	17.0	16.40	0.065	0.079	
		802.11ac80	MIMO 0 + 1	0	Rear	58	5290	82.0%	16.0	14.78	0.143	0.231	
					Edge 4	58	5290	82.0%	16.0	14.78	0.463	**0.748**	9

RF Exposure Conditions	Frequency Band	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Body	5.5GHz (U-NII 2C)	802.11a	Main Chain 0	0	Rear	100	5500	95.0%	17.0	16.76	0.343	0.382	
					Edge 4	100	5500	95.0%	17.0	16.76	1.360	**1.513**	10
					Edge 4	116	5580	95.0%	17.0	16.49	1.230	1.456	
					Edge 4	132	5660	95.0%	17.0	16.73	1.290	1.445	
					Edge 4	140	5700	95.0%	17.0	16.76	1.130	1.257	
					Edge 4	144	5720	95.0%	17.0	16.53	1.120	1.314	
		802.11a	Aux Chain 1	0	Rear	100	5500	95.0%	17.0	16.69	0.592	**0.669**	11
					Edge 4	100	5500	95.0%	17.0	16.69	0.126	0.142	
		802.11ac80	MIMO 0 + 1	0	Rear	138	5690	82.0%	16.5	15.15	0.325	0.541	
					Edge 4	138	5690	82.0%	16.5	15.15	0.437	**0.727**	12

RF Exposure Conditions	Frequency Band	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
									Tune-up Limit	Meas.	Meas.	Scaled	
Body	5.8GHz (U-NII 3)	802.11a	Main Chain 0	0	Rear	165	5825	95.0%	17.0	16.73	0.400	0.448	
					Edge 4	149	5745	95.0%	17.0	16.71	1.190	**1.339**	13
					Edge 4	157	5785	95.0%	17.0	16.59	1.130	1.307	
					Edge 4	165	5825	95.0%	17.0	16.73	1.090	1.221	
		802.11a	Aux Chain 1	0	Rear	149	5745	95.0%	17.0	16.67	0.547	**0.621**	14
					Edge 3	149	5745	95.0%	17.0	16.67	0.190	0.216	
					Edge 4	149	5745	95.0%	17.0	16.67	0.131	0.149	
		802.11ac80	MIMO 0 + 1	0	Rear	155	5775	82.0%	16.0	14.61	0.202	0.339	
					Edge 4	155	5775	82.0%	16.0	14.61	0.325	**0.546**	15

9.3 Bluetooth

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Power (dBm)		1-g SAR (W/kg)		Plot No.
								Tune-up Limit	Meas.	Meas.	Scaled	
Body	GFSK	Aux Chain 1	0	Edge 4	39	2441	76.8%	4.0	3.70	0.003	**0.004**	16

10 SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

WiFi 5.2GHz

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
								Original	Repeated	
Body	802.11a	Main Chain 0	0	Edge 4	48	5240	95.0%	0.837	0.824	1.02

WiFi 5.3GHz

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
								Original	Repeated	
Body	802.11a	Main Chain 0	0	Edge 4	60	5300	95.0%	1.120	1.140	1.02

WiFi 5.5GHz

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
								Original	Repeated	
Body	802.11a	Main Chain 0	0	Edge 4	100	5500	95.0%	1.360	1.350	1.01

WiFi 5.8GHz

RF Exposure Conditions	Mode	Antenna	Dist. (mm)	Test Position	Ch #.	Freq. (MHz)	Duty Cycle	Meas. SAR (W/kg)		Largest to Smallest SAR Ratio
								Original	Repeated	
Body	802.11a	Main Chain 0	0	Edge 4	149	5745	95.0%	1.190	1.210	1.02

Note(s):

Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is < 1.20.

11 Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance explains how to calculate the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

$SPLSR = (SAR_1 + SAR_2)^{1.5} / Ri$

Where:

SAR_1 is the highest measured or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition

SAR_2 is the highest measured or estimated SAR for the second of a pair of simultaneous transmitting antennas, in the same test operating mode and exposure condition as the first

Ri is the separation distance between the pair of simultaneous transmitting antennas. When the SAR is measured, for both antennas in the pair, it is determined by the actual x, y and z coordinates in the 1-g SAR for each SAR peak location, based on the extrapolated and interpolated result in the zoom scan measurement, using the formula of **$[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$**

In order for a pair of simultaneous transmitting antennas with the sum of 1-g SAR > 1.6 W/kg to qualify for exemption from Simultaneous Transmission SAR measurements, it has to satisfy the condition of:

$(SAR_1 + SAR_2)^{1.5} / Ri \leq 0.04$

Simultaneous Transmission Condition

RF Exposure Condition	Item	Capable Transmit Configurations		
Standalone	1	DTS (Main Antenna)	+	BT (Aux Antenna)
	2	DTS (MIMO)	+	BT (Aux Antenna)
	3	U-NII (Main Antenna)	+	BT (Aux Antenna)
	4	U-NII (MIMO)	+	BT (Aux Antenna)

Notes:

1. DTS Main Antenna Radio can transmit simultaneously with Bluetooth Radio.
2. U-NII Main Antenna Radio can transmit simultaneously with Bluetooth Radio.

Estimated SAR for Simultaneous Transmission SAR Analysis
Considerations for SAR estimation

1. When standalone SAR test exclusion applies, standalone SAR must also be estimated to determine simultaneous transmission SAR test exclusion.
2. Dedicated Host Approach criteria for SAR test exclusion is likewise applied to SAR estimation, with certain distinctions between test exclusion and SAR estimation:
   - When the separation distance from the antenna to an adjacent edge is ≤ 5 mm, a distance of 5 mm is applied for SAR estimation; this is the same between test exclusion and SAR estimation calculations.
   - When the separation distance from the antenna to an adjacent edge is > 5 mm but ≤ 50 mm, the actual antenna-to-edge separation distance is applied for SAR estimation.
   - When the minimum test separation distance is > 50 mm, the estimated SAR value is 0.4 W/kg
3. Please refer to Estimated SAR Tables to see which test positions are inherently compliant as they consist of only estimated SAR values for all applicable transmitters and consequently will always have sum of SAR values < 1.2 W/kg. Simultaneous transmission SAR analysis was therefore not performed for these test positions.

Estimated SAR for WLAN

Tx Interface	Output Power		Separation Distances (mm)					Estimated 1-g SAR Value (W/kg)				
	dBm	mW	Rear	Edge 1	Edge 2	Edge 3	Edge 4	Rear	Edge 1	Edge 2	Edge 3	Edge 4
Main Antenna (Chain 0)												
Wi-Fi 2.4 GHz	18.00	63	21	41.87	170.26	136.5	20.42	-MEASURE-	0.314	0.400	0.400	-MEASURE-
Wi-Fi 5.2 GHz	15.00	32	21	41.87	170.26	136.5	20.42	-MEASURE-	0.233	0.400	0.400	-MEASURE-
Wi-Fi 5.3 GHz	16.00	40	21	41.87	170.26	136.5	20.42	-MEASURE-	0.293	0.400	0.400	-MEASURE-
Wi-Fi 5.5 GHz	17.00	50	21	41.87	170.26	136.5	20.42	-MEASURE-	0.379	0.400	0.400	-MEASURE-
Wi-Fi 5.8 GHz	17.00	50	21	41.87	170.26	136.5	20.42	-MEASURE-	0.383	0.400	0.400	-MEASURE-
Aux Antenna (Chain 1)												
Wi-Fi 2.4 GHz	18.00	63	21	117.37	206.69	40.27	5	-MEASURE-	0.400	0.400	0.330	-MEASURE-
Wi-Fi 5.2 GHz	15.50	35	21	117.37	206.69	40.27	5	-MEASURE-	0.400	0.400	0.267	-MEASURE-
Wi-Fi 5.3 GHz	17.00	50	21	117.37	206.69	40.27	5	-MEASURE-	0.400	0.400	0.384	-MEASURE-
Wi-Fi 5.5 GHz	17.00	50	21	117.37	206.69	40.27	5	-MEASURE-	0.400	0.400	0.398	-MEASURE-
Wi-Fi 5.8 GHz	17.00	50	21	117.37	206.69	40.27	5	-MEASURE-	0.400	0.400	-MEASURE-	-MEASURE-
Bluetooth	4.00	3	21	81.6	206.69	40.27	5	0.030	0.400	0.400	0.016	0.126
MIMO												
Wi-Fi 2.4 GHz	13.00	20	21	41.87	170.26	40.27	5	0.199	0.100	0.400	0.105	-MEASURE-
Wi-Fi 5.2 GHz	16.00	40	21	41.87	170.26	40.27	5	-MEASURE-	0.291	0.400	0.305	-MEASURE-
Wi-Fi 5.3 GHz	16.00	40	21	41.87	170.26	40.27	5	-MEASURE-	0.293	0.400	0.308	-MEASURE-
Wi-Fi 5.5 GHz	16.50	45	21	41.87	170.26	40.27	5	-MEASURE-	0.341	0.400	0.358	-MEASURE-
Wi-Fi 5.8 GHz	16.00	40	21	41.87	170.26	40.27	5	-MEASURE-	0.306	0.400	0.322	-MEASURE-

11.1 Sum of the SAR for Wi-Fi & BT

Test Position	Standalone SAR (W/kg)							∑ 1-g SAR (W/kg)			
	DTS			U-NII			BT	DTS + BT	DTS + BT	U-NII + BT	U-NII + BT
	Main Chain 0 ①	Aux Chain 1 ②	MIMO ③	Main Chain 0 ④	Aux Chain 1 ⑤	MIMO ⑥	Aux ⑦	① + ⑦	③ + ⑦	④ + ⑦	⑥ + ⑦
Rear	0.198	0.359	0.199	0.448	0.669	0.541	0.030	0.23	0.23	0.48	0.57
Edge 3	0.330	0.400	0.105	0.400	0.216	0.358	0.016	0.35	0.12	0.42	0.37
Edge 4	0.546	0.419	0.097	1.513	0.149	0.835	0.004	0.55	0.10	1.52	0.84

Conclusion:

Simultaneous transmission SAR measurement (Volume Scan) is not required because either the sum of the 1-g SAR is < 1.6 W/kg or the SPLSR is < 0.04 for all circumstances that require SPLSR calculation.

12 Equipment List & Calibration Status

Dielectric Property Measurements				
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
Dielectric Assessment Kit	SPEAG	DAKS-3.5	1053	2022/2/10
Thermometer	LKM	DTM3000	EC14010603	2021/10/12

System Check				
Name of Equipment	Manufacturer	Type/Model	Serial No.	Cal. Due Date
MXG Analog Signal Generator	Agilent	N5181A	MY50145142	2021/12/27
Power Meter	Agilent	E4417A	MY52240003	2021/10/17
Power Sensor	Agilent	E9301H	MY52200004	2021/10/18
Power Sensor	Agilent	E9301H	MY51470002	2022/3/22
Dual Directional Coupler	Agilent	772D	MY46151242	2021/10/5
Amplifier	EMCI	ZHL-42	980189	N/A
Amplifier	EMCI	ZVE-8G	980190	N/A
Data Acquisition Electronice	SPEAG	DAE4	558	2021/11/24
Dosimetric E-Field Probe	SPEAG	EX3DV4	3665	2021/8/19
Dosimetric E-Field Probe	SPEAG	EX3DV4	3665	2022/8/25
System Validation Dipole	SPEAG	D2450V2	835	2021/6/15
System Validation Dipole	SPEAG	D5GHzV2	1023	2022/1/25
Humidity/Temp meter	TECPEL	DTM-303A	TP130077	2021/9/29
Thermometer	LKM	DTM3000	EC14010603	2021/10/12

Software Version
DASY NEO52 D10.3 S14.6.13
SEMCAD-X-PostPro

13 Facilities

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

14 Attachments

Exhibit	Content
1	System Performance Check Plots
2	SAR Test Data Plots
3	SAR Equipment calibration report
4	T210113D03-SF PHOTOs

END OF REPORT