FCC TEST REPORT

for

SYSTEM TABLET CONTROLLER
Model Name: SC-1

Issued to:

ADLINK TECHNOLOGY INC.
9F, No.166, Jian Yi Rd., Zhonghe Dist., New Taipei City, 235 Taiwan

Issued by

Compliance Certification Services Inc.
Wugu Lab.
No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City, Taiwan. (R.O.C.)
Issued Date: 2020/05/26

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	2020/5/26	Initial Issue	ALL	Edison Hu

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1 Certificate of Compliance (SAR Evaluation)

Applicant	ADLINK TECHNOLOGY INC. 9F, No.166, Jian Yi Rd., Zhonghe Dist., New Taipei City, 235 Taiwan
Manufacturer	ADLINK TECHNOLOGY INC. 9F, No.166, Jian Yi Rd., Zhonghe Dist., New Taipei City, 235 Taiwan
Equipment Under Test:	SYSTEM TABLET CONTROLLER
Trade Name:	OLYMPUS
Model Name:	SC-1
Date of Test:	Mar 13 ~ 18, 2020
Receive EUT Date:	Feb 13, 2020
Device Category:	PORTABLE DEVICES
Exposure Category:	GENERAL POPULATION/UNCONTROLLED EXPOSURE

Applicable Standards	
FCC	● IEEE 1528 2013 ● KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04 ● KDB 865664 D02 RF Exposure Reporting v01r02 ● KDB 447498 D01 General RF Exposure Guidance v06 ● KDB 616217 D04 SAR for laptop and tablets v01r02 ● KDB 248227 D01 SAR Meas for 802.11 v02r02
Limit	
1.6 W/kg	
Test Result	
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:

Kevin Tsai
Section Manager
Compliance Certification Services Inc.

Tested by:

Stella Chang
SAR Engineer
Compliance Certification Services Inc.

2 Description of Equipment Under Test

Product	SYSTEM TABLET CONTROLLER		
Trade Name	OLYMPUS		
Model Name	SC-1		
Modulation Technique	Bluetooth:GFSK for 1Mbps;π/4-DQPSK for 2Mbps;8DPSK for 3Mbps;LE		
	802.11a: Orthogonal Frequency Division Multiplexing (OFDM)		
	802.11b: Direct Sequence Spread Spectrum(DSSS)		
	802.11g: Orthogonal Frequency Division Multiplexing (OFDM)		
	802.11n: Orthogonal Frequency Division Multiplexing (OFDM)		
	802.11ac: Orthogonal Frequency Division Multiplexing (OFDM)		
	Operating Mode	TX Freq Range (MHz)	Peak Antenna Gain (dBi)
	Antenna Main		
	WLAN2.4GHz	2412~2462	1.57
	WLAN5GHz	5150~5250	2.75
	WLAN5GHz	5250~5350	1.11
	WLAN5GHz	5470~5725	2.22
	WLAN5GHz	5725~5850	0.9
	Antenna Aux		
	WLAN2.4GHz	2412~2462	1.75
	WLAN5GHz	5150~5250	2.87
	WLAN5GHz	5250~5350	2.41
	WLAN5GHz	5470~5725	3.37
	WLAN5GHz	5725~5850	2.66
	Bluetooth	2402~2480	1.75
WLAN Antenna Specification	Brand name	WIESON	
	Type	PCB	
Simulatious Transmission Configurations	WLAN Ant Main + WLAN Ant Aux		

Remark:

1.The sample selected for test was prototype that representative to production product and was provided by manufacturer

2.1 Summary of Highest SAR Values

Results for highest reported SAR values for each frequency band and mode are as below:

Technology/Band	Test configuration	Highest Reported 1g-SAR (W/kg)	Simultaneous Transmission 1g SAR (W/kg)
WLAN2.4GHz Ant Aux	Edge 4	0.470	1.37
WLAN2.4GHz Ant Main	Edge 1	0.279	1.27
WLAN5GHz Ant Aux	Edge 4	1.114	1.42
WLAN5GHz Ant Main	Edge 1	1.199	

3 Requirements for Compliance Testing Defined

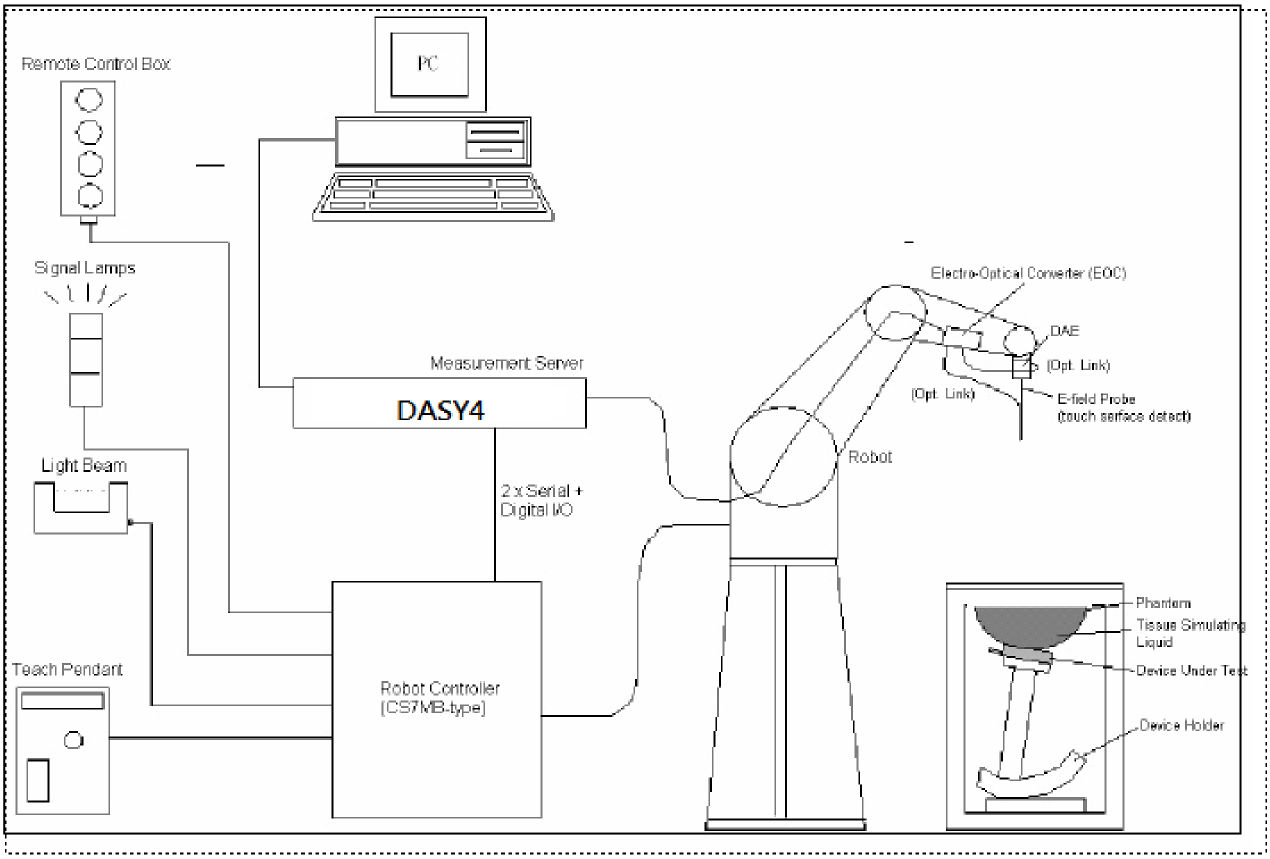
3.1 Requirements for Compliance Testing Defined by the FCC

The US Federal Communications Commission has released the report and order “Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1]. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 W/kg for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the FCC 47 CFR §2.1093 and IEEE Std 1528-2013.

4 Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system DASY4/DASY5 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9 m) which positions the probes with a positional repeatability of better than ± 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the dosimetric probe EX3DV4-SN: 7466 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure and found to be better than ±0.25 dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEEE 1528 2013.

4.1 Measurement System Diagram



The DASY4/5 system for performing compliance tests consists of the following items:

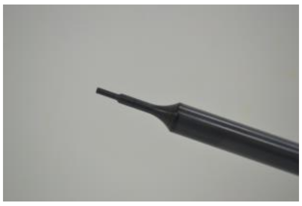
- A standard high precision 6-axis robot (St¨aubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. 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.
- DASY4 software version: 4.7, Build 80.
- 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.

4.2 System Components

DASY4/DASY5 Measurement Server	
	The DASY4/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 DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4/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 (V4.0)

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

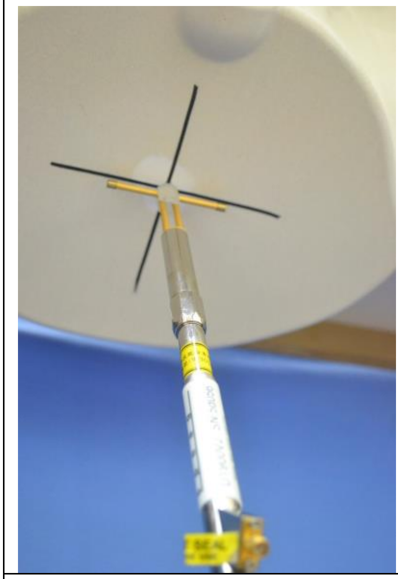
SAM Phantom (ELI4)

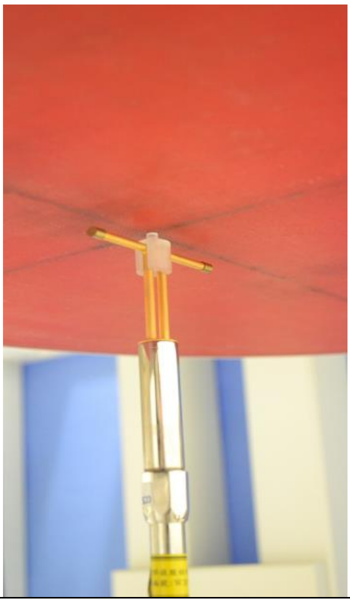
Construction: Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance 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 DASY4/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: Major ellipse axis: 600 mm
Minor axis: 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 (V4.0)		
	**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 ELI4 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

5 Evaluation Procedures

Data Evaluation

The DASY4/DASY5 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	*$Norm_i$, a_{i0}, a_{i1}, a_{i2}*
	- Conversion factor	*$ConvF_i$*
	- Diode compression point	*dcp_i*
Device parameters:	- Frequency	*f*
	- Crest factor	*cf*
Media parameters:	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	U_i	= Input signal of channel i	(i = x, y, z)
	cf	= Crest factor of exciting field	(DASY parameter)
	dcp_i	= Diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes:

$$H_i = \sqrt{Vi} \cdot \frac{a_{i10} + a_{i11} f + a_{i12} f^2}{f}$$

with	V_i	= Compensated signal of channel i	(i = x, y, z)
	$Norm_i$	= Sensor sensitivity of channel i	(i = x, y, z)

$\mu V/(V/m)^2$ for E0field Probes

ConvF	= Sensitivity enhancement in solution
aij	= Sensor sensitivity factors for H-field probes
f	= Carrier frequency (GHz)
Ei	= Electric field strength of channel i in V/m
Hi	= Magnetic field strength of channel i in A/m

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with *SAR* = local specific absorption rate in W/kg

E_{tot} = total field strength in V/m

σ = conductivity in [mho/m] or [Siemens/m]

ρ = equivalent tissue density in g/cm^3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

The power flow density is calculated assuming the excitation field as a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{377} \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with P_{pwe} = Equivalent power density of a plane wave in mW/cm^2

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

6 SAR Measurement Procedures

6.1 Normal SAR Test Procedure

- **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.

- **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 finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4/DASY5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan’s property sheet is brought-up, the grid resolution has to less than 15 mm by 15 mm at frequency ≤2GHz; the grid resolution has to less than 12mm by 12 mm at frequency between 2GHz to 4GHz; grid resolution has to less than 10 mm by 10 mm at frequency between 4GHz to 6GHz.

According to KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe abgle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	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.	

- **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 default zoom scan measures points in accordance with the frequency can be divided into three parts. (1)The zoom scan volume was set to 5x5x7 points at frequency ≤ 2GHz. (2) The zoom scan volume was set to 7x7x7 points at frequency between 2GHz to 4GHz (3) The zoom scan volume was set to 7x7x12 points at frequency between 4GHz to 6GHz. The measures points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly.

According to KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04

<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">≤ $1.5 \cdot \Delta z_{Zoom}(n-1)$</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>

- **Power Drift Measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY4/DASY5 software stop the measurements if this limit is exceeded.

- **Z-Scan**

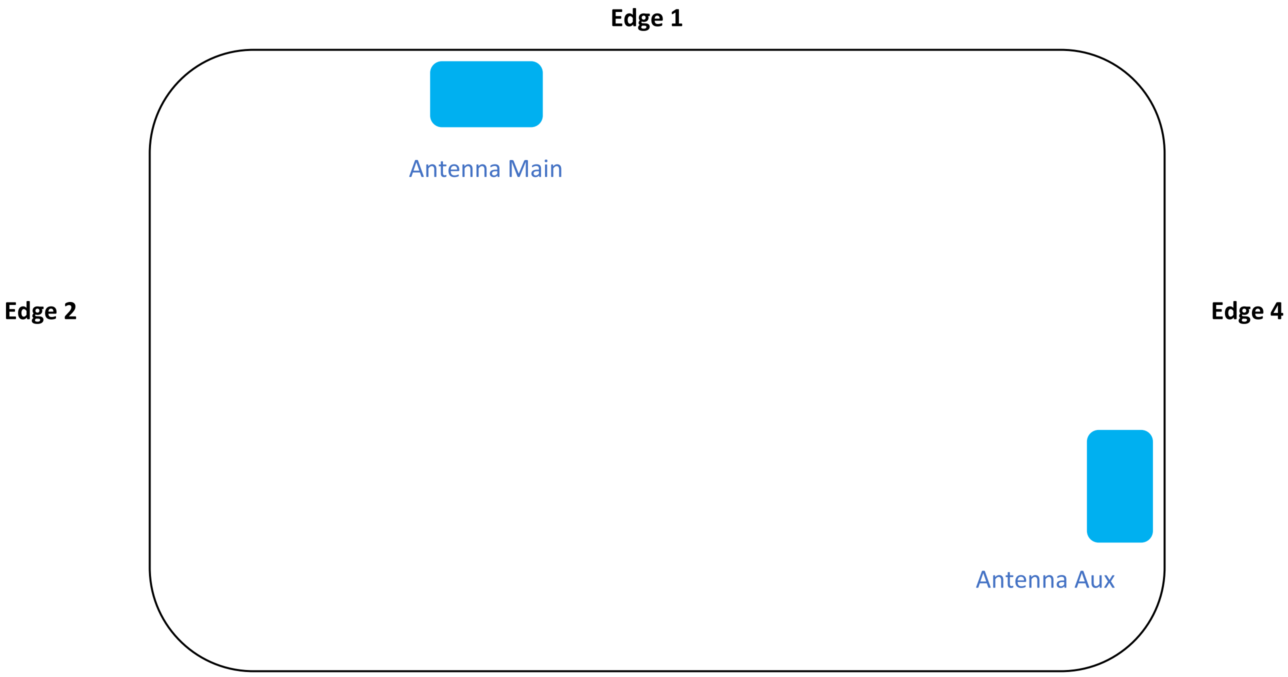
The Z Scan job measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. A user can anchor the grid to the current probe location. As with any other grids, the local Z-axis of the anchor location establishes the Z-axis of the grid.

7 Measurement Uncertainty

According to KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz section 2.8.2, SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528-2013 is not required in SAR reports submitted for equipment approval.

8 Antenna Location

Back View



Antenna Aux to surface (Unit : mm)				
Back	Edge 1	Edge 2	Edge 3	Edge 4
18.25	140.8	285.3	37.2	6.7
Antenna Main to surface (Unit : mm)				
Back	Edge 1	Edge 2	Edge 3	Edge 4
18.25	8.93	77.47	199.1	184.5

9 Summary of SAR Test Exclusion Configurations

9.1 Standalone SAR Test Exclusion Calculations

Since the device is a Tablet whose antenna is already determined to not meet the minimum antenna to user separation distance for modular SAR, therefore testing is required by default.

9.1.1 SAR Exclusion Calculations for Wi-Fi Antenna < 50mm from the User

According to KDB 447498 v06 in section 4.3.1, if the calculated **threshold value is > 3** then SAR testing is required.

Ant Aux

Antenna Aux	Band	Frequency (MHz)	Output Power		Separation Distances(mm)					Calculated Threshold Value				
			dBm	mW	Back	Edge 1	Edge 2	Edge 3	Edge 4	Back	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi	2.4GHz	2462	18.0	63	18.25	140.80	285.30	37.20	6.70	5.42	>50mm	>50mm	2.66	14.75
Wi-Fi	5.2GHz U-NII-I	5240	17.0	50	18.25	140.80	285.30	37.20	6.70	6.27	>50mm	>50mm	3.08	17.08
Wi-Fi	5.3GHz U-NII-2A	5320	17.0	50	18.25	140.80	285.30	37.20	6.70	6.32	>50mm	>50mm	3.10	17.21
Wi-Fi	5.5GHz U-NII-2C	5720	17.0	50	18.25	140.80	285.30	37.20	6.70	6.55	>50mm	>50mm	3.21	17.85
Wi-Fi	5.8GHz U-NII-3	5825	17.0	50	18.25	140.80	285.30	37.20	6.70	6.61	>50mm	>50mm	3.24	18.01
Wi-Fi	Bluetooth	2480	6.0	4	18.25	140.80	285.30	37.20	6.70	0.35	>50mm	>50mm	0.17	0.94

Ant Main

Antenna Main	Band	Frequency (MHz)	Output Power		Separation Distances(mm)					Calculated Threshold Value				
			dBm	mW	Back	Edge 1	Edge 2	Edge 3	Edge 4	Back	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi	2.4GHz	2462	18.0	63	18.25	8.93	77.47	199.10	184.50	5.42	11.07	>50mm	>50mm	>50mm
Wi-Fi	5.2GHz U-NII-I	5240	17.0	50	18.25	8.93	77.47	199.10	184.50	6.27	12.82	>50mm	>50mm	>50mm
Wi-Fi	5.3GHz U-NII-2A	5320	17.0	50	18.25	8.93	77.47	199.10	184.50	6.32	12.91	>50mm	>50mm	>50mm
Wi-Fi	5.5GHz U-NII-2C	5720	17.0	50	18.25	8.93	77.47	199.10	184.50	6.55	13.39	>50mm	>50mm	>50mm
Wi-Fi	5.8GHz U-NII-3	5825	17.0	50	18.25	8.93	77.47	199.10	184.50	6.61	13.51	>50mm	>50mm	>50mm

9.1.2 SAR Exclusion Calculations for Wi-Fi Antenna > 50mm from the User

According to KDB 447498 v06, if the calculated Power threshold is less than the output power then SAR testing is required.

Ant Aux

Antenna Aux	Band	Frequency (MHz)	Output Power		Separation Distances(mm)					Calculated Threshold Value				
			dBm	mW	Back	Edge 1	Edge 2	Edge 3	Edge 4	Back	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi	2.4GHz	2462	18.0	63	18.25	140.80	285.30	37.20	6.70	<50mm	1003.60	2448.60	<50mm	<50mm
Wi-Fi	5.2GHz U-NII-I	5240	17.0	50	18.25	140.80	285.30	37.20	6.70	<50mm	973.53	2418.53	<50mm	<50mm
Wi-Fi	5.3GHz U-NII-2A	5320	17.0	50	18.25	140.80	285.30	37.20	6.70	<50mm	973.03	2418.03	<50mm	<50mm
Wi-Fi	5.5GHz U-NII-2C	5720	17.0	50	18.25	140.80	285.30	37.20	6.70	<50mm	970.72	2415.72	<50mm	<50mm
Wi-Fi	5.8GHz U-NII-3	5825	17.0	50	18.25	140.80	285.30	37.20	6.70	<50mm	970.15	2415.15	<50mm	<50mm
Wi-Fi	Bluetooth	2480	6.0	4	18.25	140.80	285.30	37.20	6.70	<50mm	1003.25	2448.25	<50mm	<50mm

Ant Main

Antenna Main	Band	Frequency (MHz)	Output Power		Separation Distances(mm)					Calculated Threshold Value				
			dBm	mW	Back	Edge 1	Edge 2	Edge 3	Edge 4	Back	Edge 1	Edge 2	Edge 3	Edge 4
Wi-Fi	2.4GHz	2462	18.0	63	18.25	8.93	77.47	199.10	184.50	<50mm	<50mm	370.30	1586.60	1440.60
Wi-Fi	5.2GHz U-NII-I	5240	17.0	50	18.25	8.93	77.47	199.10	184.50	<50mm	<50mm	340.23	1556.53	1410.53
Wi-Fi	5.3GHz U-NII-2A	5320	17.0	50	18.25	8.93	77.47	199.10	184.50	<50mm	<50mm	339.73	1556.03	1410.03
Wi-Fi	5.5GHz U-NII-2C	5720	17.0	50	18.25	8.93	77.47	199.10	184.50	<50mm	<50mm	337.42	1553.72	1407.72
Wi-Fi	5.8GHz U-NII-3	5825	17.0	50	18.25	8.93	77.47	199.10	184.50	<50mm	<50mm	336.85	1553.15	1407.15

9.1.3 SAR Required Test Configuration

For Wi-Fi and Bluetooth

Test Configurations	Back	Edge1	Edge2	Edge3	Edge4
Wi-Fi 2.4GHz Ant Aux	Yes	No	No	No	Yes
Wi-Fi 2.4GHz Ant Main	Yes	Yes	No	No	No
Wi-Fi 5.2GHz Ant Aux	Yes	No	No	Yes	Yes
Wi-Fi 5.2GHz Ant Main	Yes	Yes	No	No	No
Wi-Fi 5.3GHz Ant Aux	Yes	No	No	Yes	Yes
Wi-Fi 5.3GHz Ant Main	Yes	Yes	No	No	No
Wi-Fi 5.5GHz Ant Aux	Yes	No	No	Yes	Yes
Wi-Fi 5.5GHz Ant Main	Yes	Yes	No	No	No
Wi-Fi 5.8GHz Ant Aux	Yes	No	No	Yes	Yes
Wi-Fi 5.8GHz Ant Main	Yes	Yes	No	No	No
Bluetooth	No	No	No	No	No

Note(s):

1. Yes = SAR is required.
2. No = SAR is not required.

10 Exposure Limit

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	2.0

(B). Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

NOTE: **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments:

are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Occupational/Controlled Environments:

are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

NOTE GENERAL POPULATION/UNCONTROLLED EXPOSURE PARTIAL BODY LIMIT 1.6 W/kg

11 Tissue Dielectric Properties

11.1 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 and body 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		Body	
	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 – 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5000	36.2	4.45	49.3	5.07
5100	36.1	4.55	49.1	5.18
5200	36.0	4.66	49.0	5.30
5300	35.9	4.76	48.9	5.42
5400	35.8	4.86	48.7	5.53
5500	35.6	4.96	48.6	5.65
5600	35.5	5.07	48.5	5.77
5700	35.4	5.17	48.3	5.88
5800	35.3	5.27	48.2	6.00

11.2 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 $M\Omega^{+}$ 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

11.3 Simulating Liquids Parameter Check Results

Tissue Type	Measurement Date	Measured Frequency (MHz)	Target Dielectric Constant, εr	Target Conductivity, σ (S/m)	Measured Dielectric Constant, εr	Measured Conductivity, σ (S/m)	% dev εr	% dev σ
Head	Mar, 13. 2020	2412.00	39.268	1.766	38.133	1.810	-2.89%	2.48%
		2437.00	39.223	1.788	38.125	1.826	-2.80%	2.10%
		2450.00	39.200	1.800	38.095	1.830	-2.82%	1.67%
		2462.00	39.185	1.813	38.036	1.835	-2.93%	1.21%
	Mar, 16. 2020	5260.00	35.917	4.717	37.331	4.555	3.94%	-3.42%
		5280.00	35.894	4.737	37.223	4.575	3.70%	-3.42%
		5300.00	35.871	4.758	37.034	4.578	3.24%	-3.77%
		5320.00	35.849	4.778	36.865	4.579	2.84%	-4.16%
	Mar, 17. 2020	5500.00	35.643	4.963	36.309	4.855	1.87%	-2.17%
		5580.00	35.551	5.045	35.880	4.906	0.92%	-2.75%
		5600.00	35.529	5.065	35.867	4.950	0.95%	-2.27%
		5620.00	35.506	5.086	35.808	4.978	0.85%	-2.11%
		5660.00	35.460	5.127	35.734	4.979	0.77%	-2.88%
		5700.00	35.414	5.168	35.622	5.072	0.59%	-1.85%
		5720.00	35.391	5.188	35.607	5.107	0.61%	-1.56%
	Mar, 18. 2020	5745.00	35.363	5.214	35.598	5.116	0.66%	-1.87%
		5785.00	35.317	5.255	35.200	5.133	-0.33%	-2.31%
		5800.00	35.300	5.270	35.107	5.160	-0.55%	-2.09%
		5825.00	35.271	5.296	35.090	5.246	-0.51%	-0.94%

12 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 DASY4/DASY5 system with an E-field probe EX3DV4 SN: 7466 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% and 100 mW ±3%(above 2GHz).
- The results are normalized to 1 W input power.

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	727	2019/4/24	2450	1g	13.6
				10g	6.28
D5GHzV2	1023	2020/1/28	5300	1g	8.32
				10g	2.35
D5GHzV2	1023	2020/1/28	5600	1g	8.36
				10g	2.37
D5GHzV2	1023	2020/1/28	5800	1g	8.19
				10g	2.29

12.1 System Performance Check Results

Date	System Dipole				Parameters	Target	Measured	Deviation[%]	Limited[%]
	Type	Freq. (MHz)	Serial No.	Liquid					
2020/3/13	D2450V2	2450	727	Head	1g SAR:	13.6	13.4	-1.47	± 10
					10g SAR:	6.28	6.24	-0.64	± 10
2020/3/16	D5GHzV2	5300	1023	Head	1g SAR:	8.32	7.64	-8.17	± 10
					10g SAR:	2.35	2.18	-7.23	± 10
2020/3/17	D5GHzV2	5600	1023	Head	1g SAR:	8.36	7.94	-5.02	± 10
					10g SAR:	2.37	2.24	-5.49	± 10
2020/3/18	D5GHzV2	5800	1023	Head	1g SAR:	8.19	7.75	-5.37	± 10
					10g SAR:	2.29	2.18	-4.80	± 10

According to April 2019 TCB workshop,Effective February 19,2019,FCC has permitted the use of single head-tissue simulating liquid specified in IEC 62209-1 for all SAR tests.

13 RF Output Power Measurement

According to KDB248227 D01 802.11 Wi-Fi SAR v02r02 section 4, the default power measurement procedures are:

1) Power must be measured at each transmit antenna port according to the DSSS and OFDM transmission configurations in each standalone and aggregated frequency band.

2) Power measurement is required for the transmission mode configuration with the highest maximum output power specified for production units.

a) When the same highest maximum output power specification applies to multiple transmission modes, the largest channel bandwidth configuration with the lowest order modulation and lowest data rate is measured.

b) When the same highest maximum output power is specified for multiple largest channel bandwidth configurations with the same lowest order modulation or lowest order modulation and lowest data rate, power measurement is required for all equivalent 802.11 configurations with the same maximum output power.

3) For each transmission mode configuration, power must be measured for the highest and lowest channels; and at the mid-band channel(s) when there are at least 3 channels. For configurations with multiple mid-band channels, due to an even number of channels, both channels should be measured.

13.1 Wi-Fi (2.4GHz Band)

Ant Aux

Band	Channel No.	Frequency (MHz)	Average power(dBm)	Tune up power(dBm)
802.11b	1	2412	17.65	18.0
	6	2437	17.97	18.0
	11	2462	17.91	18.0
802.11g	1	2412	17.68	18.0
	6	2437	17.9	18.0
	11	2462	17.72	18.0
802.11n HT20	1	2412	14.55	15.0
	6	2437	14.96	15.0
	11	2462	14.76	15.0
802.11n HT40	3	2422	12.63	13.0
	6	2437	12.95	13.0
	9	2452	12.96	13.0

Ant Main

Band	Channel No.	Frequency (MHz)	Average power(dBm)	Tune up power(dBm)
802.11b	1	2412	17.62	18.0
	6	2437	17.50	18.0
	11	2462	17.87	18.0
802.11g	1	2412	17.93	18.0
	6	2437	17.56	18.0
	11	2462	17.73	18.0
802.11n HT20	1	2412	14.89	15.0
	6	2437	14.99	15.0
	11	2462	14.83	15.0
802.11n HT40	3	2422	12.75	13.0
	6	2437	13.00	13.0
	9	2452	12.87	13.0

Note(s):

1. Output Power and SAR is not required for 802.11 g/n HT20 / n HT40 channels when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

13.2 Wi-Fi (5GHz Band)

Ant Aux

Band	Channel No.	Frequency (MHz)	Average power(dBm)	Tune up power(dBm)
802.11a	36	5180	16.72	17
	40	5200	16.71	17
	44	5220	16.85	17
	48	5240	16.86	17
	52	5260	16.84	17
	56	5280	16.73	17
	60	5300	16.91	17
	64	5320	16.74	17
	100	5500	16.74	17
	116	5580	16.99	17
	124	5620	17	17
	132	5660	16.73	17
	140	5700	17	17
	144	5720	16.93	17
	149	5745	16.91	17
	157	5785	16.92	17
	165	5825	16.98	17
802.11n HT20	36	5180	13.71	14
	40	5200	13.82	14
	44	5220	13.75	14
	48	5240	13.63	14
	52	5260	13.68	14
	56	5280	13.92	14
	60	5300	13.69	14
	64	5320	13.73	14
	100	5500	13.96	14
	116	5580	13.97	14
	124	5620	13.89	14
	132	5660	13.97	14
	140	5700	13.89	14
	144	5720	13.68	14
	149	5745	13.62	14
	157	5785	13.86	14
	165	5825	14	14

802.11n HT40	38	5190	13.82	14
	46	5230	13.93	14
	54	5270	13.97	14
	62	5310	13.98	14
	102	5510	13.86	14
	110	5550	13.75	14
	126	5630	13.73	14
	134	5670	13.95	14
	142	5710	13.72	14
	151	5755	13.97	14
	159	5795	13.83	14
802.11ac VHT20	36	5180	13.42	14
	40	5200	13.64	14
	44	5220	13.72	14
	48	5240	13.79	14
	52	5260	13.75	14
	56	5280	13.73	14
	60	5300	13.72	14
	64	5320	13.75	14
	100	5500	13.58	14
	116	5580	13.57	14
	124	5620	13.55	14
	132	5660	13.92	14
	140	5700	13.87	14
	144	5720	13.74	14
	149	5745	13.68	14
	157	5785	13.96	14
	165	5825	13.97	14
802.11ac VHT40	38	5190	13.98	14
	46	5230	14	14
	54	5270	13.87	14
	62	5310	13.97	14
	102	5510	13.63	14
	110	5550	13.84	14
	126	5630	13.64	14
	134	5670	13.89	14
	142	5710	13.93	14
	151	5755	13.93	14
	159	5795	13.76	14

802.11ac VHT80	42	5210	12.89	13
	58	5290	12.62	13
	106	5530	12.78	13
	122	5610	13	13
	138	5690	12.73	13
	155	5775	12.72	13

Ant Main

Band	Channel No.	Frequency (MHz)	Average power(dBm)	Tune up power(dBm)
802.11a	36	5180	16.83	17
	40	5200	16.87	17
	44	5220	16.99	17
	48	5240	16.98	17
	52	5260	16.56	17
	56	5280	16.57	17
	60	5300	16.99	17
	64	5320	17	17
	100	5500	16.6	17
	116	5580	16.98	17
	124	5620	16.97	17
	132	5660	16.88	17
	140	5700	16.98	17
	144	5720	16.99	17
	149	5745	16.65	17
	157	5785	16.87	17
	165	5825	16.66	17
802.11n HT20	36	5180	13.96	14
	40	5200	13.8	14
	44	5220	13.92	14
	48	5240	13.91	14
	52	5260	13.93	14
	56	5280	13.95	14
	60	5300	13.83	14
	64	5320	13.78	14
	100	5500	13.72	14
	116	5580	13.75	14
	124	5620	13.87	14
	132	5660	13.91	14
	140	5700	13.73	14
	144	5720	13.8	14
	149	5745	13.85	14
	157	5785	13.76	14
	165	5825	14	14

802.11n HT40	38	5190	13.62	14
	46	5230	13.81	14
	54	5270	13.83	14
	62	5310	13.72	14
	102	5510	13.99	14
	110	5550	13.65	14
	126	5630	13.86	14
	134	5670	13.85	14
	142	5710	14	14
	151	5755	13.76	14
	159	5795	13.7	14
802.11ac VHT20	36	5180	13.78	14
	40	5200	13.86	14
	44	5220	13.9	14
	48	5240	13.93	14
	52	5260	23.99	14
	56	5280	13.92	14
	60	5300	13.59	14
	64	5320	13.68	14
	100	5500	13.62	14
	116	5580	13.83	14
	124	5620	13.85	14
	132	5660	13.96	14
	140	5700	13.84	14
	144	5720	13.73	14
	149	5745	13.93	14
	157	5785	13.77	14
	165	5825	13.63	14
802.11ac VHT40	38	5190	14	14
	46	5230	13.75	14
	54	5270	13.99	14
	62	5310	13.92	14
	102	5510	13.76	14
	110	5550	13.87	14
	126	5630	13.67	14
	134	5670	13.82	14
	142	5710	13.95	14
	151	5755	13.89	14
	159	5795	13.72	14
802.11ac VHT80	42	5210	12.81	13
	58	5290	12.86	13
	106	5530	12.54	13
	122	5610	12.72	13
	138	5690	12.68	13
	155	5775	13	13

Note(s):

1. 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
   a ≤ 1.2 W/kg, SAR is not required for UNII band I.
   b > 1.2 W/kg, both bands should be tested independently for SAR.
2. Output Power and SAR measurement is not required for 802.11n HT20/n HT40/802.11ac channels when the specified maximum tune-up powers are less or same with 802.11a .

13.3 Bluetooth

Per exclusion calculations in Section 9, SAR testing for Bluetooth is not required.

Band	Channel No.	Frequency (MHz)	Average power(dBm)	Tune up power(dBm)
DH5	Low	2402	4.44	6
	Middle	2441	5.25	6
	High	2480	5.54	6
2DH5	Low	2402	3.02	4.5
	Middle	2441	3.85	4.5
	High	2480	4.11	4.5
3DH5	Low	2402	2.03	3.5
	Middle	2441	2.83	3.5
	High	2480	3.14	3.5
BLE	Low	2402	-2.65	-1.5
	Middle	2441	-2.22	-1.5
	High	2480	-1.87	-1.5

14 SAR Measurements Results

According to KDB248227D01 802.11 Wi-Fi SAR v02r02, the SAR test reduction procedures are:

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

14.1 WI-FI (2.4GHZ BAND):

Test Mode	Band	Mode	Dist. (mm)	Test Position	Ch#	Freq. (MHz)	Chain	Power (dBm)		Duty Cycle (%)	Zoom Scan 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Plot No.
								Tune up limit	Meas.				
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Back	6	2437	Ant Aux	18.00	17.97	99.49	0.302	0.306	
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 4	6	2437	Ant Aux	18.00	17.97	99.49	0.464	0.470	1
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 4	1	2412	Ant Aux	18.00	17.65	99.49	0.351	0.382	
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 4	11	2462	Ant Aux	18.00	17.91	99.49	0.268	0.275	
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Back	11	2462	Ant Main	18.00	17.87	98.80	0.199	0.208	
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 1	11	2462	Ant Main	18.00	17.87	98.80	0.268	0.279	2
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 1	1	2412	Ant Main	18.00	17.62	98.80	0.216	0.239	
FCC & IC	WLAN2.4GHz	IEEE 802.11b 1Mbps	0	Edge 1	6	2437	Ant Main	18.00	17.50	98.80	0.217	0.246	

14.2 WI-FI (5 GHZ BAND):

Test Mode	Band	Mode	Dist. (mm)	Test Position	Ch#	Freq. (MHz)	Chain	Power (dBm)		Duty Cycle (%)	Zoom Scan 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Plot No.
								Tune up limit	Meas.				
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	60	5300	Ant Aux	17.00	16.91	95.30	0.409	0.438	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	60	5300	Ant Aux	17.00	16.91	95.30	0.047	0.050	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 2	60	5300	Ant Aux	17.00	16.91	95.30	0.009	0.009	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 3	60	5300	Ant Aux	17.00	16.91	95.30	0.413	0.442	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	60	5300	Ant Aux	17.00	16.91	95.30	0.527	0.564	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	52	5260	Ant Aux	17.00	16.84	95.30	0.534	0.581	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	56	5280	Ant Aux	17.00	16.73	95.30	0.551	0.615	3
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	64	5320	Ant Aux	17.00	16.74	95.30	0.488	0.543	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	140	5700	Ant Aux	17.00	17.00	95.30	0.504	0.529	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 3	140	5700	Ant Aux	17.00	17.00	95.30	0.062	0.065	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	140	5700	Ant Aux	17.00	17.00	95.30	0.775	0.813	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	100	5500	Ant Aux	17.00	16.74	95.30	0.777	0.865	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	116	5580	Ant Aux	17.00	16.99	95.30	1.050	1.104	4
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	124	5620	Ant Aux	17.00	17.00	95.30	0.882	0.925	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	132	5660	Ant Aux	17.00	16.73	95.30	0.724	0.808	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	144	5720	Ant Aux	17.00	16.93	95.30	0.782	0.834	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	165	5825	Ant Aux	17.00	16.98	95.30	0.520	0.548	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 3	165	5825	Ant Aux	17.00	16.98	95.30	0.105	0.111	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	165	5825	Ant Aux	17.00	16.98	95.30	0.715	0.753	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	149	5745	Ant Aux	17.00	16.91	95.30	1.040	1.114	5
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	157	5785	Ant Aux	17.00	16.92	95.30	0.820	0.876	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	64	5320	Ant Main	17.00	17.00	95.30	0.458	0.480	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	64	5320	Ant Main	17.00	17.00	95.30	0.907	0.951	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 2	64	5320	Ant Main	17.00	17.00	95.30	0.017	0.017	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 3	64	5320	Ant Main	17.00	17.00	95.30	0.046	0.048	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	64	5320	Ant Main	17.00	17.00	95.30	0.060	0.063	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	52	5260	Ant Main	17.00	16.56	95.30	0.915	1.062	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	56	5280	Ant Main	17.00	16.57	95.30	0.921	1.067	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	60	5300	Ant Main	17.00	16.99	95.30	1.140	1.199	6
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	144	5720	Ant Main	17.00	16.99	95.30	0.495	0.520	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	144	5720	Ant Main	17.00	16.99	95.30	0.996	1.047	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	100	5500	Ant Main	17.00	16.60	95.30	0.933	1.073	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	116	5580	Ant Main	17.00	16.98	95.30	1.080	1.138	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	124	5620	Ant Main	17.00	16.97	95.30	1.040	1.099	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	132	5660	Ant Main	17.00	16.88	95.30	1.060	1.143	7
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	140	5700	Ant Main	17.00	16.98	95.30	1.040	1.096	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Back	157	5785	Ant Main	17.00	16.87	95.30	0.426	0.460	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	157	5785	Ant Main	17.00	16.87	95.30	0.804	0.869	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	149	5745	Ant Main	17.00	16.65	95.30	1.030	1.171	8
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	165	5825	Ant Main	17.00	16.66	95.30	0.762	0.864	

14.3 REPEATED SAR

Test Mode	Band	Mode	Dist. (mm)	Test Position	Ch#	Freq. (MHz)	Chain	Power (dBm)		Duty Cycle (%)	Zoom Scan 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Plot No.	Ratio
								Tune up limit	Meas.					
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	116	5580	Ant Aux	17.00	16.99	95.30	1.050	1.104	Original	0.01
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	116	5580	Ant Aux	17.00	16.99	95.30	1.040	1.093	Repeat	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	149	5745	Ant Aux	17.00	16.91	95.30	1.040	1.114	Original	0.02
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 4	149	5745	Ant Aux	17.00	16.91	95.30	1.020	1.092	Repeat	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	60	5300	Ant Main	17.00	16.99	95.30	1.140	1.199	Original	0.01
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	60	5300	Ant Main	17.00	16.99	95.30	1.130	1.188	Repeat	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	116	5580	Ant Main	17.00	16.98	95.30	1.080	1.138	Original	0.01
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	116	5580	Ant Main	17.00	16.98	95.30	1.070	1.128	Repeat	
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	149	5745	Ant Main	17.00	16.65	95.30	1.030	1.171	Original	0.01
FCC & IC	WLAN5GHz	IEEE 802.11a 6Mbps	0	Edge 1	149	5745	Ant Main	17.00	16.65	95.30	1.020	1.160	Repeat	

Note(s):

1. Repeated measurements are required only when the measured SAR is ≥0.80 W/kg. If the measured SAR values are < 1.45 W/kg with ≤20% variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. (Per KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04)
   1.1 Repeat SAR < 1.45 W/kg only one repeated measurement is required
   1.2 SAR variation < 20%

15 Simultaneous Transmission SAR Analysis

KDB 447498 D01 General RF Exposure Guidance v06, introduces a new formula for calculating the SAR to Peak Location Ratio (SPLSR) between pairs of simultaneously transmitting antennas:

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

Where:

SAR_1 is the highest Reported 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 Reported 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

R_i 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 $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$

A new threshold of 0.04 is also introduced in the KDB. Thus, 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:

$$(SAR_1 + SAR_2)^{1.5} / R_i \le 0.04$$

15.1 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

15.1.1 Estimated SAR for Bluetooth

According to section 9, the Bluetooth must be estimated according to following to determine simultaneous transmission SAR test exclusion:

- *(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)]·[$\sqrt{f_{(GHz)}}$/x]* W/kg for test separation distances ≤ 50 mm; where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

Antenna	Band	Frequency (MHz)	Output Power		Separation Distances (mm)	Estimated 1-g SAR (W/Kg)
			dBm	mW		
Bluetooth	2.4GHz	2480	6.0	4.0	5.0	0.168

15.2 Simultaneous Transmission Analysis

15.2.1 Sum of the SAR for Wi-Fi + BT

Per KDB 447498 D01 section 4.3.2, the simultaneous transmitting antennas in each operating mode and exposure condition combination must be considered one pair at a time to determine the SAR to peak location separation ratio to qualify for test exclusion.

Test Position	Simulataneous Transmission Scenario					1+2 Summed 1g SAR(W/kg)	3+4 Summed 1g SAR(W/kg)	1+4 Summed 1g SAR(W/kg)	2+3 Summed 1g SAR(W/kg)	2+6 Summed 1g SAR(W/kg)	4+6 Summed 1g SAR(W/kg)	1+2+6 Summed 1g SAR(W/kg)	3+4+6 Summed 1g SAR(W/kg)	1+4+6 Summed 1g SAR(W/kg)	2+3+6 Summed 1g SAR(W/kg)
	1.Wi-Fi 2.4 GHz Ant Aux 1g SAR (W/kg)	2.Wi-Fi 2.4 GHz Ant Main 1g SAR (W/kg)	3.Wi-Fi 5 GHz Ant Aux 1g SAR (W/kg)	4.Wi-Fi 5 GHz Ant Main 1g SAR (W/kg)	6.Bluetooth Ant Aux 1g SAR (W/kg)										
Back 0mm	0.306	0.208	0.548	0.520	0.168	0.513	1.068	0.83	0.76	0.376	0.69	0.68	1.24	0.99	0.92
Edge 1 0mm	0.000	0.279	0.050	1.199	0.168	0.279	1.249	1.20	0.33	0.447	1.37	0.45	1.42	1.37	0.50
Edge 2 0mm	0.000	0.000	0.009	0.017	0.168	0.000	0.027	0.02	0.01	0.168	0.19	0.17	0.19	0.19	0.18
Edge 3 0mm	0.000	0.000	0.442	0.048	0.168	0.000	0.490	0.05	0.44	0.168	0.22	0.17	0.66	0.22	0.61
Edge 4 0mm	0.470	0.000	1.114	0.063	0.168	0.470	1.177	0.53	1.11	0.168	0.23	0.64	1.35	0.70	1.28

Note(s):

As the Sum of the SAR is less than 1.6W/Kg, so SPLSR is not required.

16 Equipment List & Calibration Status

Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Cycle(year)	Calibration Due
Signal Grenerator	Agilent	N5181A	MY50141235	1	2020/4/21
Dielectric parameter probes	SPEAG	DAKS-3.5	1053	1	2021/1/27
Power Meter	Agilent	E4417A	MY51410006	1	2021/3/8
Power Sensor	Agilent	E9301H	MY51470001	1	2021/3/8
Power Meter	Anritsu	ML2496A	1337004	1	2020/9/3
Power Sensor	Anritsu	MA2411B	1306052	1	2020/9/3
Data Acquisition Electronics (DAE)	SPEAG	DAE4	856	1	2020/4/23
Dosimetric E-Field Probe	SPEAG	EX3DV4	7466	1	2021/2/3
2450MHz System Validation Dipole	SPEAG	D2450V2	727	1	2020/4/23
5GHz System Validation Dipole	SPEAG	D5GHzV2	1023	1	2021/1/27
Robot	Staubli	RX90L	F02/5T69A1/A/01	N/A	N/A
Amplifier	Mini-Circuit	ZVE-8G	665500309	N/A	N/A
Amplifier	Mini-Circuit	ZHL-1724HLN	D072602#2	N/A	N/A
Thermometer	Changzhou Xinwang	PT1	EC14011603	1	2020/7/30

17 Facilities

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

☐ No. 81-1, Lane 210, Bade Rd. 2, Luchu Hsiang, Taoyuan Hsien, Taiwan, R.O.C.

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

☐ No. 199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

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19 Attachments

Exhibit	Content
1	System Performance Check
2	SAR Test Data Plots
3	SAR Equipment calibration report
4	T200205D04-SF PHOTOs

END OF REPORT