Test Report

Applicant	：	Realtek Semiconductor Corp.
Applicant Address	：	No. 2 Innovation Road II, Hsinchu Science Park Hsinchu Taiwan 300
Product Type	：	802.11 a/b/g/n/ac RTL8821CE Combo module
Trade Name	：	Realtek
Model Number	：	RTL8821CE
Applicable Standard	：	47 CFR Part §2.1093
Received Date	：	Jan. 05, 2022
Test Period	：	Jan. 25 ~ Jan. 26, 2022
Issued Date	：	Mar. 29, 2022

Issued by

Approved By ： Kris Pan

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Testing Laboratory
1330

Taiwan Accreditation Foundation accreditation number: 1330
Test Firm MRA designation number: TW0010

Note:
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Revision History

Rev.	Issue Date	Revisions	Revised By
00	Mar. 29, 2022	Initial Issue	Nina Lin

Contents

1. General Information

1.1 Reference Testing Standards

Standard	Description	Version
47 CFR Part §2.1093	Radiofrequency radiation exposure evaluation: portable devices	-
IEC/IEEE 62209-1528	Measurement procedure for the assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Part 1528: Human models, instrumentation, and procedures (Frequency range of 4 MHz to 10 GHz)	2020
IEEE 1528	Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques	2013
IEEE C95.1	IEEE Standard for Safety Levels with Respect to Human Exposure to Electric, Magnetic, and Electromagnetic Fields, 0 Hz to 300 GHz	1992
KDB 248227 D01	SAR guidance for IEEE 802.11 (Wi-Fi) transmitters	v02r02
KDB 447498 D04	RF exposure procedures and equipment authorization policies for mobile and portable devices	v01
KDB 616217 D04	SAR evaluation considerations for laptop, notebook and tablet computers	v01r02
KDB 865664 D01	SAR measurement requirement for 100 MHz to 6 GHz	v01r04
KDB 865664 D02	RF exposure compliance reporting and documentation considerations	v01r02

2. Description of Device Under Test (DUT)

Applicant	Realtek Semiconductor Corp. No. 2 Innovation Road II, Hsinchu Science Park Hsinchu Taiwan 300	
Product Type	802.11 a/b/g/n/ac RTL8821CE Combo module	
Trade Name	Realtek	
Model Number	RTL8821CE	
SN No.	MBP2CJ00P97347C	
FCC ID	TX2-RTL8821CE	
Host Information	Product Type: ASUS All-in-One PC Trade Name: ASUS Model Name: E1600WK All models are electrically identical, different model names are for marketing purpose.	
Frequency Range	WLAN 2.4 GHz Band：2412 - 2472 MHz WLAN 5.2 GHz Band：5180 - 5240 MHz WLAN 5.3 GHz Band：5260 - 5320 MHz WLAN 5.6 GHz Band：5500 - 5720 MHz WLAN 5.8 GHz Band：5745 - 5825 MHz Bluetooth：2402 - 2480 MHz	
Supported Modulations	WLAN 2.4 GHz : 802.11 b / g / n HT20 / HT40 / VHT20 / VHT40	
	WLAN 5 GHz : 802.11 a / n / ac HT20 / HT40 / VHT20 / VHT40 / VHT80	
	Bluetooth : BR / EDR / LE	
Device Category	Portable Device	

Note:

1. The above information of DUT was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description**.**

Antenna list:

<table>
<tr><th>Antenna Source</th><th>ANT</th><th>Manufacturer</th><th>Part No. (Vendor)</th><th>Type</th><th>Frequency (MHz)</th><th>Max. Gain (dBi)</th></tr>
<tr><td rowspan="10">1</td><td rowspan="5">Chain 1</td><td rowspan="5">High-Tek</td><td rowspan="5">0ACCN021036N</td><td rowspan="5">PIFA Antenna</td><td>2402 – 2480</td><td>0.99</td></tr>
<tr><td>5150 – 5250</td><td>-0.60</td></tr>
<tr><td>5250 – 5350</td><td>-0.11</td></tr>
<tr><td>5470 – 5725</td><td>1.52</td></tr>
<tr><td>5725 – 5850</td><td>2.10</td></tr>
<tr><td rowspan="5">Chain 2</td><td rowspan="5">High-Tek</td><td rowspan="5">0ACCN021035N</td><td rowspan="5">PIFA Antenna</td><td>2402 – 2480</td><td>1.79</td></tr>
<tr><td>5150 – 5250</td><td>1.90</td></tr>
<tr><td>5250 – 5350</td><td>2.53</td></tr>
<tr><td>5470 – 5725</td><td>2.63</td></tr>
<tr><td>5725 – 5850</td><td>1.28</td></tr>
<tr><td rowspan="10">2</td><td rowspan="5">Chain 1</td><td rowspan="5">SOUTHSTAR TECHNOLOGY CO.,LTD</td><td rowspan="5">N12-8030-R0A</td><td rowspan="5">PIFA Antenna</td><td>2402 – 2480</td><td>1.75</td></tr>
<tr><td>5150 – 5250</td><td>1.90</td></tr>
<tr><td>5250 – 5350</td><td>1.90</td></tr>
<tr><td>5470 – 5725</td><td>1.85</td></tr>
<tr><td>5725 – 5850</td><td>2.76</td></tr>
<tr><td rowspan="5">Chain 2</td><td rowspan="5">SOUTHSTAR TECHNOLOGY CO.,LTD</td><td rowspan="5">N12-8029-R0A</td><td rowspan="5">PIFA Antenna</td><td>2402 – 2480</td><td>1.85</td></tr>
<tr><td>5150 – 5250</td><td>2.60</td></tr>
<tr><td>5250 – 5350</td><td>2.60</td></tr>
<tr><td>5470 – 5725</td><td>2.73</td></tr>
<tr><td>5725 – 5850</td><td>2.19</td></tr>
<tr><td colspan="7">Note :
1. Antenna Source 1 (SOUTHSTAR TECHNOLOGY CO.,LTD antenna) gain is higher. Hence, it is regarded as the initial configuration, and then tested and recorded in this report.
2. Antenna Source 1 (High-Tek antenna) and Antenna Source 2 (SOUTHSTAR TECHNOLOGY CO.,LTD antenna) are the same type of antenna, only different in manufacturer.
3. The Chain 1 is connected to AUX port / Chain 2 is connected to Main port of module.</td></tr>
</table>

3. Summary of Maximum Value

Equipment Class	Mode	Highest Reported SAR	
		Body standalone $SAR_{1\,g}$ (W/kg)	Simultaneous Transmission SAR (W/kg)
DTS	WLAN 2.4 GHz ANT Main	0.27	Not supported
	WLAN 2.4 GHz ANT Aux	0.55	
NII	WLAN 5 GHz ANT Main	0.57	1.09
	WLAN 5 GHz ANT Aux	1.06	
DSS / DTS	Bluetooth ANT Main	0.02	1.09
	Bluetooth ANT Aux	0.03	

Note:

1. The SAR limit for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.
2. The test procedures, as described in American National Standards, Institute ANSI/IEEE C95.1 were employed and they specify the maximum exposure limit of tissue for portable devices being used within 20 cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

4. Introduction

4.1 SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dw) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$\text{SAR} = \frac{d}{dt}\left(\frac{dw}{dm}\right) = \frac{d}{dt}\left(\frac{dw}{\rho dv}\right)$$

SAR measurement can be related to the electrical field in the tissue by

$$\text{SAR} = \frac{\sigma|E|^2}{\rho}$$

Where：

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = RMS electric field strength (V/m)

SAR is expressed in units of Watts per kilogram (W/kg).

4.2 RF Exposure Limits

Table 1 Safety Limits for Controlled / Uncontrolled Environment Exposure

SAR Exposure Limit		
	General Population / Uncontrolled Exposure [1] (W/kg)	**Occupational / Controlled Exposure [2] (W/kg)**
Spatial Peak SAR [3] (head or Body)	1.60	8.00
Spatial Peak SAR [4] (Whole Body)	0.08	0.40
Spatial Peak SAR [5] (Hands / Feet / Ankle / Wrist)	4.00	20.00

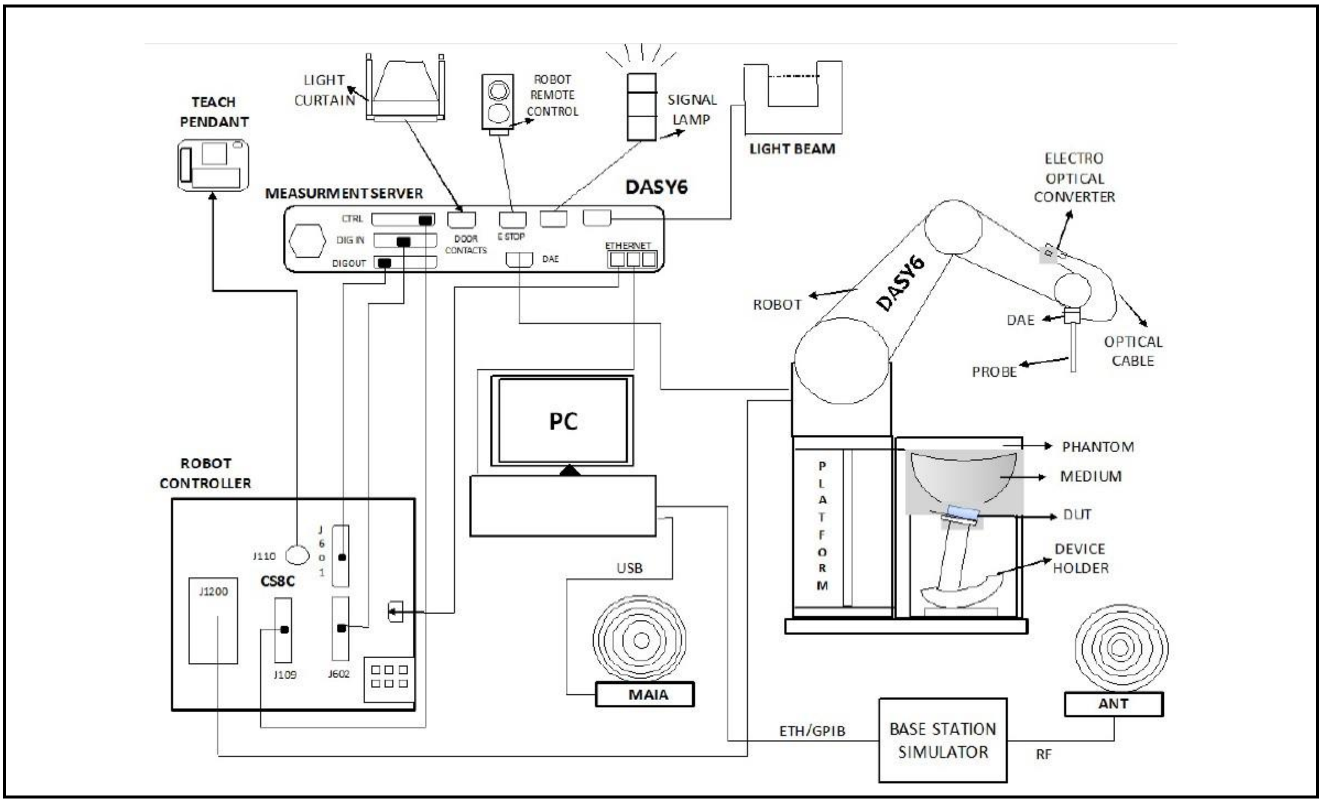
Notes：

1. **General Population / Uncontrolled Environments** are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.
2. **Occupational / Controlled Environments** are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).
3. The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
4. The Spatial Average value of the SAR averaged over the whole body.
5. The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

5. System Describtion

5.1 SAR Measurement System

The DASY6 system in cDASY6/DASY5 V5.2 SAR Configuration is shown below:



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

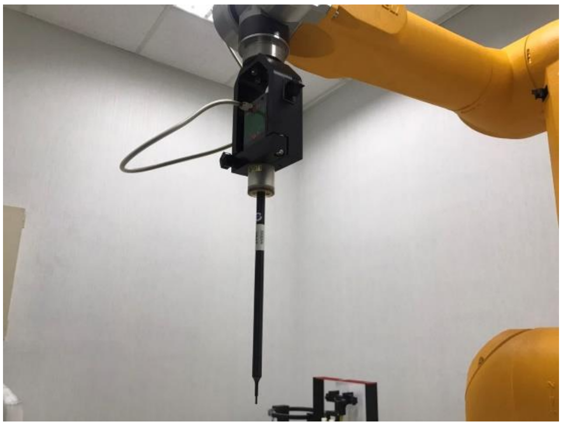
1. A standard high precision 6-axis robot (Stäubli TX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. An isotropic field probe optimized and calibrated for the targeted measurements.
3. A data acquisition electronics (DAE) 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.
4. The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
5. 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.
6. The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
7. A computer running Win7/Win8/Win10 professional operating system and the cDASY6 and DASY5 V5.2 software.
8. Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The phantom, the device holder and other accessories according to the targeted measurement.
10. Tissue simulating liquid mixed according to the given recipes.
11. The validation dipole has been calibrated within and the system performance check has been successful.

<DASY E-Field Probe System>

The SAR measurements were conducted with the dosimetric probe (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probes is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	4 MHz to 10 GHz Linearity: ± 0.2 dB (30 MHz to 10 GHz)
Directivity	±0.1 dB in TSL (rotation around probe axis) ±0.3 dB in TSL (rotation normal to probe axis)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Calibration	ISO/IEC 17025 calibration service available

EX3DV4 E-Field Probe



Probe setup on robot

<Data Acquisition Electronic (DAE) System>

Model	DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4 mV, 400 mV)
Input Offset Voltage	< 5 μV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm

<Robot>

Positioner	Stäubli Unimation Corp.
Robot Model	TX90XL
Number of Axes	6
Nominal Load	5 kg
Reach	1450 mm
Repeatability	± 0.035 mm

<Device Holder>

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ=0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

	
Device Holder 1	Device Holder 2

<Oval Flat Phantom – ELI>

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (Oval Flat) phantom defined in IEEE 1528, IEC 62209-2 and IEC/IEEE 62209-1528. It enables the dosimetric evaluation of wireless portable device 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. 30 liters	
Dimensions	190×600×400 mm (H × L × W)	

<SAM Phantom>

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528, IEC 62209-1 and IEC/IEEE 62209-1528. 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 teaching three points with the robot.

Shell Thickness	2 ±0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet	

5.2 Tissue Simulating Liquids (TSL)

<Tissue Dielectric Parameters in IEEE 1528-2013 and IEC/IEEE 62209-1528>

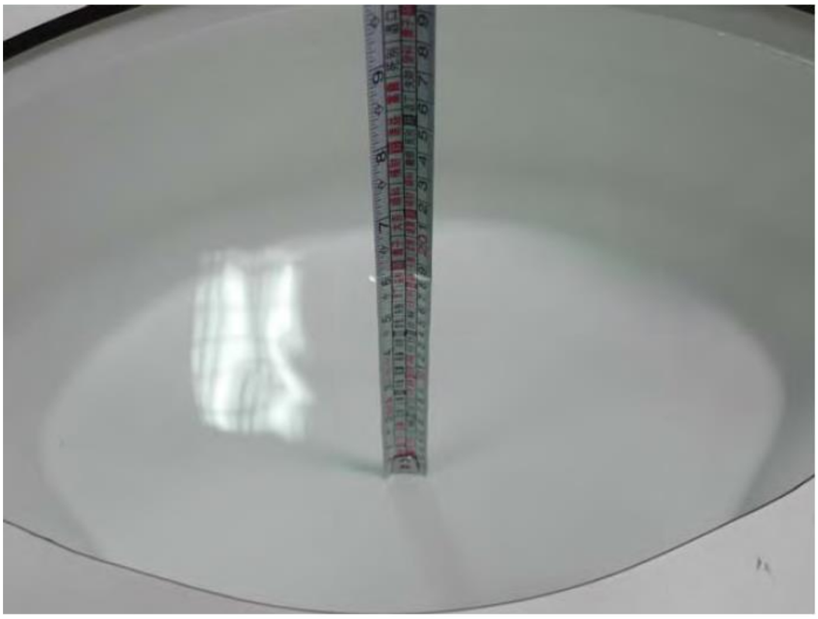
The following table incorporates the tissue dielectric parameters of head recommended by IEEE 1528-2013 and IEC/IEEE 62209-1528. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified are derived from the tissue dielectric parameters which computed by the 4-Cole-Cole equation according to the above-mentioned standards.

Table 2 Dielectric properties of the tissue-equivalent liquid material

Frequency (MHz)	Relative Permittivity (ε_r)	Conductivity (σ)
30	55.0	0.75
150	52.3	0.76
300	45.3	0.87
450	43.5	0.87
750	41.9	0.89
835	41.5	0.90
900	41.5	0.97
1450	40.5	1.20
1800	40.0	1.40
1900	40.0	1.40
1950	40.0	1.40
2000	40.0	1.40
2100	39.8	1.49
2450	39.2	1.80
2600	39.0	1.96
3000	38.5	2.40
3500	37.9	2.91
4000	37.4	3.43
4500	36.8	3.94
5000	36.2	4.45
5200	36.0	4.66
5400	35.8	4.86
5600	35.5	5.07
5800	35.3	5.27
6000	35.1	5.48
6500	34.5	6.07
7000	33.9	6.65
7500	33.3	7.24
8000	32.7	7.84
8500	32.1	8.46
9000	31.6	9.08
9500	31.0	9.71
10000	30.4	10.4

<Liquid Depth>

The depth of tissue-equivalent liquid in a phantom must be ≧ 15.0 cm to ensure that the probe is immersed sufficiently in the tissue medium.



Tissue-equivalent Liquid Heigh

<Test Site Environment>

Temperature (°C)	21-23

<Liquid Check>

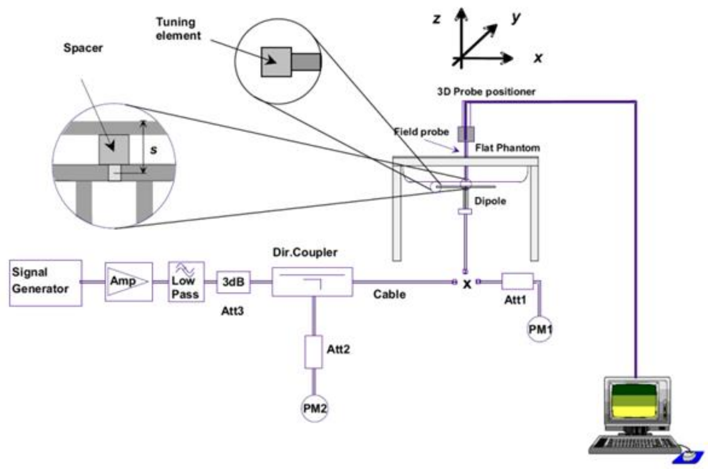
1. The dielectric parameters of the liquids were verified prior ≧ to the SAR evaluation using a DAKS 3.5 Probe Kit.
2. The SAR testing with IEC tissue parameters as an alternative option to Head and body parameters. The head TSL were applied to body SAR tests with restrictions below:
   The mixing and matching of head TSL and body TSL for body SAR testing in a single application are not permitted. For example, testing body SAR with head TSL and then switch to Body TSL for body SAR test is not allowed. The consistency of TSL is required.

Tissue Temp (°C)	Head / Body	Frequency	Cond. σ	Perm. εr	target Cond. σ	target Perm. εr	σ (Delta)(%)	εr (Delta)(%)	Limit (%)	Date
22.3	Head	5180 MHz	4.66	36.38	4.64	36.02	0.40	0.99	±5	Jan. 25, 2022
22.3	Head	5190 MHz	4.67	36.36	4.65	36.01	0.36	0.97	±5	Jan. 25, 2022
22.3	Head	5200 MHz	4.68	36.34	4.66	36.00	0.32	0.95	±5	Jan. 25, 2022
22.3	Head	5220 MHz	4.69	36.30	4.68	35.98	0.26	0.89	±5	Jan. 25, 2022
22.3	Head	5230 MHz	4.70	36.27	4.69	35.97	0.27	0.85	±5	Jan. 25, 2022
22.3	Head	5240 MHz	4.72	36.25	4.70	35.96	0.32	0.80	±5	Jan. 25, 2022
22.3	Head	5250 MHz	4.73	36.23	4.71	35.95	0.37	0.77	±5	Jan. 25, 2022
22.3	Head	5260 MHz	4.74	36.21	4.72	35.94	0.42	0.75	±5	Jan. 25, 2022
22.3	Head	5270 MHz	4.75	36.19	4.73	35.93	0.46	0.73	±5	Jan. 25, 2022
22.3	Head	5280 MHz	4.76	36.18	4.74	35.92	0.46	0.72	±5	Jan. 25, 2022
22.3	Head	5290 MHz	4.77	36.17	4.75	35.91	0.43	0.71	±5	Jan. 25, 2022
22.3	Head	5300 MHz	4.78	36.15	4.76	35.90	0.38	0.69	±5	Jan. 25, 2022
22.3	Head	5310 MHz	4.79	36.13	4.77	35.89	0.33	0.66	±5	Jan. 25, 2022
22.3	Head	5320 MHz	4.79	36.10	4.78	35.88	0.30	0.61	±5	Jan. 25, 2022
22.3	Head	5500 MHz	4.99	35.76	4.97	35.65	0.44	0.31	±5	Jan. 25, 2022
22.3	Head	5510 MHz	4.99	35.75	4.98	35.64	0.37	0.30	±5	Jan. 25, 2022
22.3	Head	5530 MHz	5.01	35.70	5.00	35.61	0.23	0.26	±5	Jan. 25, 2022
22.3	Head	5550 MHz	5.03	35.64	5.02	35.58	0.22	0.17	±5	Jan. 25, 2022
22.3	Head	5570 MHz	5.06	35.60	5.04	35.55	0.33	0.13	±5	Jan. 25, 2022
22.3	Head	5580 MHz	5.07	35.59	5.05	35.53	0.38	0.15	±5	Jan. 25, 2022
22.3	Head	5610 MHz	5.10	35.55	5.08	35.49	0.36	0.17	±5	Jan. 25, 2022
22.3	Head	5620 MHz	5.11	35.54	5.09	35.48	0.31	0.16	±5	Jan. 25, 2022
22.3	Head	5630 MHz	5.11	35.52	5.10	35.47	0.26	0.13	±5	Jan. 25, 2022
22.3	Head	5660 MHz	5.14	35.44	5.13	35.44	0.27	-0.01	±5	Jan. 25, 2022
22.3	Head	5670 MHz	5.16	35.42	5.14	35.43	0.31	-0.04	±5	Jan. 25, 2022
22.3	Head	5690 MHz	5.18	35.38	5.16	35.41	0.36	-0.09	±5	Jan. 25, 2022
22.3	Head	5700 MHz	5.19	35.36	5.17	35.40	0.35	-0.11	±5	Jan. 25, 2022
22.3	Head	5710 MHz	5.20	35.35	5.18	35.39	0.33	-0.13	±5	Jan. 25, 2022
22.3	Head	5720 MHz	5.21	35.33	5.19	35.38	0.30	-0.15	±5	Jan. 25, 2022
22.3	Head	5745 MHz	5.23	35.28	5.22	35.36	0.22	-0.24	±5	Jan. 25, 2022
22.3	Head	5755 MHz	5.24	35.25	5.23	35.35	0.20	-0.28	±5	Jan. 25, 2022
22.3	Head	5775 MHz	5.26	35.21	5.25	35.33	0.23	-0.33	±5	Jan. 25, 2022
22.3	Head	5785 MHz	5.27	35.20	5.26	35.32	0.25	-0.35	±5	Jan. 25, 2022
22.3	Head	5795 MHz	5.28	35.18	5.27	35.31	0.28	-0.36	±5	Jan. 25, 2022
22.3	Head	5825 MHz	5.31	35.15	5.30	35.28	0.20	-0.38	±5	Jan. 25, 2022
22.2	Head	2402 MHz	1.74	39.72	1.76	39.28	-1.28	1.11	±5	Jan. 26, 2022
22.2	Head	2412 MHz	1.75	39.68	1.77	39.27	-1.11	1.04	±5	Jan. 26, 2022
22.2	Head	2422 MHz	1.76	39.63	1.78	39.25	-0.94	0.98	±5	Jan. 26, 2022
22.2	Head	2437 MHz	1.78	39.60	1.79	39.22	-0.70	0.97	±5	Jan. 26, 2022
22.2	Head	2441 MHz	1.78	39.59	1.79	39.22	-0.66	0.95	±5	Jan. 26, 2022
22.2	Head	2452 MHz	1.79	39.57	1.80	39.20	-0.47	0.94	±5	Jan. 26, 2022
22.2	Head	2462 MHz	1.81	39.54	1.81	39.18	-0.40	0.91	±5	Jan. 26, 2022
22.2	Head	2467 MHz	1.81	39.52	1.82	39.18	-0.34	0.88	±5	Jan. 26, 2022
22.2	Head	2472 MHz	1.82	39.51	1.82	39.17	-0.28	0.87	±5	Jan. 26, 2022
22.2	Head	2480 MHz	1.83	39.49	1.83	39.16	-0.22	0.85	±5	Jan. 26, 2022

6. System Verification

6.1 SAR System Verification

<Symmetric Dipoles for SAR System Verification>

Construction	Symmetrical dipole with λ/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions.
Return Loss	> 20 dB at specified verification position.
Options	Dipoles for other frequencies or solutions and other calibration conditions are available upon request.
	
System Verification Setup Diagram	Validation Kit

6.1.1 SAR Verification Summary

Prior to the assessment, the validation data compared to the original value provided by SPEAG should be within its specifications of ±10%. The measured SAR will be normalized to 1 W input power. The result indicates the system check can meet the variation criterion and plots can be referred to Appendix B of this report.

Mixture Type	Frequency (MHz)	Power	Probe Model / Serial No.	Dipole Model / Serial No.	$SAR_{1\,g}$ (W/kg)	1 W Normalize $SAR_{1\,g}$ (W/kg)	1 W Target $SAR_{1\,g}$ (W/kg)	$SAR_{10\,g}$ (W/kg)	1 W Normalize $SAR_{10\,g}$ (W/kg)	1 W Target $SAR_{10\,g}$ (W/kg)	Deviation 1 g (%)	Deviation 10 g (%)	Date
Head	2450	250 mW	EX3DV4 – SN3977	D2450V2 – SN712	12.8	51.2	51.00	5.94	23.76	23.20	0.4%	2.4%	Jan. 26, 2022
Head	5250	100 mW	EX3DV4 – SN3977	D5250V2 – SN1021	7.87	78.7	78.40	2.15	21.5	22.20	0.4%	-3.2%	Jan. 25, 2022
Head	5600	100 mW	EX3DV4 – SN3977	D5600V2 – SN1021	8.31	83.1	82.20	2.24	22.4	23.50	1.1%	-4.7%	Jan. 25, 2022
Head	5750	100 mW	EX3DV4 – SN3977	D5750V2 – SN1021	7.57	75.7	77.30	2.05	20.5	21.70	-2.1%	-5.5%	Jan. 25, 2022

7. Test Equipment List

7.1 SAR Test Equipment List

Testing Engineer: Jason Tsao / Ted Hsieh / Rocky Wang

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Cal. Date	Cal.Period
SPEAG	2450 MHz System Validation Kit	D2450V2	712	Apr 14, 2021	1 year
SPEAG	5 GHz System Validation Kit	D5GHzV2	1021	Apr 16, 2021	1 year
SPEAG	Dosimetric E-Field Probe	EX3DV4	3977	Jul 26, 2021	1 year
SPEAG	Data Acquisition Electronics	DAE4	779	Jul 30, 2021	1 year
SPEAG	Measurement Server	SE UMS 011 BB	1241	NCR	
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	ELI V4.0	1036	NCR	
SPEAG	Robot	Staubli TX90XL	F11/5G9EA1/A/01	NCR	
SPEAG	Software	DASY52 V52.10.4.1535	N/A	NCR	
SPEAG	Software	SEMCAD X V14.6.14(7501)	N/A	NCR	
SPEAG	Network Analyzer	DAKS_VNA R140	0010318	May 26, 2021	1 year
SPEAG	Dielectric Probe Kit	DAKS-3.5	1101	May 26, 2021	1 year
HILA	Digital Thermometer	TM-906A	1500033	Oct 29, 2021	1 year
Agilent	Power Sensor	8481H	3318A20779	May 26, 2021	1 year
Agilent	Power Meter	EDM Series E4418B	GB40206143	May 26, 2021	1 year
Agilent	Power Sensor	N1921A	MY45241957	Dec 06, 2021	1 year
Agilent	Power Meter	N1911A	MY45101619	Dec 06, 2021	1 year
Agilent	Signal Generator	E8257D	MY44320425	Feb 18, 2021	1 year
Agilent	Spectrum Analyzer	E4445A	MY46181986	Jun 07, 2021	1 year
Mini-Circuits	Dual Directional Coupler	ZCDC20-5R263-S+	E69806	NCR	
Mini-Circuits	Power Amplifier	EMC014225P	980292	NCR	
Mini-Circuits	Power Amplifier	EMC2830P	980293	NCR	
EMCI	Power Amplifier	EMC0618-P	980833	NCR	
Attenuator	INMET	18AH-03	S180301	NCR	
Attenuator	INMET	18AH-10	S181001	NCR	
Attenuator	INMET	18AH-20	S182001	NCR	

8. Measurement Procedure

8.1 SAR Measurement Procedure

The measurement procedures are as follows:

1. The DUT is installed engineering testing software that provides continuous transmitting signal.
2. Measure output power through RF cable and power meter
3. Set scan area, grid size and other setting on the DASY software
4. Find out the largest SAR result on these testing positions of each band
5. Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

1. Power reference measurement
2. Area scan
3. Zoom scan
4. Power drift measurement

8.1.1 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures points and step size follow as below. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution.

The measure settings are referred to KDB 865664 D01v01r04 :

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>½·δ·ln(2) mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</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>
<tr><td colspan="3">Maximum zoom scan spatial resolution: Δx_{Area}, Δy_{Area}</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 closest 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·$\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm
4 – 5 GHz: ≥ 25 mm
5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.
* When zoom scan is required and the reported SAR from the area scan based 1-g SAR estimation procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

8.1.2 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1 g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

8.1.3 Power Drift Monitoring

All SAR testing is under the DUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of DUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5 %, the SAR will be retested.

8.1.4 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1 g and 10 g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1 g and 10 g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1 g and 10 g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. Extraction of the measured data (grid and values) from the Zoom Scan
2. Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. Generation of a high-resolution mesh within the measured volume
4. Interpolation of all measured values form the measurement grid to the high-resolution grid
5. Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. Calculation of the averaged SAR within masses of 1 g and 10 g

9. Measurement Uncertainty

9.1 SAR Measurement Uncertainty

Measurement Uncertainty (0.3-6 GHz)								
Uncertainty Component	**Tol.**	**Prob. Dist.**	**Div.**	**Ci - 1g**	**Ci - 10g**	**ui - 1g (%)**	**ui - 10g (%)**	**vi**
Measurement System								
Probe calibration	12.0	N	2	1	1	6.0	6.0	∞
Probe Calibration Drift	1.7	R	1.732	1	1	1.0	1.0	∞
Data acquisition	0.3	N	1	1	1	0.3	0.3	∞
Probe Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
Broadband Signal	3.0	R	1.732	1	1	1.7	1.7	∞
Probe Isotropy	7.6	R	1.732	1	1	4.4	4.4	∞
RF Ambient	1.8	N	1	1	1	1.8	1.8	∞
Probe Positioning	0.2	N	1	0.14	0.14	0.0	0.0	∞
Data Processing	1.2	N	1	1	1	1.2	1.2	∞
Phantom and Device Errors								
Conductivity (meas.)DAK	2.5	N	1	0.78	0.71	2.0	1.8	∞
Conductivity (temp.)	3.3	R	1.732	0.78	0.71	1.5	1.4	∞
Phantom Shell Permittivity	14	R	1.732	0	0	0.0	0.0	∞
Distance DUT - TSL	2	N	1	2	2	4.0	4.0	∞
Device Positioning	1	N	1	1	1	1.0	1.0	∞
Device Holder	3.6	N	1	1	1	3.6	3.6	∞
DUT Modulation	2.4	R	1.732	1	1	1.4	1.4	∞
Time-average SAR	1.7	R	1.732	1	1	1.0	1.0	∞
DUT Drift	2.5	N	1	1	1	2.5	2.5	∞
Correction to the SAR Results								
Deviation to Target	1.9	N	1	1	0.84	1.9	1.6	∞
SAR scaling	0.0	R	1.732	1	1	0.0	0.0	∞
Combined Standard Uncertainty					RSS	11.0	10.9	
Expanded Uncertainty (95% confidence interval)					k =2	21.9	21.7	

Measurement Uncertainty (3-6 GHz)								
Uncertainty Component	**Tol.**	**Prob. Dist.**	**Div.**	**Ci - 1g**	**Ci - 10g**	**ui - 1g (%)**	**ui - 10g (%)**	**vi**
Measurement System								
Probe Calibration	13.1	N	2	1	1	6.55	6.55	∞
Probe Calibration Drift	1.7	R	1.732	1	1	1.0	1.0	∞
Data Acquisition	0.3	N	1	1	1	0.3	0.3	∞
Probe Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
Broadband Signal	2.6	R	1.732	1	1	1.5	1.5	∞
Probe Isotropy	7.6	R	1.732	1	1	4.4	4.4	∞
RF Ambient	1.8	N	1	1	1	1.8	1.8	∞
Probe Positioning	0.2	N	1	0.33	0.33	0.1	0.1	∞
Data Processing	2.3	N	1	1	1	2.3	2.3	∞
Phantom and Device Errors								
Conductivity (meas.)DAK	2.5	N	1	0.78	0.71	2.0	1.8	∞
Conductivity (temp.)	3.4	R	1.732	0.78	0.71	1.5	1.4	∞
Phantom Shell Permittivity	14	R	1.732	0.25	0.25	2.0	2.0	∞
Distance DUT - TSL	2	N	1	2	2	4.0	4.0	∞
Device Positioning	1	N	1	1	1	1.0	1.0	∞
Device Holder	3.6	N	1	1	1	3.6	3.6	∞
DUT Modulation	2.4	R	1.732	1	1	1.4	1.4	∞
Time-average SAR	1.7	R	1.732	1	1	1.0	1.0	∞
DUT Drift	2.5	N	1	1	1	2.5	2.5	∞
Correction to the SAR Results								
Deviation to Target	1.9	N	1	1	0.84	1.9	1.6	∞
SAR scaling	0.0	R	1.732	1	1	0.0	0.0	∞
Combined Standard Uncertainty					RSS	11.6	11.5	
Expanded Uncertainty (95% confidence interval)					k =2	23.2	23.0	

Measurement Uncertainty (6-10 GHz)								
Uncertainty Component	**Tol.**	**Prob. Dist.**	**Div.**	**Ci - 1g**	**Ci - 10g**	**ui - 1g (%)**	**ui - 10g (%)**	**vi**
Measurement System								
Probe calibration	18.6	N	2	1	1	9.3	9.3	∞
Probe Calibration Drift	1.7	R	1.732	1	1	1.0	1.0	∞
Data Acquisition	0.3	N	1	1	1	0.3	0.3	∞
Probe Linearity	4.7	R	1.732	1	1	2.7	2.7	∞
Broadband Signal	2.8	R	1.732	1	1	1.6	1.6	∞
Probe Isotropy	7.6	R	1.732	1	1	4.4	4.4	∞
RF Ambient Condition	1.8	N	1	1	1	1.8	1.8	∞
Probe Positioning	0.2	N	1	0.67	0.67	0.1	0.1	∞
Data Processing	3.5	N	1	1	1	3.5	3.5	∞
Phantom and Device Errors								
Conductivity (meas.)DAK	2.5	N	1	0.78	0.71	2.0	1.8	∞
Conductivity (temp.)	2.4	R	1.732	0.78	0.71	1.1	1.0	∞
Phantom Shell Permittivity	14.0	R	1.732	0.5	0.5	4.0	4.0	∞
Distance DUT - TSL	2	N	1	2	2	4.0	4.0	∞
Device Positioning	1	N	1	1	1	1.0	1.0	∞
Device Holder	3.6	N	1	1	1	3.6	3.6	∞
DUT Modulation	2.4	R	1.732	1	1	1.4	1.4	∞
Time-average SAR	1.7	R	1.732	1	1	1.0	1.0	∞
DUT Drift	2.5	N	1	1	1	2.5	2.5	∞
Correction to the SAR Results								
Deviation to Target	1.9	N	1	1	0.84	1.9	1.6	∞
SAR scaling	0.0	R	1.732	1	1	0.0	0.0	∞
Combined Standard Uncertainty					RSS	14.0	13.9	
Expanded Uncertainty (95% confidence interval)					k =2	28.0	27.9	

10. Measurement Evaluation

10.1 Positioning of the DUT in Relation to the Phantom

According to KDB 616217 D04:

1. SAR evaluation is required for back (bottom) surface and side edges of the devices.
2. Some 2-in-1 tablets may operate with the display folded on top of the keyboard. Most recent tablets are designed with an interactive display that may not require a physical keyboard. Both configurations are used in similar manners and require SAR evaluation for the back surface and edges of the tablet. For keyboards that can be unfolded like a laptop, SAR evaluation is required for the bottom surface of the keyboard.
3. SAR evaluation for the front surface of tablet display screens are generally not necessary, except for tablets that are designed to require continuous operations with the hand(s) next to the antenna.
4. When voice mode is supported on a tablet and it is limited to speaker mode or headset operations only, additional SAR testing for this type of voice use is not required.

10.2 SAR Testing with RF Transmitter

10.2.1 SAR Testing with WLAN

A Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. The test frequencies established using test mode must correspond to the actualchannel frequencies.
For WLAN SAR testing, the DUT has installed WLAN engineering testing software which can provide continuous transmitting RF signal. And the RF signal utilized in SAR measurement has almost 100 % duty cycle and crest factor is 1.

- The cards was operated utilizing proprietary software (RTLBTAPP) and each channel was measured using a broadband power meter to determine the maximum average power.
- RTL8821CE-VCCG is a single-chip which connects to Main Port and Aux Port by DPDT Switch.

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 as the worst case position; thus used as the initial test position.

- After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following:
  (1) The channel closest to mid-band frequency is selected for SAR measurement.
  (2) For channels with equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.
  These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s) selection.

10.3 Conducted Power Measurements

Refer to Appendix A.

10.4 Antenna location

Refer to Appendix E.

10.5 Test Results

10.5.1 SAR Test Result

Index.	Band	Modulation	Channel	Frequency (MHz)	Test Position	Spacing (mm)	SAR_{1g} (W/kg)	Meas. Conducted Power (dBm)	Tune-up (dBm)	Duty Cycle (%)	Reported SAR_{1g} (W/kg)	Antenna
	WLAN 2.4 GHz	802.11b	6	2437	Back	0	0.027	15.96	17	100	0.03	ANT Main
1	WLAN 2.4 GHz	802.11b	6	2437	Side 1	0	0.211	15.96	17	100	0.27	ANT Main
	WLAN 2.4 GHz	802.11b	1	2412	Side 1	0	0.171	14.49	15.5	100	0.22	ANT Main
	WLAN 2.4 GHz	802.11b	11	2462	Side 1	0	0.205	15.95	17	100	0.26	ANT Main
	WLAN 2.4 GHz	802.11b	12	2467	Side 1	0	0.061	10.89	12	100	0.08	ANT Main
	WLAN 2.4 GHz	802.11b	13	2472	Side 1	0	0.021	6.38	7.5	100	0.03	ANT Main
	WLAN 2.4 GHz	802.11b	6	2437	Side 2	0	0.01	15.96	17	100	0.01	ANT Main
	WLAN 2.4 GHz	802.11b	6	2437	Side 3	0	0.01	15.96	17	100	0.01	ANT Main
	WLAN 2.4 GHz	802.11b	6	2437	Side 4	0	0.01	15.96	17	100	0.01	ANT Main
	WLAN 2.4 GHz	802.11b	6	2437	Slant Side 1	0	0.139	15.96	17	100	0.18	ANT Main
	WLAN 2.4 GHz	802.11b	6	2437	Back	0	0.048	15.98	17	100	0.06	ANT Aux
2	WLAN 2.4 GHz	802.11b	6	2437	Side 1	0	0.435	15.98	17	100	0.55	ANT Aux
	WLAN 2.4 GHz	802.11b	1	2412	Side 1	0	0.233	14.45	15.5	100	0.30	ANT Aux
	WLAN 2.4 GHz	802.11b	11	2462	Side 1	0	0.411	15.91	17	100	0.53	ANT Aux
	WLAN 2.4 GHz	802.11b	12	2467	Side 1	0	0.125	10.92	12	100	0.16	ANT Aux
	WLAN 2.4 GHz	802.11b	13	2472	Side 1	0	0.042	6.44	7.5	100	0.05	ANT Aux
	WLAN 2.4 GHz	802.11b	6	2437	Side 2	0	0.01	15.98	17	100	0.01	ANT Aux
	WLAN 2.4 GHz	802.11b	6	2437	Side 3	0	0.01	15.98	17	100	0.01	ANT Aux
	WLAN 2.4 GHz	802.11b	6	2437	Side 4	0	0.104	15.98	17	100	0.13	ANT Aux
	WLAN 2.4 GHz	802.11b	6	2437	Slant Side 1	0	0.347	15.98	17	100	0.44	ANT Aux
	Bluetooth	GFSK	0	2402	Back	0	0.01	4.85	6	100	0.01	ANT Main
3	Bluetooth	GFSK	0	2402	Side 1	0	0.018	4.85	6	100	0.02	ANT Main
	Bluetooth	GFSK	39	2441	Side 1	0	0.011	4.29	6	100	0.02	ANT Main
	Bluetooth	GFSK	78	2480	Side 1	0	0.014	4.32	6	100	0.02	ANT Main
	Bluetooth	GFSK	0	2402	Side 2	0	0.01	4.85	6	100	0.01	ANT Main
	Bluetooth	GFSK	0	2402	Side 3	0	0.01	4.85	6	100	0.01	ANT Main
	Bluetooth	GFSK	0	2402	Side 4	0	0.01	4.85	6	100	0.01	ANT Main
	Bluetooth	GFSK	0	2402	Slant Side 1	0	0.01	4.85	6	100	0.01	ANT Main

Index.	Band	Modulation	Channel	Frequency (MHz)	Test Position	Spacing (mm)	SAR_{1g} (W/kg)	Meas. Conducted Power (dBm)	Tune-up (dBm)	Duty Cycle (%)	Reported SAR_{1g} (W/kg)	Antenna
	Bluetooth	GFSK	0	2402	Back	0	0.01	5.02	6	100	0.01	ANT Aux
10	Bluetooth	GFSK	0	2402	Side 1	0	0.025	5.02	6	100	0.03	ANT Aux
	Bluetooth	GFSK	39	2441	Side 1	0	0.019	4.36	6	100	0.03	ANT Aux
	Bluetooth	GFSK	78	2480	Side 1	0	0.014	4.25	6	100	0.02	ANT Aux
	Bluetooth	GFSK	0	2402	Side 2	0	0.01	5.02	6	100	0.01	ANT Aux
	Bluetooth	GFSK	0	2402	Side 3	0	0.01	5.02	6	100	0.01	ANT Aux
	Bluetooth	GFSK	0	2402	Side 4	0	0.01	5.02	6	100	0.01	ANT Aux
	Bluetooth	GFSK	0	2402	Slant Side 1	0	0.01	5.02	6	100	0.01	ANT Aux
	WLAN 5 GHz	802.11n HT40	54	5270	Back	0	0.01	10.79	11	100	0.01	ANT Main
4	WLAN 5 GHz	802.11n HT40	54	5270	Side 1	0	0.541	10.79	11	100	0.57	ANT Main
	WLAN 5 GHz	802.11n HT40	62	5310	Side 1	0	0.395	10.47	11	100	0.45	ANT Main
	WLAN 5 GHz	802.11n HT40	54	5270	Side 2	0	0.01	10.79	11	100	0.01	ANT Main
	WLAN 5 GHz	802.11n HT40	54	5270	Side 3	0	0.01	10.79	11	100	0.01	ANT Main
	WLAN 5 GHz	802.11n HT40	54	5270	Side 4	0	0.01	10.79	11	100	0.01	ANT Main
	WLAN 5 GHz	802.11n HT40	54	5270	Slant Side 1	0	0.236	10.79	11	100	0.25	ANT Main
	WLAN 5 GHz	802.11n HT40	54	5270	Back	0	0.051	10.93	11.5	100	0.06	ANT Aux
5	WLAN 5 GHz	802.11n HT40	54	5270	Side 1	0	0.93	10.93	11.5	100	1.06	ANT Aux
	WLAN 5 GHz	802.11n HT40	62	5310	Side 1	0	0.767	10.41	11.5	100	0.99	ANT Aux
	WLAN 5 GHz	802.11n HT40	54	5270	Side 2	0	0.01	10.93	11.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11n HT40	54	5270	Side 3	0	0.01	10.93	11.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11n HT40	54	5270	Side 4	0	0.01	10.93	11.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11n HT40	54	5270	Slant Side 1	0	0.476	10.93	11.5	100	0.54	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	106	5530	Back	0	0.01	8.96	9	100	0.01	ANT Main
6	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 1	0	0.375	8.96	9	100	0.38	ANT Main
	WLAN 5 GHz	802.11ac VHT80	122	5610	Side 1	0	0.333	8.91	9	100	0.34	ANT Main
	WLAN 5 GHz	802.11ac VHT80	138	5690	Side 1	0	0.225	8.94	9	100	0.23	ANT Main
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 2	0	0.01	8.96	9	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 3	0	0.01	8.96	9	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 4	0	0.01	8.96	9	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	106	5530	Slant Side 1	0	0.153	8.96	9	100	0.15	ANT Main

Index.	Band	Modulation	Channel	Frequency (MHz)	Test Position	Spacing (mm)	SAR_{1g} (W/kg)	Meas. Conducted Power (dBm)	Tune-up (dBm)	Duty Cycle (%)	Reported SAR_{1g} (W/kg)	Antenna
	WLAN 5 GHz	802.11ac VHT80	106	5530	Back	0	0.066	8.95	10.5	100	0.09	ANT Aux
7	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 1	0	0.595	8.95	10.5	100	0.85	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	122	5610	Side 1	0	0.355	8.84	10.5	100	0.52	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	138	5690	Side 1	0	0.336	8.89	10.5	100	0.49	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 2	0	0.01	8.95	10.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 3	0	0.01	8.95	10.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	106	5530	Side 4	0	0.01	8.95	10.5	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	106	5530	Slant Side 1	0	0.348	8.95	10.5	100	0.50	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Back	0	0.01	9.97	10	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 1	0	0.308	9.97	10	100	0.31	ANT Main
8	WLAN 5 GHz	802.11n HT40	159	5795	Side 1	0	0.317	9.98	10	100	0.32	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 2	0	0.01	9.97	10	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 3	0	0.01	9.97	10	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 4	0	0.01	9.97	10	100	0.01	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Slant Side 1	0	0.203	9.97	10	100	0.20	ANT Main
	WLAN 5 GHz	802.11ac VHT80	155	5775	Back	0	0.105	9.94	10	100	0.11	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 1	0	0.403	9.94	10	100	0.41	ANT Aux
9	WLAN 5 GHz	802.11n HT40	159	5795	Side 1	0	0.498	9.78	10	100	0.52	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 2	0	0.01	9.94	10	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 3	0	0.01	9.94	10	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Side 4	0	0.01	9.94	10	100	0.01	ANT Aux
	WLAN 5 GHz	802.11ac VHT80	155	5775	Slant Side 1	0	0.306	9.94	10	100	0.31	ANT Aux

10.6 Measurement Variability

According to KDB 865664 D01v01r04, SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required:

1. The original highest measured Reported SAR 1-g is ≧0.80 W/kg, repeated that measurement once.
2. Perform a second repeated measurement the ratio of the largest to the smallest SAR for the original and first repeated measurements is <1.2 W/kg, or when the original or repeated measurement is ≧ 1.45 W/kg (~10% from the 1-g SAR limit).

Band	Modulation	Channel	Frequency (MHz)	Test Position	Spacing (mm)	Note	Original SAR_{1g} (W/kg)	First SAR_{1g} (W/kg)	First Ratio SAR_{1g}
WLAN 5 GHz	802.11n HT40	54	5270	Side 1	0	Index. #5_once	0.93	0.906	2.58%

10.7 Simultaneous Transmission Evaluation

10.7.1 Simultaneous Transmission Configurations

Condition(s)	Band					
	WLAN 2.4 GHz ANT Main	WLAN 2.4 GHz ANT Aux	WLAN 5 GHz ANT Main	WLAN 5 GHz ANT Aux	Bluetooth ANT Main	Bluetooth ANT Aux
1	-	-	V	-	V	-
2	-	-	-	V		V

10.7.2 Simultaneous Transmission Result

When the sum of SAR_{1g} of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration.

The sum of SAR_{1g} results is shown as below.

Exposure Position	1	2	3	4	5	6	3+5	4+6
	WLAN 2.4 GHz ANT Main	WLAN 2.4 GHz ANT Aux	WLAN 5 GHz ANT Main	WLAN 5 GHz ANT Aux	Bluetooth ANT Main	Bluetooth ANT Aux	ΣSAR_{1g} (W/kg)	ΣSAR_{1g} (W/kg)
	SAR_{1g} (W/kg)	SAR_{1g} (W/kg)	SAR_{1g} (W/kg)	SAR_{1g} (W/kg)	SAR_{1g} (W/kg)	SAR_{1g} (W/kg)		
Slant Side 1 at 0 mm	0.18	0.44	0.25	0.54	0.01	0.01	0.26	0.55
Back at 0 mm	0.03	0.06	0.01	0.11	0.01	0.01	0.02	0.12
side 1 at 0 mm	0.27	0.55	0.57	1.06	0.02	0.03	0.59	1.09
side 2 at 0 mm	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
side 3 at 0 mm	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02
side 4 at 0 mm	0.01	0.13	0.01	0.01	0.01	0.01	0.02	0.02

10.7.3 SAR to peak location separation (SPLSR)

According to KDB 447498, when the sum of SAR is greater than the limit, SAR test exclusion is determined by the SAR to peak location separation ratio (SPLSR), and the simultaneously transmitting antennas must be considered one pair at a time. The ratio is determined by **$(SAR1+SAR2)^{1.5}$ / (separation distance between the peak SAR locations for the antenna pair, mm)**, round to two decimal digits, and must be ≦ 0.04 for all antenna pairs in the configuration to qualify for 1-g SAR test exclusion.

The SPLSR hotspot combination procedure in TCB workshop Nov. 2019 was applied when simultaneous transmission SAR is > 1.6 W/kg and antenna pair is co-located.

SPLSR analysis is not required in this report since the sum of SAR is under the SAR limit.

10.8 Requirements on the Uncertainty Evaluation

Decision Rule

■ Uncertainty is not included.

☐ Uncertainty is included.

The highest measured 1-g SAR is less than 1.5 W/kg and the highest measured 10-g SAR is less than 3.75 W/kg. Therefore, per KDB Publication 865664 D01, the extended measurement uncertainty analysis described in IEEE 1528-2013 and IEC/IEEE 62209-1528 is not required.

11. Conclusion

The SAR test values found for the device are below the maximum limit of 1.6 W/kg.

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