



FCC SAR TEST REPORT

FCC ID : PD9AX411E2
Equipment : WLAN and BT, 2x2 PCIe M.2 1625 adapter card
Brand Name : Intel® Wi-Fi 6E AX411
Model Name : AX411E2W
Applicant : Intel Mobile Communications
100 Center Point Circle, Suite 200 / Columbia,
SC 29210 / United States
Standard : FCC 47 CFR Part 2 (2.1093)

The product was received on Jul. 19, 2022 and testing was started from Jul. 19, 2022 and completed on Aug. 20, 2022. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample provide by manufacturer and the test data has been evaluated in accordance with the test procedures given in 47 CFR Part 2.1093 and FCC KDB and has been pass the FCC requirement.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC. Laboratory, the test report shall not be reproduced except in full.

Approved by: Cona Huang / Deputy Manager



Sporton International Inc. Wensan Laboratory



Table of Contents

1. Statement of Compliance 4
2. Guidance Applied..... 4
3. Equipment Under Test (EUT) Information 5
3.1 General Information 5
4. RF Exposure Limits..... 6
4.1 Uncontrolled Environment..... 6
4.2 Controlled Environment..... 6
4.3 RF Exposure limit for above 6GHz..... 7
5. Specific Absorption Rate (SAR)..... 8
5.1 Introduction 8
5.2 SAR Definition..... 8
6. System Description and Setup 9
6.1 Test Site Location..... 9
6.2 E-Field Probe10
6.3 Data Acquisition Electronics (DAE)10
6.4 Phantom.....11
6.5 Device Holder.....12
7. Measurement Procedures13
7.1 Spatial Peak SAR Evaluation.....13
7.2 Power Reference Measurement.....14
7.3 Area Scan14
7.4 Zoom Scan.....15
7.5 Volume Scan Procedures.....15
7.6 Power Drift Monitoring.....15
8. Test Equipment List16
9. System Verification17
9.1 Tissue Verification17
9.2 System Performance Check Results.....17
9.3 PD System Performance Check Results.....18
10. WiFi Output Power (Unit: dBm).....19
11. SAR Test Results21
11.1 Head SAR22
11.2 6GHz PD Test Result.....23
12. Simultaneous Transmission Analysis.....24
12.1 Body Exposure Conditions.....24
13. Uncertainty Assessment25
14. References.....28
Appendix A. Plots of SAR System Performance Check
Appendix B. Plots of PD System Performance Check
Appendix C. Plots of High SAR Measurement
Appendix D. Plots of High PD Measurement
Appendix E. DASy Calibration Certificate
Appendix F. Test Setup Photos



History of this test report

Report No.	Version	Description	Issued Date
FA251034B	01	Initial issue of report	Sep. 27, 2022



1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for Intel Mobile Communications, WLAN and BT, 2x2 PCIe M.2 1625 adapter card, AX411E2W, are as follows.

Equipment Class	Frequency		Body SAR (Separation 5mm) 1g SAR (W/kg)	Highest Simultaneous Transmission 1g SAR (W/kg)	Body APD 4cm ² (W/m ²)	Body Reported PD 4cm ² (W/m ²)
6XD	WLAN	6GHz WLAN	0.63	1.36	4.17	9.33
Date of Testing:			2022/7/19 ~ 2022/8/20			

Sporton Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation and the FCC designation No. TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test. This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg for Partial-Body 1g SAR) specified in FCC 47 CFR part 2 (2.1093), Human Exposure to RF Radiation Limits (1.0 mW/cm²=10 W/m²) specified in FCC 47 CFR part 1.1310 and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

Reviewed by: Jason Wang
Report Producer: Paula Chen

2. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards, the below KDB standard may not including in the TAF code without accreditation.

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02
- IEC/IEEE 62209-1528:2020
- SPEAG DASY6 System Handbook
- SPEAG DASY6 Application Note (Interim Procedure for Device Operation at 6GHz-10GHz)
- IEC TR 63170:2018
- IEC 62479:2010
- DASY System Handbook



3. Equipment Under Test (EUT) Information

3.1 General Information

Product Feature & Specification	
Equipment Name	WLAN and BT, 2x2 PCIe M.2 1625 adapter card
Brand Name	Intel® Wi-Fi 6E AX411
Model Name	AX411E2W
FCC ID	PD9AX411E2
Description	WLAN module + PIFA antenna
Wireless Technology and Frequency Range	WLAN 2.4 GHz Band: 2400 MHz ~ 2483.5 MHz WLAN 5.2 GHz Band: 5150 MHz ~ 5250 MHz WLAN 5.3 GHz Band: 5250 MHz ~ 5350 MHz WLAN 5.6 GHz Band: 5470 MHz ~ 5725 MHz WLAN 5.8 GHz Band: 5725 MHz ~ 5850 MHz WLAN 6E: 5925 MHz ~ 6425 MHz, 6425 MHz ~ 6525 MHz, 6525 MHz ~ 6875 MHz, 6875 MHz ~ 7125 MHz Bluetooth: 2400 MHz ~ 2483.5 MHz
Mode	WLAN: 802.11a/b/g/n/ac/ax HT20/HT40/VHT20/VHT40/VHT80/VHT160/HE20/HE40/HE80/HE160 Bluetooth BR/EDR/LE
SW Version	99.2100.64.0-OEM.DRTU.12485
Driver Version	WLAN 99.0.63.5, BT 22.70.31654.21224
EUT Stage	Production Unit
Additional Information	No WWAN transmitter is considered in this report



4. RF Exposure Limits

4.1 Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

4.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

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

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram 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.



4.3 RF Exposure limit for above 6GHz

According to ANSI/IEEE C95.1-1992, the criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio frequency (RF) radiation as specified in §1.1310.

Peak Spatially Averaged Power Density was evaluated over a circular area of 4cm² per interim FCC Guidance for near-field power density evaluations per October 2018 TCB Workshop notes

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3-3.0	614	1.63	*(100)	6
3.0-30	1842/f	4.89/f	*(900/f ²)	6
30-300	61.4	0.163	1.0	6
300-1500			f/300	6
1500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*(100)	30
1.34-30	824/f	2.19/f	*(180/f ²)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

5. Specific Absorption Rate (SAR)

5.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

5.2 SAR Definition

The SAR definition is 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:

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

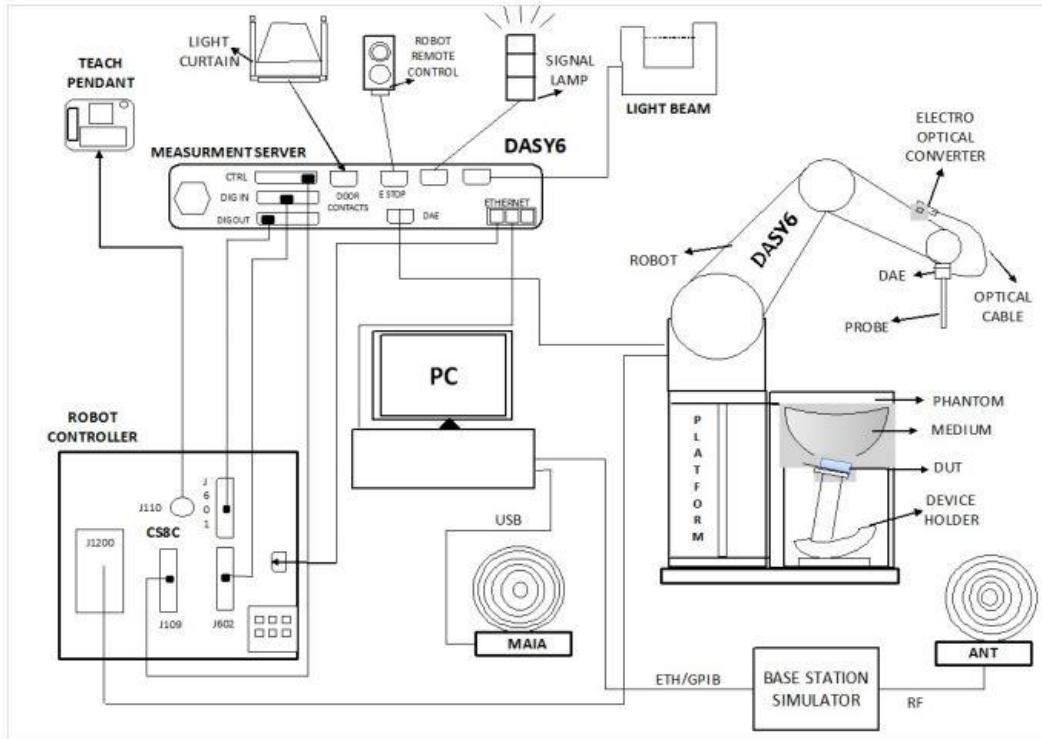
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

6. System Description and Setup

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



- The DASY system in SAR Configuration is shown above
- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- 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 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.
- 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.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running windows software and the DASY software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6.1 Test Site Location


The SAR measurement facilities used to collect data are within both Sporton Lab list below test site location are accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 1190 and 3786) and the FCC designation No. TW1190 and TW3786 under the FCC 2.948(e) by Mutual Recognition Agreement (MRA) in FCC test.

Test Site	EMC & Wireless Communications Laboratory		Wensan Laboratory		
Test Site Location	TW1190 No.52, Huaya 1st Rd., Guishan Dist., Taoyuan City 333, Taiwan		TW3786 No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan		
Test Site No.	SAR01-HY	SAR03-HY	SAR08-HY	SAR09-HY	SAR15-HY
	SAR04-HY	SAR05-HY	SAR11-HY	SAR12-HY	
	SAR06-HY	SAR10-HY	SAR13-HY	SAR14-HY	


6.2 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

<ES3DV3 Probe>

Construction	Symmetric design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – 4 GHz; Linearity: ± 0.2 dB (30 MHz – 4 GHz)	
Directivity	± 0.2 dB in TSL (rotation around probe axis) ± 0.3 dB in TSL (rotation normal to probe axis)	
Dynamic Range	5 μ W/g – >100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 3.9 mm (body: 12 mm) Distance from probe tip to dipole centers: 3.0 mm	

<EX3DV4 Probe>

Construction	Symmetric design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz – >6 GHz Linearity: ± 0.2 dB (30 MHz – 6 GHz)	
Directivity	± 0.3 dB in TSL (rotation around probe axis) ± 0.5 dB in TSL (rotation normal to probe axis)	
Dynamic Range	10 μ W/g – >100 mW/g Linearity: ± 0.2 dB (noise: typically <1 μ W/g)	
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	

6.3 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) 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 input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.



Fig 5.1 Photo of DAE

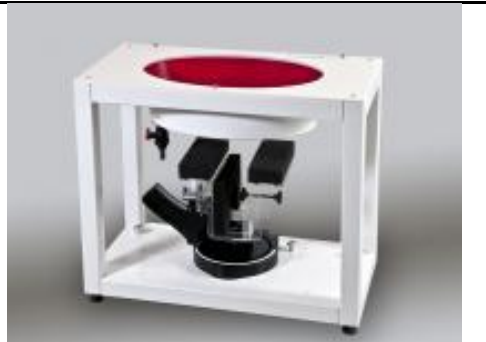
6.4 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm	
Filling Volume	Approx. 25 liters	
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet	
Measurement Areas	Left Hand, Right Hand, Flat Phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)	
Filling Volume	Approx. 30 liters	
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm	

The ELI phantom is intended 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 standard and all known tissue simulating liquids.

6.5 Device Holder

<Mounting Device for Hand-Held Transmitter>

In combination with the Twin SAM V5.0/V5.0c or ELI phantoms, the Mounting Device for Hand-Held Transmitters enables rotation of the mounted transmitter device to specified spherical coordinates. At the heads, the rotation axis is at the ear opening. Transmitter devices can be easily and accurately positioned according to IEC 62209-1, IEEE 1528, FCC, or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). And upgrade kit to Mounting Device to enable easy mounting of wider devices like big smart-phones, e-books, small tablets, etc. It holds devices with width up to 140 mm.



Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

<Mounting Device for Laptops and other Body-Worn Transmitters>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.



Mounting Device for Laptops

7. Measurement Procedures

The measurement procedures are as follows:

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported 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:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

7.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, 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 1g and 10g 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 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

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

7.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

7.3 Area Scan

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: $\Delta x_{Area}, \Delta y_{Area}$	≤ 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.	

7.4 Zoom Scan

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

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

		≤ 3 GHz	> 3 GHz	
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}, \Delta y_{Zoom}$		≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*	
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$	≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm	
	graded grid	$\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z	≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm	
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB 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.				

7.5 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 1g aggregate SAR, the EUT 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.

7.6 Power Drift Monitoring

All SAR testing is under the EUT 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 EUT 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. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	6500MHz System Validation Kit	D6.5GHzV2	1003	Sep. 24, 2021	Sep. 23, 2022
SPEAG	Data Acquisition Electronics	DAE4	656	Jan. 19, 2022	Jan. 18, 2023
SPEAG	Data Acquisition Electronics	DAE4	1424	Jan. 20, 2022	Jan. 19, 2023
SPEAG	Data Acquisition Electronics	DAE4	1707	Jan. 12, 2022	Jan. 11, 2023
SPEAG	EUmmWV Probe Tip Protection	EUmmWV3	9424	Apr. 06, 2022	Apr. 05, 2023
SPEAG	EUmmWV Probe Tip Protection	EUmmWV4	9461	Oct. 22, 2021	Oct. 21, 2022
SPEAG	5G Verification Source	10GHz	1020	Jan. 18, 2022	Jan. 17, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	3976	Jan. 27, 2022	Jan. 26, 2023
SPEAG	Dosimetric E-Field Probe	EX3DV4	7625	Jan. 27, 2022	Jan. 26, 2023
RCPTWN	Thermometer	HTC-1	TM685-1	Oct. 28, 2021	Oct. 27, 2022
RCPTWN	Thermometer	HTC-1	TM560-2	Oct. 28, 2021	Oct. 27, 2022
SPEAG	Device Holder	N/A	N/A	N/A	N/A
Anritsu	Signal Generator	MG3710A	6201502524	Oct. 24, 2021	Oct. 23, 2022
Keysight	ENA Network Analyzer	E5071C	MY46104758	Sep. 19, 2021	Sep. 18, 2022
SPEAG	Dielectric Probe Kit	DAK-3.5	1126	Sep. 24, 2021	Sep. 23, 2022
LINE SEIKI	Digital Thermometer	DTM3000-spezial	2942	Oct. 26, 2021	Oct. 25, 2022
Anritsu	Power Meter	ML2495A	1804003	Oct. 09, 2021	Oct. 08, 2022
Anritsu	Power Meter	ML2496A	2119003	Jun. 22, 2022	Jun. 21, 2023
R&S	Power Sensor	NRP8S	103999	Jan. 09, 2022	Jan. 08, 2023
R&S	Power Sensor	NRP8S	109687	Sep. 07, 2021	Sep. 06, 2022
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jul. 21, 2022	Jul. 20, 2023
Anritsu	Spectrum Analyzer	N9010A	MY53470118	Jan. 12, 2022	Jan. 11, 2023
Mini-Circuits	Power Amplifier	ZVE-8G+	6418	Oct. 12, 2021	Oct. 11, 2022
Mini-Circuits	Power Amplifier	ZVE-8G+	479102029	Sep. 06, 2021	Sep. 05, 2022
ATM	Dual Directional Coupler	C122H-10	P610410z-02	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	

General Note:

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.
2. The dipole calibration interval can be extended to 3 years with justification according to KDB 865664 D01. The dipoles are also not physically damaged, or repaired during the interval. The justification data in appendix C can be found which the return loss is < -20dB, within 20% of prior calibration, the impedance is within 5 ohm of prior calibration for each dipole.

9. System Verification

9.1 Tissue Verification

The tissue dielectric parameters of tissue-equivalent media used for SAR measurements must be characterized within a temperature range of 18°C to 25°C, measured with calibrated instruments and apparatuses, such as network analyzers and temperature probes. The temperature of the tissue-equivalent medium during SAR measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized. The tissue dielectric measurement system must be calibrated before use. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements.

The liquid tissue depth was at least 15cm in the phantom for all SAR testing.

<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Liquid Temp. (°C)	Conductivity (σ)	Permittivity (ε _r)	Conductivity Target (σ)	Permittivity Target (ε _r)	Delta (σ) (%)	Delta (ε _r) (%)	Limit (%)	Date
6500	22.5	6.100	34.600	6.07	34.50	0.49	0.29	±5	2022/7/23
6500	22.5	6.060	34.420	6.07	34.50	-0.16	-0.23	±5	2022/8/20

9.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Test Site	Date	Frequency (MHz)	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)	Deviation (%)
SAR13	2022/7/23	6500	100	D6.5GHzV2-1003	EX3DV4 - SN7625	DAE4 Sn1424	30.3	292.00	303	3.77	3.79
SAR15	2022/8/20	6500	100	D6.5GHzV2-1003	EX3DV4 - SN3976	DAE4 Sn1707	26.4	292.00	264	-9.59	-7.58

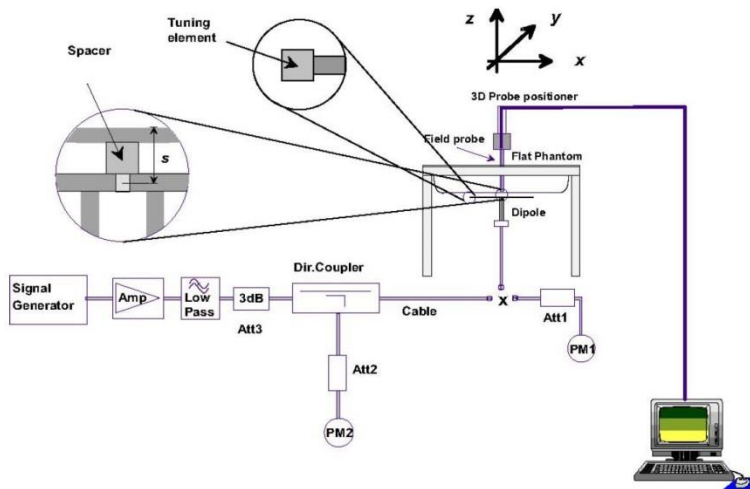


Fig 8.3.1 System Performance Check Setup



Fig 8.3.2 Setup Photo

9.3 PD System Performance Check Results

The system was verified to be within ± 0.66 dB of the power density targets on the calibration certificate according to the test system specification in the user’s manual and calibration facility recommendation. The 0.66 dB deviation threshold represents the expanded uncertainty for system performance checks using SPEAG’s mmWave verification sources. The same spatial resolution and measurement region used in the source calibration was applied during the system check. The measured power density distribution of verification source was also confirmed through visual inspection to have no noticeable differences, both spatially (shape) and numerically (level) from the distribution provided by the manufacturer, per November 2017 TCBC Workshop Notes.

Test Site	Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N	Distance (mm)	Measured 4 cm ² (W/m ²)	Targeted 4 cm ² (W/m ²)	Deviation (dB)	Date
SAR13	10G	10GHz_1020	EUmmWV3 - SN9424	DAE4 Sn1424	10	55.7	51.7	0.32	2022/7/19
SAR14	10G	10GHz_1020	EUmmWV3 - SN9461	DAE4 Sn656	10	55.3	51.7	0.29	2022/8/19

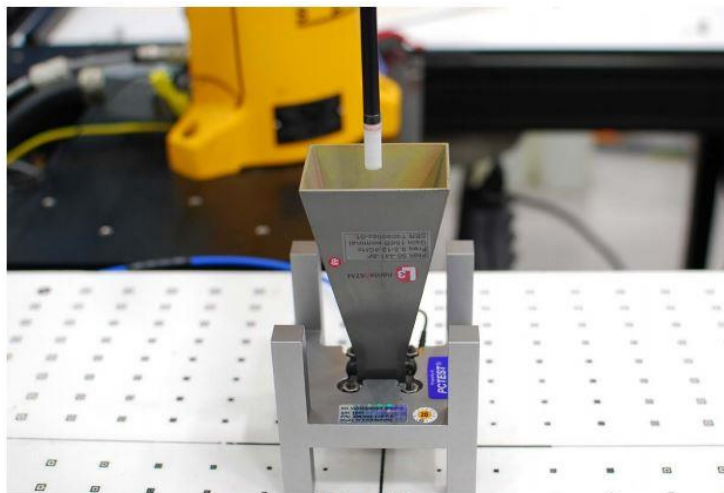


Figure 4-3
System Verification Setup Photo

System Performance Check Setup



10. WiFi Output Power (Unit: dBm)

General Note:

1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures. For "Not required", SAR Test reduction was applied from KDB 248227 guidance, Sec. 2.1, b), 1) when the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, additional output power measurements were not necessary.
2. Per KDB 248227 D01v02r02, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
3. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
4. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
5. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures. 18 The initial test position procedure is described in the following:
 - a. When the reported SAR of 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 802.11 transmission mode combinations within the frequency band or aggregated band.
 - b. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode 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 report SAR is ≤ 0.8 W/kg or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
6. Per 201904 TCBC workshops, General principles of FCC KDB Publication 248227 D01 can be applied to determine the SAR Initial Test Configurations and test reduction for 802.11ax SAR testing. For the table below the 802.11ax maximum power is SU (non-OFDMA), and the SU maximum power also higher than RU (OFDMA)
7. In applying the test guidance, the IEEE 802.11 mode with the maximum output power (out of all modes) should be considered for testing
8. For modes with the same maximum output power, the guidance from section 5.3.2 a) of FCC KDB Publication 248227 D01 should be applied, with 802.11ax being considered as the highest 802.11 mode for the appropriate frequency bands
9. When SAR testing for 802.11ax is required
 - a. If the maximum output power is highest for OFDMA scenarios, choose the tone size with the maximum number of tones and the highest maximum output power
 - b. Otherwise, consider the fully allocated channel for SAR testing
 - c. When SAR testing is required on RU sizes less than the fully allocated channel, use the RU number closest to the middle of the channel, choosing the higher RU number when two RUs are equidistant to the middle of the channel



<WLAN Non-CDB>

WiFi 6E				Main Ant			Aux Ant		
WiFi 6E	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	WiFi 6E	802.11ax-HE20 MCS0	1	5955	Not Required	5.00	Not Required	Not Required	5.00
57			6235	5.00		5.00			
113			6515	5.00		5.00			
173			6815	4.25		4.25			
233			7115	0.00		0.00			
802.11ax-HE40 MCS0		3	5965	8.25		8.25			
		59	6245	8.25		8.25			
		107	6485	8.25		8.25			
		171	6805	7.50		7.50			
802.11ax-HE80 MCS0		227	7085	7.50		7.50			
		7	5985	10.75		10.75			
		71	6305	10.75		10.75			
		119	6545	10.75		10.75			
		167	6785	10.00		10.00			
802.11ax-HE160 MCS0		215	7025	10.00		10.00			
	15	6025	13.30	13.50	97.30	12.60	13.00	97.30	
	47	6185	13.30	13.50		12.40	13.00		
	111	6505	13.40	13.50		12.70	13.00		
	175	6825	12.70	12.75		12.50	12.75		
207	6985	12.40	12.75	12.70		12.75			

<WLAN CDB>

WiFi 6E				Ant 1			Ant 2		
WiFi 6E	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	WiFi 6E	802.11ax-HE20 MCS0	1	5955	Not Required	2.00	Not Required	Not Required	2.00
57			6235	2.00		2.00			
113			6515	2.00		2.00			
173			6815	1.25		1.25			
233			7115	-3.00		-3.00			
802.11ax-HE40 MCS0		3	5965	5.25		5.25			
		59	6245	5.25		5.25			
		107	6485	5.25		5.25			
		171	6805	4.50		4.50			
802.11ax-HE80 MCS0		227	7085	4.50		4.50			
		7	5985	7.75		7.75			
		71	6305	7.75		7.75			
		119	6545	7.75		7.75			
		167	6785	7.00		7.00			
802.11ax-HE160 MCS0		215	7025	7.00		7.00			
	15	6025	10.20	10.50	97.30	10.20	10.50	97.30	
	47	6185	10.20	10.50		10.00	10.50		
	111	6505	10.20	10.50		10.30	10.50		
	175	6825	9.60	9.75		9.70	9.75		
207	6985	9.70	9.75	9.60		9.75			



11. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
 - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
 - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
 - c. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
 - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
 - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
 - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥ 0.8 W/kg.
4. The testing has been performed on all positions (except back face) in both chains and the four considered bands, U-NII-5, U-NII-6, U-NII-7 and U-NII-8 in SAR mode, the back face position has not been tested due to antenna design constraints.

WLAN Note:

1. When the reported SAR of the test position is > 0.4 W/kg, SAR is repeated for the 802.11 transmission mode 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 report SAR is ≤ 0.8 W/kg or all required test position are tested.
2. For all positions / configurations, when the reported SAR is > 0.8 W/kg, SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is ≤ 1.2 W/kg or all required channels are tested.
3. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
4. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6 W/kg and SAR peak to location ratio ≤ 0.04 , no additional SAR measurements for MIMO.
5. The device support CDB operation (Concurrent Dual Band simultaneous Wi-Fi connection), when the 2.4GHz WLAN and 6GHz WLAN transmit at the same time, the device will limit different power for Sim-Tx compliance.
6. The WLAN was performed on non-CDB mode due do it's higher power, also using the result to assessment all Sim-Tx configuration, if the Sim-Tx SAR result is higher than 1.6W/kg, additional CDB mode active SAR is necessary, the required test position when CDB mode active list as following table.
7. During SAR testing the WLAN transmission was verified using a spectrum analyzer.



WLAN PD Note:

1. The manufacturer has confirmed that the devices tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
2. Absorbed power density (APD) using a 4cm² averaging area is reported based on SAR measurements.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by λ/4.
4. The device was configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools.
5. Per FCC guidance and equipment manufacturer guidance, power density results were scaled according to IEC 62479:2010 for the portion of the measurement uncertainty > 30%. Total expanded uncertainty of 2.68 dB (85.4%) was used to determine the psPD measurement scaling factor.
6. The measurement procedure consists of measuring the PDinc at two different distances: 2 mm (compliance distance) and λ/5. The grid extents should be large enough to fully capture the transmitted energy. The grid step should be fine enough to demonstrate that the integrated Power Density iPDn fulfill the criterion described below. Since iPD ratio between the two distances is ≥ -1dB, the grid step (0.0625) was sufficient for determining compliance at d=2mm.

$$10 \cdot \log_{10} \frac{iPD_n(2mm)}{iPD_n(\lambda/5)} \geq -1$$

11.1 Head SAR

<WLAN SAR>

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)	Measured APD (W/m ²)
01	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	Non-CDB	111	6505	13.40	13.50	1.023	97.3	1.028	0.18	0.337	0.355	2.770
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	Non-CDB	15	6025	13.30	13.50	1.047	97.3	1.028	0.09	0.584	0.629	4.170
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	Non-CDB	47	6185	13.30	13.50	1.047	97.3	1.028	0.13	0.438	0.471	3.300
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	Non-CDB	175	6825	12.70	12.75	1.012	97.3	1.028	0.14	0.300	0.312	2.160
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	Non-CDB	207	6985	12.40	12.75	1.084	97.3	1.028	0.14	0.230	0.256	1.810
	WLAN6GHz	802.11ax-HE160 MCS0	Top side	5mm	Main	Non-CDB	111	6505	13.40	13.50	1.023	97.3	1.028	-0.16	0.094	0.099	0.696
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom side	5mm	Main	Non-CDB	111	6505	13.40	13.50	1.023	97.3	1.028	0.15	0.076	0.080	0.684
	WLAN6GHz	802.11ax-HE160 MCS0	Right side	5mm	Main	Non-CDB	111	6505	13.40	13.50	1.023	97.3	1.028	0.01	0.020	0.021	0.163
	WLAN6GHz	802.11ax-HE160 MCS0	Left side	5mm	Main	Non-CDB	111	6505	13.40	13.50	1.023	97.3	1.028	0.12	0.082	0.086	0.653
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	CDB	15	6025	10.20	10.50	1.072	97.3	1.028	-0.01	0.294	0.324	2.020
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	Non-CDB	111	6505	12.70	13.00	1.072	97.3	1.028	-0.11	0.313	0.345	2.510
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	Non-CDB	15	6025	12.60	13.00	1.096	97.3	1.028	0	0.488	0.550	3.340
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	Non-CDB	47	6185	12.40	13.00	1.148	97.3	1.028	0.03	0.347	0.410	2.660
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	Non-CDB	175	6825	12.50	12.75	1.059	97.3	1.028	0.05	0.372	0.405	2.700
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	Non-CDB	207	6985	12.70	12.75	1.012	97.3	1.028	0	0.291	0.303	2.170
	WLAN6GHz	802.11ax-HE160 MCS0	Top side	5mm	Aux	Non-CDB	111	6505	12.70	13.00	1.072	97.3	1.028	-0.12	0.065	0.072	0.561
	WLAN6GHz	802.11ax-HE160 MCS0	Bottom side	5mm	Aux	Non-CDB	111	6505	12.70	13.00	1.072	97.3	1.028	0.07	0.067	0.074	0.575
	WLAN6GHz	802.11ax-HE160 MCS0	Right side	5mm	Aux	Non-CDB	111	6505	12.70	13.00	1.072	97.3	1.028	0.04	0.017	0.019	0.129
	WLAN6GHz	802.11ax-HE160 MCS0	Left side	5mm	Aux	Non-CDB	111	6505	12.70	13.00	1.072	97.3	1.028	-0.03	0.079	0.087	0.629
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	CDB	15	6025	10.20	10.50	1.072	97.3	1.028	-0.13	0.341	0.376	2.310



11.2 6GHz PD Test Result

Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Grid Step (λ)	iPDn	iPD ratio (≥ -1)	Normal psPD (W/m ²)	Total psPD (W/m ²)
WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	15	6025	13.30	0.0625	2.11	-0.48629548	3.6	4.85
WLAN6GHz	802.11ax-HE160 MCS0	Front	10mm	Main	15	6025	13.30	0.25	2.36		3.11	3.38
WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	207	6985	12.40	0.0625	2.19	0.372480574	2.79	3.07
WLAN6GHz	802.11ax-HE160 MCS0	Front	8.59mm	Main	207	6985	12.40	0.25	2.01		1.92	2.1
WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	15	6025	12.60	0.0625	2.78	-0.35962147	3.92	4.93
WLAN6GHz	802.11ax-HE160 MCS0	Front	10mm	Aux	15	6025	13.30	0.25	3.02		2.66	2.79
WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	207	6985	12.70	0.0625	2.91	-0.96013636	3.68	3.99
WLAN6GHz	802.11ax-HE160 MCS0	Front	8.59mm	Aux	207	6985	12.40	0.25	3.63		2.46	2.53

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Grid Step (λ)	Scaling Factor for Measurement Uncertainty	Power Drift (dB)	Normal psPD (W/m ²)	Scaled Normal psPD (W/m ²)	Total psPD (W/m ²)	Scaled Total psPD (W/m ²)
01	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	15	6025	13.30	13.50	1.047	97.30	1.028	0.0625	1.5535	-0.06	3.6	6.02	4.85	8.11
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	47	6185	13.30	13.50	1.047	97.30	1.028	0.0625	1.5535	-0.01	4.46	7.46	5.58	9.33
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	111	6505	13.40	13.50	1.023	97.30	1.028	0.0625	1.5535	-0.06	4.49	7.34	4.92	8.04
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	175	6825	12.70	12.75	1.012	97.30	1.028	0.0625	1.5535	0.13	3.27	5.28	3.68	5.95
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Main	207	6985	12.40	12.75	1.084	97.30	1.028	0.0625	1.5535	0.11	2.79	4.83	3.07	5.31
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Main	15	6025	13.30	13.50	1.047	97.30	1.028	0.0625	1.5535	-0.04	0.193	0.32	0.2	0.33
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Main	47	6185	13.30	13.50	1.047	97.30	1.028	0.0625	1.5535	0.07	0.121	0.20	0.132	0.22
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Main	111	6505	13.40	13.50	1.023	97.30	1.028	0.0625	1.5535	-0.19	0.536	0.88	0.552	0.90
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Main	175	6825	12.70	12.75	1.012	97.30	1.028	0.0625	1.5535	-0.07	0.269	0.43	0.287	0.46
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Main	207	6985	12.40	12.75	1.084	97.30	1.028	0.0625	1.5535	-0.18	0.248	0.43	0.296	0.51
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	15	6025	12.60	13.00	1.096	97.30	1.028	0.0625	1.5535	0.02	3.92	6.86	4.93	8.63
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	47	6185	12.40	13.00	1.148	97.30	1.028	0.0625	1.5535	0.03	3.41	6.25	3.83	7.02
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	111	6505	12.70	13.00	1.072	97.30	1.028	0.0625	1.5535	-0.16	4.03	6.90	4.46	7.63
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	175	6825	12.50	12.75	1.059	97.30	1.028	0.0625	1.5535	-0.06	4.27	7.22	4.64	7.85
	WLAN6GHz	802.11ax-HE160 MCS0	Front	5mm	Aux	207	6985	12.70	12.75	1.012	97.30	1.028	0.0625	1.5535	-0.13	3.68	5.95	3.99	6.45
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Aux	15	6025	12.60	13.00	1.096	97.30	1.028	0.0625	1.5535	-0.05	0.327	0.57	0.337	0.59
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Aux	47	6185	12.40	13.00	1.148	97.30	1.028	0.0625	1.5535	0.18	0.387	0.71	0.42	0.77
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Aux	111	6505	12.70	13.00	1.072	97.30	1.028	0.0625	1.5535	-0.16	0.268	0.46	0.29	0.50
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Aux	175	6825	12.50	12.75	1.059	97.30	1.028	0.0625	1.5535	-0.07	0.348	0.59	0.379	0.64
	WLAN6GHz	802.11ax-HE160 MCS0	Back	5mm	Aux	207	6985	12.70	12.75	1.012	97.30	1.028	0.0625	1.5535	-0.01	0.42	0.68	0.45	0.73

12. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Body
Non-CDB		
1.	WLAN2.4GHz Main Ant + WLAN2.4GHz Aux Ant	Yes
2.	WLAN2.4GHz Main Ant + Bluetooth Aux Ant	Yes
3.	WLAN 5GHz Main Ant +WLAN 5GHz Aux Ant + Bluetooth Aux Ant	Yes
4.	WLAN 6GHz Main Ant + WLAN 6GHz Aux Ant+ Bluetooth Aux Ant	Yes
CDB		
5.	WLAN2.4GHz Main Ant + WLAN 5GHz Main Ant + Bluetooth Aux Ant	Yes
6.	WLAN2.4GHz Main Ant + WLAN 5GHz Aux Ant + Bluetooth Aux Ant	Yes
7.	WLAN2.4GHz Main Ant + WLAN2.4GHz Aux Ant + WLAN 5GHz Main Ant + WLAN 5GHz Aux Ant	Yes
8.	WLAN2.4GHz Main Ant + WLAN 6GHz Main Ant + Bluetooth Aux Ant	Yes
9.	WLAN2.4GHz Main Ant + WLAN 6GHz Aux Ant + Bluetooth Aux Ant	Yes
10.	WLAN2.4GHz Main Ant + WLAN2.4GHz Aux Ant + WLAN 6GHz Main Ant + WLAN 6GHz Aux Ant	Yes

General Note:

1. The 2.4GHz and 5GHz Sim-Tx analysis was include in the Sporton report no.: FA251034A.
2. The worst case WLAN reported SAR for each configuration was used for SAR summation. Therefore, the following summations represent the absolute worst cases for simultaneous transmission with WLAN.
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - i) Scalar SAR summation < 1.6W/kg.
 - ii) $SPLSR = (SAR1 + SAR2)^{1.5} / (\min. \text{ separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$, where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - iii) If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

12.1 Body Exposure Conditions

<Non-CDB>

1	2	3	4	5	1+2 Summed 1g SAR (W/kg)	1+5 Summed 1g SAR (W/kg)	3+4+5 Summed 1g SAR (W/kg)
Maximum WLAN2.4GHz Main Ant	Maximum WLAN2.4GHz Aux Ant	Maximum WLAN6GHz Main Ant	Maximum WLAN6GHz Aux Ant	Maximum Bluetooth Aux Ant			
1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
0.563	0.514	0.629	0.550	0.180	1.077	0.743	1.359

<CDB>

1	2	3	4	5	1+3+5 Summed 1g SAR (W/kg)	1+4+5 Summed 1g SAR (W/kg)	1+2+3+4 Summed 1g SAR (W/kg)
Maximum WLAN2.4GHz Main Ant	Maximum WLAN2.4GHz Aux Ant	Maximum WLAN6GHz Main Ant	Maximum WLAN6GHz Aux Ant	Maximum Bluetooth Aux Ant			
1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)			
0.312	0.264	0.324	0.376	0.180	0.816	0.868	1.276

Test Engineer : Jimmy Lu, Dennis Hsieh, Rain Chiu, Mood Huang and Bob Cheng

13. Uncertainty Assessment

Declaration of Conformity:

The test results with all measurement uncertainty excluded is presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture’s specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/k ^(b)	1/√3	1/√6	1/√2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

The judgment of conformity in the report is based on the measurement results excluding the measurement uncertainty.



Applicable for SAR Measurements:

Uncertainty Budget (4 MHz - 10 GHz range)							
Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	18.60	N	2	1	1	9.3	9.3
Axial Isotropy	4.70	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.60	R	1.732	0.7	0.7	3.9	3.9
Linearity	4.70	R	1.732	1	1	2.7	2.7
Modulation Response	4.68	R	1.732	1	1	2.7	2.7
System Detection Limits	1.00	R	1.732	1	1	0.6	0.6
Boundary Effects	2.00	R	1.732	1	1	1.2	1.2
Readout Electronics	0.30	N	1	1	1	0.3	0.3
Response Time	0.00	R	1.732	1	1	0.0	0.0
Integration Time	2.60	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.00	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.00	R	1.732	1	1	1.7	1.7
Probe Positioner	0.40	R	1.732	1	1	0.2	0.2
Probe Positioning	6.70	R	1.732	1	1	3.9	3.9
Post-processing	4.00	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Holder	3.60	N	1	1	1	3.6	3.6
Test sample Positioning	3.03	N	1	1	1	3.0	3.0
Power Scaling	0.00	R	1.732	1	1	0.0	0.0
Power Drift	5.00	R	1.732	1	1	2.9	2.9
Phantom and Setup							
Phantom Uncertainty	7.60	R	1.732	1	1	4.4	4.4
SAR correction	0.00	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.03	N	1	0.78	0.77	0.0	0.0
Liquid Conductivity (target)	5.00	R	1.732	0.78	0.77	2.3	2.2
Liquid Conductivity (mea.)	2.50	R	1.732	0.78	0.77	1.1	1.1
Temp. unc. - Conductivity	3.68	R	1.732	0.78	0.77	1.7	1.6
Liquid Permittivity Repeatability	0.02	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.00	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.50	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.84	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						14.5%	14.2%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						29.0%	28.4%



Applicable for Power Density Measurements according to Dasy System Handbook :

Uncertainty Budget for PD (avg $\geq 1 \text{ cm}^2$) Evaluation Distances to the Antennas $\geq \lambda/5$					
Error Description	Uncertainty Value (\pm dB)	Probability	Divisor	(Ci)	Standard Uncertainty (\pm dB)
Probe Calibration	0.49	N	1	1	0.49
Probe correction	0.00	R	1.732	1	0.00
Frequency response (BW ≤ 1 GHz)	0.20	R	1.732	1	0.12
Sensor cross coupling	0.00	R	1.732	1	0.00
Isotropy	0.50	R	1.732	1	0.29
Linearity	0.20	R	1.732	1	0.12
Probe scattering	0.00	R	1.732	1	0.00
Probe positioning offset	0.30	R	1.732	1	0.17
Probe positioning repeatability	0.04	R	1.732	1	0.02
Sensor mechanical offset	0.00	R	1.732	1	0.00
Probe spatial resolution	0.00	R	1.732	1	0.00
Field impedance dependence	0.00	R	1.732	1	0.00
Amplitude and phase drift	0.00	R	1.732	1	0.00
Amplitude and phase noise	0.04	R	1.732	1	0.02
Measurement area truncation	0.00	R	1.732	1	0.00
Data acquisition	0.03	N	1	1	0.03
Sampling	0.00	R	1.732	1	0.00
Field reconstruction	2.00	R	1.732	1	1.15
Forward transformation	0.00	R	1.732	1	0.00
Power density scaling	0.00	R	1.732	1	0.00
Spatial averaging	0.10	R	1.732	1	0.06
System detection limit	0.04	R	1.732	1	0.02
Uncertainty terms dependent on the DUT and environmental factors					
Probe coupling with DUT	0.00	R	1.732	1	0.0
Modulation response	0.40	R	1.732	1	0.2
Integration time	0.00	R	1.732	1	0.0
Response time	0.00	R	1.732	1	0.0
Device holder influence	0.10	R	1.732	1	0.1
DUT alignment	0.00	R	1.732	1	0.0
RF ambient conditions	0.04	R	1.732	1	0.0
Ambient reflections	0.04	R	1.732	1	0.0
Immunity / secondary reception	0.00	R	1.732	1	0.0
Drift of the DUT		R	1.732	1	
Combined Std. Uncertainty					1.34
Expanded STD Uncertainty (95%)					2.68



14. References

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- [6] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015
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- [15] Dasy user manual