REPORT No.: SZ21070092S01

RF EXPOSURE
EVALUATION REPORT

APPLICANT	:	Lenovo (Shanghai) Electronics Technology Co., Ltd.
PRODUCT NAME	:	Intel WiFi 6E AX210 Module
MODEL NAME	:	AX210NGW
BRAND NAME	:	N/A
FCC ID	:	O57AX210NGW
STANDARD(S)	:	FCC 47 CFR Part 2(2.1093)
RECEIPT DATE	:	2021-07-20
TEST DATE	:	2021-07-25 to 2021-08-15
ISSUE DATE	:	2021-09-10

Edited by : Liang Yumei (Rapporteur)

Approved by: Shen Junsheng (Supervisor)

DIRECTORY

Annex D Plots of Power Density Measurement
Annex E DASY Calibration Certificate
Annex F Maximum Target Conducted Power

Changed History		
Version	**Date**	**Reason for Change**
1.0	2021-09-10	First edition

1. Power Density Summary

The maximum results of power density found during test as bellows:

<Highest Reported Power Density>

Frequency Band	Standalone Transmission	
	PD Value over 4cm^2 (mW/cm^2)	Limit (FCC Part 1.310) (mW/cm^2)
Wi-Fi 6E	0.71	1.0

Highest Simultaneous Transmission with Multiple transmitters	Total Exposure Radio
SAR & Power Density	0.52

Note:

1. This device is in compliance with power density for general population or uncontrolled exposure limits (1.0 mW/cm^2 specified in FCC 47 CFR Part 1.310), and has been tested in accordance with the measurement methods and procedures specified in TCBC workshop notes and IEC TR 63170.
2. When the test result is a critical value, we will use the measurement uncertainty give the judgment result based on the 95% risk level.

2. Technical Information

Note: Provide by applicant.

2.1. Applicant and Manufacturer Information

Applicant:	Lenovo (Shanghai) Electronics Technology Co., Ltd.
Applicant Address:	Section 304-305, Building No. 4, # 222, Meiyue Road, China (Shanghai) Pilot Free Trade Zone, 200131, CHINA
Manufacturer:	Lenovo PC HK Limited
Manufacturer Address:	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong, P.R.China

2.2. Equipment under Test (EUT) Description

Product Name:		Intel WiFi 6E AX210 Module
Device ID:		BB8BD01D-0DD2-4A8E-B586-BACAF4A3235F
Host	**Product Name:**	Notebook Computer
	Mode Name:	IdeaPad Slim 7 Carbon 14ACN6
	Brand Name:	Lenovo
Hardware Version:		N/A
Software Version:		N/A
Frequency Bands:		WLAN: 5925 MHz ~ 6425 MHz 6425 MHz ~ 6525 MHz 6525 MHz ~ 6875 MHz 6875 MHz ~ 7125 MHz
Modulation Mode:		802.11a/n/ac: OFDM 802.11ax: OFDMA

Note: For a more detailed description, please refer to specification or user manual supplied by the applicant and/or manufacturer.

2.3. Environment of Test Site/Conditions

Normal Temperature (NT):	20-25 °C
Relative Humidity:	30-75 %
Air Pressure:	980-1020 hPa

Test Frequency:	WLAN: 5925 MHz ~ 6425 MHz 6425 MHz ~ 6525 MHz 6525 MHz ~ 6875 MHz 6875 MHz ~ 7125 MHz
Operation Mode:	Call established
Power Level:	See the power list

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the Factory. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.
The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 35 dB.

3. RF Exposure Limits

3.1. 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.

Limits for Maximum Permissible Exposure (MPE)

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/f2)	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/f2)	30
30-300	27.5	0.073	0.2	30
300-1500			f/1500	30
1500-100,000			1.0	30

3.2. 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.

4. Applied Reference Documents

Leading reference documents for testing:

Identity	Document Title	Method Determination /Remark
FCC 47 CFR Part 2(2.1093)	Radio Frequency Radiation Exposure Evaluation: Portable Devices	No deviation
KDB 447498 D01v06	General RF Exposure Guidance	No deviation
KDB 248227 D01v02r02	SAR Guidance for IEEE 802 (Wi-Fi) Transmitters	No deviation
KDB 865664 D02v01r02	RF Exposure Reporting	No deviation
KDB 616217 D04v01r02	SAR Evaluation Consideration for Laptop, Notebook, Netbook, and Tablet Computers	No deviation
KDB 648474 D04v01r03	SAR Evaluation Consideration for Wireless Handset	No deviation
IEC TR 63170:2018	Measurement procedure for the evaluation of power density related to human exposure to radio frequency fields from wireless communication devices operating between 6 GHz and 100 GHz	No deviation

Note 1: The test item is not applicable.
Note 2: Additions to, deviation, or exclusions from the method shall be judged in the "method determination" column of add, deviate or exclude from the specific method shall be explained in the "Remark" of the above table.

5. Power Density Measurement System

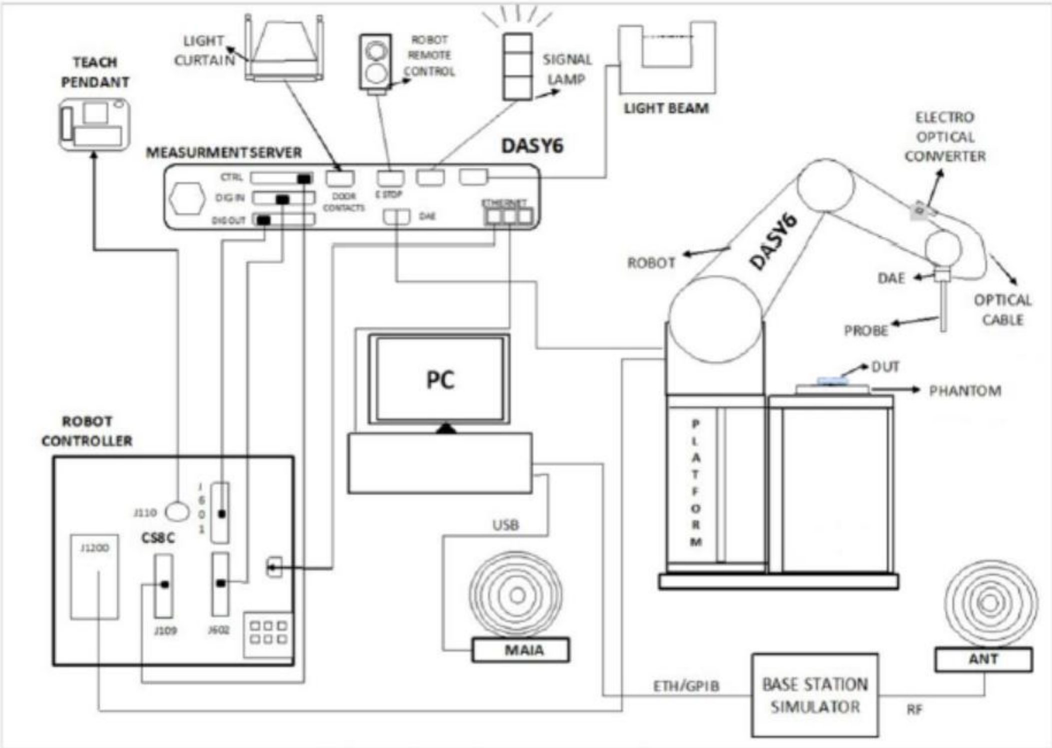


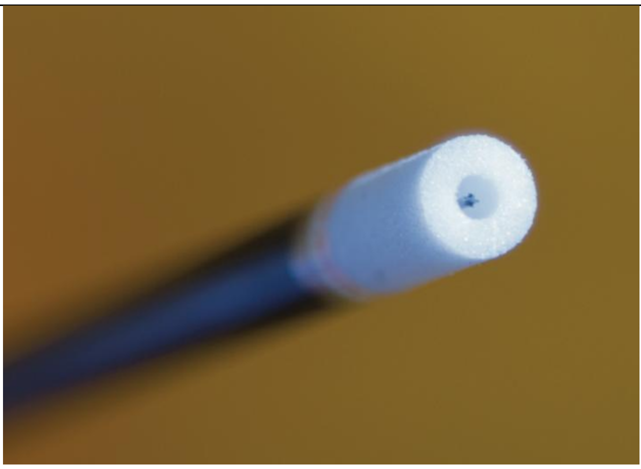
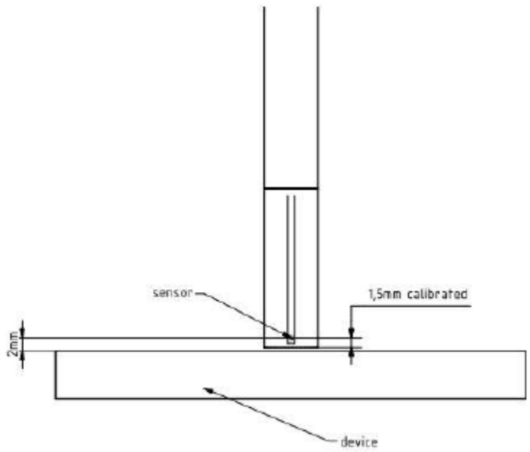
Fig 5.1 SPEAG DASY System Configurations

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software.
- A data acquisition electronic (DAE) attached to the robot arm extension.
- A dosimetric probe equipped with an optical surface detector system.
- The electro-optical converter (ECO) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning.
- A computer operating Windows XP.
- DASY software.
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom.
- A device holder.
- Tissue simulating liquid.
- Dipole for evaluating the proper functioning of the system.
- Some of the components are described in details in the following sub-sections.

5.1. EUmmWave Probe

The probe designed allows measurement at distances as small as 2mm from the sensor to the surface of EUT. The typical senor to the tip of probe is 1.5mm.

Frequency	750 MHz ~110 GHz
Probe Overall Length	320 mm
Probe Body Diameter	8.0 mm
Tip Length	23.0 mm
Tip Diameter	8.0 mm
Two dipoles' Length of Probe	0.9 mm – Diode located
Dynamic Range	＜20 V/m – 10000 V/m with PRE-10 (min ＜50 V/m – 3000 V/m)
Linearity	＜0.2 dB
Position Precision	＜0.2 mm
Distance between Diode Sensors and Probe's tip	1.5 mm
Minimum Mechanical Separation between Probe Tip and a Surface	0.5 mm
Applications	E-field measurement of mm-Wave transmitters operating above 10 GHz in ＜ 2mm distance from device (free-space) power density H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY 6 + 5G Module SW1.0 and higher
 Fig 5.2 Photo of EUmmWave Probe	

5.2. 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 fast16 bit AD-converter and a command decoder and control logic unit. 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 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

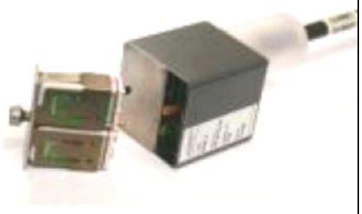


Fig 5.3 Photo of DAE

5.3. Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

High precision (repeatability ±0.035 mm)

High reliability (industrial design)

Jerk-free straight movements

Low ELF interference (the closed metallic construction shields against motor control fields)

Fig 5.4 Photo of DASY6

5.4. Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chip disk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

5.5. Data Storage and Evaluation

➢ **Data Storage**

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

➢ **Data Evaluation**

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

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

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

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

The formula for each channel can be given as:

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

With Vi = compensated signal of channel i, (i = x, y, z)
Ui = input signal of channel i, (i = x, y, z)
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

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

E-field Probes: $E_i = \sqrt{\frac{V_i}{Norm_i \times ConvF}}$

H-field Probes: $H_i = \sqrt{V_i} \times \frac{a_{i0} + a_{i1} + a_{i2} f^2}{f}$

With V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), $\mu V/(V/m)^2$ forE-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

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

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

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

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

with SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5.6. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	DOSIMETRIC ASSESSMENT SYSTEM	cDASY6 mmWave	V2.4.2.62	NA	NA
SPEAG	5G Verification Source	10GHz	1019	2020.11.03	2021.11.02
SPEAG	EUmmWave Probe	EUmmMV4	9512	2020.11.02	2021.11.01
SPEAG	Data Acquisition Electronics	DAE4	1643	2020.11.30	2021.11.29
Agilent	MAX Signal Analyzer	N9020A	MY52091436	2021.03.25	2022.03.24
mini-circuits	Amplifier	ZVE-8G+	754401735	NA	NA
Agilent	Signal Generator	N5182B	MY53050509	2021.03.25	2022.03.24
Agilent	Power Senor	N8482A	MY41091706	2020.11.19	2021.11.18
Agilent	Power Meter	E4416A	MY45102093	2020.11.19	2021.11.18
Anritsu	Power Sensor	MA2411B	N/A	2020.11.19	2021.11.18
R&S	Power Meter	NRVD	101066	2020.11.19	2021.11.18
Agilent	Dual Directional Coupler	778D	50422	NA	NA
MCL	Attenuation	351-218-010	N/A	NA	NA
KTJ	Thermo meter	TA298	N/A	2021.01.15	2022.01.14

Note:

The calibration certificate of DASY can be referred to annex E of this report.

6. System Verification Source

The system verification sources at 30GHz and above comprise born-antennas and very stable signal generators.

Model	Ka-band born antenna
Calibrated Frequency	30GHz and above at 10mm from the case surface
Frequency Accuracy	±100 MHz
E-field Polarization	Linear
Harmonics	-20dBc
Total Radio Power	14dBm
Power Stability	0.05 dB
Power Consumption	5W
Size	100 x 100 x 100 mm
Weight	1 kg

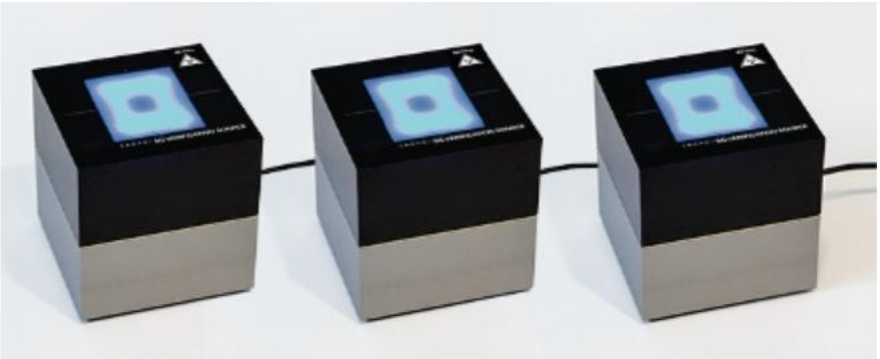


Fig 6.1 Photos of Verification Sources

7. Power Density System Verification

➢ **General description**

The EUT is replaced by a calibrated source, the same spatial resolution, measurement region and test separation used in the calibration was applied to system check. Through visual inspection into the measured power density distribution, both the spatially (shape) and numerically (level) have no noticeable difference. The measurement results should be within ±10% of the calibrated targets.

Frequency [GHz]	Grid step	Grid extent X/Y [mm]	Measurement points
10	0.25 $(\frac{\lambda}{4})$	120/120	16 × 16
30	0.25 $(\frac{\lambda}{4})$	60/60	24 × 24
60	0.25 $(\frac{\lambda}{4})$	32.5/32.5	26 × 26
90	0.25 $(\frac{\lambda}{4})$	30/30	36 × 36

Setting for measurement of verification sources

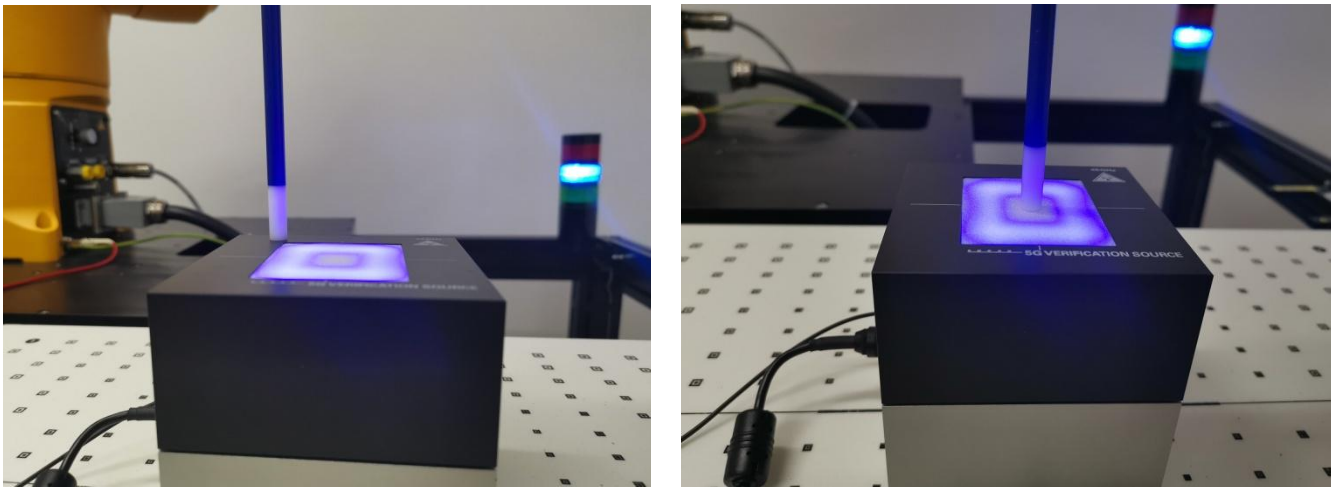


Fig 7.1 Photos of Verification Setup

➢ **Validation Results**

After system check testing, the results of power density will be compared with the reference value derived from the certificate report. The deviation of system check should be within ±10%.

<Validation Setup>

Frequency (GHz)	5G Verification Source	Probe S/N	DAE S/N
10	10GHz-SN 1019	9512	1643

<Validation Results>

Date	Frequency (GHz)	Test Ditance (mm)	Measured 4cm² (W/m²)	Targeted 4cm² (W/m²)	Deviation (%)
2021.07.25	10	5.5	43.8	44.50	-1.57

Note: System checks the specific test data please see Annex C.

8. Conducted Power List

- **Duty Cycle**

Test Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle
802.11ax160	4.4950	4.5920	97.89%

- **Conducted Power of Wi-Fi 6E**

Remark: The conducted power of Wi-Fi 6E was recorded in annex F.

9. Antenna Location

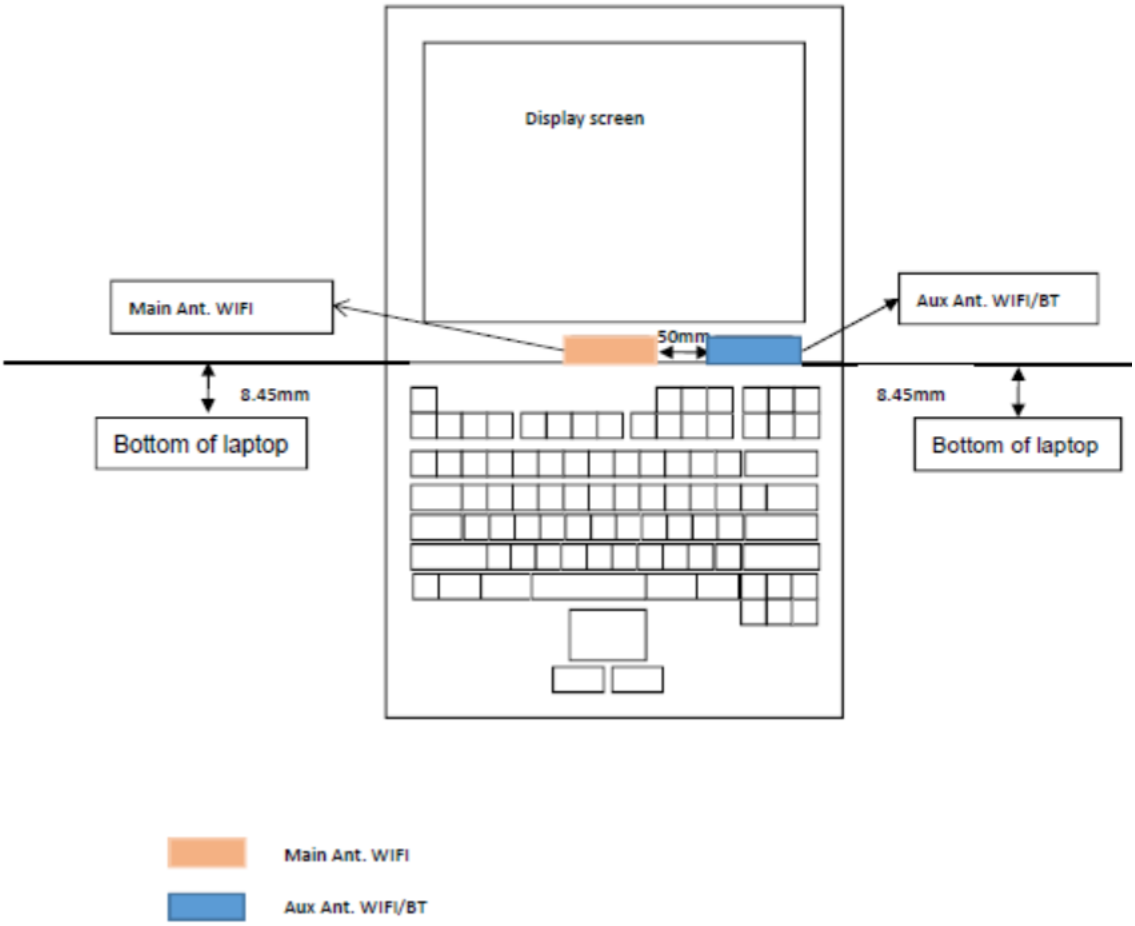


Fig.9.1 EUT Antenna Locations

10. Power Density Measurement Procedure

- **Computation of the Electric Field Polarization Ellipse**

For the numerical description of an arbitrarily oriented ellipse in three-dimensional space, five parameters are needed: the semi-major axis (a), the semi-minor axis (b), two angles describing the orientation of the normal vector of the ellipse (ϕ ,θ), and one angle describing the tilt of the semi-major axis (Ψ). For the two extreme cases, i.e. circular and linear polarizations, three parameters only (a, ϕ and θ) are sufficient for the description of the incident field.

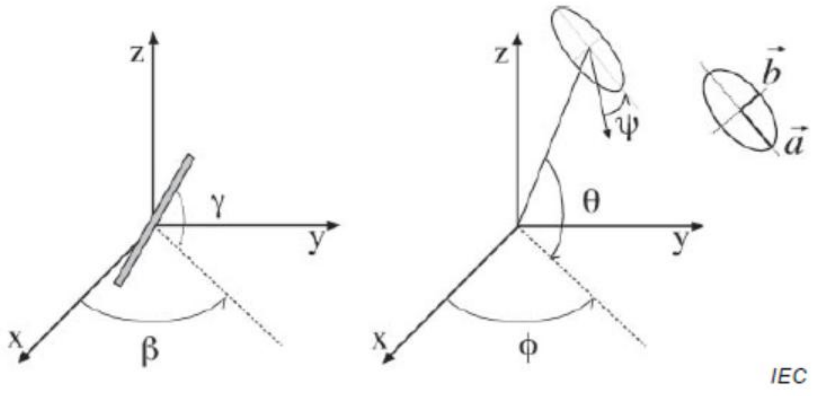


Fig 10.1 Illustration of the angles used for the numerical description of the sensor and the orientation of an ellipse in 3-D space

For the construction of the ellipse parameters from measured data, the problem can be reformulated as a nonlinear search problem. The semi-major and semi-minor axes of an elliptical field can be express as functions of the three angles (ϕ , θ and Ψ). The parameters can be uniquely determined towards minimizing the error based on least-squares for the given set of angles and the measured data. In this way, the numbers of three parameters is reduced from five to three, which means that least three sensors readings are necessary to gain sufficient information for the reconstruction of ellipse parameters. However, to suppress the noise and increase the reconstruction accuracy, it is desirable to have an over determined system of equations. The solution to use a probe consisting of two sensors angled by γ_1 and γ_2 toward the probe axis and to perform measurements at three angular positions of the probe, i.e. at β_1, β_2 and β_3, results in over determination of two. If there is a need for more information or increased accuracy, more rotation angles can be added.

The reconstruction of ellipse parameters can be separated into linear and non-linear parts that are best solved by the givens algorithm combined with a downhill simplex algorithm. To minimize the mutual coupling, sensor angles are set with a 90° shift (γ_1= γ_2+90°), and, to simplify, the first rotation angle of the probe (β_1) can be set to 0°.

- **Total Field and Power Flux Density Reconstruction**

Computation of the power density in general requires knowledge of the electric and magnetic field amplitudes and phases in the plane of incidence. Reconstruction of these quantities from pseudo-vector E-field measurements is feasible, as they are constrained by Maxiwell's equations. The SPEAG have developed a reconstruction approach based on the Gerchberg-Saxton algorithm, which benefits from the availability of the E-Field polarization ellipse information obtained with the EUmmWV2 probe. This reconstruction algorithm, together with the ability of the probe to measure extremely close to the source without perturbing the field, permits reconstruction of the E-field and H-field, as well as of the power density, on measurement planes located as near as λ /5 away.

- **Power Flux Density Averaging**

The average of the reconstructed power density is evaluated over a circular area in each measurement plane. The area of the circle is defined by the user; the default is $1cm^2$. The computed peak average value is displayed in the box at the top right. Note that the average is evaluated only for grid points where the averaging circle is completely filed with values; for points at the edge where the averaging circle is only partly filled with values, the average power density is set to zero. Two average power density values are computed.

- **Measurement Workflow: Incident Power Density Measurements with cDASY6 Module mmWave**

The incident power density must be measured for the test configuration producing the highest SAR value. The measurement procedure is summarized below:

1. Perform a system performance check at 10 GHz.
2. Determine the optimal grid resolution to be used for subsequent measurements.
3. Assess the incident power for the configuration to be tested.
4. Calculate the additional reconstruction uncertainty at 2mm and compute the total measurement uncertainty.
5. Adjust the incident psPD results by the amount that the measurement uncertainty exceeds 30%.

11. Test Results of Power Density

➢ **General Note**

1. The reported PD is the measured Total PD 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 PD testing of WLAN signal with non-100% duty cycle, the measured PD is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)".
   c. For WLAN: Reported PD(W/m^2)= Measured Total PD(W/m^2)* Duty Cycle scaling factor * Tune-up scaling factor.
2. The most conservative test distance of 2mm was applied to PD measurement.
3. The Reported PD should be calculated together with the duty cycle scaling factor of 1.022.
4. For WLAN MIMO, only the worst condition of the standalone antenna would be tested in this report.
5. According to the manufacturer that summation for different antenna modules and exposure planes, the worst case would be selected for power density measurement.
6. According to TCBC workshop in October 2018 that $4cm^2$ averaging area may now be considered.

➢ **Test Results**

Plot No.	Band	Mode	RF Exposure Position	Ant.	Ch.	Ave. Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	PD over $4cm^2$ (W/m^2)	
									Mea. Total	Rep.
	U-NII-5	802.11ax-HE160	Bottom Surface	MAIN	15	12.87	13	1.030	1.28	1.35
	U-NII-5	802.11ax-HE160	Bottom Surface	MAIN	47	12.62	13	1.091	2.40	2.68
1#	U-NII-5	802.11ax-HE160	Bottom Surface	MAIN	79	12.89	13	1.026	3.22	3.38
2#	U-NII-5	802.11ax-HE160	Bottom Surface	AUX	15	12.55	13	1.109	4.69	5.32
	U-NII-5	802.11ax-HE160	Bottom Surface	AUX	47	12.55	13	1.109	4.56	5.12
	U-NII-5	802.11ax-HE160	Bottom Surface	AUX	79	12.59	13	1.099	4.68	5.16
	U-NII-5	802.11ax-HE160	Bottom Surface	MIMO	15	12.75	13	1.059	2.82	3.05
	U-NII-6	802.11ax-HE160	Bottom Surface	MAIN	111	12.74	13	1.062	2.57	2.79
	U-NII-6	802.11ax-HE160	Bottom Surface	AUX	111	12.53	13	1.114	4.55	5.18
	U-NII-7	802.11ax-HE160	Bottom Surface	MAIN	143	12.2	12.25	1.012	2.511	2.60
	U-NII-7	802.11ax-HE160	Bottom Surface	MAIN	175	12.39	12.5	1.026	2.55	2.67
	U-NII-7	802.11ax-HE160	Bottom Surface	AUX	143	11.76	12.25	1.119	4.56	5.22
	U-NII-7	802.11ax-HE160	Bottom Surface	AUX	175	12.4	12.5	1.023	3.52	3.68
	U-NII-8	802.11ax-HE160	Bottom Surface	MAIN	207	12.48	12.5	1.005	2.57	2.64
	U-NII-8	802.11ax-HE160	Bottom Surface	AUX	207	12.38	12.5	1.028	2.36	2.48

- **Incident Power Density**

Antenna	Test Distance	Measured PD over 4cm² (W/m²)	iPDn over 4cm² (W/m²)
MAIN ANT	<2mm	3.22	31.8
AUX ANT	<2mm	4.69	45.5

- **Final PD Value**

1. According to TCBC workshop in April 2021 that In addition to tune-up tolerance scaling, adjust measured results per amount that measurement uncertainty exceeds 30% (e.g. per methods of IEC 62479:2010).
2. The REC (field reconstruction) component of the uncertainty budget for a given E-field input given in the DASY8 manual is valid only for d ≥λ /5. The reconstruction uncertainty has been revised, and can be evaluated with:

$$REC = \begin{cases} 2.35 - 8.75d/\lambda & for\, d = 0.04...0.2\lambda \\ 0.6 & for\, d \geq \lambda/5 \end{cases}$$

For the HSA-10G measured at 2mm that was used as example above, the reconstruction uncertainty is: 0.6dB. The total measurement uncertainty can be calculated with the new REC component using Chapter 6.2 of the DASY8 manual.

3. The worst RF exposure should be determined by accounting for the expanded uncertainty of 2.12dB of this measurement system, which is converted to percentage as 63%.
4. RF exposure compliance with PD is demonstrated for various radio configurations using below equation:

   *Final PD=Rep. PD (adjusted to tune-up factor and duty cycle factor)*Uncertainty Factor*

   Where Uncertainty factor=1 + (actual expanded uncertainty – 30%)

- **Results of PD Value**

Wireless Band	Reported Power Density (W/m²)		Final PD Value	
	MAIN ANT	AUX ANT	MAIN ANT	AUX ANT
U-NII-5	3.38	5.32	4.50	7.08
U-NII-6	2.79	5.18	3.71	6.89
U-NII-7	2.67	5.22	3.55	6.94
U-NII-8	2.64	2.48	3.51	3.30

Note: Final PD Value=Rep. PD*1.33.

12. Simultaneous Transmission Assessment

➢ **Simultaneous Transmission Consideration**

No.	Transmit Configurations	Body Exposure Condition
1	Wi-Fi 6E_MAIN ANT + AUX ANT	Yes
2	Wi-Fi 6E_MIMO + Bluetooth AUX ANT	Yes

➢ **Total Exposure Radio Analysis**

The fields generated by the antennas can be correlated or uncorrelated. At different frequencies, fields are always uncorrelated, and the aggregate power density contributions can be summed according to spatially averaged values of corresponding sources at any point in space, r, to determine the total exposure ratio (TER). Assuming I sources, the TER at each point in space is equal to

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \sum_{i=1}^{I} \mathrm{ER}_i = \sum_{i=1}^{I} \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

Where $S_{av,i}$ is the power density for the source I operating at a frequency f_i and S_{lim} is the power density limit as specified by the relevant standard.

Exposure from transmitters operating above and below 6GHz, where 6GHz denotes the transmission frequency where the basic restrictions change from being defined in terms of SAR to being defined in terms of power density, therefore uncorrelated and the TER is determined as

$$\mathrm{TER}^{\mathrm{uncorr}}(\mathrm{r}) = \sum_{i=1}^{I} \mathrm{ER}_i = \sum_{i=1}^{I} \frac{S_{av,i}(r, f_i)}{S_{lim}(f_i)}$$

According to the FCC guidance in TCBC workshop and IEC TR 63170, the total exposure ratio calculated by taking ratio of maximum reported SAR divided by SAR limit and adding it to maximum measured power density by its limit. Numerical sum of the ratios should be less or equal to 1. Therefore the simultaneous transmission should be follows:

$$TER = \sum_{n=1}^{N} \frac{\mathrm{SAR}_n}{\mathrm{SAR}_{n,limit}} + \sum_{n=1}^{N} \frac{S_{m,avg}}{S_{m,limit}} < 1$$

➢ Total Exposure Ratio

Exposure Position		Power Density (W/m^2)	Reported SAR (W/kg)	Total Exposure Ratio
		Wi-Fi 6E(MAIN ANT)	**Bluetooth(AUX ANT)**	
Body	Reported Exposure	4.50	0.116	0.52
	Ratio to Limit	10	1.6	

Note:

1. The maximum SAR of Bluetooth refers to the normal SAR report BL-SZ2170133-701.
2. The simultaneous transmission analysis of PD results based on the final PD value.

13. Uncertainty Assessment

The budget is valid for evaluation distance ＞λ /2π. For specific tests and configurations, the uncertainty can be considered smaller.

Error Description	Uncertainty (±dB)	Probability Distribution	Divisor	*ci*	Standard Uncertainty (±dB)	ν_i or ν_{eff}
Uncertainty terms dependent on the measurement system						
Probe calibration	0.49	N	1	1	0.49	∞
Probe correction	0	R	1.732	1	0	∞
Frequency response	0.20	R	1.732	1	0.12	∞
Sensor cross coupling	0	R	1.732	1	0	∞
Isotropy	0.50	R	1.732	1	0.29	∞
Linearity	0.20	R	1.732	1	0.12	∞
Probe scattering	0	R	1.732	1	0	∞
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	R	1.732	1	0	∞
Probe spatial resolution	0	R	1.732	1	0	∞
Field impedance dependance	0	R	1.732	1	0	∞
Amplitude and phase drift	0	R	1.732	1	0	∞
Amplitude and phase noise	0.04	R	1.732	1	0.02	∞
Measurement area truncation	0	R	1.732	1	0	∞
Data acquisition	0.03	R	1.732	1	0.03	∞
Sampling	0	R	1.732	1	0	∞
Field reconstruction	0.60	R	1.732	1	0.35	∞
Forward transformation	0	R	1.732	1	0	∞
Power density scaling	-	R	1.732	1	-	∞
Spatial averaging	0.10	R	1.732	1	0.06	∞
System Detection Limits	0.04	R	1.732	1	0.02	∞
Uncertainty terms dependent on the DUT and environmental factors						
Probe coupling with DUT	0	R	1.732	1	0	∞
Modulation response	0.40	R	1.732	1	0.23	∞
Integration time	0	R	1.732	1	0	∞
Response time	0	R	1.732	1	0	∞
Device holder influence	0.10	R	1.732	1	0.06	∞
DUT alignment	0	R	1.732	1	0	∞
RF ambient	0.04	R	1.732	1	0.02	∞
Ambient reflections	0.04	R	1.732	1	0.02	∞
Immunity / secondary reception	0	R	1.732	1	0	∞
Drift of the DUT	-	R	1.732	1	-	∞
Combined standard uncertainty					0.76 dB	∞
Coverage Factor for 95%					K=2	N/A
Expanded standard uncertainty					1.52 dB	

Annex A General Information

1. Identification of the Responsible Testing Laboratory

Laboratory Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Laboratory Address:	FL.1-3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China
Telephone:	+86 755 36698555
Facsimile:	+86 755 36698525

2. Identification of the Responsible Testing Location

Name:	Shenzhen Morlab Communications Technology Co., Ltd.
Address:	FL.3, Building A, FeiYang Science Park, No.8 LongChang Road, Block 67, BaoAn District, ShenZhen, GuangDong Province, P. R. China

3. Facilities and Accreditations

The FCC designation number is CN1192, the test firm registration number is 226174.

Note：

The main report is end here and the other Annex (B,C,D,E,F) will be submitted separately.

****** END OF REPORT ******