TEST REPORT

Applicant:	Realtek Semiconductor Corp.
Address:	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan
Equipment Type:	11ax RTL8852CE Combo module
Model Name:	RTL8852CE
Brand Name:	N/A
FCC ID:	TX2-RTL8852CE
Test Standard:	FCC 47 CFR Part 2.1093 (refer section 3.1)
Maximum PD:	5.49 W/m^2
Sample Arrival Date:	Dec. 09, 2022
Test Date:	Jan. 20, 2023
Date of Issue:	Jan. 30, 2023

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Zhang Jiwei

Zhang Jiwei

Checked by: Xu Rui

Xu Rui

Approved by: Tolan Tu (Testing Director)

Tolan Tu

Revision History

Version	Issue Date	Revisions Content
Rev. 01	Jan. 30, 2023	Initial Issue

TABLE OF CONTENTS

1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

1.3 Test Environment Condition

Ambient Temperature	18℃ to 25℃
Ambient Relative Humidity	30% to 70%

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Realtek Semiconductor Corp.
Address	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

2.2 Manufacturer Information

Manufacturer	Realtek Semiconductor Corp.
Address	No. 2, Innovation Road II, Hsinchu Science Park, Hsinchu 300, Taiwan

2.3 General Description for Equipment under Test (EUT)

EUT Name	11ax RTL8852CE Combo module
Model Name Under Test	RTL8852CE
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.3.1 Host Information:

Product Name	Notebook Computer
Model Name	Lenovo Slim Pro 7 14ARP8
Brand Name	Lenovo

2.3.2 Antenna Information:

Antenna Port	Model Name	Antenna Manufacturer	Antenna Type	Antenna Gain (dBi)								
				2.4 GHz	5.15 - 5.25 GHz	5.25 - 5.35 GHz	5.47 - 5.725 GHz	5.725 - 5.895 GHz	5.925 - 6.425 GHz	6.425 - 6.525 GHz	6.525 - 6.875 GHz	6.875 - 7.125 GHz
Main Antenna	WA-P-LELE-04-038	INPAQ	PIFA	2.72	3.38	3.29	3.44	3.17	3.33	3.34	3.35	3.47
Auxiliary Antenna	WA-P-LELE-04-038		PIFA	2.72	3.2	3.29	3.38	3.39	3.42	3.14	3.33	3.37
Main Antenna	AYP6Y-200060	AWAN	PIFA	2.73	3.07	3.16	3.22	3.52	3.79	3.26	3.87	3.62
Auxiliary Antenna	AYP6Y-200060		PIFA	2.91	3.11	3.32	3.76	3.46	3.43	3.62	3.23	3.79

2.4 Ancillary Equipment

Note: Not application.

2.5 Technical Information

Network and Wireless connectivity	Bluetooth (BR+EDR+BLE) 2.4G WIFI 802.11b, 802.11g, 802.11n(HT20/40), VHT20/40 and 802.11ax(HE20/40) 5G WIFI 802.11a, 802.11n(HT20/40), 802.11ac(VHT20/40/80/160) and 802.11ax(HE20/40/80/160), U-NII-1/2A/2C/3/4 6G WIFI 802.11ax(HE20/40/80/160), U-NII-5/6/7/8

The requirement for the following technical information of the EUT was tested in this report:

Operating Mode	6G WLAN	
Frequency Range	802.11 ax(HE20/HE40/HE80/HE160)	5925 MHz ~ 6425 MHz
		6425 MHz ~ 6525 MHz
		6525 MHz ~ 6875 MHz
		6875 MHz ~ 7125 MHz
Antenna Type	WLAN: PIFA Antenna	
Hotspot Function	N/A	
Exposure Category	General Population/Uncontrolled exposure	
EUT Stage	Portable Device	
Product	Type	
	☒ Production unit	☐ Identical prototype

3 SUMMARY OF TEST RESULT

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 2.1093	Radio frequency radiation exposure evaluation: portable devices
2	ANSI C95.1-1992	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz
3	KDB 447498 D04 v01	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
4	KDB 865664 D02 v01r02	RF Exposure Reporting
5	KDB 248227 D01 v02r02	SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters
6	KDB 616217 D04v01r02	SAR for laptop and tablets
7	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
8	IEC/IEEE 62209-1528:2020	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)
9	47 CFR Part 1.1310	Radiofrequency radiation exposure limits

3.2 Device Category and Limit

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user.

Limit for General Population/Uncontrolled exposure should be applied for this device, it is power density for frequencies between 1.5GHz and 100 GHz is 1.0 mW/cm^2= 10 W/m^2

Table of Exposure Limits:

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 Exposure				
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
300-1,500	/	/	f/300	6
1,500-100,000	/	/	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
300-1,500	/	/	f/1500	30
1,500-100,000	/	/	1.0	30
*f = frequency in MHz * = Plane-wave equivalent power density*				

NOTE:

General Population/Uncontrolled Exposure: Locations where there is the exposure of individuals who have no knowledge or control of their exposure. 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.

Occupational/Controlled Exposure: Locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, 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. This 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.

3.3 Test Result Summary

3.3.1 Highest Power Density

Band	Antenna	Maximum Scaled PD (W/m^2)	Maximum Report PD (W/m^2)
		Body	Body
6G WLAN	Main	4.48	**5.49**
6G WLAN	Aux.	**5.49**	
Limit (W/m^2)		10	
Verdict		Pass	

3.3.2 Highest Total Exposure Ratio

Test Mode	Position	Mode	Power Density (W/m^2)	Power Density Limt	1g SAR (W/kg)	1g SAR Limt	Total Exposure Ratio
Body (Separation 0 mm)							
Laptop	Bottom Side	6G WLAN (Main Antenna)	5.491	10	/	/	**0.997**
		6G WLAN (Auxiliary Antenna)	4.483	10	/	/	
Note: The simultaneous transmission detail please refer section 10.							

3.4 Test Uncertainty

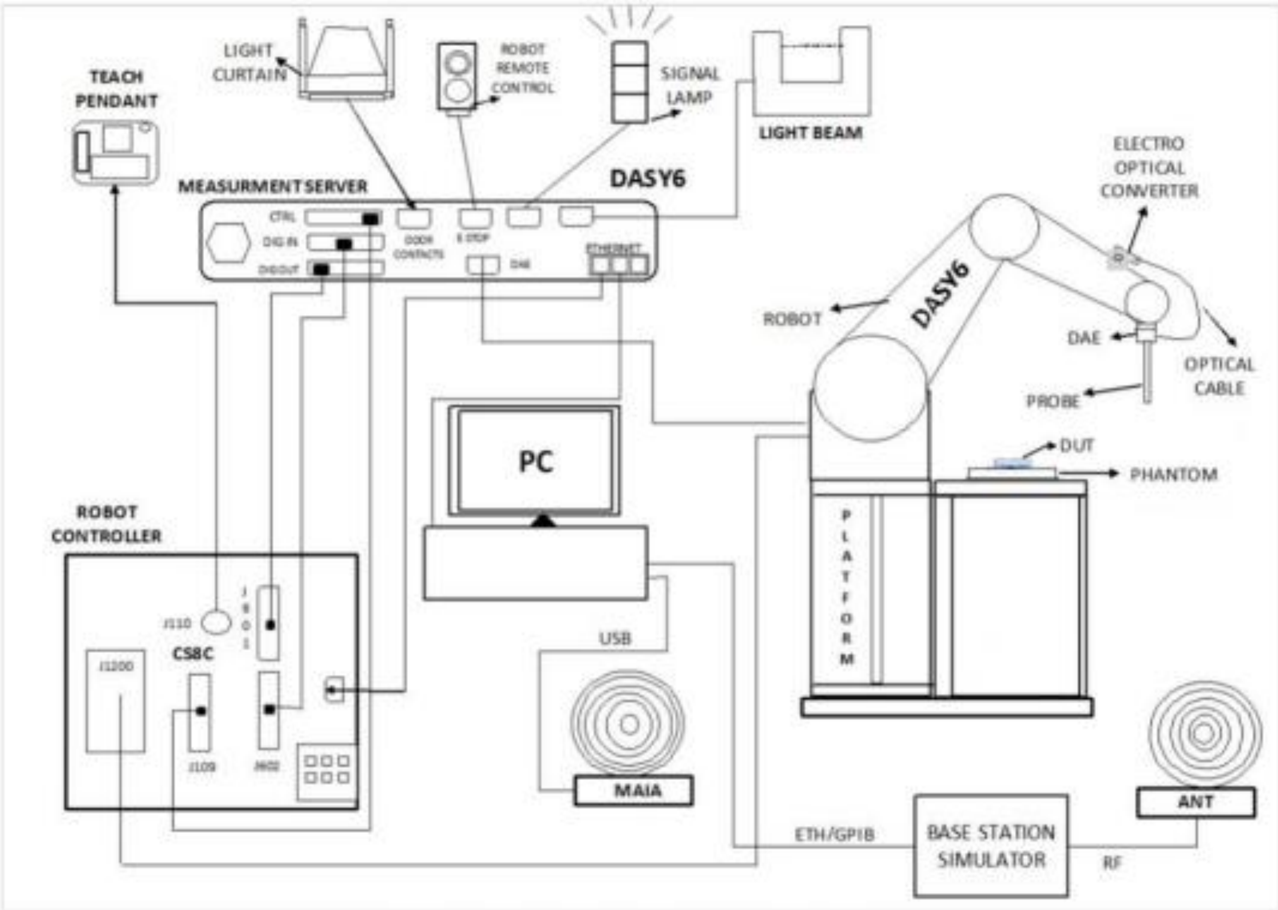
According to TR 63170, the budget is valid for evaluation distances > λ/2π. For specific tests and configurations, the Uncertainty could be considerably smaller.

Uncertainty Component	Unc. (+-dB)	Prob. Dist.	Div.	Ci	Ui (+-dB)	Vi V_{eff}
Measurement System						
Probe calibration	0.49	N	1	1	0.49	∞
Frequency response (BW ≤ 1 GHz)	0.2	R	1.732	1	0.12	∞
Hemispherical Isotropy	0.50	R	$\sqrt{3}$	1	0.29	∞
Linearity	0.20	R	$\sqrt{3}$	1	0.12	∞
System detection limits	0.04	R	$\sqrt{3}$	1	0.02	∞
Data acquisition	0.03	N	1	1	0.03	∞
Readout Electronics	0.03	N	1	1	0.03	∞
Response Time	0.00	R	$\sqrt{3}$	1	0.00	∞
Integration Time	0.00	R	$\sqrt{3}$	1	0.00	∞
RF ambient Conditions - Noise	0.04	R	$\sqrt{3}$	1	0.02	∞
Probe positioner Mechanical Tolerance	0.04	R	$\sqrt{3}$	1	0.02	∞
Probe positioning with Respect to Phantom	0.30	R	$\sqrt{3}$	1	0.17	∞
S_{avg} Reconstruction	2.00	R	$\sqrt{3}$	1	1.15	∞
Test Sample Related						
Power Drift of Measurement	0.20	R	$\sqrt{3}$	1	0.12	∞
Modulation response	0.40	R	$\sqrt{3}$	1	0.23	∞
Device holder influence	0.10	R	$\sqrt{3}$	1	0.06	∞
RF Ambient Noise	0.04	R	$\sqrt{3}$	1	0.02	∞
RF Ambient Reflections	0.04	R	$\sqrt{3}$	1	0.02	∞
Combined Standard Uncertainty	/	/	RSS		1.33	/
Expanded Uncertainty (95% Confidence interval)	/	k	2		2.66	/

4 MEASUREMENT SYSTEM

4.1 DASY Power Density System

4.1.1 DASY PD System Diagram



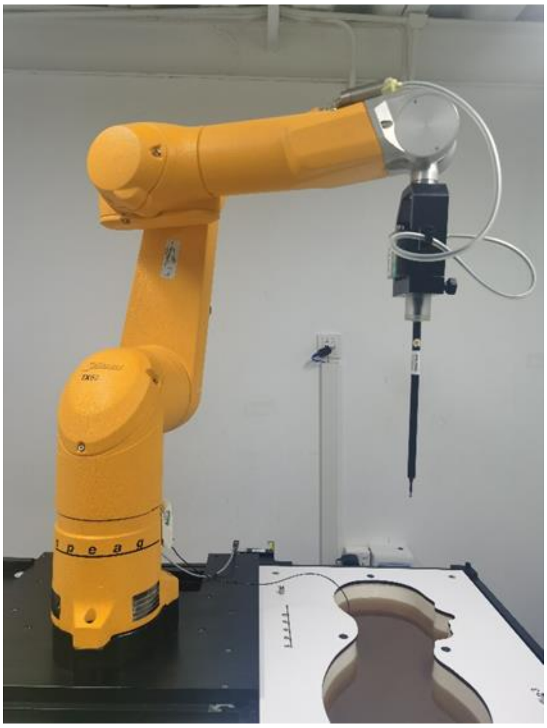
The DASY system for performing compliance tests consists of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).
2. A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
3. A data acquisition electronic (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. A unit to operate the optical surface detector which is connected to the EOC.
5. The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY measurement server.
6. The DASY measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.
7. DASY software and SEMCAD data evaluation software.

8. Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling the testing of left-hand and right-hand usage.
10. The device holder for handheld mobile phones.
11. Tissue simulating liquid mixed according to the given recipes.
12. System validation dipoles allowing to validate the proper functioning of the system.

4.1.2 Robot

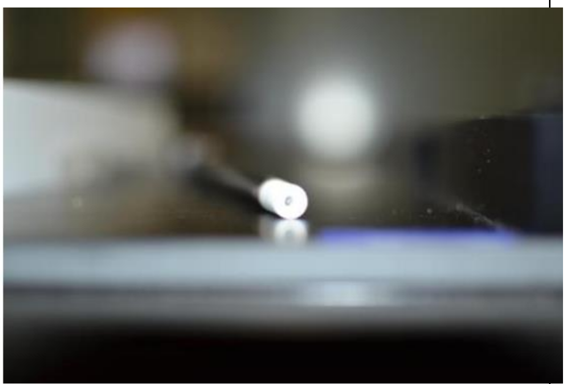
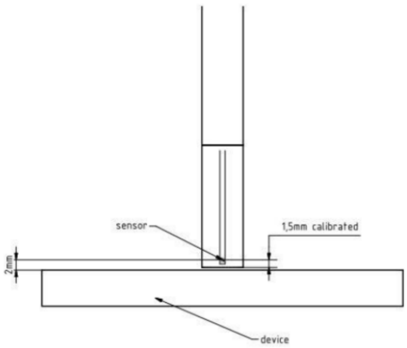
The Dasy SAR system uses the high precision robots. Symmetrical design with triangular core Built-in optical fiber for surface detection system For the 6-axis controller system, Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents). The robot series have many features that are important for our application:



- High precision
  (repeatability ±0.02 mm)
- High reliability
  (industrial design)
- Low maintenance costs
  (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements
  (brush less synchron motors; no stepper motors)
- Low ELF interference
  (motor control _elds shielded via the closed metallic construction shields)

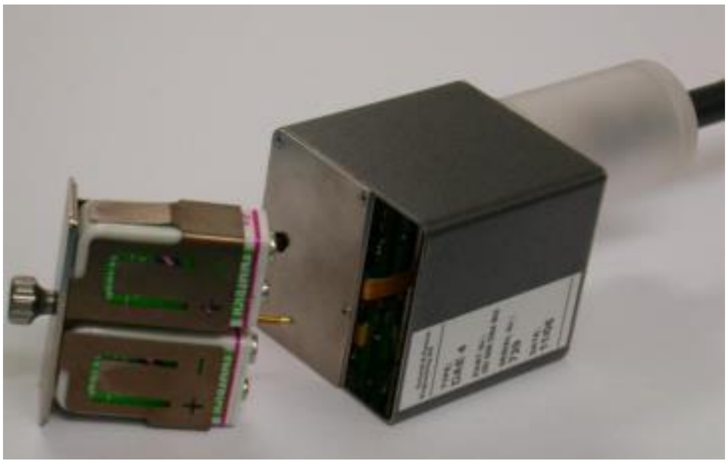
4.1.3 EUmmWave Probe / E-Field 5G Probe

The EUmmWave3 probe design allows measurements at distances as small as 2mm

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
Probe’s two dipoles length	0.9 mm – Diode loaded
Dynamic Range	< 20 V/m – 10000 V/m with PRE-10 (min < 50 V/m – 3000 V/m)
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 measurements of 5G devices and other mm-wave transmitters operating above 10GHz in < 2 mm distance from device (free-space) Power density, H-field and far-field analysis using total field reconstruction.
Compatibility	cDASY6 + 5G-Module SW1.0 and higher
	

4.1.4 Data Acquisition Electronics

The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converte and a command decoder with a 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.



- Input Impedance: 200MOhm
- The Inputs: Symmetrical and Floating
- Commom Mode Rejection: Above 80dB

5 SYSTEM VERIFICATION

5.1 Purpose of System Check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal Power Density measurements in a simplified setup with a well characterized source.This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

5.2 System Check Setup

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.

6 POWER DENSITY MEASUREMENT PROCEDURE

6.1 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.

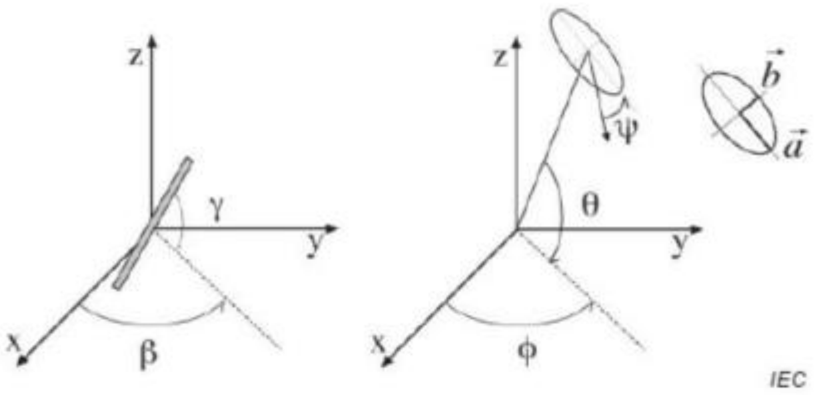


Illustration of the angles used for the numerical description of the sensor and the orientation of an ellipse in 3-D space

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 γ1 and γ2 toward the probe axis and to perform measurements at three angular positions of the probe, i.e. at β1, β2 and β3, 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 (γ1=γ2+90°), and, to simplify, the first rotation angle of the probe (β1) can be set to 0°.

6.2 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.

6.3 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 1cm2. 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.

6.4 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%

7 CONDUCTED RF OUPUT POWER

7.1 WIFI

7.1.1 6G WIFI (Main Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Average Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
6 (5.925~7.125)	802.11ax(HE20)	1	5955	6.80	7.00	No
		49	6195	6.81	7.00	No
		93	6415	6.90	7.00	No
		97	6435	6.78	7.00	No
		105	6475	6.85	7.00	No
		113	6515	6.96	7.00	No
		117	6535	6.74	7.00	No
		149	6695	7.16	8.00	No
		181	6855	6.74	7.50	No
		185	6875	7.00	7.50	No
		189	6895	6.70	7.50	No
		209	6995	6.67	7.50	No
		229	7095	7.02	7.50	No
		233	7115	7.23	7.50	No
	802.11ax(HE40)	3	5965	9.95	10.50	No
		51	6205	9.81	10.50	No
		91	6405	9.64	10.50	No
		99	6445	9.79	10.50	No
		107	6485	9.95	10.50	No
		115	6525	9.84	10.50	No
		123	6565	9.55	10.50	No
		147	6685	10.01	10.50	No
		187	6885	9.60	10.50	No
		195	6925	10.53	11.00	No
		211	7005	9.78	10.00	No
		227	7085	10.10	11.00	No
	802.11ax(HE80)	7	5985	12.40	13.50	No
		55	6225	12.31	13.50	No
		87	6385	12.50	13.50	No
		103	6465	12.61	13.50	No
		119	6545	12.64	13.50	No
		135	6625	12.72	13.50	No
		151	6705	12.40	13.50	No
		167	6785	12.71	13.50	No
		183	6865	12.80	13.50	No

		199	6945	12.72	13.50	No
		215	7025	12.40	13.50	No
	802.11ax(HE160)	15	6025	13.30	13.50	Yes
		47	6185	13.26	13.50	Yes
		79	6345	13.05	13.50	Yes
		111	6505	13.25	13.50	Yes
		143	6665	13.21	13.50	Yes
		175	6825	13.30	13.50	Yes
		207	6985	**13.31**	13.50	Yes

Note: When multiple channel bandwidth configurations in a frequency band have the same maximum tune-up output power, the test configuration is determined by applying the following steps sequentially.
1) The largest channel bandwidth configuration is selected between the multiple configurations in a frequency band with the same maximum tune-up output power.

7.1.2 6G WIFI (Aux. Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Average Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
6 (5.925~7.125)	802.11ax(HE20)	1	5955	6.83	7.00	No
		49	6195	6.69	7.00	No
		93	6415	6.64	7.00	No
		97	6435	6.40	7.00	No
		105	6475	6.77	7.00	No
		113	6515	6.55	7.00	No
		117	6535	6.76	7.00	No
		149	6695	6.91	8.00	No
		181	6855	7.08	7.50	No
		185	6875	6.81	7.50	No
		189	6895	6.70	7.50	No
		209	6995	6.29	7.50	No
		229	7095	6.87	7.50	No
		233	7115	7.05	7.50	No
	802.11ax(HE40)	3	5965	10.08	10.50	No
		51	6205	9.67	10.50	No
		91	6405	10.00	10.50	No
		99	6445	10.04	10.50	No
		107	6485	9.95	10.50	No
		115	6525	10.05	10.50	No
		123	6565	9.91	10.50	No
		147	6685	10.15	10.50	No
		187	6885	10.07	10.50	No
		195	6925	10.15	11.00	No
		211	7005	9.40	10.00	No
		227	7085	9.87	11.00	No
	802.11ax(HE80)	7	5985	12.48	13.50	No
		55	6225	12.48	13.50	No
		87	6385	12.36	13.50	No
		103	6465	12.29	13.50	No
		119	6545	12.29	13.50	No
		135	6625	12.32	13.50	No
		151	6705	12.60	13.50	No
		167	6785	12.86	13.50	No
		183	6865	12.88	13.50	No
		199	6945	12.92	13.50	No
		215	7025	12.36	13.50	No
	802.11ax(HE160)	15	6025	13.13	13.50	Yes
		47	6185	13.15	13.50	Yes

		79	6345	13.03	13.50	Yes
		111	6505	13.05	13.50	Yes
		143	6665	13.14	13.50	Yes
		175	6825	**13.35**	13.50	Yes
		207	6985	13.04	13.50	Yes

Note: When multiple channel bandwidth configurations in a frequency band have the same maximum tune-up output power, the test configuration is determined by applying the following steps sequentially.
1) The largest channel bandwidth configuration is selected between the multiple configurations in a frequency band with the same maximum tune-up output power.

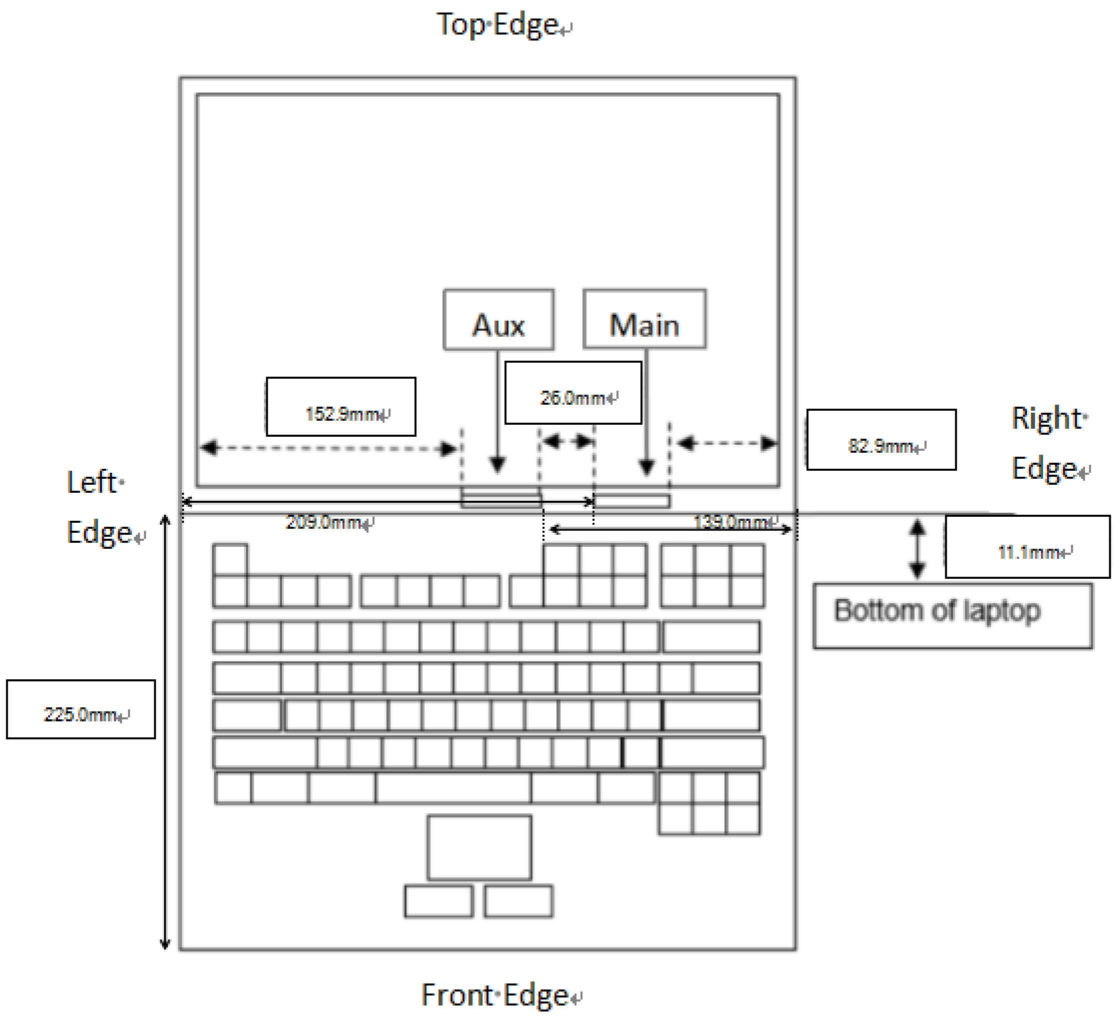
7.1.3 6G WIFI (MIMO)

Band (GHz)	Mode	Channel	Freq. (MHz)	Average Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
6 (5.925~7.125)	802.11ax(HE20)	1	5955	3.19	4.50	No
		49	6195	3.39	4.50	No
		93	6415	3.57	4.50	No
		97	6435	3.69	4.50	No
		105	6475	3.72	4.50	No
		113	6515	3.67	4.50	No
		117	6535	3.95	4.50	No
		149	6695	3.60	4.50	No
		181	6855	3.60	4.50	No
		185	6875	3.90	4.50	No
		189	6895	3.61	4.50	No
		209	6995	3.54	4.50	No
		229	7095	3.89	4.50	No
		233	7115	4.41	4.50	No
	802.11ax(HE40)	3	5965	6.88	7.50	No
		51	6205	6.91	7.50	No
		91	6405	6.99	7.50	No
		99	6445	6.90	7.50	No
		107	6485	7.07	7.50	No
		115	6525	6.94	7.50	No
		123	6565	6.82	7.50	No
		147	6685	6.96	7.50	No
		179	6645	6.77	7.50	No
		187	6885	6.55	7.50	No
		195	6925	7.11	7.50	No
		211	7005	6.58	7.50	No
		227	7085	6.99	7.50	No
	802.11ax(HE80)	7	5985	9.72	10.00	No
		55	6225	9.30	10.00	No
		87	6385	9.43	10.00	No
		103	6465	9.49	10.00	No
		119	6545	9.40	10.00	No
		135	6625	9.21	10.00	No
		151	6705	9.06	10.00	No
		167	6785	9.28	10.00	No
		183	6865	9.45	10.00	No
		199	6945	9.32	10.00	No
		215	7025	9.72	10.00	No
	802.11ax(HE160)	15	6025	12.08	13.00	No

		47	6185	11.64	13.00	No
		79	6345	11.88	13.00	No
		111	6505	11.91	13.00	No
		143	6665	11.82	13.00	No
		175	6825	12.07	13.00	No
		207	6985	7.60	8.00	No
Note: For WiFi power density testing was performed on single antenna RF power in SISO mode that is larger to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission used more conservative “Max. (main ant) + Max. (aux. ant) ” method to determine power density compliance. When the sum of power density SISO transmission power density measurement is <10 $W/m^{2,}$ MIMO power density test is not required.						

8 ANTENNA LOCATION

8.1 Laptop Mode antenna location sketch



Antenna	Support Bands
Antenna Aux.	BT、WLAN 2.4/5/6G
Antenna Main	WLAN 2.4/5/6G

9 TEST RESULT OF POWER DENSITY

General Note:

1. The reported PD is the measured Total PD value adjusted for maximum tune-up tolerance and duty cycle factor.
   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)".
2. The most conservative test distance of 2mm was applied to PD measurement.
3. Power density was calculated by repeated E-field measurements on two measurement planes separated by $\lambda/4$.
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 2.66 dB (84.5%) was used to determine the psPD measurement scaling factor.
6. According to TCBC workshop in October 2018 that $4cm^2$ averaging area may now be considered.

9.1 WIFI 6GHz

Mode	Antenna manufacturer	Antenna	State	Position	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1g Meas SAR (W/kg)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	Duty cycle (%)	Duty cycle Factor	1g Scaled SAR (W/kg)	Measured APD W/m2 (4cm2)	Meas. uncertainty Scaling Factor	Meas Modulation psPD [W/m2]	Scaled Modulation psPD [W/m2]	PD Meas. No.
Body																				
802.11 ax 160	AWAN	Main	Laptop	Bottom Side	0	207	6985	0.15	0.051	13.31	13.50	1.045	91.32	1.095	0.058	0.374	1.545	/	/	/
	INPAQ				0	207	6985	-0.03	0.055	13.31	13.50	1.045	91.32	1.095	0.063	0.410	1.545	/	/	/
					0	15	6025	-0.15	0.162	13.30	13.50	1.047	91.32	1.095	0.186	1.210	1.545	3.100	**5.491**	1#
					0	47	6185	-0.14	0.106	13.26	13.50	1.057	91.32	1.095	0.123	0.784	1.545	/	/	/
					0	79	6345	0.14	0.141	13.05	13.50	1.109	91.32	1.095	0.171	1.100	1.545	/	/	/
					0	111	6505	0.04	0.073	13.25	13.50	1.059	91.32	1.095	0.085	0.536	1.545	/	/	/
					0	143	6665	0.13	0.054	13.21	13.50	1.069	91.32	1.095	0.063	0.423	1.545	/	/	/
					0	175	6825	-0.11	0.095	13.30	13.50	1.047	91.32	1.095	0.109	0.715	1.545	/	/	/
	AWAN	Aux.	Laptop	Bottom Side	0	175	6825	0.04	0.183	13.35	13.50	1.035	91.32	1.095	0.207	1.300	1.545	2.560	**4.483**	2#
					0	15	6025	-0.18	0.161	13.13	13.50	1.089	91.32	1.095	0.192	1.200	1.545	/	/	/
					0	47	6185	0.19	0.171	13.15	13.50	1.084	91.32	1.095	0.203	1.200	1.545	/	/	/
					0	79	6345	-0.02	0.155	13.03	13.50	1.114	91.32	1.095	0.189	1.150	1.545	/	/	/
					0	111	6505	0.12	0.121	13.05	13.50	1.109	91.32	1.095	0.147	0.939	1.545	/	/	/
					0	143	6665	0.07	0.134	13.14	13.50	1.086	91.32	1.095	0.159	0.964	1.545	/	/	/
					0	207	6985	0.01	0.075	13.04	13.50	1.112	91.32	1.095	0.091	0.570	1.545	/	/	/
	INPAQ				0	175	6825	0.11	0.121	13.35	13.50	1.035	91.32	1.095	0.137	0.829	1.545	/	/	/
Note: According to FCC test 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 2.66 dB (84.5%) was used to determine the psPD measurement scaling factor.																				

10 SIMULTANEOUS TRANSMISSION

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

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

Where Sav,i is the power density for the source I operating at a frequency fi and Slim 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

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

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:

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

10.1 Simultaneous Transmission Mode Considerations

No.	Simultaneous Tx Combination	Body
1	Bluetooth + WLAN 6GHz (Antenna Main)	Yes
2	Bluetooth + WLAN 6GHz (Antenna Auxiliary)	Yes
3	WLAN 2.4GHz (Antenna Main) + WLAN 6GHz (Antenna Auxiliary)	Yes
4	WLAN 2.4GHz (Antenna Auxiliary) + WLAN 6GHz (Antenna Main)	Yes
5	WLAN 6GHz (Antenna Auxiliary) + WLAN 6GHz (Antenna Main)	Yes

Note:

1.The EUT supports the Antenna Auxiliary with TX/RX diversity function for WLAN and Bluetooth, the Antenna Main with TX/RX diversity function for WLAN.

2.WLAN 2.4GHz and Bluetooth will not be transmitting from the Antenna Auxiliary at same time.

3. The simultaneous transmission combinations of the more antennas contain combinations of less antennas, so only the worst simultaneous transmission combinations is shown in this report.

4. The maximum SAR of Bluetooth and WLAN 2.4G refers to the SAR report BL-SZ22C0366-701.

10.2 RF Exposure Simultaneous Transmission Evaluation

10.2.1 Highest Bluetooth and WLAN Body Power Density Simultaneous Transmission

Test Mode	Position	Mode	Power Density		1g SAR		Total Exposure Ratio
			(W/m2)	Limt	(W/kg)	Limt	
Laptop	Bottom Side	6G WLAN (Main Antenna)	5.491	10	/	/	0.600
		Bluetooth	/	/	0.081	1.6	
		6G WLAN (Auxiliary Antenna)	4.483	10	/	/	0.499
		Bluetooth	/	/	0.081	1.6	
		6G WLAN (Main Antenna)	5.491	10	/	/	0.639
		2.4G WLAN (Auxiliary Antenna)	/	/	0.144	1.6	
		6G WLAN (Auxiliary Antenna)	4.483	10	/	/	0.536
		2.4G WLAN (Main Antenna)	/	/	0.141	1.6	
		6G WLAN (Main Antenna)	5.491	10	/	/	**0.997**
		6G WLAN (Auxiliary Antenna)	4.483	10	/	/	

Note:

1.The maximum SAR of Bluetooth and WLAN 2.4G refers to the SAR report BL-SZ22C0366-701.

11 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No./Version	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
Test System	Speag	cDASY6 mmWave	V2.4.2.62	N/A	N/A
Verification Source	Speag	10GHz	SN: 2010	2022/06/28	2023/06/27
EUmmW Probe	Speag	EUmmWV4	SN: 9607	2022/02/04	2023/02/03
Data Acquisition Electronicsr	Speag	DAE4	SN: 1454	2022/11/18	2023/11/17
Signal Generator	R&S	SMB100A	177746	2022/05/19	2023/05/18
Power Meter	R&S	NRVD-B2	7250BJ-0112/2011	2022/09/06	2023/09/05
Power Sensor	R&S	NRV-Z4	100381	2022/09/06	2023/09/05
Power Sensor	R&S	NRV-Z2	100211	2022/09/06	2023/09/05
Thermometer	Elitech	RC-4HC	EF7216002985	2022/11/18	2023/11/17
Power Amplifier	mini-circuits	ZVA-183W-S+	505102223	N/A	N/A

ANNEX A SYSTEM CHECK RESULT

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 users manual and calibration facility recommendation.

Date	Freq. (GHz)	Meas. Forward Power (dBm)	Measured PD 4 cm^2 (W/m^2)	Normalized PD 4 cm^2 (W/m^2)	Target Forward PD 4 cm^2 (W/m^2)	Deviation (dB)
2023.01.20	10	21.88	144.00	144.00	150.00	-0.18
Note1: The tolerance limit of System validation ±0.66dB. Note2: According the verification source 10GHz calibration report the target forward power is 21.88dBm. Note3: Normalized PD 4 cm^2= Measured PD 4 cm^2 *10^(0.1*(Target Forward power- Meas. Forward Power))						

System Performance Check Data (10GHz)

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	DUT Type
5G Verification Source 10GHz, SPEAG	100.0 x 100.0 x 130.0	5G Verification Source 10GHz

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Frequency [MHz], Channel Number	Conversion Factor
5G Air	Front, 10.00	10000.0Validation band, 10000	1.0

Hardware Setup

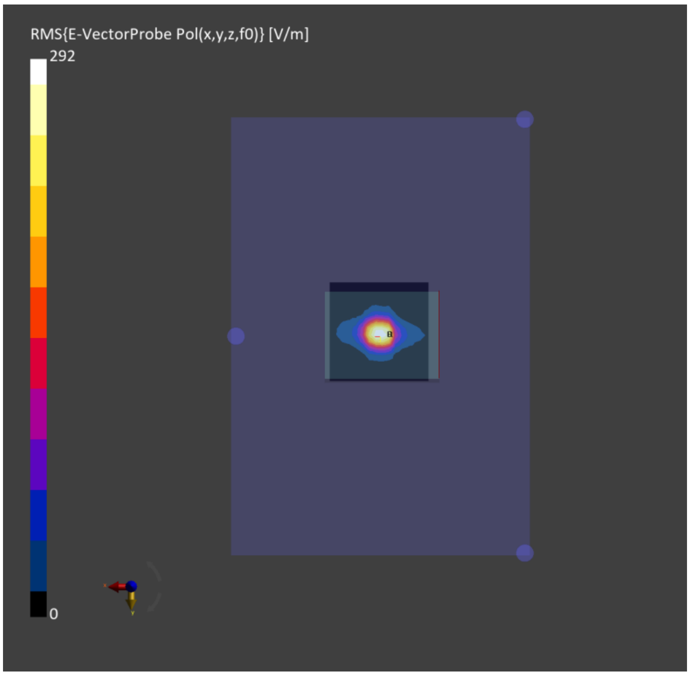
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave- 1083	---Air	EUmmWV4 - SN9607_F1-55GHz, 2022-02-04	DAE4 Sn1454, 2022-11-18

Scan Setup

	5G Scan
Grid Extents [mm]	25.0 x 25.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	10.0
MAIA	N/A

Measurement Results

	5G Scan
Date	2023-01-20
Avg. Area [cm^2]	4.00
psPDn+ [W/m^2]	143
psPDtot+ [W/m^2]	144
psPDmod+ [W/m^2]	148
E_{max} [V/m]	292
Power Drift [dB]	0.05



ANNEX B POWER DENDITY TEST DATA

Meas.1 Measurement Report for Device

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	DUT Type
S780 AMD	320.0 x 220.0 x 15	Laptop

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Frequency [MHz], Channel Number	Conversion Factor
5G Air	Bottom, 2.00	6025.0 U-NII-5, 155	1.0

Hardware Setup

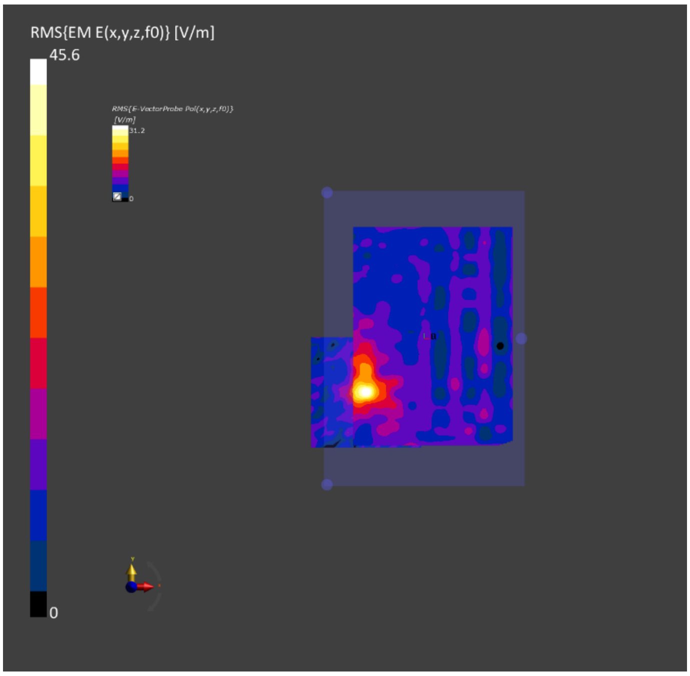
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave- 1083	---Air	EUmmWV4 - SN9607_F1-55GHz, 2022-02-04	DAE4 Sn1454, 2022-11-18

Scan Setup

	5G Scan
Grid Extents [mm]	25.0 x 25.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	2.0
MAIA	N/A

Measurement Results

	5G Scan
Date	2023-01-20
Avg. Area [cm^2]	4.00
psPDn+ [W/m^2]	2.72
psPDtot+ [W/m^2]	3.10
psPDmod+ [W/m^2]	3.26
E_{max} [V/m]	45.6
Power Drift [dB]	0.12



Meas.2 Measurement Report for Device

Device under Test Properties

Model, Manufacturer	Dimensions [mm]	DUT Type
S780 AMD	320.0 x 220.0 x 15	Laptop

Exposure Conditions

Phantom Section	Position, Test Distance [mm]	Frequency [MHz], Channel Number	Conversion Factor
5G Air	Bottom, 2.00	6825.0 U-NII-7, 175	1.0

Hardware Setup

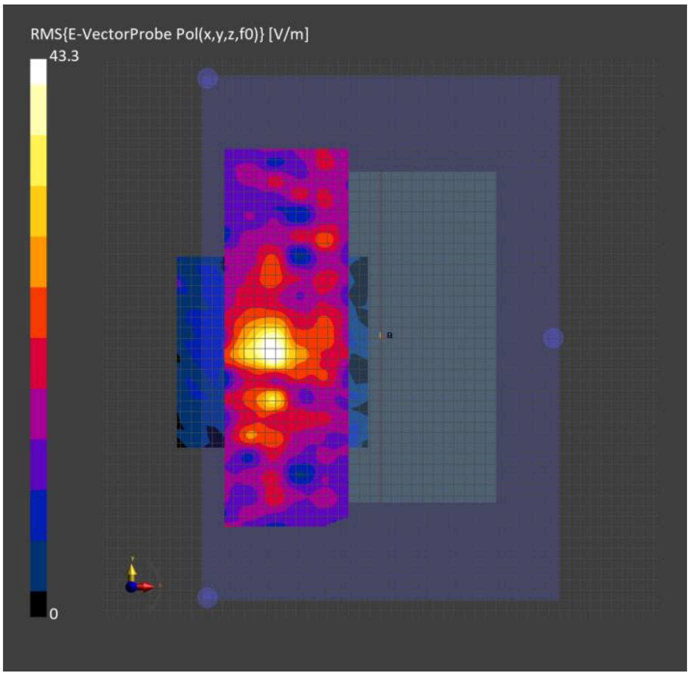
Phantom	Medium	Probe, Calibration Date	DAE, Calibration Date
mmWave- 1083	---Air	EUmmWV4 - SN9607_F1-55GHz, 2022-02-04	DAE4 Sn1454, 2022-11-18

Scan Setup

	5G Scan
Grid Extents [mm]	25.0 x 25.0
Grid Steps [lambda]	0.25 x 0.25
Sensor Surface [mm]	2.0
MAIA	N/A

Measurement Results

	5G Scan
Date	2023-01-20
Avg. Area [cm^2]	4.00
psPDn+ [W/m^2]	2.41
psPDtot+ [W/m^2]	2.56
psPDmod+ [W/m^2]	2.87
E_{max} [V/m]	43.4
Power Drift [dB]	0.04



ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ22C0366-AW.pdf”.

ANNEX D POWER DENSITY TEST SETUP PHOTOS

Please refer the document “BL-SZ22C0366-AS-2.pdf”.

ANNEX E POWER DENSITY CALIBRATION REPORT

Please refer the document “CALIBRATION REPORT-2.pdf”.

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