

TEST REPORT

Applicant: Realtek Semiconductor Corp.
Address: No. 2, Innovation Road II, Hsinchu Science Park,
Hsinchu 300, Taiwan
Equipment Type: 11ax RTL8852BE Combo module
Model Name: RTL8852BE
Brand Name: N/A
FCC ID: TX2-RTL8852BE
Test Standard: FCC 47 CFR Part 2.1093
(refer section 3.1)
Maximum SAR: Body 2.4GHz(1 g): 0.19 W/kg
Body 5GHz(1 g): 0.47 W/kg
Test Date: Feb. 15, 2022 – Mar. 7, 2022
Date of Issue: Mar. 21, 2022

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Xu Rui

Checked by: Zong Liyao

Approved by: Wei Yanquan
(Chief Engineer)

Xu Rui

Liyao. Zong

Wei Yanquan

Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Mar. 21, 2022</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION.....	4
1.1	Identification of the Testing Laboratory	4
1.2	Identification of the Responsible Testing Location	4
2	PRODUCT INFORMATION	5
2.1	Applicant Information	5
2.2	Manufacturer Information.....	5
2.3	General Description for Equipment under Test (EUT).....	5
2.4	Ancillary Equipment.....	6
2.5	Technical Information	7
3	SUMMARY OF TEST RESULT	8
3.1	Test Standards	8
3.2	Device Category and SAR Limit	9
3.3	Test Result Summary	10
3.4	Test Uncertainty	11
4	MEASUREMENT SYSTEM	12
4.1	Specific Absorption Rate (SAR) Definition	12
4.2	DASY SAR System	13
5	SYSTEM VERIFICATION	22
5.1	Purpose of System Check	22
5.2	System Check Setup	22
6	TEST POSITION CONFIGURATIONS	23
6.1	Laptop Exposure Condition.....	23
7	MEASUREMENT PROCEDURE	24
7.1	Measurement Process Diagram	24

7.2	SAR Scan General Requirement	25
7.3	Measurement Procedure	26
7.4	Area & Zoom Scan Procedure	26
8	CONDUCTED RF OUPUT POWER	27
8.1	WIFI.....	27
8.2	Bluetooth (Aux. Antenna).....	39
9	EUT ANTENNA LOCATION SKETCH	错误!未定义书签。
10	TEST EXCLUSION CONSIDERATION	错误!未定义书签。
10.1	SAR Test Consideration Table	错误!未定义书签。
11	TEST RESULT	46
11.1	Bluetooth	46
11.2	WIFI 2.4GHz.....	46
11.3	WIFI 5GHz.....	47
12	SAR Measurement Variability	48
13	SIMULTANEOUS TRANSMISSION.....	49
13.1	Simultaneous Transmission Mode Considerations	49
13.2	Sum SAR of Simultaneous Transmission	50
14	TEST EQUIPMENTS LIST	51
ANNEX A	SIMULATING LIQUID VERIFICATION RESULT	52
ANNEX B	SYSTEM CHECK RESULT	53
ANNEX C	TEST DATA.....	58
ANNEX D	EUT EXTERNAL PHOTOS.....	67
ANNEX E	SAR TEST SETUP PHOTOS	67
ANNEX F	CALIBRATION REPORT	67

1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park Shahe Xi Road, Nanshan District Shenzhen, Guangdong Province, People's Republic of China
Phone Number	+86 755 6685 0100
Fax Number	+86 755 6182 4271

1.2 Identification of the Responsible Testing Location

Test Location	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park Shahe Xi Road, Nanshan District Shenzhen, Guangdong Province, People's Republic of China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.
Description	All measurement facilities used to collect the measurement data are located at Block B, 1/F, Baisha Science and Technology Park Shahe Xi Road, Nanshan District Shenzhen, Guangdong Province, People's Republic of China

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 RTL8852BE Combo module
Model Name Under Test	RTL8852BE
Series Model Name	N/A
Description of Model name differentiation	N/A
Serial Number	N/A
Hardware Version	N/A
Software Version	N/A
Dimensions (Approx.)	N/A

2.3.1 Host Information:

Product Name	Notebook Computer
Model Name	IdeaPad 5 Pro 16ARH7, IdeaPad 5 Pro 16IAH7
Brand Name	Lenovo

2.3.2 Antenna Information:

Antenna Port	Model Name	Antenna Manufacturer	Antenna Type	Antenna Gain (dBi)			
				2.4 GHz	5.15 - 5.35 GHz	5.47 - 5.725 GHz	5.725 - 5.85 GHz
Main Antenna	2.00004826	ZhongTianXun	PIFA	0.58	1.70	1.02	1.82
Auxiliary Antenna	2.00004826		PIFA	-0.54	0.44	-0.56	-1.12
Main Antenna	N12-7313-R0A	South Star	PIFA	1.46	1.77	2.41	2.14
Auxiliary Antenna	N12-7313-R0A		PIFA	2.78	2.96	3.36	2.37
Note: The report only shown the antenna which matches the antenna with the highest antenna gain.							

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, VHT20/40 and 802.11ax(HE20/40) 5G WIFI 802.11a, 802.11ac(VHT20/40/80) and 802.11ac(HE20/40/80), U-NII-1/2A/2C/3
-----------------------------------	---

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

Operating Mode	2.4G WLAN, 5G WLAN, Bluetooth	
Frequency Range	802.11b/g /n(HT20/HT40)	2412 MHz ~ 2472 MHz
	802.11 VHT20/40	2412 MHz ~ 2472 MHz
	802.11 ax(HE20/40)	2412 MHz ~ 2472 MHz
	802.11a/n (HT20/HT40)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	802.11ac (VHT20/40/80)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	802.11ac (HE20/40/80)	5150 MHz ~ 5250 MHz
		5250 MHz ~ 5350 MHz
		5470 MHz ~ 5725 MHz
		5725 MHz ~ 5850 MHz
	Bluetooth	2402 MHz ~ 2480 MHz
Antenna Type	WLAN: PIFA Antenna Bluetooth: 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	Radiofrequency 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	IEEE Std. 1528-2013	Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
4	FCC KDB 447498 D04	RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
5	FCC KDB 865664 D01 v01r04	SAR Measurement 100 MHz to 6 GHz
6	FCC KDB 865664 D02 v01r02	RF Exposure Reporting
7	KDB 248227 D01 v02r02	SAR Guidance for IEEE 802.11 (Wi-Fi) Transmitters
8	KDB 616217 D04v01r02	SAR for laptop and tablets

3.2 Device Category and SAR 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 1.6 W/kg as averaged over any 1 gram of tissue.

Table of Exposure Limits:

Body Position	SAR Value (W/Kg)	
	General Population/ Uncontrolled Exposure	Occupational/ Controlled Exposure
Whole-Body SAR (averaged over the entire body)	0.08	0.4
Partial-Body SAR (averaged over any 1 gram of tissue)	1.60	8.0
SAR for hands, wrists, feet and ankles (averaged over any 10 grams of tissue)	4.0	20.0

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 SAR (1 g Value)

Band	Antenna	Maximum Scaled SAR (W/kg)	Maximum Report SAR (W/kg)
		Body	Body
2.4G WLAN	Aux.	0.19	0.47
2.4G WLAN	Main	0.11	
5.3G WLAN	Aux.	0.38	
5.3G WLAN	Main	0.21	
5.6G WLAN	Aux.	0.47	
5.6G WLAN	Main	0.32	
5.8G WLAN	Aux.	0.31	
5.8G WLAN	Main	0.42	
Bluetooth	Aux.	0.13	
Limit (W/kg)		1.60	
Verdict		Pass	

3.4 Test Uncertainty

According to KDB 865664 D01, when the highest measured 1 g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis is not required in SAR reports submitted for equipment approval.

The maximum 1 g SAR for the EUT in this report is 0.469 W/kg, which is lower than 1.5 W/kg, so the extensive SAR measurement uncertainty analysis is not required in this report.

4 MEASUREMENT SYSTEM

4.1 Specific Absorption Rate (SAR) Definition

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.

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

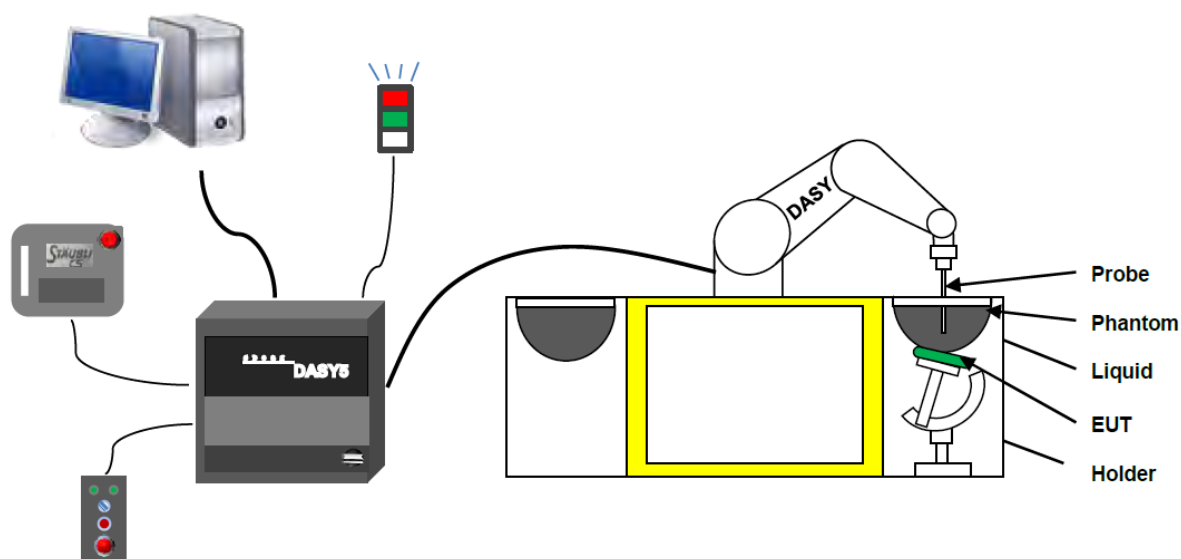
$$SAR = \frac{\sigma E^2}{\rho}$$

Where: σ is the conductivity of the tissue,

ρ is the mass density of the tissue and E is the RMS electrical field strength.

4.2 DASY SAR System

4.2.1 DASY SAR System Diagram



The DASY5 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 DASY5 measurement server.
6. The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.
7. DASY5 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.

4.2.2 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)

4.2.3 E-Field Probe

The probe is specially designed and calibrated for use in liquids with high permittivities for the measurements the Specific Dosimetric E-Field Probe EX3DV4-SN:7607 with following specifications is used.

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycolether)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ; ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic range	5 μ W/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 9 mm) Tip diameter: 2.5 mm (Body: 10 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (EX3DV4)



Probe calibration is realized, in compliance with CENELEC EN 62209-1/-2 and IEEE 1528 std, with CALISAR, Antennessa proprietary calibration system. The calibration is performed with the EN 62209-1/2 annexe technique using reference guide at the five frequencies.

4.2.4 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-converter 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: 200M Ω m
- The Inputs: Symmetrical and Floating
- Common Mode Rejection: Above 80dB

4.2.5 Phantoms

For the measurements the Specific Anthropomorphic Mannequin (SAM) defined by the IEEE SCC-34/SC2 group is used. The phantom is a polyurethane shell integrated in a wooden table. The thickness of the phantom amounts to 2mm +/- 0.2mm. It enables the dosimetric evaluation of left and right phone usage and includes an additional flat phantom part for the simplified performance check. The phantom set-up includes a cover, which prevents the evaporation of the liquid.



- Left hand
- Right hand
- Flat phantom

Photo of Phantom SN1859



Serial Number	Material	Length	Height
SN 1859 SAM	Vinylester, glass fiber reinforced	1000	500

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points.



• Flat phantom

Photo of Phantom SN1012



Serial Number	Shell Thickness (mm)	Major ellipse axis (mm)	Minor axis (mm)
SN 1012 ELI4	2.0 ± 0.2	600	500

4.2.6 Device Holder

The DASY5 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65° . 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. This device holder is used for standard mobile phones or PDA"s only. If necessary an additional support of polystyrene material is used. Larger DUT"s (e.g. notebooks) cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values. Therefore those devices are normally only tested at the flat part of the SAM.

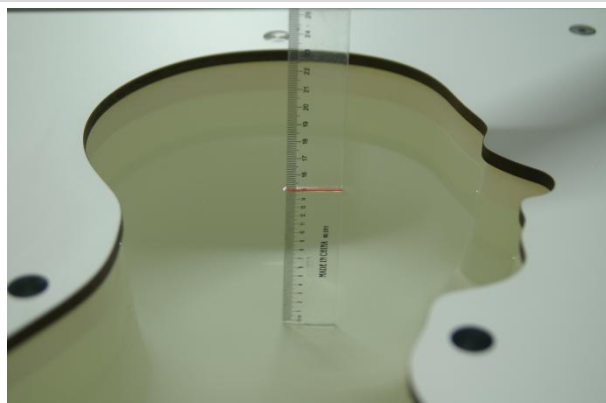


The positioning system allows obtaining cheek and tilting position with a very good accuracy. Incompliance with CENELEC, the tilt angle uncertainty is lower than 1° .

4.2.7 Simulating Liquid

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5%.

Head Liquid Depth



Body Liquid Depth



The following table gives the recipes for tissue simulating liquid and the theoretical Conductivity/Permittivity.

Head (Reference IEEE1528)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ϵ
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.4	40.0
2450	55.0	0	0	0.1	0	44.9	1.80	39.2
2600	54.9	0	0	0.1	0	45.0	1.96	39.0
Frequency (MHz)	Water (%)	Hexyl Carbitol (%)			Triton X-100 (%)		Conductivity σ (S/m)	Permittivity ϵ
5200	62.52	17.24			17.24		4.66	36.0
5800	62.52	17.24			17.24		5.27	35.3
Body (From instrument manufacturer)								
Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity σ (S/m)	Permittivity ϵ
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0.1	0	31.3	1.95	52.7
2600	68.2	0	0	0.1	0	31.7	2.16	52.5
Frequency(MHz)	Water	DGBE			Salt		Conductivity	Permittivity

		(%)	(%)	σ (S/m)	ε
5200	78.60	21.40	/	5.54	47.86
5800	78.50	21.40	0.1	6.0	48.20

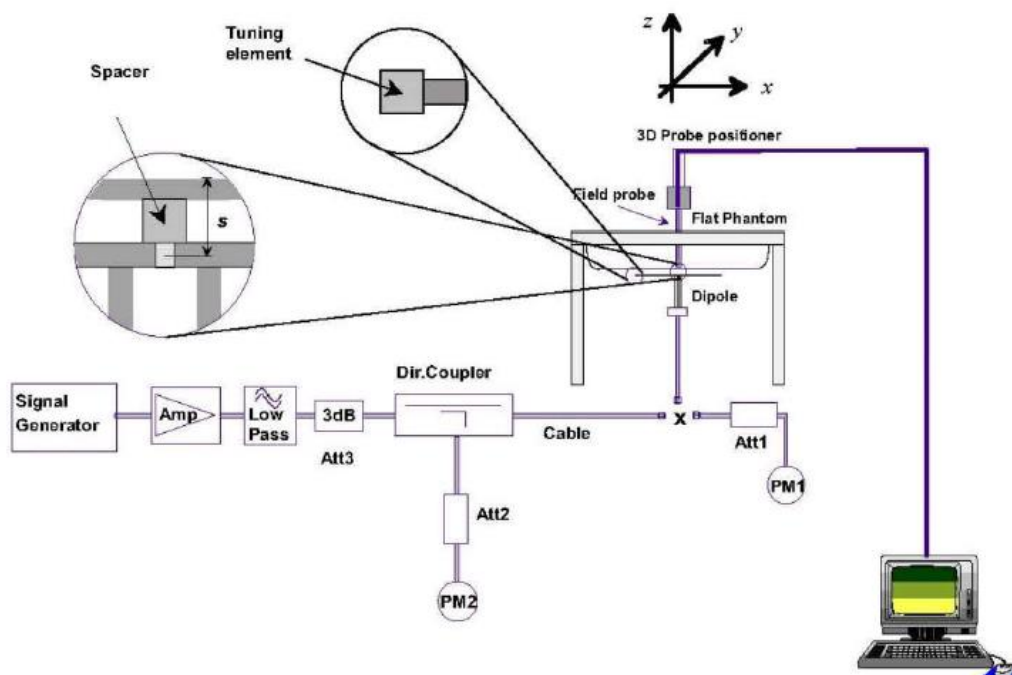
5 SYSTEM VERIFICATION

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 SAR 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

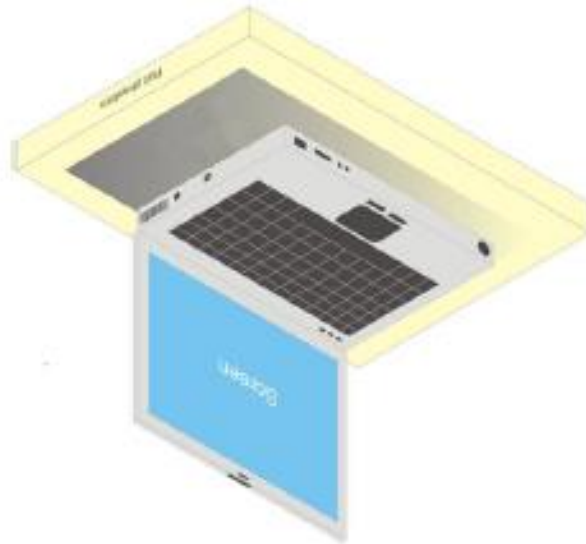
In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:



6 TEST POSITION CONFIGURATIONS

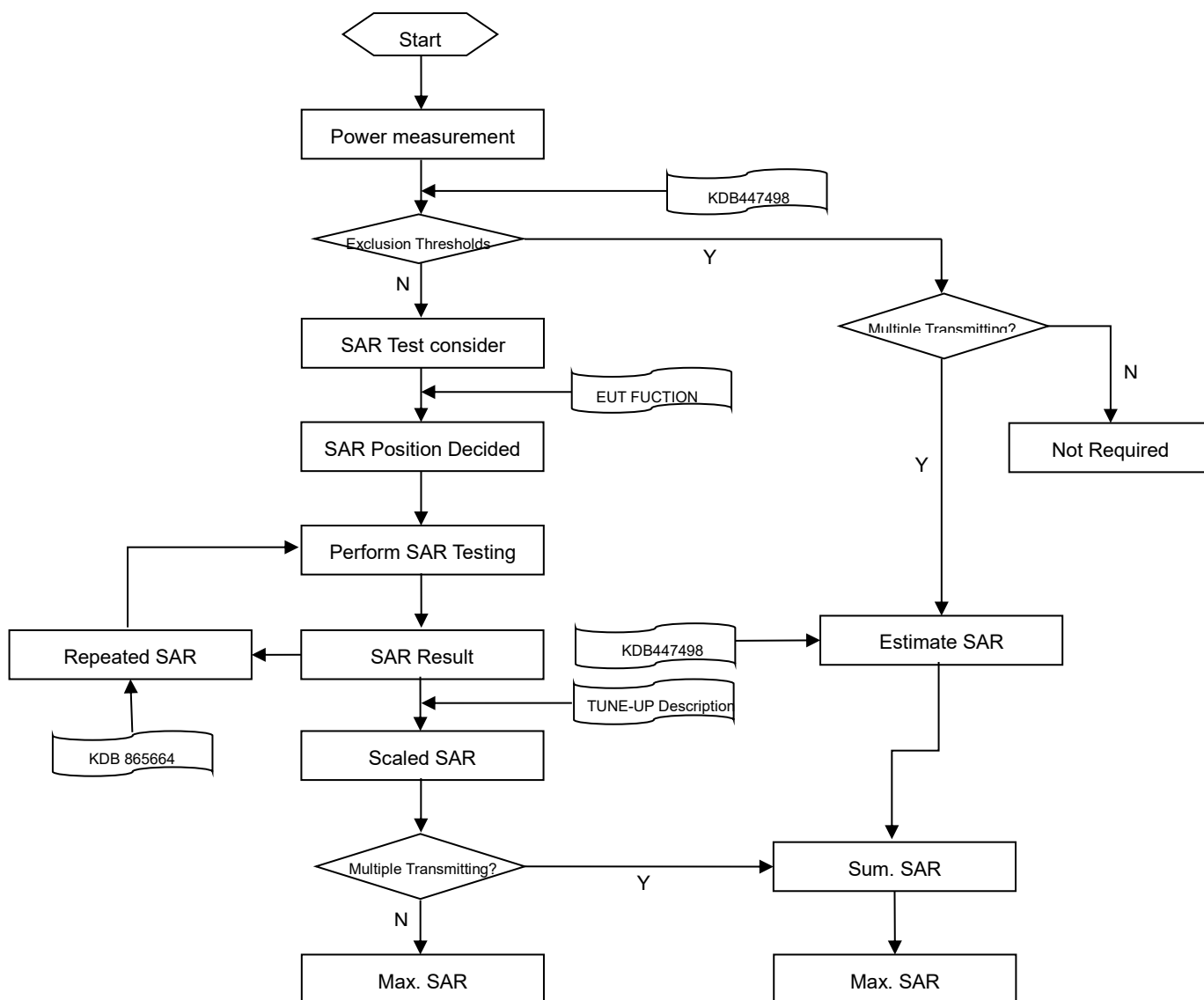
6.1 Laptop Exposure Condition

This DUT should consider one position which is bottom of laptop touching with phantom 0 mm air gap and the screen portion of the device shall be an open position at a 90° angle.



7 MEASUREMENT PROCEDURE

7.1 Measurement Process Diagram



7.2 SAR Scan General Requirement

Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1 g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013.

			≤3GHz	>3GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5±1 mm	½·δ·ln(2)±0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30°±1°	20°±1°
Maximum area scan spatial resolution: Δx Area , Δy 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.	
Maximum zoom scan spatial resolution: Δx Zoom , Δy 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: Δz Zoom (n)		≤ 5 mm	3–4 GHz: ≤ 4 mm
				4–5 GHz: ≤ 3 mm
				5–6 GHz: ≤ 2 mm
	graded grid	Δz Zoom (1): between 1st two points closest to phantom surface	≤ 4 mm	3–4 GHz: ≤ 3 mm
				4–5 GHz: ≤ 2.5 mm
		Δz Zoom (n>1): between subsequent points	≤ 1.5·Δz 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:

1. δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.
2. * When zoom scan is required and the reported SAR from the area scan based 1 g SAR estimation 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 3GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

7.3 Measurement Procedure

The following steps are used for each test position

- a. Establish a call with the maximum output power with a base station simulator. The connection between the mobile and the base station simulator is established via air interface
- b. Measurement of the local E-field value at a fixed location. This value serves as a reference value for calculating a possible power drift.
- c. Measurement of the SAR distribution with a grid of 8 to 16mm * 8 to 16 mm and a constant distance to the inner surface of the phantom. Since the sensors cannot directly measure at the inner phantom surface, the values between the sensors and the inner phantom surface are extrapolated. With these values the area of the maximum SAR is calculated by an interpolation scheme.
- d. Around this point, a cube of 30 * 30 * 30 mm or 32 * 32 * 32 mm is assessed by measuring 5 or 8 * 5 or 8*4 or 5 mm. With these data, the peak spatial-average SAR value can be calculated.

7.4 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01r04 quoted below.

When the 1 g SAR of the highest peak is within 2 dB of the SAR limit, additional zoom scans are required for other peaks within 2 dB of the highest peak that have not been included in any zoom scan to ensure there is no increase in SAR.

8 CONDUCTED RF OUTPUT POWER

8.1 WIFI

8.1.1 2.4G WIFI (Aux. Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)	Tune-up Limit (dBm)	SAR Test Require.
2.4 (2.4~2.4835)	802.11b	1	2412	16.19	16.50	Yes
		6	2437	16.27	16.50	Yes
		11	2462	16.07	16.50	Yes
		12	2467	14.95	15.50	No
		13	2472	11.53	12.50	No
	802.11g	1	2412	16.07	16.50	No
		6	2437	16.11	16.50	No
		11	2462	16.09	16.50	No
		12	2467	12.73	13.50	No
		13	2472	11.99	12.50	No
	802.11n(HT20)	1	2412	15.55	16.50	No
		6	2437	15.71	16.50	No
		11	2462	15.58	16.50	No
		12	2467	12.57	13.50	No
		13	2472	11.03	12.50	No
	802.11n(HT40)	3	2422	14.28	14.50	No
		6	2437	16.26	16.50	No
		9	2452	14.70	16.50	No
		10	2457	11.83	12.50	No
		11	2462	10.66	11.50	No
	VHT(20 MHz)	1	2412	15.69	16.50	No
		6	2437	16.14	16.50	No
		11	2462	15.57	16.50	No
		12	2467	12.45	13.50	No
		13	2472	11.64	12.50	No
	VHT(40 MHz)	3	2422	14.51	15.00	No
		6	2437	16.27	16.50	No
		9	2452	14.50	15.50	No
		10	2457	11.88	12.50	No
		11	2462	10.64	11.50	No
	802.11ax(HE20) (SU)	1	2412	15.71	16.50	No
		6	2437	16.12	16.50	No
		11	2462	15.75	16.50	No

		12	2467	12.96	13.50	No
		13	2472	11.95	12.50	No
	802.11ax(HE40) (SU)	3	2422	14.28	15.50	No
		6	2437	16.09	16.50	No
		9	2452	14.45	15.50	No
		10	2457	11.73	12.50	No
		11	2462	10.73	11.50	No
	802.11ax(RU26)	1	2412	16.33	16.50	No
		6	2437	16.04	16.50	No
		11	2462	15.76	16.50	No
		12	2467	13.88	14.50	No
		13	2472	8.44	9.50	No
	802.11ax(RU52)	1	2412	16.03	16.50	No
		6	2437	16.32	16.50	No
		11	2462	16.02	16.50	No
		12	2467	12.81	13.50	No
		13	2472	8.58	9.50	No
	802.11ax(RU106)	1	2412	16.14	16.50	No
		6	2437	16.26	16.50	No
		11	2462	16.28	16.50	No
		12	2467	15.71	16.50	No
		13	2472	11.87	12.50	No

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.
- 2) When multiple transmission modes (802.11b/g/n/VHT/ax) have the same maximum tune-up output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11b is chosen over 802.11g, and 802.11g chosen over 802.11n than 802.11VHT than 802.11ax.
- 3) According KDB 247228, when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, OFDM SAR test is not required.

Adjusted SAR = $0.193^* (44.67\text{mW}/44.67\text{mW}) = 0.193$ W/Kg, so 2.4G OFDM SAR test is not required.

8.1.2 2.4G WIFI (Main Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)	Tune-up Limit (dBm)	SAR Test Require.
2.4 (2.4~2.4835)	802.11b	1	2412	15.95	16.50	Yes
		6	2437	16.04	16.50	Yes
		11	2462	16.14	16.50	Yes
		12	2467	14.55	15.50	No

		13	2472	11.28	12.50	No
	802.11g	1	2412	16.19	16.50	No
		6	2437	16.19	16.50	No
		11	2462	16.37	16.50	No
		12	2467	12.28	13.50	No
		13	2472	11.31	12.50	No
	802.11n(HT20)	1	2412	15.02	16.50	No
		6	2437	15.96	16.50	No
		11	2462	14.93	16.50	No
		12	2467	12.14	13.50	No
		13	2472	11.32	12.50	No
	802.11n(HT40)	3	2422	13.74	14.50	No
		6	2437	16.08	16.50	No
		9	2452	14.23	16.50	No
		10	2457	10.96	12.50	No
		11	2462	9.80	11.50	No
	VHT(20 MHz)	1	2412	15.30	16.50	No
		6	2437	16.01	16.50	No
		11	2462	15.20	16.50	No
		12	2467	12.45	13.50	No
		13	2472	11.33	12.50	No
	VHT(40 MHz)	3	2422	13.93	15.00	No
		6	2437	15.90	16.50	No
		9	2452	14.22	15.50	No
		10	2457	11.38	12.50	No
		11	2462	10.07	11.50	No
	802.11ax(HE20) (SU)	1	2412	15.60	16.50	No
		6	2437	16.01	16.50	No
		11	2462	15.42	16.50	No
		12	2467	12.34	13.50	No
		13	2472	11.31	12.50	No
	802.11ax(HE40) (SU)	3	2422	14.42	15.50	No
		6	2437	15.94	16.50	No
		9	2452	14.53	15.50	No
		10	2457	11.55	12.50	No
		11	2462	10.56	11.50	No
	802.11ax(RU26)	1	2412	16.18	16.50	No
		6	2437	15.93	16.50	No
		11	2462	15.59	16.50	No

		12	2467	13.78	14.50	No
		13	2472	8.63	9.50	No
	802.11ax(RU52)	1	2412	16.05	16.50	No
		6	2437	16.33	16.50	No
		11	2462	16.21	16.50	No
		12	2467	12.35	13.50	No
		13	2472	8.36	9.50	No
	802.11ax(RU106)	1	2412	16.22	16.50	No
		6	2437	16.38	16.50	No
		11	2462	16.24	16.50	No
		12	2467	16.03	16.50	No
		13	2472	11.60	12.50	No

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.
- 2) When multiple transmission modes (802.11b/g/n/VHT/ax) have the same maximum tune-up output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11b is chosen over 802.11g, and 802.11g chosen over 802.11n than 802.11VHT than 802.11ax.
- 3) According KDB 247228, when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, OFDM SAR test is not required.
Adjusted SAR = $0.113 * (44.67\text{mW}/44.67\text{mW}) = 0.113$ W/Kg, so 2.4G OFDM SAR test is not required.

8.1.3 5G WIFI (Aux. Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
5.2 (5.15~5.25)	802.11a	36	5180	15.51	16.00	No
		40	5200	15.76	16.00	No
		48	5240	15.78	16.00	No
	802.11n(HT20)	36	5180	15.83	16.00	No
		40	5200	15.46	16.00	No
		48	5240	15.62	16.00	No
	802.11n(HT40)	38	5190	15.75	16.00	No
		46	5230	15.56	16.00	No
	802.11ac(VHT20)	36	5180	15.49	16.00	No
		40	5200	15.64	16.00	No
		48	5240	15.55	16.00	No
	802.11ac(VHT40)	38	5190	15.72	16.00	No
		46	5230	15.53	16.00	No
	802.11ac(VHT80)	42	5210	15.27	16.00	No
	802.11ax(HE20)	36	5180	15.63	16.00	No
		40	5200	15.42	16.00	No
		48	5240	15.52	16.00	No
	802.11ax(HE40)	38	5190	15.48	16.00	No
		46	5230	15.42	16.00	No
	802.11ax(HE80)	42	5210	15.33	16.00	No
	802.11ax(RU26)	36	5180	9.44	10.00	No
		40	5200	10.24	11.00	No
		48	5240	9.61	10.00	No
	802.11ax(RU52)	36	5180	11.49	12.00	No
		40	5200	12.52	13.00	No
		48	5240	11.61	12.00	No
	802.11ax(RU106)	36	5180	13.42	14.00	No
		40	5200	13.69	14.00	No
		48	5240	13.82	14.00	No
5.3 (5.25~5.35)	802.11a	52	5260	15.79	16.00	No
		60	5300	15.71	16.00	No
		64	5320	15.41	16.00	No
	802.11n(HT20)	52	5260	15.85	16.00	No
		60	5300	15.58	16.00	No
		64	5320	15.67	16.00	No
	802.11n(HT40)	54	5270	15.87	16.00	Yes
		62	5310	15.78	16.00	Yes
	802.11ac(VHT20)	52	5260	15.83	16.00	No
		60	5300	15.64	16.00	No

		64	5320	15.85	16.00	No
	802.11ac(VHT40)	54	5270	15.83	16.00	No
		62	5310	15.45	16.00	No
	802.11ac(VHT80)	58	5290	15.63	16.00	No
	802.11ax(HE20)	52	5260	15.88	16.00	No
		60	5300	15.46	16.00	No
		64	5320	15.74	16.00	No
	802.11ax(HE40)	54	5270	15.80	16.00	No
		62	5310	15.41	16.00	No
	802.11ax(HE80)	58	5290	15.57	16.00	No
	802.11ax(RU26)	52	5260	9.71	10.00	No
		60	5300	10.43	11.00	No
		64	5320	9.62	10.00	No
	802.11ax(RU52)	52	5260	12.48	13.00	No
		60	5300	12.78	13.00	No
		64	5320	11.07	12.00	No
	802.11ax(RU106)	52	5260	13.56	14.00	No
		60	5300	13.71	14.00	No
		64	5320	13.52	14.00	No
5.6 (5.47~5.725)	802.11a	100	5500	15.84	16.00	No
		116	5580	15.78	16.00	No
		140	5700	15.79	16.00	No
		144	5720	15.66	16.00	No
	802.11n(HT20)	100	5500	15.82	16.00	No
		116	5580	15.76	16.00	No
		140	5700	15.63	16.00	No
		144	5720	15.56	16.00	No
	802.11n(HT40)	102	5510	15.08	16.00	No
		110	5550	15.72	16.00	No
		134	5670	15.61	16.00	No
		142	5710	15.41	16.00	No
	802.11ac(VHT20)	100	5500	15.89	16.00	No
		116	5580	15.58	16.00	No
		140	5700	15.61	16.00	No
		144	5720	15.49	16.00	No
	802.11ac(VHT40)	102	5510	14.60	16.00	No
		110	5550	15.67	16.00	No
		134	5670	15.63	16.00	No
		142	5710	15.53	16.00	No
	802.11ac(VHT80)	106	5530	14.74	16.00	Yes
		122	5610	15.85	16.00	Yes
		138	5690	15.74	16.00	Yes
	802.11ax(HE20)	100	5500	15.67	16.00	No

		116	5580	15.82	16.00	No
		140	5700	15.49	16.00	No
		144	5720	15.74	16.00	No
	802.11ax(HE40)	102	5510	15.20	16.00	No
		110	5550	15.61	16.00	No
		134	5670	15.91	16.00	No
		142	5710	15.72	16.00	No
	802.11ax(HE80)	106	5530	14.95	16.00	No
		122	5610	15.81	16.00	No
		138	5690	15.68	16.00	No
	802.11ax(RU26)	100	5500	9.53	10.00	No
		116	5580	9.88	10.00	No
		140	5700	9.33	10.00	No
		144	5720	11.09	12.00	No
		144	5720	10.74	11.00	No
	802.11ax(RU52)	100	5500	11.51	12.00	No
		116	5580	11.19	12.00	No
		140	5700	10.84	11.00	No
		144	5720	11.97	12.00	No
		144	5720	12.05	13.00	No
	802.11ax(RU106)	100	5500	13.08	14.00	No
		116	5580	13.22	14.00	No
		140	5700	13.20	14.00	No
		144	5720	11.66	12.00	No
		144	5720	13.01	14.00	No
5.8 (5.725~5.850)	802.11a	149	5745	15.45	16.00	No
		157	5785	15.78	16.00	No
		165	5825	15.55	16.00	No
	802.11n(HT20)	149	5745	15.56	16.00	No
		157	5785	15.84	16.00	No
		165	5825	15.65	16.00	No
	802.11n(HT40)	151	5755	15.63	16.00	No
		159	5795	15.53	16.00	No
	802.11ac(VHT20)	149	5745	15.48	16.00	No
		157	5785	15.58	16.00	No
		165	5825	15.55	16.00	No
	802.11ac(VHT40)	151	5755	15.41	16.00	No
		159	5795	15.47	16.00	No
	802.11ac(VHT80)	155	5775	15.62	16.00	Yes
	802.11ax(HE20)	149	5745	15.53	16.00	No
		157	5785	15.56	16.00	No
		165	5825	15.48	16.00	No
	802.11ax(HE40)	151	5755	15.84	16.00	No

		159	5795	15.85	16.00	No
	802.11ax(HE80)	155	5775	15.49	16.00	No
	802.11ax(RU26)	149	5745	15.75	16.00	No
		157	5785	15.71	16.00	No
		165	5825	15.73	16.00	No
	802.11ax(RU52)	149	5745	15.47	16.00	No
		157	5785	15.61	16.00	No
		165	5825	15.41	16.00	No
	802.11ax(RU106)	149	5745	15.63	16.00	No
		157	5785	15.65	16.00	No
		165	5825	15.48	16.00	No

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 among the multiple configurations in a frequency band with the same maximum Tune-Up output power.
- 2) If multiple configurations have the same maximum Tune-Up output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
- 3) If multiple configurations have the same maximum Tune-Up output power, largest channel bandwidth and lowest order modulation is selected.
- 4) When multiple transmission modes (802.11a/n/ac/ax) have the same maximum Tune-Up output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac and 802.11ac and 802.11ax.
- 5) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.

8.1.4 5G WIFI (Main Antenna)

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)	Tune-up Power Limit (dBm)	SAR Test Require.
5.2 (5.15~5.25)	802.11a	36	5180	15.49	16.00	No
		40	5200	15.84	16.00	No
		48	5240	15.79	16.00	No
	802.11n(HT20)	36	5180	15.62	16.00	No
		40	5200	15.61	16.00	No
		48	5240	15.66	16.00	No
	802.11n(HT40)	38	5190	15.87	16.00	No
		46	5230	15.52	16.00	No
	802.11ac(VHT20)	36	5180	15.58	16.00	No
		40	5200	15.85	16.00	No
		48	5240	15.83	16.00	No
	802.11ac(VHT40)	38	5190	15.56	16.00	No
		46	5230	15.59	16.00	No
	802.11ac(VHT80)	42	5210	15.08	16.00	No
	802.11ax(HE20)	36	5180	15.48	16.00	No
		40	5200	15.46	16.00	No
		48	5240	15.67	16.00	No
	802.11ax(HE40)	38	5190	15.77	16.00	No
		46	5230	15.55	16.00	No
	802.11ax(HE80)	42	5210	15.87	16.00	No
	802.11ax(RU26)	36	5180	8.80	9.00	No
		40	5200	10.28	11.00	No
		48	5240	9.54	10.00	No
	802.11ax(RU52)	36	5180	11.18	12.00	No
		40	5200	11.72	12.00	No
		48	5240	11.16	12.00	No
	802.11ax(RU106)	36	5180	13.48	14.00	No
		40	5200	13.67	14.00	No
		48	5240	13.69	14.00	No
5.3 (5.25~5.35)	802.11a	52	5260	15.76	16.00	No
		60	5300	15.74	16.00	No
		64	5320	15.71	16.00	No
	802.11n(HT20)	52	5260	15.77	16.00	No
		60	5300	15.52	16.00	No
		64	5320	15.51	16.00	No
	802.11n(HT40)	54	5270	15.75	16.00	Yes
		62	5310	15.77	16.00	Yes
	802.11ac(VHT20)	52	5260	15.73	16.00	No
		60	5300	15.53	16.00	No

		64	5320	15.51	16.00	No
	802.11ac(VHT40)	54	5270	15.59	16.00	No
		62	5310	15.67	16.00	No
	802.11ac(VHT80)	58	5290	15.78	16.00	No
	802.11ax(HE20)	52	5260	15.75	16.00	No
		60	5300	15.82	16.00	No
		64	5320	15.69	16.00	No
	802.11ax(HE40)	54	5270	15.57	16.00	No
		62	5310	15.75	16.00	No
	802.11ax(HE80)	58	5290	15.56	16.00	No
	802.11ax(RU26)	52	5260	8.95	9.00	No
		60	5300	10.28	11.00	No
		64	5320	9.13	10.00	No
	802.11ax(RU52)	52	5260	11.12	12.00	No
		60	5300	11.84	12.00	No
		64	5320	11.07	12.00	No
	802.11ax(RU106)	52	5260	13.42	14.00	No
		60	5300	13.62	14.00	No
		64	5320	13.48	14.00	No
5.6 (5.47~5.725)	802.11a	100	5500	15.79	16.00	No
		116	5580	15.75	16.00	No
		140	5700	15.84	16.00	No
		144	5720	15.52	16.00	No
	802.11n(HT20)	100	5500	15.88	16.00	No
		116	5580	15.48	16.00	No
		140	5700	15.74	16.00	No
		144	5720	15.45	16.00	No
	802.11n(HT40)	102	5510	15.05	16.00	No
		110	5550	15.89	16.00	No
		134	5670	15.74	16.00	No
		142	5710	15.81	16.00	No
	802.11ac(VHT20)	100	5500	15.42	16.00	No
		116	5580	15.78	16.00	No
		140	5700	15.51	16.00	No
		144	5720	15.62	16.00	No
	802.11ac(VHT40)	102	5510	14.56	16.00	No
		110	5550	15.51	16.00	No
		134	5670	15.58	16.00	No
		142	5710	15.71	16.00	No
	802.11ac(VHT80)	106	5530	15.19	16.00	Yes
		122	5610	15.83	16.00	Yes
		138	5690	15.79	16.00	Yes
	802.11ax(HE20)	100	5500	15.48	16.00	No

		116	5580	15.75	16.00	No
		140	5700	15.46	16.00	No
		144	5720	15.91	16.00	No
	802.11ax(HE40)	102	5510	14.97	16.00	No
		110	5550	15.71	16.00	No
		134	5670	15.55	16.00	No
		142	5710	15.75	16.00	No
	802.11ax(HE80)	106	5530	14.82	16.00	No
		122	5610	15.78	16.00	No
		138	5690	15.69	16.00	No
	802.11ax(RU26)	100	5500	9.41	10.00	No
		116	5580	10.61	11.00	No
		140	5700	9.33	10.00	No
		144	5720	9.16	10.00	No
		144	5720	9.17	10.00	No
	802.11ax(RU52)	100	5500	11.20	12.00	No
		116	5580	11.65	12.00	No
		140	5700	10.42	11.00	No
		144	5720	9.72	10.00	No
		144	5720	12.73	13.00	No
	802.11ax(RU106)	100	5500	13.19	14.00	No
		116	5580	12.69	13.00	No
		140	5700	13.18	14.00	No
		144	5720	10.97	11.00	No
		144	5720	13.58	14.00	No
5.8 (5.725~5.850)	802.11a	149	5745	15.51	16.00	No
		157	5785	15.67	16.00	No
		165	5825	15.64	16.00	No
	802.11n(HT20)	149	5745	15.46	16.00	No
		157	5785	15.77	16.00	No
		165	5825	15.48	16.00	No
	802.11n(HT40)	151	5755	15.62	16.00	No
		159	5795	15.69	16.00	No
	802.11ac(VHT20)	149	5745	15.69	16.00	No
		157	5785	15.55	16.00	No
		165	5825	15.81	16.00	No
	802.11ac(VHT40)	151	5755	15.48	16.00	No
		159	5795	15.80	16.00	No
	802.11ac(VHT80)	155	5775	15.61	16.00	Yes
	802.11ax(HE20)	149	5745	15.87	16.00	No
		157	5785	15.75	16.00	No
		165	5825	15.49	16.00	No
	802.11ax(HE40)	151	5755	15.50	16.00	No

		159	5795	15.51	16.00	No
	802.11ax(HE80)	155	5775	15.65	16.00	No
	802.11ax(RU26)	149	5745	15.75	16.00	No
		157	5785	15.86	16.00	No
		165	5825	15.46	16.00	No
	802.11ax(RU52)	149	5745	15.72	16.00	No
		157	5785	15.62	16.00	No
		165	5825	15.71	16.00	No
	802.11ax(RU106)	149	5745	15.75	16.00	No
		157	5785	15.83	16.00	No
		165	5825	15.71	16.00	No

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 among the multiple configurations in a frequency band with the same maximum Tune-Up output power.
- 2) If multiple configurations have the same maximum Tune-Up output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
- 3) If multiple configurations have the same maximum Tune-Up output power, largest channel bandwidth and lowest order modulation is selected.
- 4) When multiple transmission modes (802.11a/n/ac/ax) have the same maximum Tune-Up output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac and 802.11ac and 802.11ax.
- 5) When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.

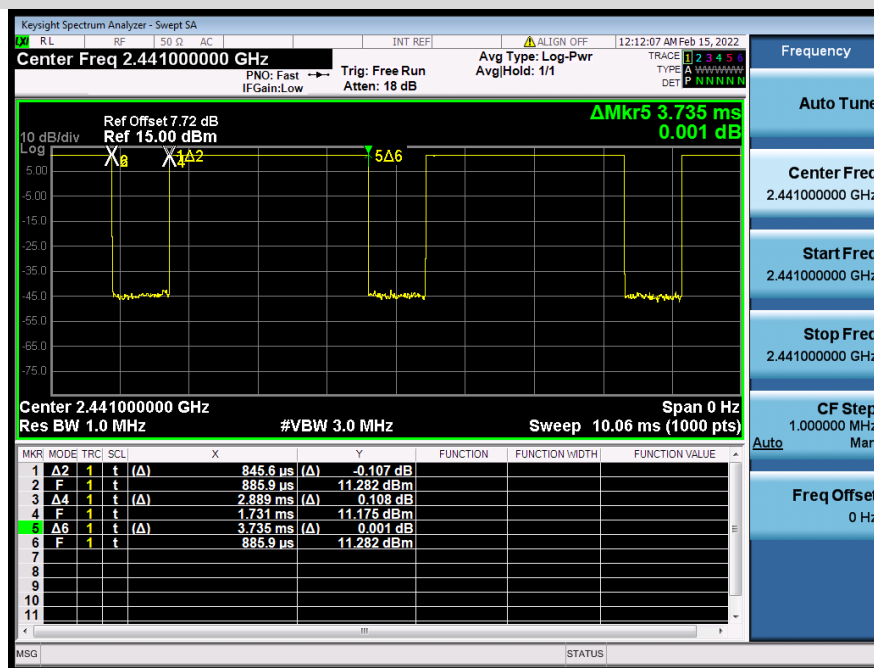
8.2 Bluetooth (Aux. Antenna)

Mode	GFSK			8-DPSK		
Channel	0	39	78	0	39	78
Frequency (MHz)	2402	2441	2480	2402	2441	2480
Conducted Power (dBm)	11.84	12.04	11.74	8.98	8.88	9.08
Tune-Up Limit (dBm)	12.50	12.50	12.50	9.50	9.50	9.50
SAR Test Require	Yes	Yes	Yes	No	No	No
Mode	BLE-1Mbps			BLE-2Mbps		
Channel	0	39	78	0	19	39
Frequency (MHz)	2402	2440	2480	2402	2440	2480
Conducted Power (dBm)	11.07	11.30	10.87	11.31	10.71	11.10
Tune-Up Limit (dBm)	11.50	11.50	11.50	11.50	11.50	11.50
SAR Test Require	No	No	No	No	No	No

Note: The Bluetooth duty cycle is 77.36 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the maximum duty cycle is 100%, therefore the actual duty cycle will be scaled up to 100% for Bluetooth reported SAR calculation.

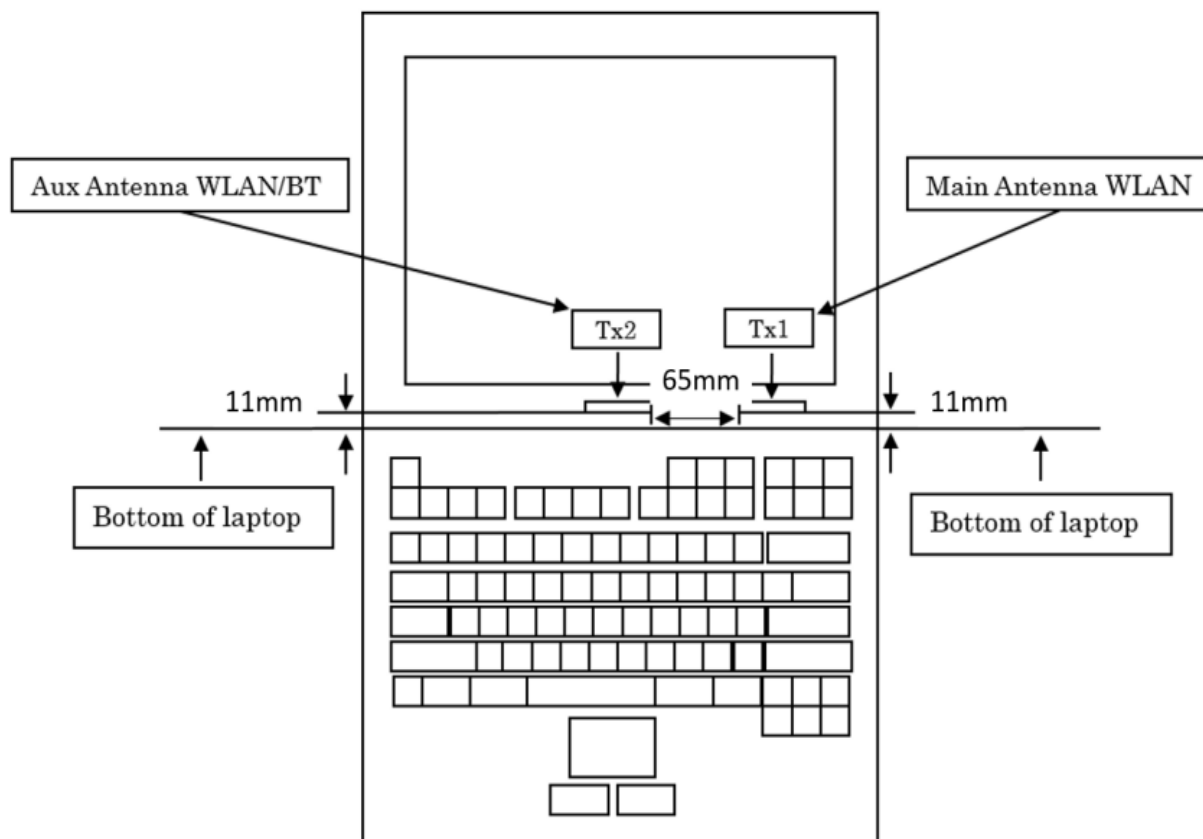
Duty Cycle

8-DPSK



9 TEST EXCLUSION CONSIDERATION

9.1 Laptop Mode antenna location sketch



9.2 SAR Test Consideration Table

According with FCC KDB 447498 D04, Appendix B, The SAR-based exemption formula applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold Pth (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). The following table shows the power threshold from 5mm to 50mm.

Power Thresholds (mW)					
Frequency (MHz)	At separation distance of ≤ 5 mm	At separation distance of 10 mm	At separation distance of 15 mm	At separation distance of 20 mm	At separation distance of 25 mm
300	39 mW	65 mW	88 mW	110 mW	129 mW
450	22 mW	44 mW	67 mW	89 mW	112 mW
835	9 mW	25 mW	44 mW	66 mW	90 mW
1900	3 mW	12 mW	26 mW	44 mW	66 mW
2450	3 mW	10 mW	22 mW	38 mW	59 mW
3600	2 mW	8 mW	18 mW	32 mW	49 mW
5800	1 mW	6 mW	14 mW	25 mW	40 mW
Frequency (MHz)	At separation distance of 30 mm	At separation distance of 35 mm	At separation distance of 40 mm	At separation distance of 45 mm	At separation distance of 50 mm
300	148 mW	166 mW	184 mW	201 mW	217 mW
450	135 mW	158 mW	180 mW	203 mW	226 mW
835	116 mW	145 mW	175 mW	207 mW	240 mW
1900	92 mW	122 mW	157 mW	195 mW	236 mW
2450	83 mW	111 mW	143 mW	179 mW	219 mW
3600	71 mW	96 mW	125 mW	158 mW	195 mW
5800	58 mW	80 mW	106 mW	136 mW	169 mW

9.2.1 Laptop mode SAR Test Consideration

Aux. Antenna

Band	Mode	Max. Conducted Power		Test Position Configurations
		dBm	mW	Bottom Edge
WLAN 2.4 G	Distance to User			<5mm
	802.11b	16.50	44.67	Yes
	802.11g	16.50	44.67	No
	802.11n(HT20)	16.50	44.67	No
	802.11n(HT40)	16.50	44.67	No
	VHT(20 MHz)	16.50	44.67	No
	VHT(40 MHz)	16.50	44.67	No
	802.11ax(HE20)	16.50	44.67	No
	802.11ax(HE40)	16.50	44.67	No
WLAN 5.2 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	No
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.3 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.6 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes

	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.8 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
Bluetooth	Distance to User			<5mm
	BR/EDR	12.50	17.78	Yes
	BLE	11.50	14.13	No

Main Antenna

Band	Mode	Max. Conducted Power		Test Position Configurations
		dBm	mW	Bottom Edge
WLAN 2.4 G	Distance to User			<5mm
	802.11b	16.50	44.67	Yes
	802.11g	16.50	44.67	No
	802.11n(HT20)	16.50	44.67	No
	802.11n(HT40)	16.50	44.67	No
	VHT(20 MHz)	16.50	44.67	No
	VHT(40 MHz)	16.50	44.67	No
	802.11ax(HE20)	16.50	44.67	No
	802.11ax(HE40)	16.50	44.67	No
WLAN 5.2 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	No
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.3 G	Distance to User			<5mm
	802.11a	16.00	39.81	No

	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.6 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No
WLAN 5.8 G	Distance to User			<5mm
	802.11a	16.00	39.81	No
	802.11n(HT20)	16.00	39.81	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	16.00	39.81	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	16.00	39.81	Yes
	802.11ax(HE20)	16.00	39.81	No
	802.11ax(HE40)	16.00	39.81	No
	802.11ax(HE80)	16.00	39.81	No

- Maximum power is the source-based time-average power and represents the maximum RF output power including tune-up tolerance among production units
- Per KDB 447498 D04, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
- Per KDB 447498 D04, standalone SAR test exclusion threshold is applied; If the distance of the antenna to the user is < 5mm, 5mm is used to determine SAR exclusion threshold
- Per KDB 447498 D04, for separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive), the threshold P_{th} (mW) is given by Following:

$$P_{th}(mW) = \begin{cases} ERP_{20cm}(d/20cm)^x & d \leq 20cm \\ ERP_{20cm} & 20cm < d \leq 40cm \end{cases}$$

where

$$x = -\log_{10} \left(\frac{60}{ERP_{20cm}\sqrt{f}} \right)$$

- a. f(GHz) is the RF channel transmit frequency in GHz

b. d is the separation distance (cm), The result is rounded to one decimal place for comparison

c. ERP_{20cm} are determined by:

$$ERP_{20cm}(mW) = f(x) = \begin{cases} 2040f & 0.3GHz \leq f < 1.5GHz \\ 3060 & 1.5GHz \leq f \leq 6GHz \end{cases}$$

5. Per KDB 248227 D01, choose the highest output power channel to test SAR and determine further SAR exclusion.8.
For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate
6. Per KDB 248227 D01 SAR is not required for the following 2.4 GHz OFDM conditions.
 - a. When KDB Publication 447498 D04 SAR test exclusion applies to the OFDM configuration.
 - b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
7. Per KDB 248227 D01 SAR is not required for the following U-NII-1 and U-NII-2A bands conditions.
 - a. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements. If the highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, each band is tested independently for SAR.
 - a. b. When different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

10 TEST RESULT

10.1 Bluetooth

Mode	Antenna	Position	Antenna Manufacturer	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1 g Meas SAR (W/kg)	Meas. Power (dBm)	Max. tune- up power (dBm)	Scaling Factor	Duty cycle (%)	Duty cycle Factor	1g Scaled SAR (W/kg)	Meas. No.
Body															
DH5	Aux	Bottom Side	South Star	0	39	2441	0.14	0.065	12.04	12.50	1.111	77.36	1.293	0.093	/
			ZhongTianXun	0	39	2441	0.08	0.076	12.04	12.50	1.111	77.36	1.293	0.109	/
				0	0	2402	0.08	0.085	11.84	12.50	1.163	77.36	1.293	0.128	1#
				0	78	2480	-0.11	0.075	11.74	12.50	1.192	77.36	1.293	0.116	/
Note: Refer to ANNEX C for the detailed test data for each test configuration.															

10.2 WIFI 2.4GHz

Mode	Antenna	Position	Antenna Manufacturer	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1 g Meas SAR (W/kg)	Meas. Power (dBm)	Max. tune- up power (dBm)	Scaling Factor	Duty cycle (%)	Duty cycle Factor	1g Scaled SAR (W/kg)	Meas. No.	
Body																
802.11b	Main-S0	Bottom Side	South Star	0	11	2462	0.01	0.094	16.14	16.50	1.086	99.59	1.004	0.103	/	
				0	1	2412	-0.06	0.099	15.95	16.50	1.135	99.59	1.004	0.113	2#	
				0	6	2437	0.08	0.097	16.04	16.50	1.112	99.59	1.004	0.108	/	
			ZhongTianXun	0	11	2462	-0.06	0.023	16.14	16.50	1.086	99.59	1.004	0.025	/	
	Aux-S1	Bottom Side	South Star	0	1	2412	0.14	0.148	16.27	16.50	1.054	99.59	1.004	0.157	/	
				0	6	2437	-0.13	0.179	16.19	16.50	1.074	99.59	1.004	0.193	3#	
				0	11	2462	0.07	0.133	16.07	16.50	1.104	99.59	1.004	0.147	/	
			ZhongTianXun	0	1	2412	-0.05	0.135	16.27	16.50	1.054	99.59	1.004	0.143	/	
			Note: Refer to ANNEX C for the detailed test data for each test configuration.													

10.3WIFI 5GHz

Fre. Band	Mode	Antenna	Position	Antenna Manufacturer	Dist. (mm)	Ch.	Freq. (MHz)	Power Drift (dB)	1 g Meas SAR (W/kg)	Meas. Power (dBm)	Max. tune-up power (dBm)	Scaling Factor	Duty cycle (%)	Duty cycle Factor	1g Scaled SAR (W/kg)	Meas. No.
Body																
5.3G	802.11 ac80	Main-S0	Bottom Side	South Star	0	58	5290	0.00	0.179	15.78	16.00	1.052	90.91	1.100	0.207	4#
				ZhongTianXun	0	58	5290	-0.09	0.164	15.78	16.00	1.052	90.91	1.100	0.190	/
		Aux-S1	Bottom Side	South Star	0	58	5290	0.04	0.260	15.63	16.00	1.089	90.91	1.100	0.311	/
				ZhongTianXun	0	58	5290	0.18	0.321	15.63	16.00	1.089	90.91	1.100	0.384	5#
Body																
5.6G	802.11 ac80	Main-S0	Bottom Side	South Star	0	122	5610	-0.13	0.258	15.83	16.00	1.040	90.91	1.100	0.295	/
					0	106	5530	-0.16	0.117	15.19	16.00	1.205	90.91	1.100	0.155	/
					0	138	5690	-0.10	0.280	15.79	16.00	1.050	90.91	1.100	0.323	6#
				ZhongTianXun	0	122	5610	0.01	0.155	15.83	16.00	1.040	90.91	1.100	0.177	/
		Aux-S1	Bottom Side	South Star	0	122	5610	-0.09	0.383	15.85	16.00	1.035	90.91	1.100	0.436	/
					0	106	5530	-0.14	0.161	14.74	16.00	1.337	90.91	1.100	0.237	/
					0	138	5690	0.02	0.402	15.74	16.00	1.062	90.91	1.100	0.469	7#
				ZhongTianXun	0	122	5610	-0.18	0.336	15.85	16.00	1.035	90.91	1.100	0.383	/
Body																
5.8G	802.11 ac80	Main-S0	Bottom Side	South Star	0	155	5775	-0.16	0.349	15.61	16.00	1.094	90.91	1.100	0.420	8#
				ZhongTianXun	0	155	5775	0.15	0.110	15.61	16.00	1.094	90.91	1.100	0.132	/
		Aux-S1	Bottom Side	South Star	0	155	5775	0.14	0.259	15.62	16.00	1.091	90.91	1.100	0.311	9#
				ZhongTianXun	0	155	5775	-0.19	0.238	15.62	16.00	1.091	90.91	1.100	0.286	/
Note: Refer to ANNEX C for the detailed test data for each test configuration.																

11 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10 , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement procedure:

1. When the highest measured SAR is < 0.80 W/kg, repeated measurement is not required.
2. When the highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 , or when the original or repeated measurement is ≥ 1.45 W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 , and the original, first or second repeated measurement is ≥ 1.5 W/kg, perform a third repeated measurement.

Note: For 1g SAR, the highest measured 1g SAR is $0.402 < 0.80$ W/kg, repeated measurement is not required.

12 SIMULTANEOUS TRANSMISSION

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR 1g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR 1g 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR 1g is greater than the SAR limit (SAR 1g 1.6 W/kg), SAR test exclusion is determined by the SAR to Peak Location Ratio (SPLSR).

According KDB 447498 D04, simultaneous transmission:

- a) $SPLSR = (SAR1 + SAR2)^{1.5} / R_i$ (min. 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.
SAR1 is the highest reported or estimated SAR for the first of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition.
SAR2 is the highest reported or estimated SAR for the second of a pair of simultaneous transmitting antennas, in a specific test operating mode and exposure condition as the first.
- b) If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
- c) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.

12.1 Simultaneous Transmission Mode Considerations

NO.	Mode	Body
1	2.4 G WLAN (Main Antenna)	+ 2.4 G WLAN (Auxiliary Antenna)
2	5 G WLAN (Main Antenna)	+ 5 G WLAN (Auxiliary Antenna)
3	5 G WLAN (Main Antenna)	+ Bluetooth (Auxiliary Antenna)
4	5 G WLAN (Auxiliary Antenna)	+ Bluetooth (Auxiliary Antenna)

Note:

1. The EUT supports the Auxiliary antenna with TX/RX diversity function for WLAN and Bluetooth, the Main antenna with TX/RX diversity function for WLAN.
2. WLAN 2.4GHz and Bluetooth will not be transmitting from the Auxiliary antenna at same time.

12.2 Sum SAR of Simultaneous Transmission

12.2.1 Highest Bluetooth and WLAN Sum Body SAR of Simultaneous Transmission

Simultaneous Mode	Mode	Max. 1g SAR (W/kg)	1g Sum SAR (W/kg)	SPLSR
Body (Separation 0 mm)				
2.4 G WLAN (Main Antenna) + 2.4 G WLAN (Auxiliary Antenna)	2.4 G WLAN (Main Antenna)	0.113	0.306	No
	2.4 G WLAN (Auxiliary Antenna)	0.193		
5 G WLAN (Main Antenna) + 5 G WLAN (Auxiliary Antenna)	5 G WLAN (Main Antenna)	0.323	0.792	No
	5 G WLAN (Auxiliary Antenna)	0.469		
5 G WLAN (Main Antenna) + Bluetooth (Auxiliary Antenna)	5 G WLAN (Main Antenna)	0.323	0.451	No
	Bluetooth (Auxiliary Antenna)	0.128		
5 G WLAN (Auxiliary Antenna) + Bluetooth (Auxiliary Antenna)	5 G WLAN (Auxiliary Antenna)	0.469	0.597	No
	Bluetooth (Auxiliary Antenna)	0.128		

13 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No./Version	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
Test Software	Speag	DASY5	52.8.8.1222	N/A	N/A
2450MHz Validation Dipole	Speag	D2450V2	SN: 952	2021/05/19	2024/05/18
5GHz Validation Dipole	Speag	D5GHzV2	SN: 1200	2021/05/18	2024/05/17
E-Field Probe	Speag	EX3DV4	SN: 7607	2021/08/12	2022/08/11
Data Acquisition Electronics	Speag	DAE4	SN: 1454	2021/11/05	2022/11/04
Signal Generator	R&S	SMB100A	177746	2021/08/24	2022/08/23
Power Meter	R&S	NRVD-B2	7250BJ-0112/2011	2021/09/08	2022/09/07
Power Sensor	R&S	NRV-Z4	100381	2021/09/08	2022/09/07
Power Sensor	R&S	NRV-Z2	100211	2021/09/08	2022/09/07
Network Analyzer	Agilent	E5071B	MY42404001	2021/04/01	2022/03/31
Thermometer	Elitech	RC-4HC	EF720B004820	2021/12/01	2022/11/30
Power Amplifier	SATIMO	6552B	22374	N/A	N/A
Dielectric Probe Kit	SATIMO	SCLMP	SN 25/13 OCPG56	N/A	N/A
Phantom1	Speag	SAM	SN: 1859	N/A	N/A
Phantom2	Speag	ELI4	SN: 1012	N/A	N/A
Attenuator	COM-MW	ZA-S1-31	1305003187	N/A	N/A
Directional coupler	AA-MCS	AAMCS-UDC	000272	N/A	N/A

Note: For dipole antennas, BALUN has adopted 3 years as calibration intervals, and on annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss in within 20% of calibrated measurement.
4. Impedance (real or imaginary parts) in within 5 Ohms of calibrated measurement.

ANNEX A SIMULATING LIQUID VERIFICATION RESULT

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SCLMP Dielectric Probe Kit.

Date	Liquid Type	Fre. (MHz)	Temp. (°C)	Meas. Conductivity (σ) (S/m)	Meas. Permittivity (ϵ)	Target Conductivity (σ) (S/m)	Target Permittivity (ϵ)	Conductivity Tolerance (%)	Permittivity Tolerance (%)
2022.02.15	Head	2450	21.2	1.80	39.59	1.80	39.20	0.00	0.99
2022.03.03	Head	5250	21.1	4.70	35.96	4.66	35.99	0.86	-0.08
2022.02.24	Head	5600	21.4	5.05	35.19	5.07	35.53	-0.39	-0.96
2022.03.07	Head	5750	21.3	5.17	35.58	5.27	35.30	-1.90	0.79
Note: The tolerance limit of Conductivity and Permittivity is $\pm 5\%$.									

ANNEX B SYSTEM CHECK RESULT

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 % (for 1 g).

Date	Liquid Type	Freq. (MHz)	Power (mW)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Dipole SAR (W/kg)	Tolerance (%)
2022.02.15	Head	2450	100	5.360	53.60	52.60	1.90
2022.03.03	Head	5250	100	7.590	75.90	73.90	2.71
2022.02.24	Head	5600	100	8.510	85.10	80.30	5.98
2022.03.07	Head	5750	100	7.760	77.60	76.90	0.91
Note: The tolerance limit of System validation $\pm 10\%$.							

System Performance Check Data (2450MHz Head)

Date: 2022.02.15

Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.802$ S/m; $\epsilon_r = 39.592$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(7.68, 7.68, 7.68); Calibrated: 2021.08.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 2450 100mw/Area Scan (101x101x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 6.32 W/kg

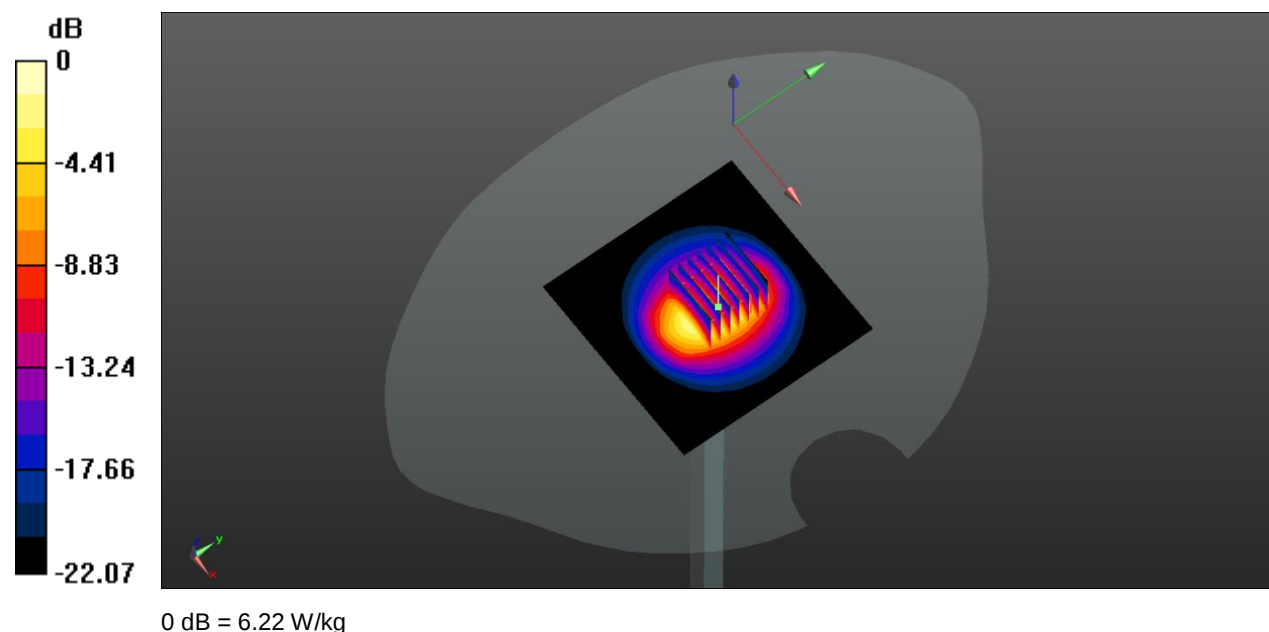
CW 2450 100mw/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 58.07 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 11.7 W/kg

SAR(1 g) = 5.36 W/kg; SAR(10 g) = 2.43 W/kg

Maximum value of SAR (measured) = 6.22 W/kg



System Performance Check Data (5250MHz Head)

Date: 2022.03.03

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5250 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.696$ S/m; $\epsilon_r = 35.96$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.2 Liquid Temperature: 21.1

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(5.46, 5.46, 5.46); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 5250 100mW/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 8.11 W/kg

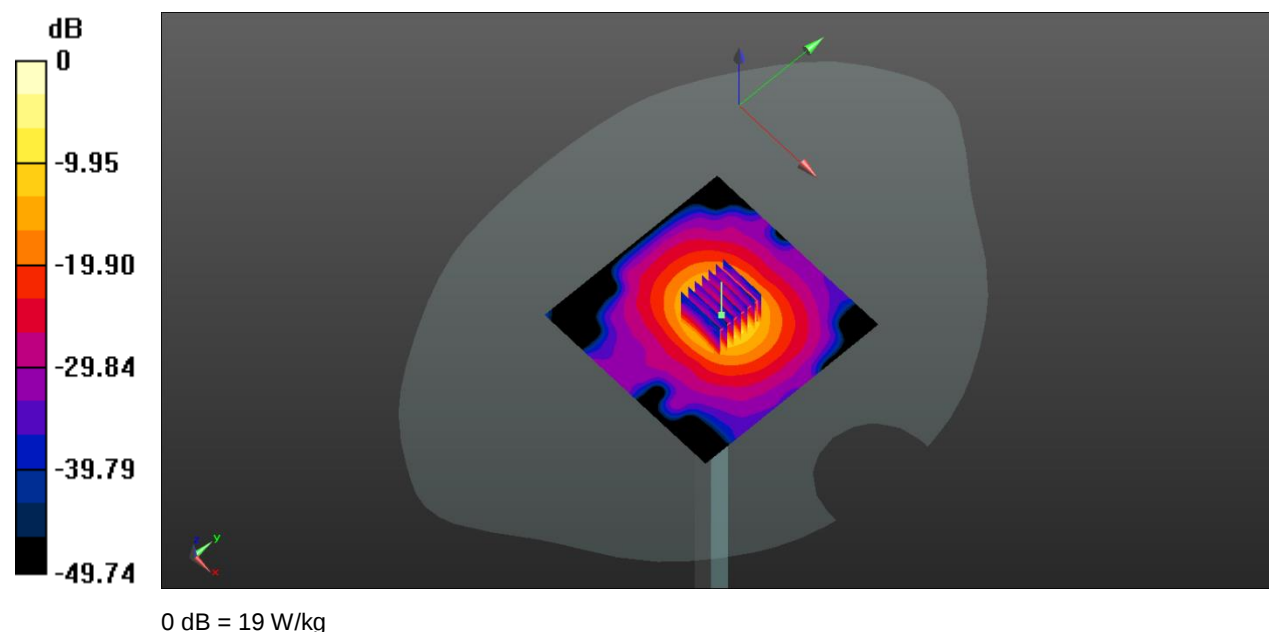
CW 5250 100mW/Zoom Scan (7x7x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 36.55 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 7.59 W/kg; SAR(10 g) = 2.15 W/kg

Maximum value of SAR (measured) = 19.1 W/kg



System Performance Check Data (5600MHz Head)

Date: 2022.02.24

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5600 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.052$ S/m; $\epsilon_r = 35.186$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.6 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.88, 4.88, 4.88); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 5600 100mW/Area Scan (81x81x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 9.85 W/kg

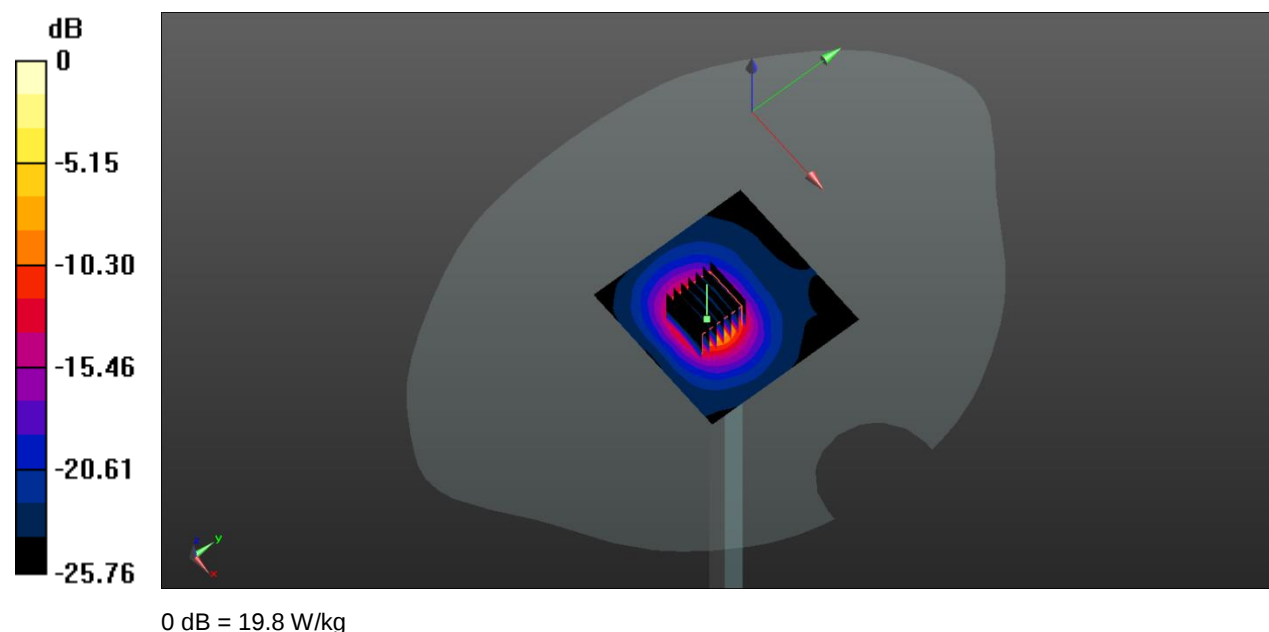
CW 5600 100mW/Zoom Scan (7x7x15)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 26.78 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 41.4 W/kg

SAR(1 g) = 8.51 W/kg; SAR(10 g) = 2.41 W/kg

Maximum value of SAR (measured) = 19.8 W/kg



System Performance Check Data (5750MHz Head)

Date: 2022.03.07

Communication System Band: D5GHz (5000.0 - 6000.0 MHz); Frequency: 5750 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.172$ S/m; $\epsilon_r = 35.577$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.92, 4.92, 4.92); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 5750 100mW/Area Scan (81x101x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 8.48 W/kg

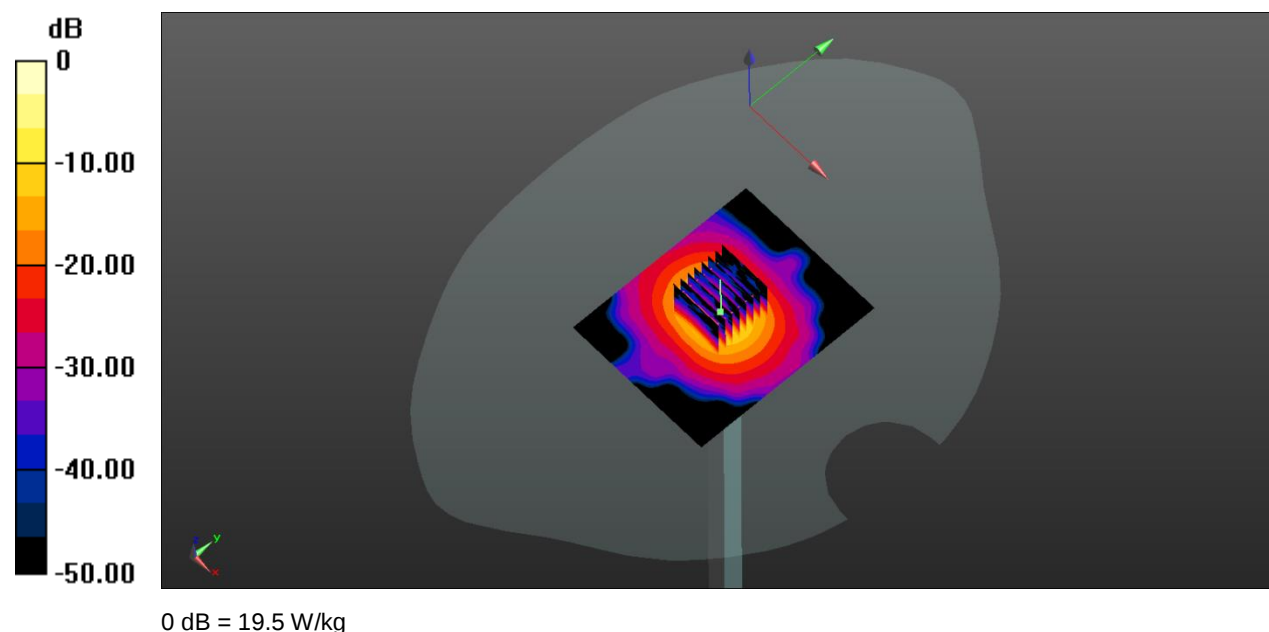
CW 5750 100mW/Zoom Scan (8x8x21)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 36.33 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 35.42 W/kg

SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.18 W/kg

Maximum value of SAR (measured) = 19.5 W/kg



ANNEX C TEST DATA

Meas.1 Body Plane with Bottom Side 0mm on Low Channel in Bluetooth mode

Date: 2022.02.15

Communication System Band: BT; Frequency: 2402 MHz; Duty Cycle: 1:1.293

Medium parameters used (interpolated): $f = 2402$ MHz; $\sigma = 1.746$ S/m; $\epsilon_r = 39.936$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(7.68, 7.68, 7.68); Calibrated: 2021.08.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch0/Area Scan (81x81x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 0.100 W/kg

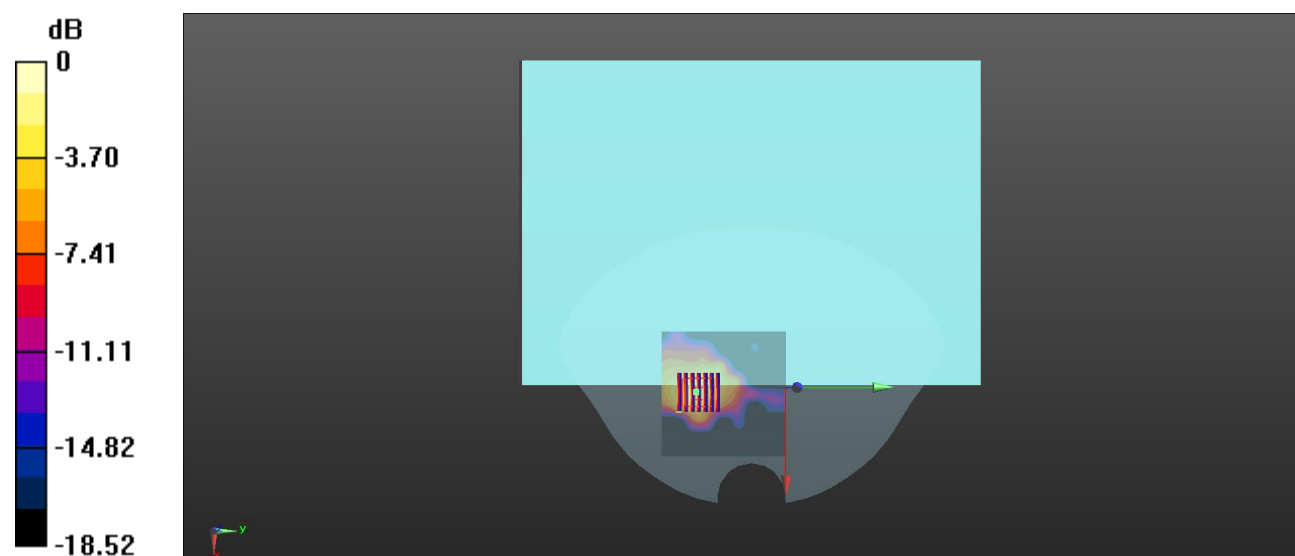
Ch0/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 2.038 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.173 W/kg

SAR(1 g) = 0.085 W/kg; SAR(10 g) = 0.039 W/kg

Maximum value of SAR (measured) = 0.0969 W/kg



0 dB = 0.0969 W/kg

Meas.2 Body Plane with Bottom Side 0mm on Low Channel in IEEE802.11b with Antenna Main

Date: 2022.02.15

Communication System Band: WLAN(b); Frequency: 2412 MHz; Duty Cycle: 1:1.004

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.757$ S/m; $\epsilon_r = 39.859$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.3 Liquid Temperature:21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(7.68, 7.68, 7.68); Calibrated: 2021.08.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.145 W/kg

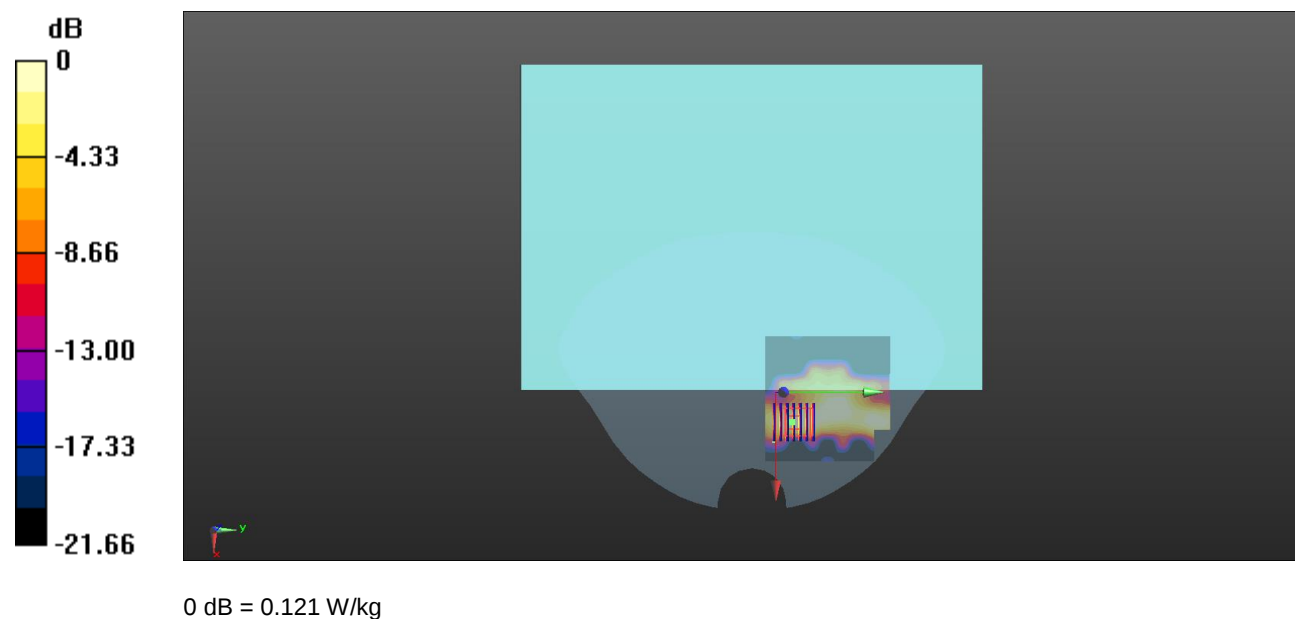
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.984 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.179 W/kg

SAR(1 g) = 0.099 W/kg; SAR(10 g) = 0.039 W/kg

Maximum value of SAR (measured) = 0.121 W/kg



Meas.3 Body Plane with Bottom Side 0mm on Middle Channel in IEEE802.11b mode with Antenna Auxiliary

Date: 2022.02.15

Communication System Band: WLAN(b); Frequency: 2437 MHz; Duty Cycle: 1:1.004

Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.784$ S/m; $\epsilon_r = 39.693$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(7.68, 7.68, 7.68); Calibrated: 2021.08.12;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch6/Area Scan (81x81x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 0.208 W/kg

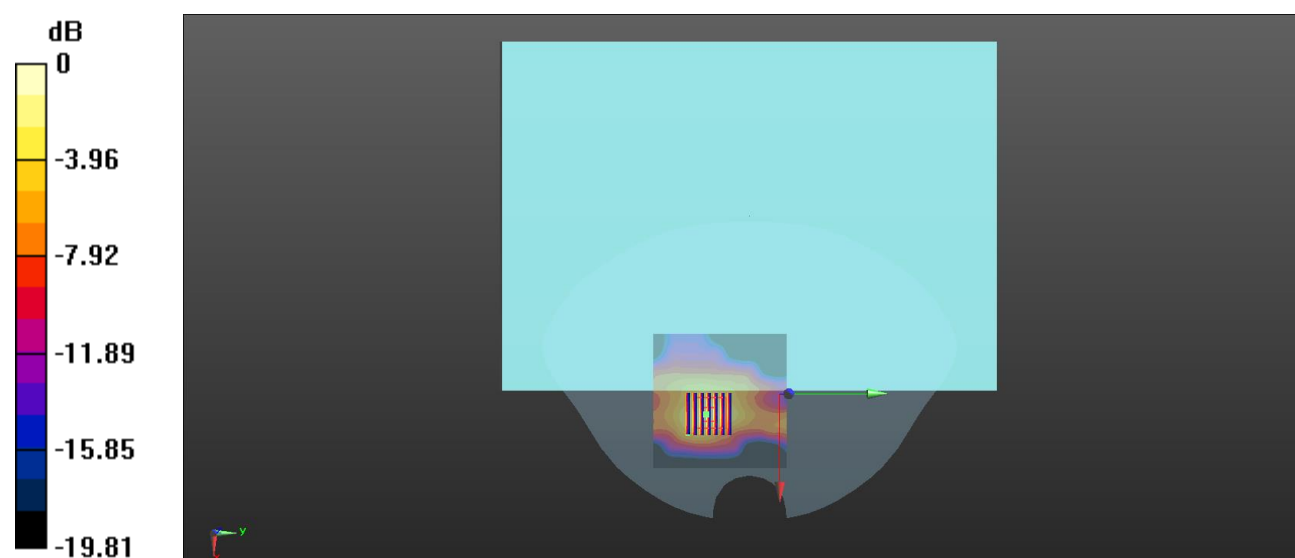
Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 3.006 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 0.378 W/kg

SAR(1 g) = 0.179 W/kg; SAR(10 g) = 0.083 W/kg

Maximum value of SAR (measured) = 0.201 W/kg



0 dB = 0.201 W/kg

Meas.4 Body Plane with Bottom Side 0mm on 58 Channel in IEEE802.11ac80 mode with Antenna Main

Date: 2022.03.03

Communication System Band: WLAN(ac)80MHz; Frequency: 5290 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5290$ MHz; $\sigma = 4.783$ S/m; $\epsilon_r = 35.44$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.2 Liquid Temperature:21.1

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(5.46, 5.46, 5.46); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch58/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.358 W/kg

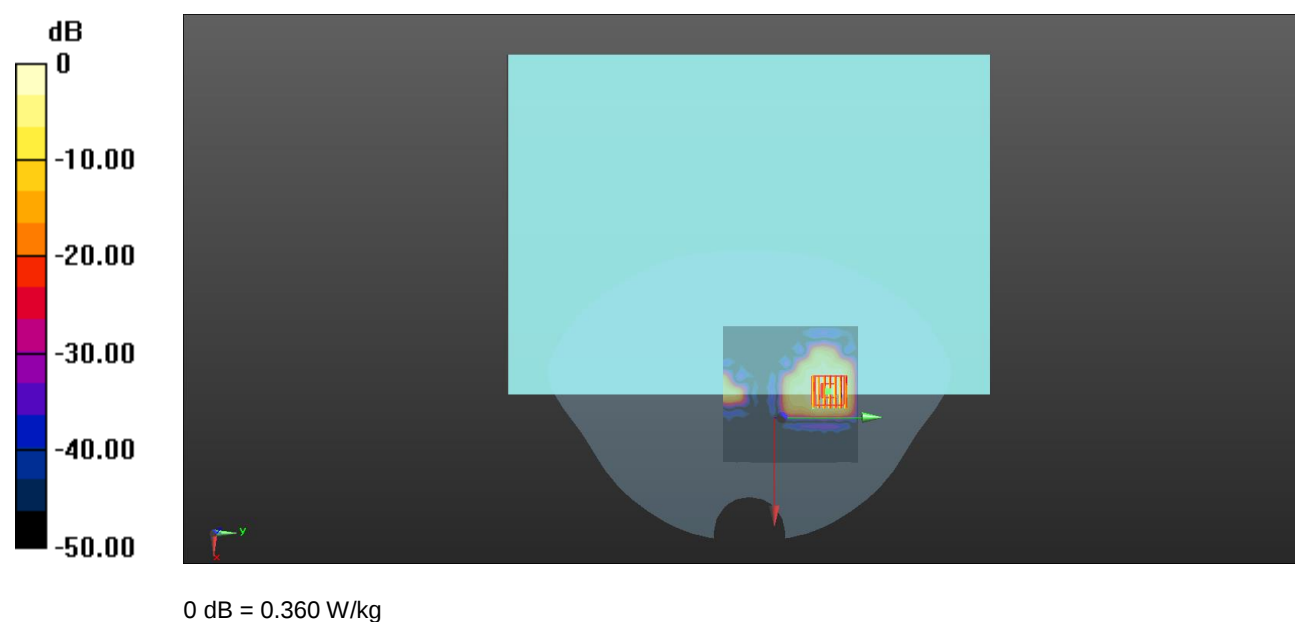
Ch58/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.849 W/kg

SAR(1 g) = 0.179 W/kg; SAR(10 g) = 0.056 W/kg

Maximum value of SAR (measured) = 0.360 W/kg



Meas.5 Body Plane with Bottom Side 0mm on 58 Channel in IEEE802.11ac80 mode with Antenna Auxiliary

Date: 2022.03.03

Communication System Band: WLAN(ac)80MHz; Frequency: 5290 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5290$ MHz; $\sigma = 4.783$ S/m; $\epsilon_r = 35.44$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.2 Liquid Temperature: 21.1

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(5.46, 5.46, 5.46); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch58/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.621 W/kg

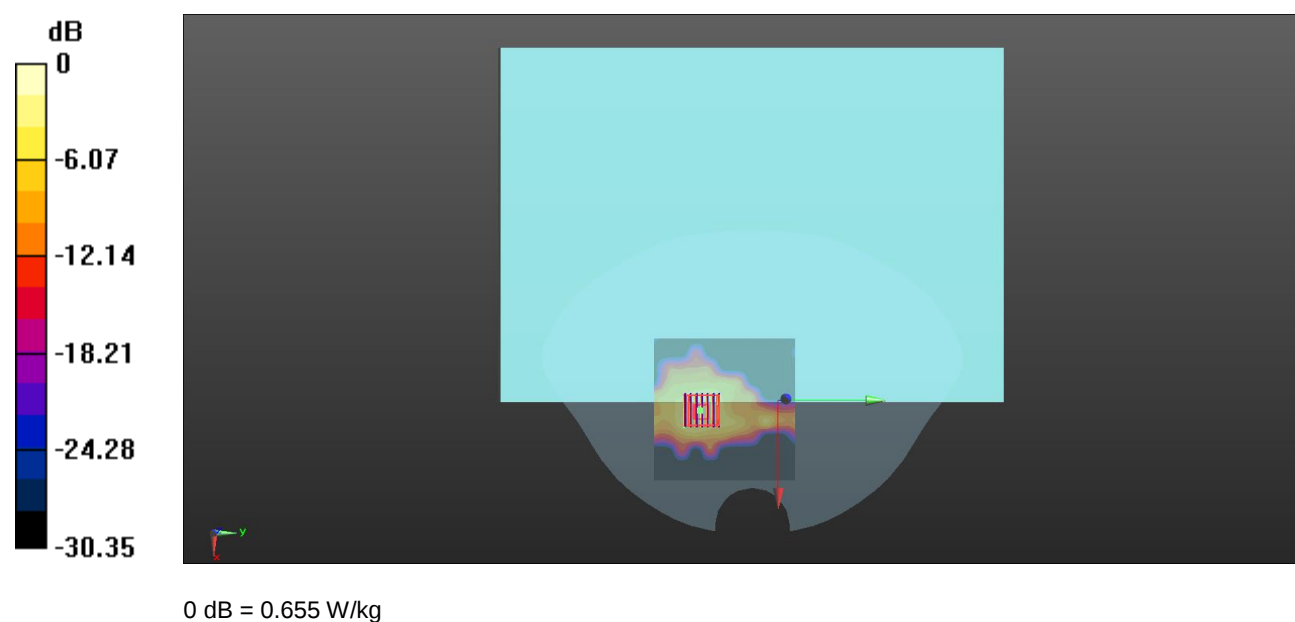
Ch58/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.600 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 1.33 W/kg

SAR(1 g) = 0.321 W/kg; SAR(10 g) = 0.105 W/kg

Maximum value of SAR (measured) = 0.655 W/kg



Meas.6 Body Plane with Bottom Side 0mm on 138 Channel in IEEE802.11ac80 mode with Antenna Main

Date: 2022.02.24

Communication System Band: WLAN(ac)80MHz; Frequency: 5690 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5690$ MHz; $\sigma = 5.19$ S/m; $\epsilon_r = 34.099$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.6 Liquid Temperature:21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.88, 4.88, 4.88); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch138/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.551 W/kg

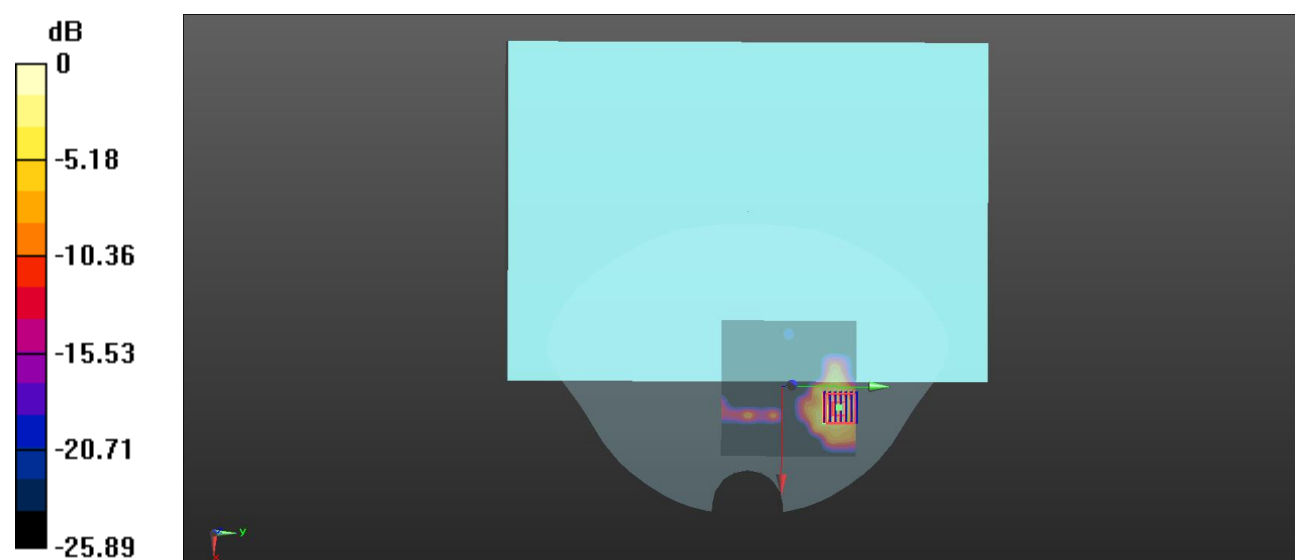
Ch138/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.9430 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.280 W/kg; SAR(10 g) = 0.094 W/kg

Maximum value of SAR (measured) = 0.575 W/kg



0 dB = 0.575 W/kg

Meas.7 Body Plane with Bottom Side 0mm on 138 Channel in IEEE802.11ac80 mode with Antenna Auxiliary

Date: 2022.02.24

Communication System Band: WLAN(ac)80MHz; Frequency: 5690 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5690$ MHz; $\sigma = 5.19$ S/m; $\epsilon_r = 34.099$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.6 Liquid Temperature:21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.88, 4.88, 4.88); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch138/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.820 W/kg

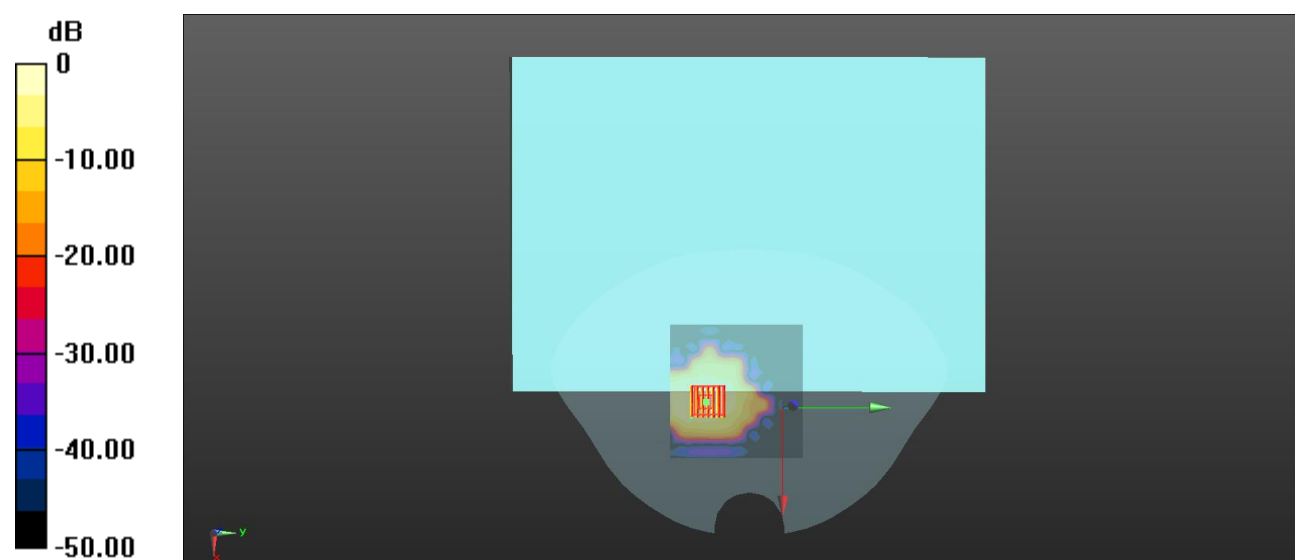
Ch138/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.843 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.69 W/kg

SAR(1 g) = 0.402 W/kg; SAR(10 g) = 0.138 W/kg

Maximum value of SAR (measured) = 0.807 W/kg



0 dB = 0.807 W/kg

Meas.8 Body Plane with Bottom Side 0mm on 155 Channel in IEEE802.11ac80 mode with Antenna Main

Date: 2022.03.07

Communication System Band: WLAN(ac)80MHz; Frequency: 5775 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5775$ MHz; $\sigma = 5.219$ S/m; $\epsilon_r = 35.277$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.3 Liquid Temperature:21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.92, 4.92, 4.92); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch155/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.747 W/kg

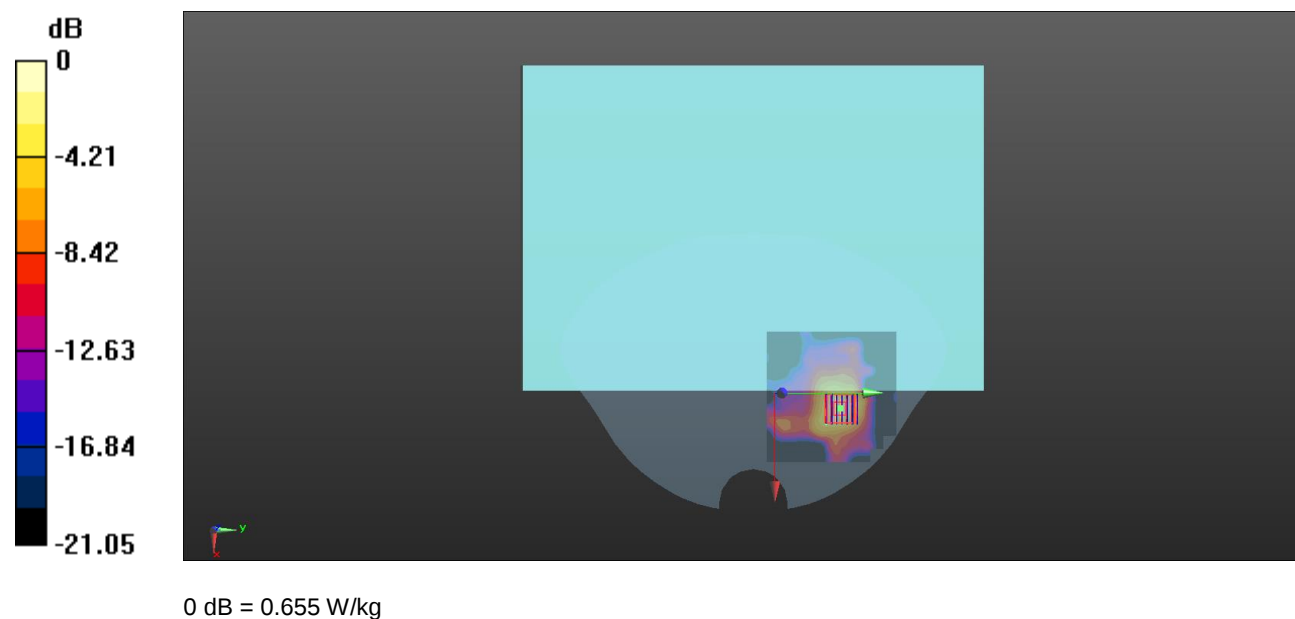
Ch155/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.234 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 1.49 W/kg

SAR(1 g) = 0.349 W/kg; SAR(10 g) = 0.123 W/kg

Maximum value of SAR (measured) = 0.655 W/kg



Meas.9 Body Plane with Bottom Side 0mm on 155 Channel in IEEE802.11ac80 mode with Antenna Auxiliary

Date: 2022.03.07

Communication System Band: WLAN(ac)80MHz; Frequency: 5775 MHz; Duty Cycle: 1:1.1

Medium parameters used (interpolated): $f = 5775$ MHz; $\sigma = 5.219$ S/m; $\epsilon_r = 35.277$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature:22.3 Liquid Temperature:21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7607; ConvF(4.92, 4.92, 4.92); Calibrated: 2021.08.12;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1454; Calibrated: 2021.11.05
- Phantom: SAM with CRP v5.0 on left 1859; Type: QD000P40CC; Serial: TP:1859
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch155/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.509 W/kg

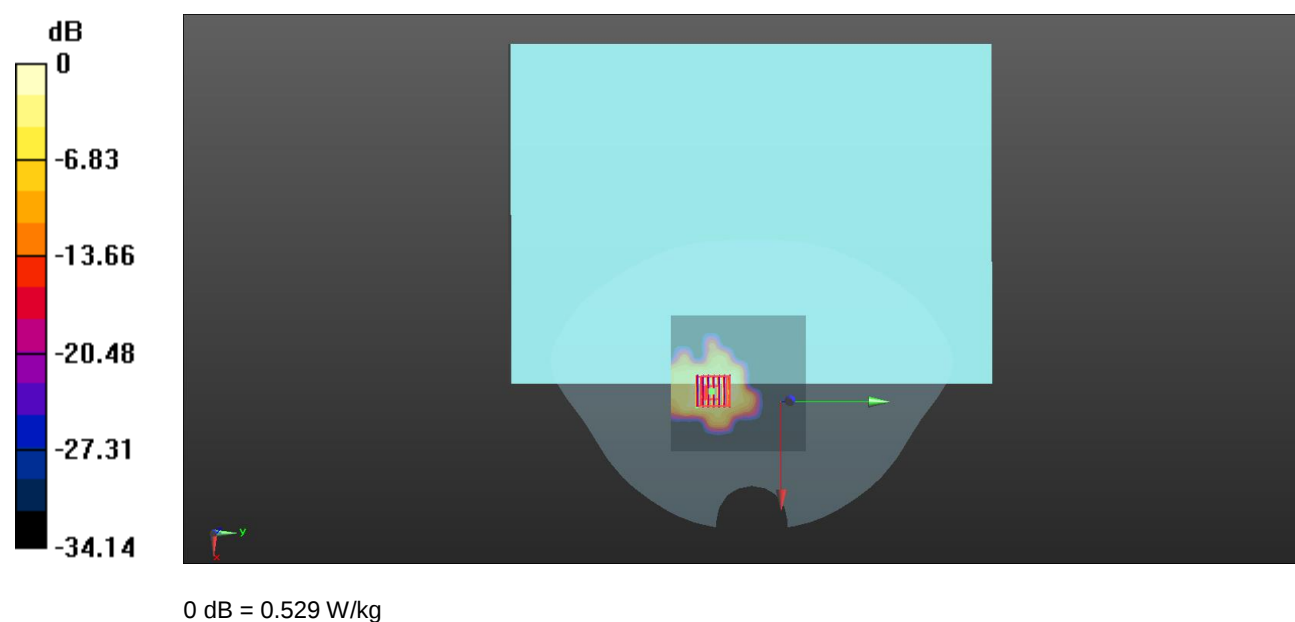
Ch155/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.896 V/m; Power Drift = 0.14 dB

Peak SAR (extrapolated) = 1.27 W/kg

SAR(1 g) = 0.259 W/kg; SAR(10 g) = 0.087 W/kg

Maximum value of SAR (measured) = 0.529 W/kg



ANNEX D EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2210787-AW.pdf”.

ANNEX E SAR TEST SETUP PHOTOS

Please refer the document “BL-SZ2210787-AS.pdf”.

ANNEX F CALIBRATION REPORT

Please refer the document “CALIBRATION REPORT.pdf”.

Statement

1. The laboratory guarantees the scientificity, accuracy and impartiality of the test, and is responsible for all the information in the report, except the information provided by the customer. The customer is responsible for the impact of the information provided on the validity of the results.
2. For the report with CNAS mark or A2LA mark, the items marked with "☆" are not within the accredited scope.
3. This report is invalid if it is altered, without the signature of the testing and approval personnel, or without the "inspection and testing dedicated stamp" or test report stamp.
4. The test data and results are only valid for the tested samples provided by the customer.
5. This report shall not be partially reproduced without the written permission of the laboratory.
6. Any objection shall be raised to the laboratory within 30 days after receiving the report.

--END OF REPORT--