

FCC

SAR

TEST REPORT

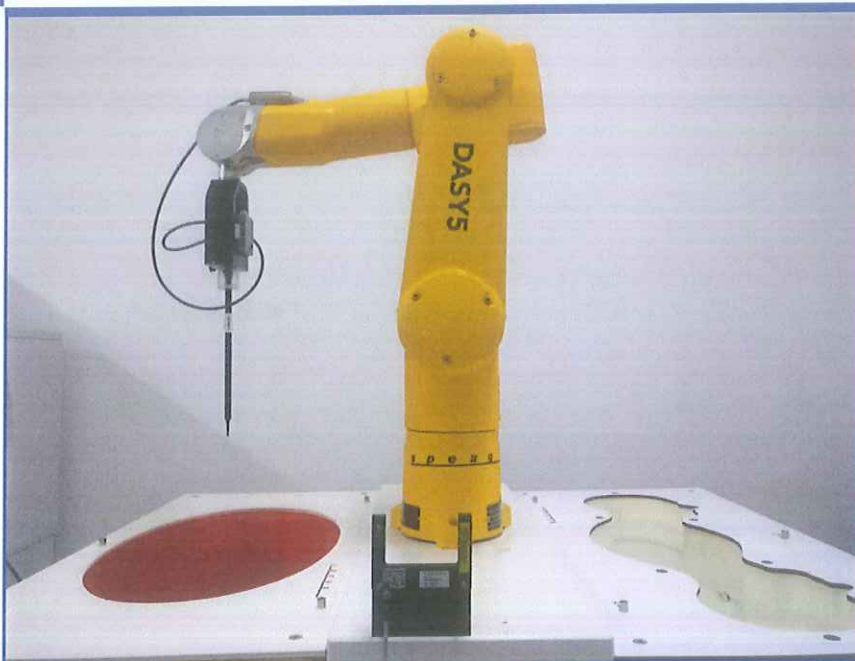
ISSUED BY
Shenzhen BALUN Technology Co., Ltd.



FOR
Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2
Type Card

ISSUED TO
Qualcomm Atheros, Inc.

1700 Technology Drive, San Jose, CA 95110



Tested by: Zong Liyao
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(Engineer)

Date: Mar. 13, 2018

Approved by: Wei Yanquan
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(Chief Engineer)

Date: Mar. 13, 2018

Report No.: BL-SZ1810286-701

EUT Type: Single Stream 802.11a/b/g/n/ac + BT 4.1
M.2 Type Card

Model Name: QCNFA435

Brand Name: Qualcomm Atheros

FCC ID: PPD-QCNFA435

Test Standard: FCC 47 CFR Part 2.1093
ANSI C95.1: 1999, IEEE 1528: 2013

Maximum SAR: Body 2.4GHz (1 g): 0.412 W/kg
Body 5GHz (1 g): 0.717 W/kg

Test Conclusion: Pass

Test Date: Jan. 25, 2018 ~ Feb. 13, 2018

Date of Issue: Mar. 13, 2018

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Revision History

Version	Issue Date	Revisions Content
<u>Rev. 01</u>	<u>Mar. 05, 2018</u>	<u>Initial Issue</u>
<u>Rev. 02</u>	<u>Mar. 13, 2018</u>	<u>Revised antenna gain information on page 7.</u>

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1 GENERAL INFORMATION

1.1 Identification of the Testing Laboratory

Company Name	Shenzhen BALUN Technology Co.,Ltd.
Address	Block B, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province,P. R. 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, 1st FL, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province,P. R. China
Accreditation Certificate	<p>The laboratory has been listed by Industry Canada to perform electromagnetic emission measurements. The recognition numbers of test site are 11524A-1.</p> <p>The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.</p> <p>The laboratory is a testing organization accredited by American Association for Laboratory Accreditation (A2LA) according to ISO/IEC 17025.The accreditation certificate is 4344.01.</p> <p>The laboratory is a testing organization accredited by China National Accreditation Service for Conformity Assessment (CNAS) according to ISO/IEC 17025. The accreditation certificate number is L6791.</p>
Description	All measurement facilities used to collect the measurement data are located at Block B, FL 1, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China 518055

1.3 Test Environment Condition

Ambient Temperature	20 to 23°C
Ambient Relative Humidity	36 to 48%
Ambient Pressure	100 to 102KPa

1.4 Announce

- (1) The test report reference to the report template version v2.2.
- (2) The test report is invalid if not marked with the signatures of the persons responsible for preparing and approving the test report.
- (3) The test report is invalid if there is any evidence and/or falsification.
- (4) The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein.
- (5) This document may not be altered or revised in any way unless done so by BALUN and all revisions are duly noted in the revisions section.
- (6) Content of the test report, in part or in full, cannot be used for publicity and/or promotional purposes without prior written approval from the laboratory.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Qualcomm Atheros, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

2.2 Manufacturer Information

Manufacturer	Qualcomm Atheros, Inc.
Address	1700 Technology Drive, San Jose, CA 95110

2.3 General Description for Equipment under Test (EUT)

EUT Type	Single Stream 802.11a/b/g/n/ac + BT 4.1 M.2 Type Card
Model Name Under Test	QCNFA435
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
Network and Wireless connectivity	WIFI 802.11a, 802.11b, 802.11g, 802.11n(HT20/40), 802.11ac(VHT20/40/80); Bluetooth

2.3.1 Host Information:

Product Description	notebook computer
Model Name	Lenovo ideapad 530S-14IKB, Lenovo ideapad 530S-14ARR
Brand	Lenovo

2.3.2 Antenna Information:

Antenna Port	Antenna Manufacturer	Antenna Type	Antenna Gain (dBi)			
			2.4~2.4835 GHz	5.15~5.35 GHz	5.47~5.725 GHz	5.725~5.850 GHz
Main Antenna	Luxshare-ICT	PIFA	-1.04	-1.86	-2.51	-1.21
Auxiliary Antenna		PIFA	-1.28	0.31	-1.02	-2.15
Main Antenna	Speed	PIFA	0.67	1.76	2.54	2.45
Auxiliary Antenna		PIFA	-2.72	1.55	1.24	-1.60
Note: The Main antenna or Auxiliary antenna supports TX/RX function, Main antenna and Auxiliary antenna can't transmit simultaneously.						

2.4 Ancillary Equipment

Note: Not applicable.

2.5 Technical Information

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) /ac(VHT20/VHT40)	2400~2483.5 MHz
	802.11a/ /n(HT20/HT40) /ac(VHT20/VHT40/VHT80)	5150 MHz~ 5250 MHz
		5250 MHz~ 5350 MHz
		5470 MHz~ 5725 MHz
		5725 MHz~ 5850 MHz
	Bluetooth	2400~2483.5 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	
	<input checked="" type="checkbox"/> Production unit	<input type="checkbox"/> Identical prototype

3 SUMMARY OF TEST RESULT

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 2	Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
2	ANSI/IEEE Std. C95.1-1999	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 D01 v06	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies
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 1g (W/kg)	Maximum Report SAR 1g (W/kg)
		Body	Body
2.4G WLAN	Main Antenna	0.412	0.717
2.4G WLAN	Aux. Antenna	0.384	
5.3G WLAN	Main Antenna	0.570	
5.3G WLAN	Aux. Antenna	0.509	
5.6G WLAN	Main Antenna	0.717	
5.6G WLAN	Aux. Antenna	0.322	
5.8G WLAN	Main Antenna	0.316	
5.8G WLAN	Aux. Antenna	0.483	
Limit (W/kg)	1.60		
Verdict	Pass		

3.3.2 Highest Simultaneous SAR

Position	Simultaneous Configuration	Simultaneous SAR (W/kg)	Limit (W/kg)	Verdict
Bottom Side	5 WLAN (Main Antenna) + Bluetooth (Main Antenna)	0.796	1.6	Pass
Bottom Side	5 WLAN (Aux. Antenna) + Bluetooth (Aux. Antenna)	0.588	1.6	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 0.717 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:

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

SAR is expressed in units of Watts per kilogram (W/kg) SAR measurement can be related to the electrical field in the tissue by

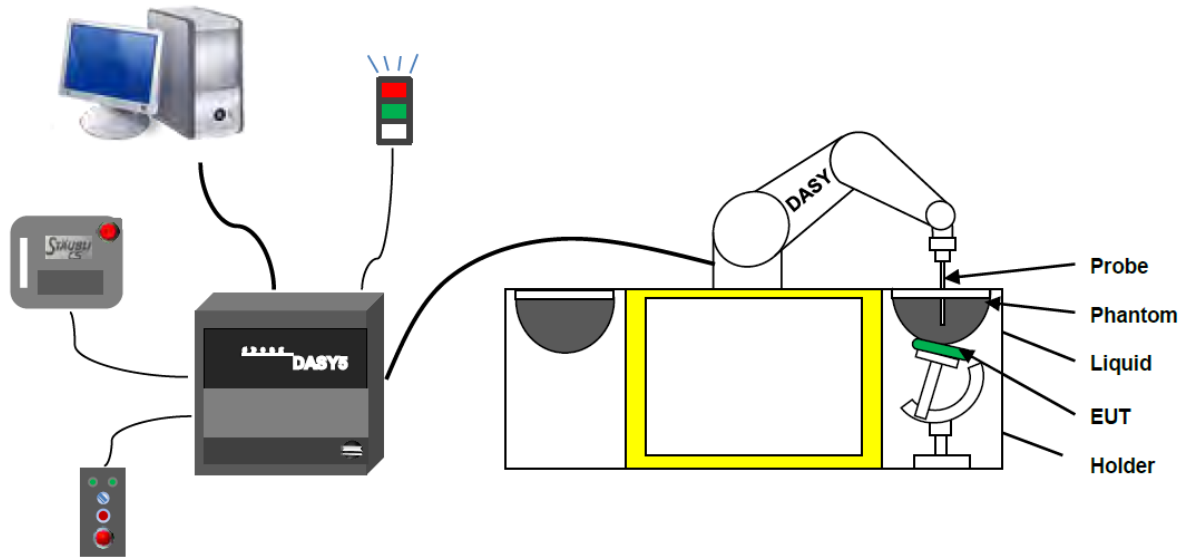
$$\text{SAR} = \frac{\sigma E^2}{\rho}$$

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

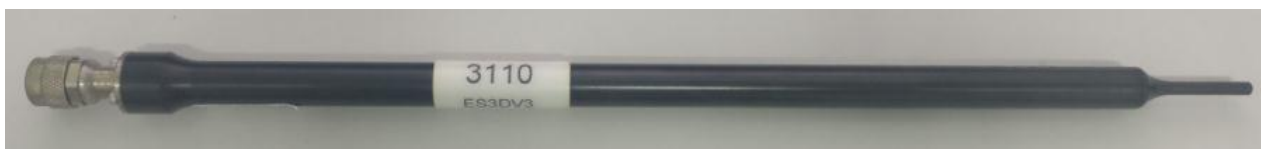
The probe is specially designed and calibrated for use in liquids with high permittivities for the measurements the Specific Dosimetric E-Field Probe EX3DV4-SN:7340 with following specifications is used.

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)



The probe is specially designed and calibrated for use in liquids with high permittivities for the measurements the Specific Dosimetric E-Field Probe ES3DV3-SN:3110 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 3 GHz; Linearity: ± 0.2 dB (30 MHz to 3 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: 10 mm) Tip diameter: 4 mm (Body: 10 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 3 GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms (ES3DV3)



E-Field Probe Calibration Process

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

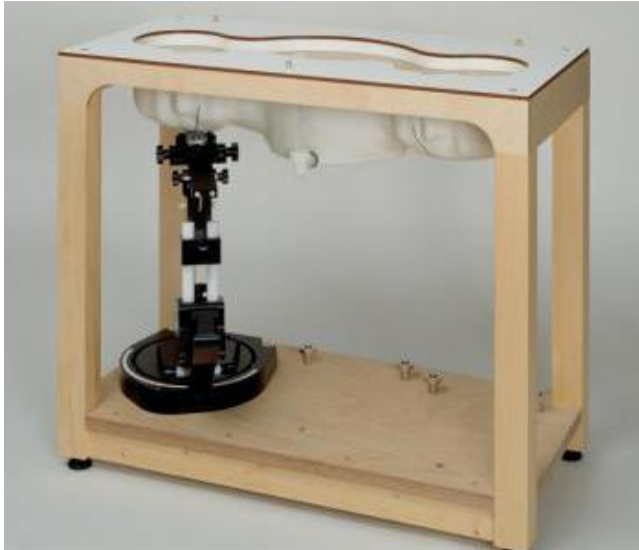
The data acquisition electronics (DAE) consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through 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 SN1857



Serial Number	Material	Length	Height
SN 1857 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%.



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

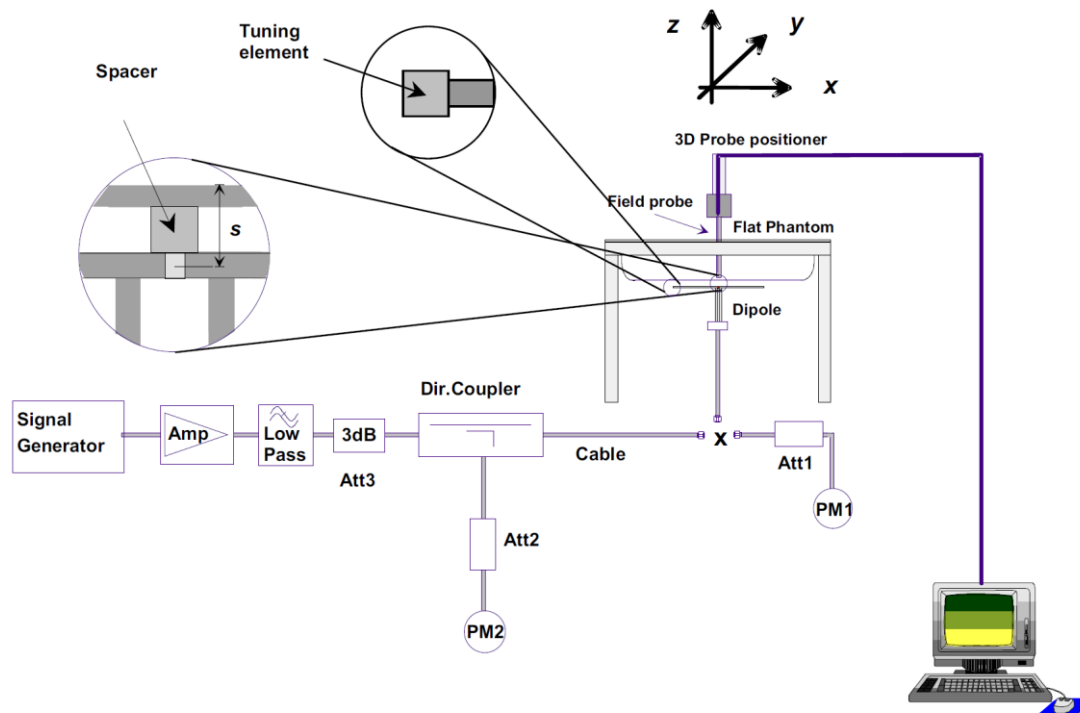
5 SYSTEM VERIFICATION

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

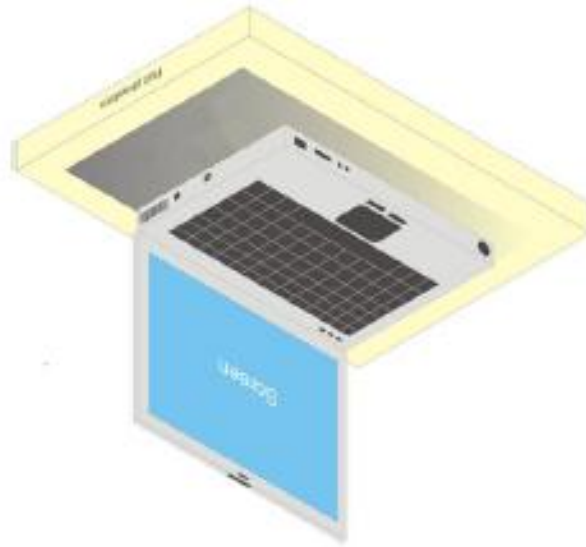
In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. 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

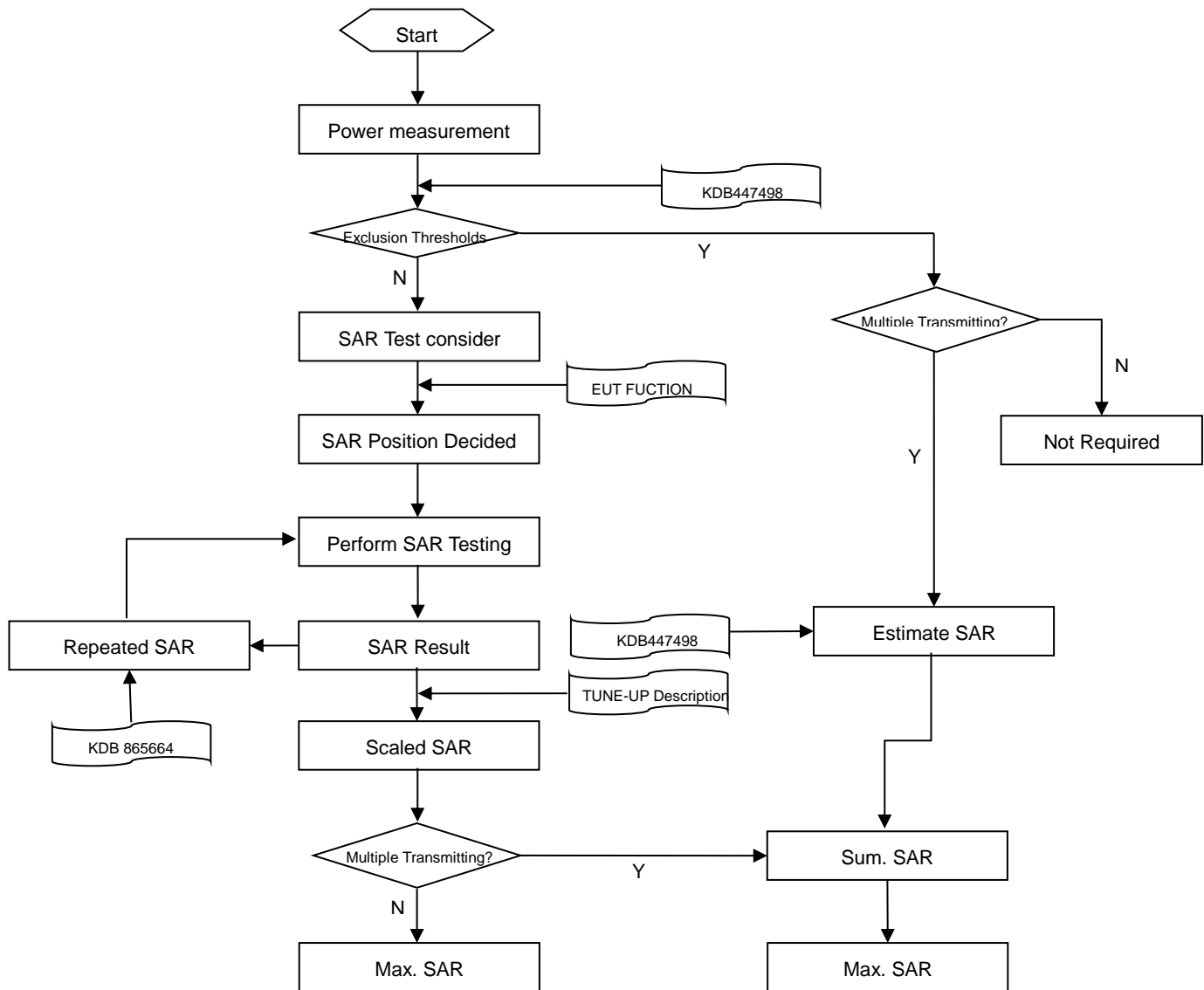
This DUT was tested in one position which is bottom of laptop touching with phantom 0 mm air gap.

6.1 Body Supported Exposure Condition



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	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location			30°±1°	20°±1°
Maximum area scan spatial resolution: 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
				5–6 GHz: ≤ 2 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 OUPUT POWER

8.1 WIFI

8.1.1 2.4G WIFI

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)		Tune-up Power Limit (dBm)	SAR Test Require.
				Main	Aux.		
2.4 (2.4~2.4835)	802.11 b	1	2412	20.36	20.40	20.50	Yes
		6	2437	20.49	20.04	20.50	Yes
		11	2462	20.00	20.45	20.50	Yes
	802.11 g	1	2412	17.30	17.50	17.50	No
		6	2437	19.25	19.28	19.50	No
		11	2462	17.81	17.75	18.00	No
	802.11 n (HT20)	1	2412	17.06	17.20	17.50	No
		6	2437	19.02	19.28	19.50	No
		11	2462	16.62	16.65	17.00	No
	802.11 n (HT40)	3	2422	16.43	16.06	16.50	No
		6	2437	18.43	18.08	18.50	No
		9	2452	14.62	14.73	15.00	No
	802.11 ac (VHT20)	1	2412	17.00	17.08	17.50	No
		6	2437	19.01	19.14	19.50	No
		11	2462	16.58	16.49	17.00	No
	802.11 ac (VHT40)	3	2422	16.26	16.05	16.50	No
		6	2437	18.39	18.00	18.50	No
		9	2452	14.52	14.58	15.00	No

Note: The output power was tuned to include the tolerance as the worst case concern.

8.1.2 5G WIFI

Band (GHz)	Mode	Channel	Freq. (MHz)	Conducted Power (dBm)		Tune-up Power Limit (dBm)	SAR Test Require.
				Main	Aux.		
5.2 (5.15~5.25)	802.11a	36	5180	15.12	15.46	15.50	No
		40	5200	16.70	17.00	17.00	No
		48	5240	16.77	16.66	17.00	No
	802.11n(HT20)	36	5180	15.11	15.44	15.50	No
		40	5200	16.50	16.55	17.00	No
		48	5240	16.86	17.00	17.00	No
	802.11n(HT40)	38	5190	11.53	11.62	12.00	No
		46	5230	15.50	15.82	16.00	No
	802.11ac(VHT20)	36	5180	15.07	15.45	15.50	No
		40	5200	16.94	16.55	17.00	No
		48	5240	16.50	16.61	17.00	No
	802.11ac(VHT40)	38	5190	11.59	11.80	12.00	No
		46	5230	15.90	15.91	16.00	No
	802.11ac(VHT80)	42	5210	13.96	13.74	14.00	No
5.3 (5.25~5.35)	802.11a	52	5260	16.67	16.92	17.00	Yes
		60	5300	16.96	16.99	17.00	Yes
		64	5320	15.90	15.65	16.00	Yes
	802.11n(HT20)	52	5260	16.85	16.70	17.00	No
		60	5300	16.69	16.78	17.00	No
		64	5320	14.73	14.81	15.00	No
	802.11n(HT40)	54	5270	15.55	15.55	16.00	No
		62	5310	12.91	12.68	13.00	No
	802.11ac(VHT20)	52	5260	16.92	16.66	17.00	No
		60	5300	16.52	16.51	17.00	No
		64	5320	14.50	14.52	15.00	No
	802.11ac(VHT40)	54	5270	15.75	15.51	16.00	No
		62	5310	12.98	12.80	13.00	No
	802.11ac(VHT80)	58	5290	11.92	11.68	12.00	No
5.6 (5.47~5.725)	802.11a	100	5500	14.88	14.68	15.00	Yes
		116	5580	16.57	16.87	17.00	Yes
		140	5700	14.27	14.25	14.50	Yes
		144	5720	16.34	16.52	17.00	Yes
	802.11n(HT20)	100	5500	14.41	14.03	15.00	No
		116	5580	16.76	16.61	17.00	No
		140	5700	14.70	14.65	15.00	No
		144	5720	16.48	16.51	17.00	No
	802.11n(HT40)	102	5510	12.89	12.61	13.00	No
		134	5670	15.47	15.33	15.50	No
		142	5710	15.5	15.47	16.00	No
	802.11ac(VHT20)	100	5500	14.32	14.83	15.00	No

		116	5580	16.83	16.72	17.00	No
		140	5700	14.75	14.50	15.00	No
		144	5720	16.47	16.31	17.00	No
	802.11ac(VHT40)	102	5510	12.93	12.77	13.00	No
		134	5670	15.44	15.30	15.50	No
		142	5710	15.4	15.67	16.00	No
	802.11ac(VHT80)	106	5530	11.81	11.71	12.00	No
		122	5610	15.62	15.44	16.00	No
		138	5690	15.37	15.49	16.00	No
5.8 (5.725~5.850)	802.11a	149	5745	16.83	16.63	17.00	Yes
		157	5785	16.62	16.62	17.00	Yes
		165	5825	16.51	16.53	17.00	Yes
	802.11n(HT20)	149	5745	16.67	16.61	17.00	No
		157	5785	16.59	16.50	17.00	No
		165	5825	16.50	16.66	17.00	No
	802.11n(HT40)	151	5755	14.81	14.67	15.00	No
		159	5795	15.51	15.64	16.00	No
	802.11ac(VHT20)	149	5745	16.71	16.74	17.00	No
		157	5785	16.74	16.54	17.00	No
		165	5825	16.67	16.65	17.00	No
	802.11ac(VHT40)	151	5755	14.79	14.88	15.00	No
		159	5795	15.51	15.79	16.00	No
	802.11ac(VHT80)	155	5775	13.00	12.90	14.50	No

Note: The output power was tuned to include the tolerance as the worst case concern.

8.2 Bluetooth

Mode	GFSK			$\pi/4$ -DQPSK		
Channel	0	39	78	0	39	78
Frequency (MHz)	2402	2441	2480	2402	2441	2480
Main Conducted Power (dBm)	3.11	3.41	3.52	4.30	4.59	4.72
Aux. Conducted Power (dBm)	2.51	2.60	2.91	3.53	3.81	4.02
Tune-up Power Limit (dBm)	6.0			6.0		
Mode	8-DPSK			BLE		
Channel	0	39	78	0	19	39
Frequency (MHz)	2402	2441	2480	2402	2440	2480
Main Conducted Power (dBm)	3.68	3.92	4.07	-3.95	-3.61	-3.30
Aux. Conducted Power (dBm)	2.84	3.10	3.39	-3.73	-3.55	-3.21
Tune-up Power Limit (dBm)	6.0			6.0		

9 TEST EXCLUSION CONSIDERATION

9.1 EUT antenna location sketch

Please refer to the “BL-SZ1810286-AI internal photos”.

9.2 SAR Test Exclusion Consideration Table

According with FCC KDB 447498 D01, Appendix A, <SAR Test Exclusion Thresholds for 100 MHz – 6 GHz and ≤ 50 mm> Table, this Device SAR test configurations consider as following :

9.2.1 Laptop mode SAR Test Exclusion Consideration

Main and Auxiliary Antenna

Band	Mode	Max. Conducted Power		Test Position Configurations
		dBm	mW	Bottom side
Distance to User (mm)				10.53
WLAN 2.4 G	Exclusion Threshold			16.7
	802.11b	20.50	112.20	Yes
	802.11g	19.50	89.13	No
	802.11n(HT20)	19.50	89.13	No
	802.11n(HT40)	18.50	70.79	No
	802.11ac(VHT20)	19.50	89.13	No
	802.11ac(VHT40)	18.50	70.79	No
WLAN 5.3G	Exclusion Threshold			11.5
	802.11a	17.00	50.12	Yes
	802.11n(HT20)	17.00	50.12	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	17.00	50.12	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	12.00	15.85	No
WLAN 5.6 G	Exclusion Threshold			11.5
	802.11a	17.00	50.12	Yes
	802.11n(HT20)	17.00	50.12	No
	802.11n(HT40)	15.50	35.48	No
	802.11ac(VHT20)	17.00	50.12	No
	802.11ac(VHT40)	15.50	35.48	No
	802.11ac(VHT80)	12.00	15.85	No
WLAN 5.8 G	Exclusion Threshold			11.5
	802.11a	17.00	50.12	Yes
	802.11n(HT20)	17.00	50.12	No
	802.11n(HT40)	16.00	39.81	No
	802.11ac(VHT20)	17.00	50.12	No
	802.11ac(VHT40)	16.00	39.81	No
	802.11ac(VHT80)	14.50	28.18	No
Bluetooth	Exclusion Threshold			0.6
	BR/EDR	6.00	3.98	No
	BLE	6.00	3.98	No

Note:

- Maximum power is the source-based time-average power and represents the maximum RF output power including

tune-up tolerance among production units

2. Per KDB 447498 D01, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
3. Per KDB 447498 D01, 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
4. Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$
for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
 - a. $f(\text{GHz})$ is the RF channel transmit frequency in GHz
 - b. Power and distance are rounded to the nearest mW and mm before calculation
 - c. The result is rounded to one decimal place for comparison
 - d. For < 50 mm distance, we just calculate mW of the exclusion threshold value (3.0) to do compare.
5. Per KDB 447498 D01, at 100 MHz to 6 GHz and for test separation distances > 50 mm, the SAR test exclusion threshold is determined according to the following
 - a. [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW, at 100 MHz to 1500 MHz
 - b. [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz
6. 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
7. Per KDB 248227 D01 SAR is not required for the following 2.4 GHz OFDM conditions.
 - a. When KDB Publication 447498 D01 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.
8. 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.
 - 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 WIFI 2.4GHz

Mode	Antenna	Antenna Manufacturer	Position	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 Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Body															
802.11 b	Main	Speed	Bottom Side	0	6	2437	0.01	0.353	20.49	20.5	1.002	98.58	1.014	0.359	/
				0	1	2412	0.06	0.393	20.36	20.5	1.033	98.58	1.014	0.412	1#
				0	11	2462	0.05	0.281	20.00	20.5	1.122	98.58	1.014	0.320	/
		Luxshare-ICT	Bottom Side	0	6	2437	-0.14	0.372	20.49	20.5	1.002	98.58	1.014	0.378	/
				0	1	2412	0.02	0.366	20.36	20.5	1.033	98.58	1.014	0.383	/
				0	11	2462	0.15	0.361	20.00	20.5	1.122	98.58	1.014	0.411	/
		Speed	Bottom Side	0	11	2462	-0.01	0.238	20.45	20.5	1.012	99.06	1.009	0.243	/
				0	1	2412	0.19	0.247	20.40	20.5	1.023	99.06	1.009	0.255	/
				0	6	2437	0.16	0.221	20.04	20.5	1.112	99.06	1.009	0.248	/
802.11 b	Aux	Luxshare-ICT	Bottom Side	0	11	2462	0.06	0.326	20.45	20.5	1.012	99.06	1.009	0.333	/
				0	1	2412	-0.03	0.372	20.40	20.5	1.023	99.06	1.009	0.384	2#
				0	6	2437	0.13	0.298	20.04	20.5	1.112	99.06	1.009	0.334	/

Fre. Band	Mode	Antenna	Antenna Manufacturer	Position	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 Scaling Factor	1 g Scaled SAR (W/Kg)	Meas. No.
Body																
5.3G	802.11a	Main	Speed	Bottom Side	0	60	5300	0.08	0.206	16.96	17.0	1.009	95.28	1.050	0.218	/
					0	52	5260	0.16	0.503	16.67	17.0	1.079	95.28	1.050	0.570	3#
					0	64	5320	0.15	0.127	15.90	16.0	1.023	95.28	1.050	0.136	/
			Luxshare-ICT	Bottom Side	0	60	5300	-0.02	0.319	16.96	17.0	1.009	95.28	1.050	0.338	/
					0	52	5260	-0.14	0.426	16.67	17.0	1.079	95.28	1.050	0.482	/
					0	64	5320	0.13	0.291	15.90	16.0	1.023	95.28	1.050	0.313	/
			Speed	Bottom Side	0	60	5300	-0.13	0.194	16.99	17.0	1.002	95.49	1.047	0.203	/
					0	52	5260	0.15	0.354	16.92	17.0	1.019	95.49	1.047	0.378	/
					0	64	5320	0.02	0.131	15.65	16.0	1.084	95.49	1.047	0.149	/
5.3G	802.11a	Aux	Luxshare-ICT	Bottom Side	0	60	5300	0.13	0.309	16.99	17.0	1.002	95.49	1.047	0.324	/
					0	52	5260	0.18	0.477	16.92	17.0	1.019	95.49	1.047	0.509	4#
					0	64	5320	-0.05	0.164	15.65	16.0	1.084	95.49	1.047	0.186	/
			Speed	Bottom Side	0	116	5580	-0.09	0.476	16.57	17.0	1.104	95.3	1.049	0.551	/
					0	100	5500	0.13	0.145	14.88	15.0	1.028	95.3	1.049	0.156	/
					0	140	5700	0.08	0.163	14.27	14.5	1.054	95.3	1.049	0.180	/
			Luxshare-ICT	Bottom Side	0	144	5720	0.11	0.294	16.34	17.0	1.164	95.3	1.049	0.359	/
					0	116	5580	0.19	0.619	16.57	17.0	1.104	95.3	1.049	0.717	5#
					0	100	5500	0.12	0.263	14.88	15.0	1.028	95.3	1.049	0.284	/
5.6G	802.11 a	Main	Speed	Bottom Side	0	140	5700	0.16	0.248	14.27	14.5	1.054	95.3	1.049	0.274	/
					0	144	5720	0.18	0.453	16.34	17.0	1.164	95.3	1.049	0.553	/
			Luxshare-ICT	Bottom Side	0	116	5580	0.01	0.298	16.87	17.0	1.030	95.28	1.050	0.322	6#
					0	100	5500	0.11	0.213	14.68	15.0	1.076	95.28	1.050	0.241	/
					0	140	5700	0.16	0.082	14.25	14.5	1.059	95.28	1.050	0.092	/
			Speed	Bottom Side	0	144	5720	-0.09	0.269	16.52	17.0	1.117	95.28	1.050	0.315	/
					0	116	5580	0.01	0.298	16.87	17.0	1.030	95.28	1.050	0.322	6#
					0	100	5500	0.11	0.213	14.68	15.0	1.076	95.28	1.050	0.241	/
					0	140	5700	0.16	0.082	14.25	14.5	1.059	95.28	1.050	0.092	/

			Luxshare-ICT	Bottom Side	0	116	5580	0.11	0.260	16.87	17.0	1.030	95.28	1.050	0.281	/
					0	100	5500	-0.14	0.152	14.68	15.0	1.076	95.28	1.050	0.172	/
					0	140	5700	0.08	0.103	14.25	14.5	1.059	95.28	1.050	0.115	/
					0	144	5720	-0.06	0.211	16.52	17.0	1.117	95.28	1.050	0.247	/
5.8G	802.11 a	Main	Speed	Bottom Side	0	149	5745	0.10	0.252	16.83	17.0	1.040	95.28	1.050	0.275	/
					0	157	5785	0.09	0.276	16.62	17.0	1.091	95.28	1.050	0.316	7#
					0	165	5825	-0.12	0.251	16.51	17.0	1.119	95.28	1.050	0.295	/
			Luxshare-ICT	Bottom Side	0	149	5745	0.09	0.203	16.83	17.0	1.040	95.28	1.050	0.222	/
					0	157	5785	0.12	0.246	16.62	17.0	1.091	95.28	1.050	0.282	/
					0	165	5825	0.15	0.166	16.51	17.0	1.119	95.28	1.050	0.195	/
5.8G	802.11 a	Aux	Speed	Bottom Side	0	149	5745	0.09	0.162	16.63	17.0	1.089	94.87	1.054	0.186	/
					0	157	5785	0.06	0.210	16.62	17.0	1.091	94.87	1.054	0.242	/
					0	165	5825	0.13	0.194	16.53	17.0	1.114	94.87	1.054	0.228	/
			Luxshare-ICT	Bottom Side	0	149	5745	-0.08	0.420	16.63	17.0	1.089	94.87	1.054	0.482	/
					0	157	5785	0.04	0.420	16.62	17.0	1.091	94.87	1.054	0.483	8#
					0	165	5825	-0.05	0.244	16.53	17.0	1.114	94.87	1.054	0.287	/

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.

The highest measured SAR is 0.619 W/kg less than 0.80 W/kg, so the 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).

12.1 Simultaneous Transmission Mode Consider

NO.	Mode	Body
1	Bluetooth (Main Antenna)	+ 5 G WLAN (Main Antenna)
2	Bluetooth (Auxiliary Antenna)	+ 5 G WLAN (Auxiliary Antenna)
<p>Note:</p> <ol style="list-style-type: none">1. The Main antenna or Auxiliary antenna supports TX/RX function, Main antenna and Auxiliary antenna can't transmit simultaneously.2. 2.4G WLAN and 5G WLAN does not support transmission together, only WLAN 5GHz and Bluetooth will be transmitting at same time.		

12.2 Estimated SAR Calculation

According to KDB 447498 D01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of ≤ 0.4 W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune Up Power (mw)}}{\text{Min Test Separation Distance}} * \frac{\sqrt{f_{\text{GHz}}}}{x} \quad (\text{where } x = 7.5 \text{ for 1-g SAR})$$

If the minimum test separation distance is < 5 mm, a distance of 5 mm is used for estimated SAR calculation. When the test separation distance is > 50 mm, the 0.4 W/kg is used for SAR-1g.

Band	Mode	Position	Antenna To user (mm)	SAR Testing	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Frequency (GHz)	Calculation Distance/Gap (mm)	Estimated SAR (W/kg)
Bluetooth	GFSK	Bottom Side	10.53	NO	6.00	3.98	2.480	10.53	0.079

12.3 Sum SAR of Simultaneous Transmission

12.3.1 Highest Sum Body SAR of Simultaneous Transmission

Test Mode	Antenna	Mode	Max. 1g SAR (W/kg)	1g Sum SAR (W/kg)	SPLSR (Yes/No)
Body					
Bottom Side	Main	Bluetooth (Main Antenna)	0.079	0.796	No
		5G WLAN (Main Antenna)	0.717		
	Auxiliary	Bluetooth (Aux. Antenna)	0.079	0.588	No
		5G WLAN (Aux. Antenna)	0.509		

13 TEST EQUIPMENTS LIST

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
PC	Dell	N/A	N/A	N/A	N/A
2450MHz Validation Dipole	Speag	D2450V2	SN: 952	2017/03/21	2018/03/20
5GHz Validation Dipole	Speag	D5GHzV2	SN: 1200	2017/06/29	2018/06/28
E-Field Probe	Speag	EX3DV4	SN: 7340	2018/01/11	2019/01/10
E-Field Probe	Speag	ES3DV3	SN: 3110	2017/08/02	2018/08/01
Data Acquisition Electronics	Speag	DAE4	SN: 685	2017/08/02	2018/08/01
Signal Generator	R&S	SMBV100A	260592	2017/06/12	2018/06/11
Power Meter	Agilent	E4419B	GB40201833	2017/11/02	2018/11/01
Power Sensor	Agilent	E9300A	MY41498012	2017/11/02	2018/11/01
Power Sensor	Agilent	E9300A	MY41499891	2017/11/02	2018/11/01
Power Amplifier	SATIMO	6552B	22374	2017/06/12	2018/06/11
Network Analyzer	Agilent	5071B	MY42404001	2017/06/12	2018/06/11
Thermometer	Elitech	RC-4HC	N/A	2017/02/18	2018/02/17
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

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 (%)
2018.02.13	Body	2450	21.2	1.99	52.93	1.95	52.70	2.05	0.44
2018.01.26	Body	5250	21.3	5.19	50.78	5.36	48.95	-3.17	3.74
2018.01.25	Body	5600	21.4	5.82	47.65	5.77	48.47	0.87	-1.69
2018.02.12	Body	5750	21.2	5.94	47.42	5.94	48.27	0.00	-1.76

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 (%)	Targeted SAR (W/kg)	Tolerance (%)
2018.02.13	Body	2450	100	4.93	49.3	50.50	-2.38	52.40	-5.92
2018.01.26	Body	5250	100	7.69	76.9	75.20	2.26	76.50	0.52
2018.01.25	Body	5600	100	8.31	83.1	77.90	6.68	83.30	-0.24
2018.02.12	Body	5750	100	7.88	78.8	75.00	5.07	78.00	1.03
Note: The tolerance limit of System validation $\pm 10\%$.									

System Performance Check Data (2450 Body)

Date: 2018.02.13

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

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.99$ S/m; $\epsilon_r = 52.93$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.5 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: ES3DV3 - SN3110; ConvF(4.23, 4.23, 4.23); Calibrated: 2017.08.02;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW2450 Body 100mw/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 5.67 W/kg

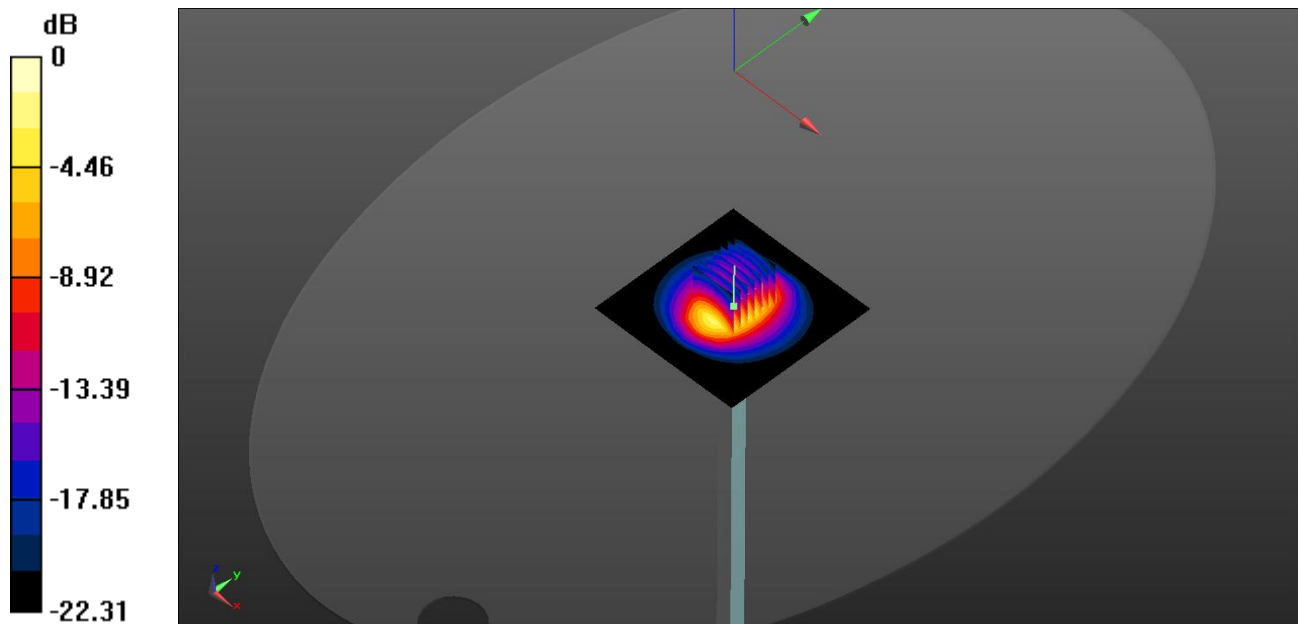
CW2450 Body 100mw/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.01 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 10.8 W/kg

SAR(1 g) = 4.93 W/kg; SAR(10 g) = 2.29 W/kg

Maximum value of SAR (measured) = 5.66 W/kg



0 dB = 5.66 W/kg

System Performance Check Data (5250 Body)

Date: 2018.01.26

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

Medium parameters used: $f = 5250$ MHz; $\sigma = 5.19$ S/m; $\epsilon_r = 50.78$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.6 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(5.16, 5.16, 5.16); Calibrated: 2018.01.11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

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

Maximum value of SAR (interpolated) = 8.85 W/kg

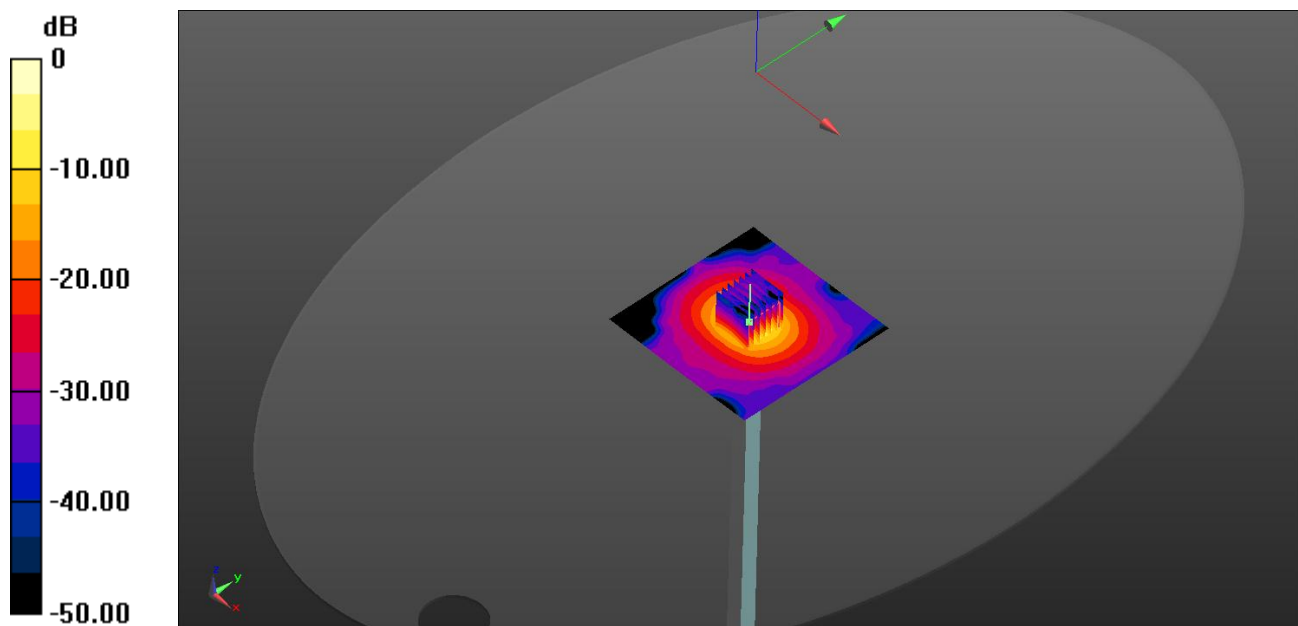
CW 5250 Body 100mw/Zoom Scan (7x7x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 41.93 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 31.1 W/kg

SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.9 W/kg

System Performance Check Data (5600 Body)

Date: 2018.02.25

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

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.82$ S/m; $\epsilon_r = 47.65$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.4 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.35, 4.35, 4.35); Calibrated: 2018.01.11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 5600 Body 100mw/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 9.42 W/kg

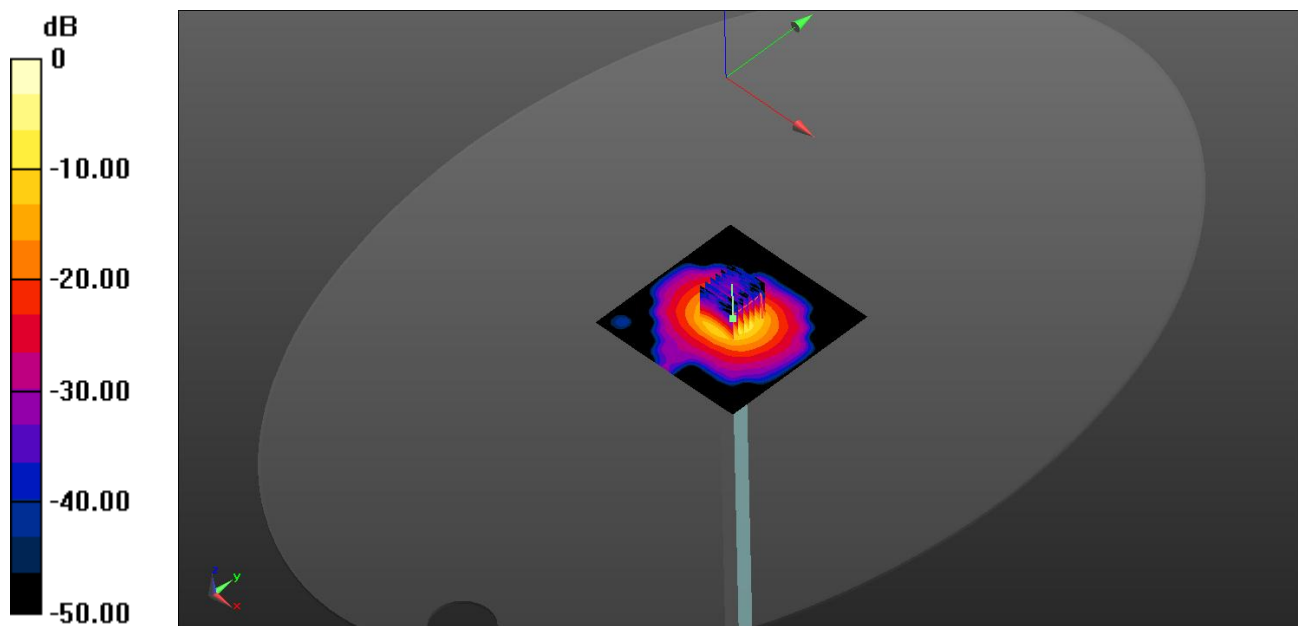
CW 5600 Body 100mw/Zoom Scan (7x7x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 41.43 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 37.1 W/kg

SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.34 W/kg

Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 21.7 W/kg

System Performance Check Data (5750 Body)

Date: 2018.02.12

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

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.94$ S/m; $\epsilon_r = 47.42$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.58, 4.58, 4.58); Calibrated: 2018.01.11;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

CW 5750 Body 100mw/Area Scan (101x101x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 8.27 W/kg

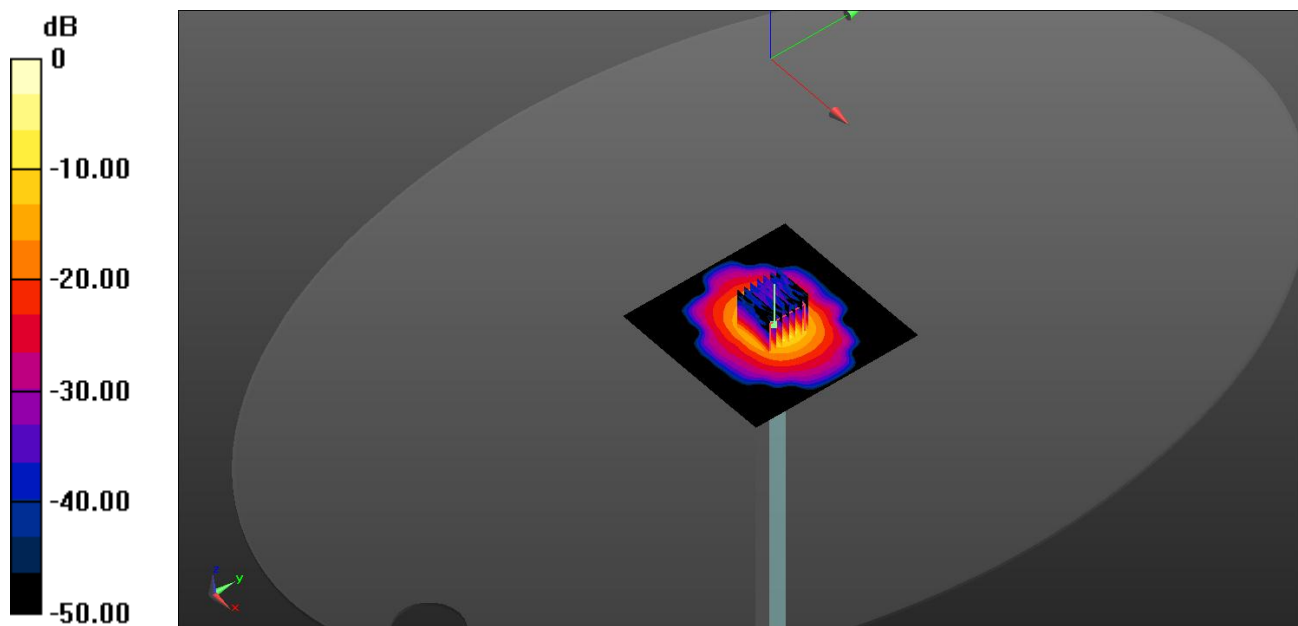
CW 5750 Body 100mw/Zoom Scan (7x7x21)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 38.14 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 36.9 W/kg

SAR(1 g) = 7.88 W/kg; SAR(10 g) = 2.11 W/kg

Maximum value of SAR (measured) = 20.2 W/kg



0 dB = 20.2 W/kg

ANNEX C TEST DATA

1_Body Plan with Bottom Side 0mm on Channel 1 in IEEE 802.11b mode with Antenna Main

Date: 2018.02.13

Communication System Band: WLAN(b); Frequency: 2412 MHz; Duty Cycle: 1:1.014

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.96$ S/m; $\epsilon_r = 54.05$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.5 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: ES3DV3 - SN3110; ConvF(4.23, 4.23, 4.23); Calibrated: 2017.08.02;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (81x141x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.429 W/kg

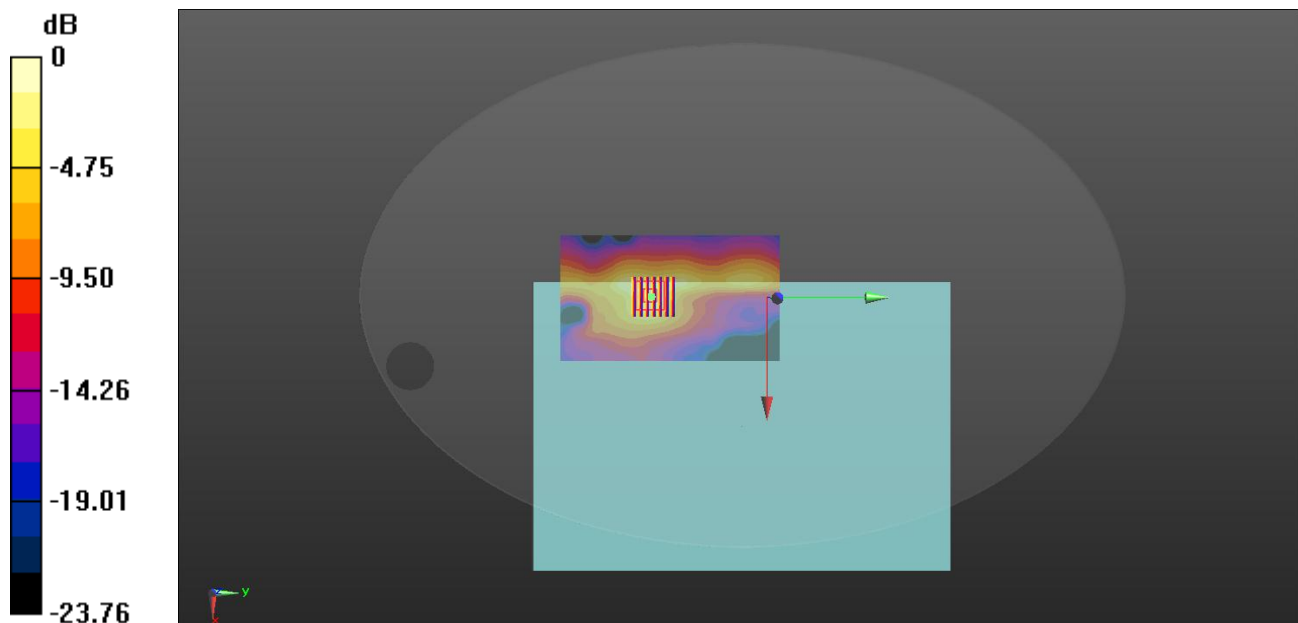
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.738 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.854 W/kg

SAR(1 g) = 0.393 W/kg; SAR(10 g) = 0.187 W/kg

Maximum value of SAR (measured) = 0.448 W/kg



0 dB = 0.448 W/kg

2_Body Plan with Bottom Side 0mm on Channel 1 in IEEE 802.11b mode with Antenna Aux

Date: 2018.02.13

Communication System Band: WLAN(b); Frequency: 2412 MHz; Duty Cycle: 1:1.009

Medium parameters used (interpolated): $f = 2412$ MHz; $\sigma = 1.96$ S/m; $\epsilon_r = 54.05$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.5 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: ES3DV3 - SN3110; ConvF(4.23, 4.23, 4.23); Calibrated: 2017.08.02;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (81x141x1): Interpolated grid: $dx=1.200$ mm, $dy=1.200$ mm

Maximum value of SAR (interpolated) = 0.436 W/kg

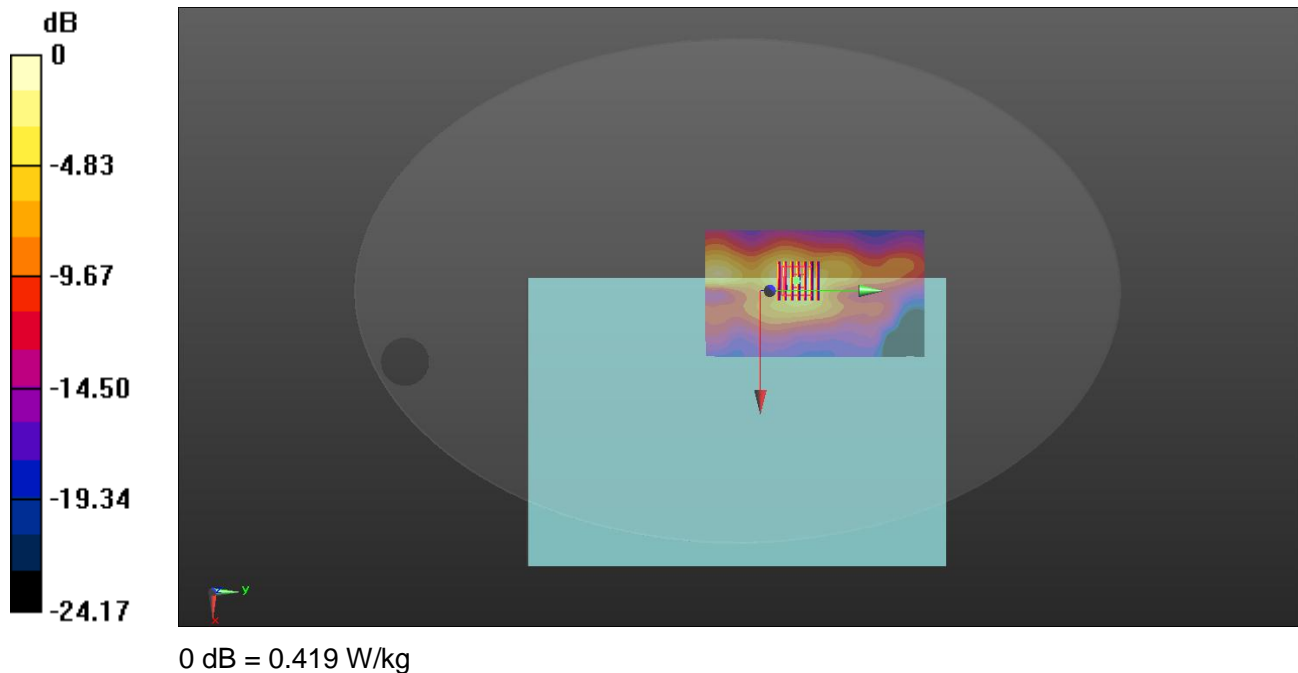
Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 4.746 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.808 W/kg

SAR(1 g) = 0.372 W/kg; SAR(10 g) = 0.175 W/kg

Maximum value of SAR (measured) = 0.419 W/kg



3_Body Plan with Bottom Side 0mm on Channel 52 in IEEE 802.11a mode with Antenna Main

Date: 2018.01.26

Communication System Band: WLAN(a); Frequency: 5260 MHz; Duty Cycle: 1:1.050

Medium parameters used (interpolated): $f = 5260$ MHz; $\sigma = 5.22$ S/m; $\epsilon_r = 50.34$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.6 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(5.16, 5.16, 5.16); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch52/Area Scan (101x151x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.585 W/kg

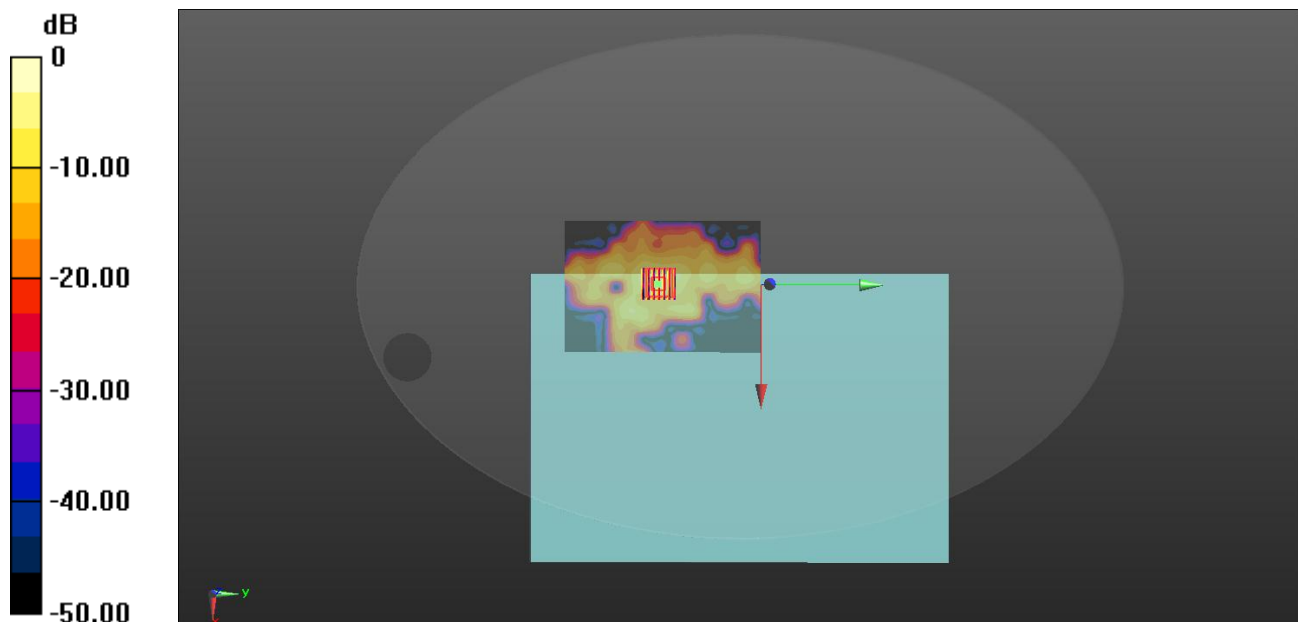
Ch52/Zoom Scan (7x7x13)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 3.986 V/m; Power Drift = 0.16dB

Peak SAR (extrapolated) = 2.01 W/kg

SAR(1 g) = 0.503 W/kg; SAR(10 g) = 0.161 W/kg

Maximum value of SAR (measured) = 0.999 W/kg



0 dB = 0.999 W/kg

4_Body Plan with Bottom Side 0mm on Channel 52 in IEEE 802.11a mode with Antenna Aux

Date: 2018.02.26

Communication System Band: WLAN(a); Frequency: 5260 MHz; Duty Cycle: 1:1.047

Medium parameters used (interpolated): $f = 5260$ MHz; $\sigma = 5.22$ S/m; $\epsilon_r = 50.34$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.6 Liquid Temperature: 21.3

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(5.16, 5.16, 5.16); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch52/Area Scan (101x171x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.439 W/kg

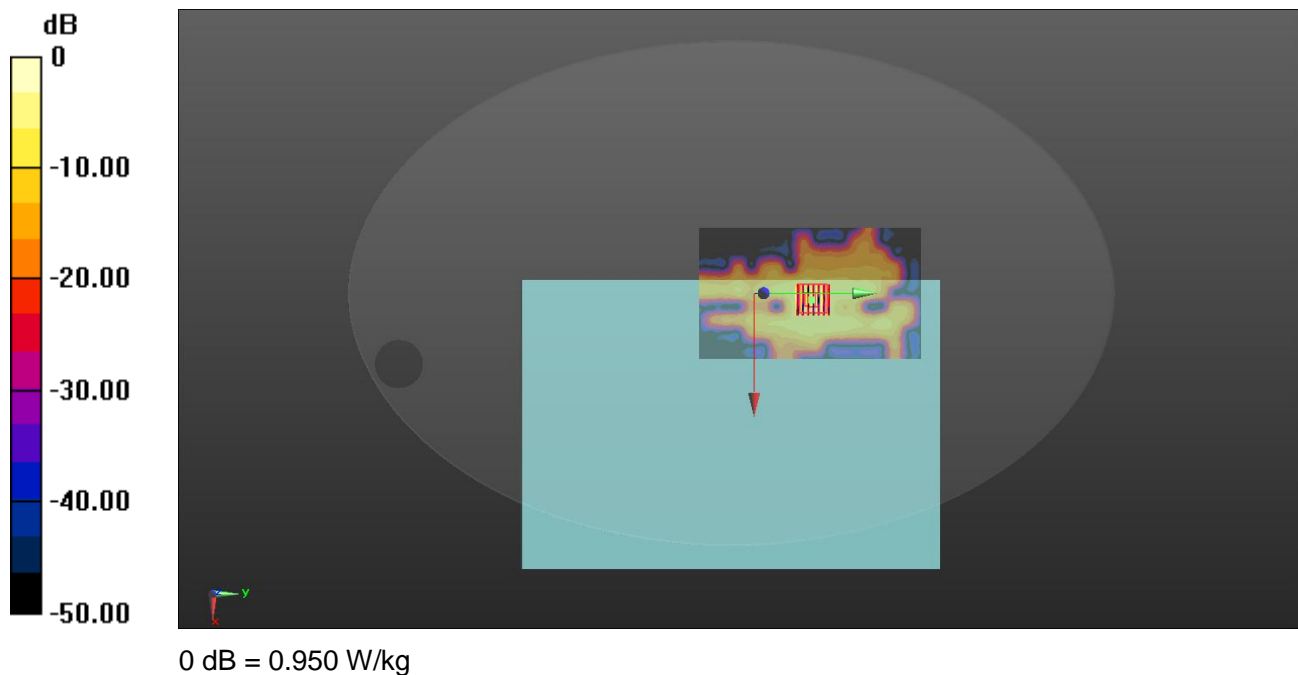
Ch52/Zoom Scan (7x7x13)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 3.381 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 1.93 W/kg

SAR(1 g) = 0.477 W/kg; SAR(10 g) = 0.150 W/kg

Maximum value of SAR (measured) = 0.950 W/kg



5_Body Plan with Bottom Side 0mm on Channel 116 in IEEE 802.11a mode with Antenna Main

Date: 2018.01.25

Communication System Band: WLAN(a); Frequency: 5580 MHz; Duty Cycle: 1:1.049

Medium parameters used: $f = 5580$ MHz; $\sigma = 5.75$ S/m; $\epsilon_r = 48.07$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.4 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.35, 4.35, 4.35); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch116/Area Scan (101x171x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.602 W/kg

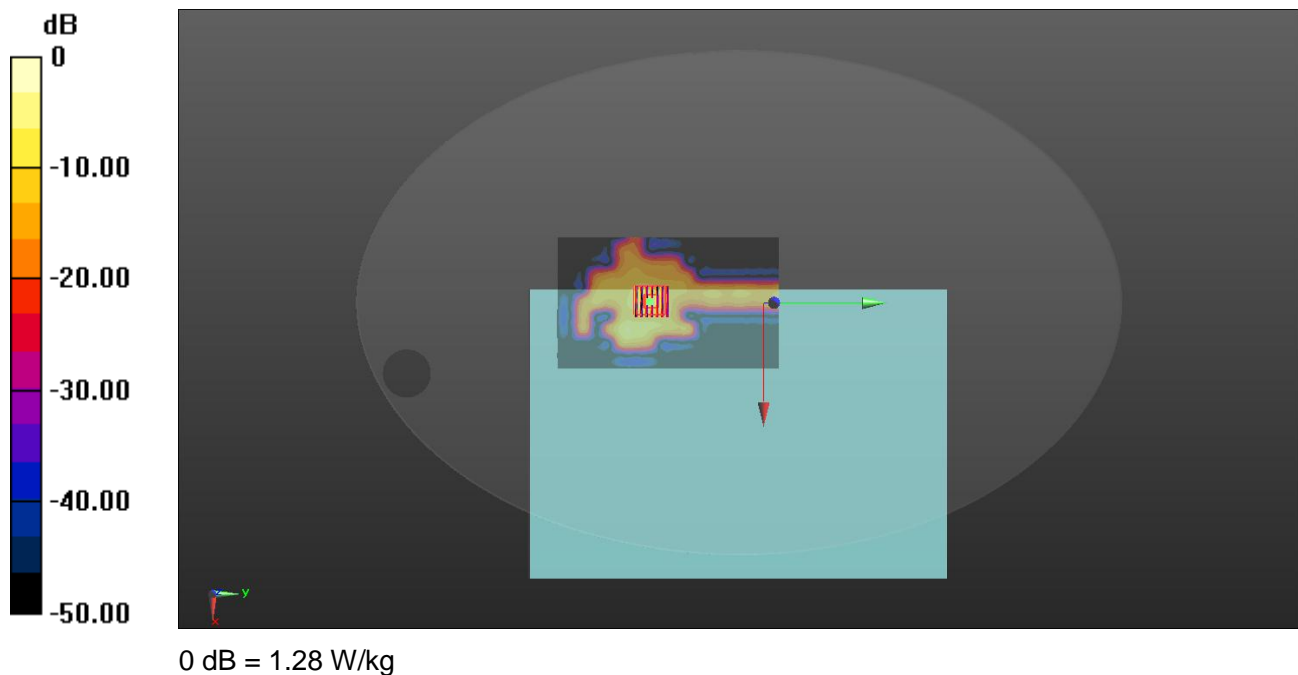
Ch116/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.840 V/m; Power Drift = 0.19 dB

Peak SAR (extrapolated) = 2.68 W/kg

SAR(1 g) = 0.619 W/kg; SAR(10 g) = 0.184 W/kg

Maximum value of SAR (measured) = 1.28 W/kg



6_Body Plan with Bottom Side 0mm on Channel 116 in IEEE 802.11a mode with Antenna Aux

Date: 2018.01.25

Communication System Band: WLAN(a); Frequency: 5580 MHz; Duty Cycle: 1:1.050

Medium parameters used: $f = 5580$ MHz; $\sigma = 5.75$ S/m; $\epsilon_r = 48.07$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.4 Liquid Temperature: 21.4

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.35, 4.35, 4.35); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch116/Area Scan (101x171x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.323 W/kg

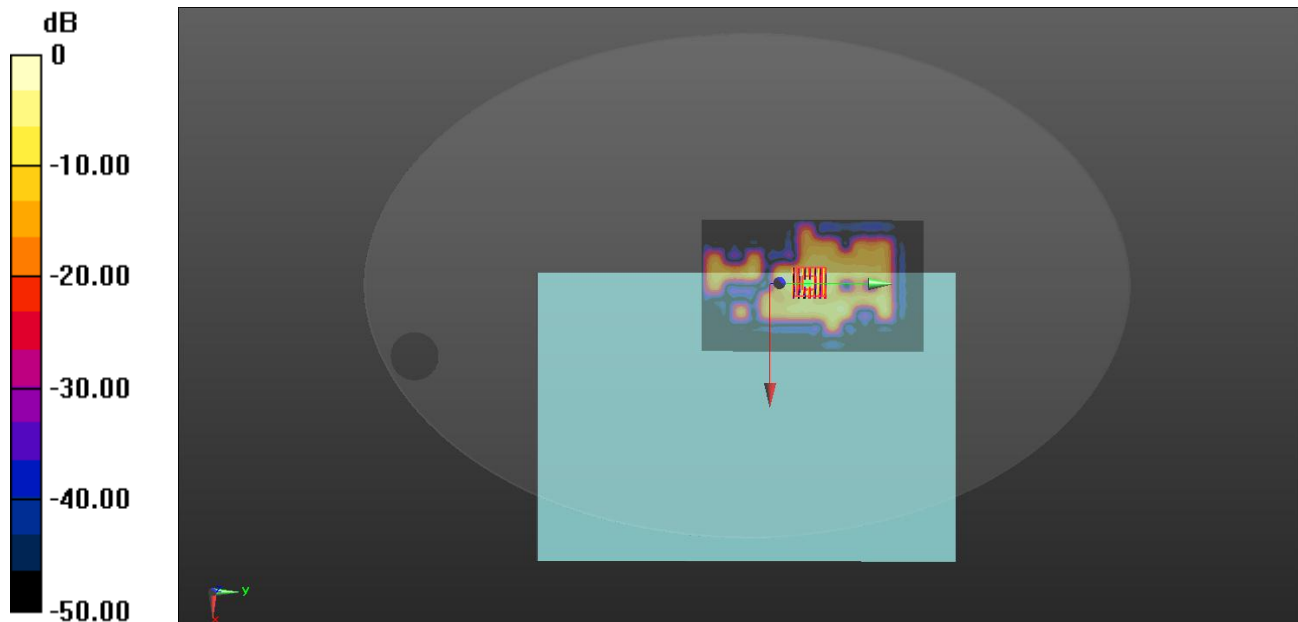
Ch116/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.442 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.35 W/kg

SAR(1 g) = 0.298 W/kg; SAR(10 g) = 0.095 W/kg

Maximum value of SAR (measured) = 0.626 W/kg



0 dB = 0.626 W/kg

7_Body Plan with Bottom Side 0mm on Channel 157 in IEEE 802.11a mode with Antenna Main

Date: 2018.02.12

Communication System Band: WLAN(a); Frequency: 5785 MHz; Duty Cycle: 1:1.050

Medium parameters used (interpolated): $f = 5785$ MHz; $\sigma = 6.03$ S/m; $\epsilon_r = 47.05$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.58, 4.58, 4.58); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch157/Area Scan (101x171x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 0.480 W/kg

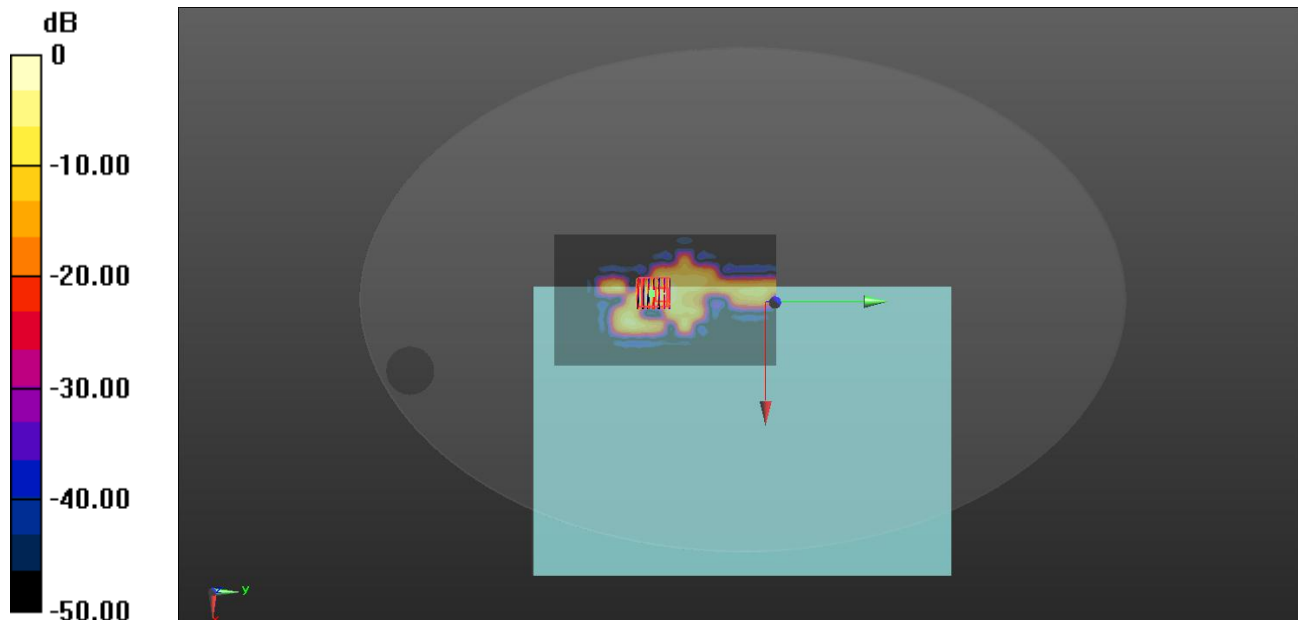
Ch157/Zoom Scan (7x7x13)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=2$ mm

Reference Value = 1.592 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 1.15 W/kg

SAR(1 g) = 0.276 W/kg; SAR(10 g) = 0.076 W/kg

Maximum value of SAR (measured) = 0.584 W/kg



0 dB = 0.584 W/kg

8_Body Plan with Bottom Side 0mm on Channel 157 in IEEE 802.11a mode with Antenna Aux

Date: 2018.02.12

Communication System Band: WLAN(a); Frequency: 5785 MHz; Duty Cycle: 1:1.054

Medium parameters used (interpolated): $f = 5785$ MHz; $\sigma = 6.03$ S/m; $\epsilon_r = 47.05$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Ambient Temperature: 22.3 Liquid Temperature: 21.2

DASY5 Configuration:

- Probe: EX3DV4 - SN7340; ConvF(4.58, 4.58, 4.58); Calibrated: 2018.01.11;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn685; Calibrated: 2017.08.02
- Phantom: ELI v4.0 (30deg probe tilt); Type: QDOVA001BB; Serial: TP:1012
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch157/Area Scan (101x171x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.401 W/kg

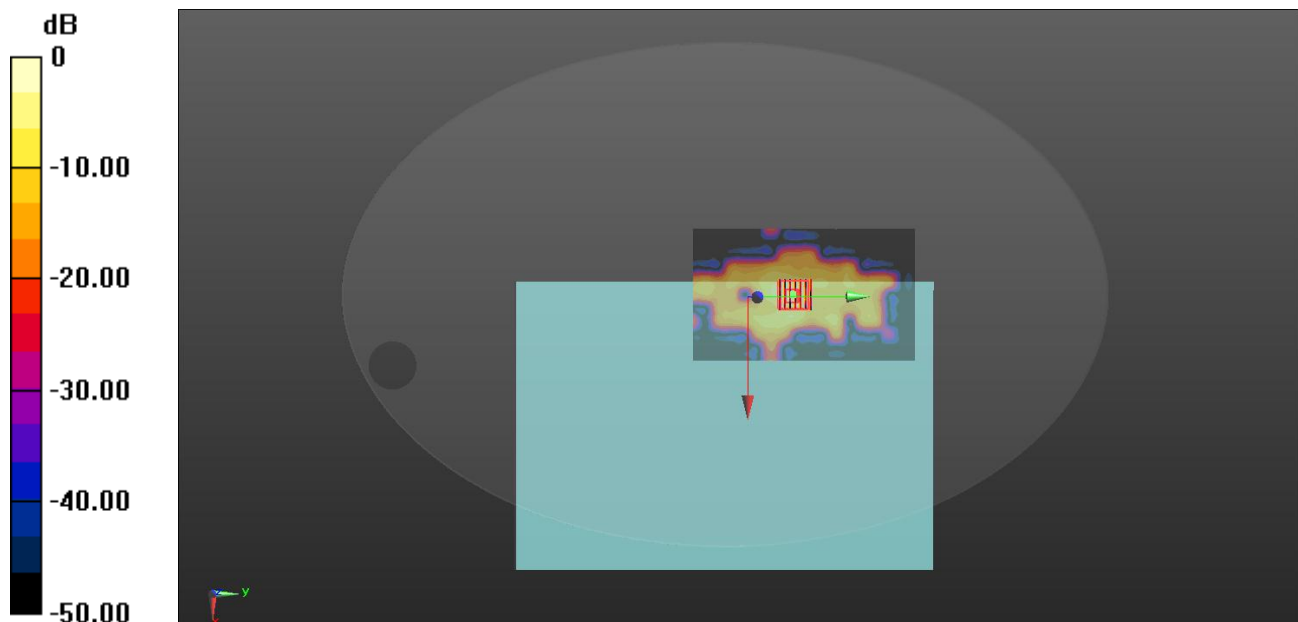
Ch157/Zoom Scan (7x7x13)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.392 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.93 W/kg

SAR(1 g) = 0.420 W/kg; SAR(10 g) = 0.129 W/kg

Maximum value of SAR (measured) = 0.843 W/kg



0 dB = 0.843 W/kg

ANNEX D EUT EXTERNAL PHOTOS

Please refer the document "BL-SZ1810286-AW.pdf".

ANNEX E SAR TEST SETUP PHOTOS

Please refer the document "BL-SZ1810286-AS.pdf".

ANNEX G CALIBRATION REPORT

Please refer the document "CALIBRATION REPORT.pdf".

--END OF REPORT--