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TEST REPORT

Report Reference No.....: TRE18070098 R/C.....: 74010

FCC ID.....: A2HCN6212

Applicant's name.....: ALCO ELECTRONICS LTD

Address.....: 11/F Metropole Square, 2 On Yiu Street, Sha Tin, New Territories, Hong Kong

Manufacturer.....: ALCO ELECTRONICS LTD

Address.....: 11/F Metropole Square, 2 On Yiu Street, Sha Tin, New Territories, Hong Kong

Test item description.....: Laptop

Trade Mark.....: Venturer / Avita

Model/Type reference.....: CN6212

Listed Model(s).....: NS12A1

Standard.....: FCC 47 CFR Part2.1093
IEEE 1528: 2013 ANSI/IEEE C95.1: 1999

Date of receipt of test sample.....: Jul.17,2018

Date of testing.....: Jul.18,2018- Jul.27,2018

Date of issue.....: Jul.31,2018

Result.....: PASS

Compiled by
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Testing Laboratory Name: Shenzhen Huatongwei International Inspection Co., Ltd

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The test report merely correspond to the test sample.

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1 . **Test Standards and Report version**

1.1. **Test Standards**

The tests were performed according to following standards:

[FCC 47 Part 2.1093](#): Radiofrequency Radiation Exposure Evaluation:Portable Devices

[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.

[IEEE Std 1528™-2013](#): IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB 865664 D02 RF Exposure Reporting v01r02](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB 447498 D01 General RF Exposure Guidance v06](#): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[KDB 248227 D01 802.11 Wi-Fi SAR v02r02](#): SAR Measurement Procedures for 802.11 a/b/g Transmitters

[KDB 616217 D04 SAR for laptop and tablets v01r02](#): describes the SAR evaluation requirements for laptop, notebook, netbook and tablet computers.

1.2. **Report version information**

Revision No.	Date of issue	Description
N/A	2018-07-31	Original

2. Summary

2.1. Client Information

Applicant:	ALCO ELECTRONICS LTD
Address:	11/F Metropole Square, 2 On Yiu Street, Sha Tin, New Territories, Hong Kong
Manufacturer:	ALCO ELECTRONICS LTD
Address:	11/F Metropole Square, 2 On Yiu Street, Sha Tin, New Territories, Hong Kong

2.2. Product Description

Name of EUT:	Laptop		
Trade Mark:	Venturer / Avita		
Model No.:	CN6212		
Listed Model(s):	NS12A1		
Power supply:	DC 7.4V		
Device Category:	Portable		
Product stage:	Production unit		
RF Exposure Environment:	General Population / Uncontrolled		

Maximum SAR Value

Separation Distance:	Body: 0mm		
Max Report SAR Value (1g):	Test location:	DTS/U-NII	Simultaneous TX

WIFI 2.4G

Supported type:	802.11b/802.11g/802.11n(HT20)/802.11n(HT40)		
Modulation:	DSSS for 802.11b OFDM for 802.11g/802.11n(HT20)/802.11n(HT40)		
Operation frequency:	2412MHz~2462MHz		
Channel number:	11		
Channel separation:	5MHz		
Antenna type:	Integral antenna		

WIFI 5G

Supported type:	802.11a/802.11n(HT20)/802.11n(HT40)/802.11ac(HT20)/802.11ac(HT40)/802.11ac(HT80)		
Modulation:	BPSK, QPSK, 16QAM, 64QAM		
Operation frequency:	Band U-NII-1:5150MHz~5250MHz Band U-NII-3:5725MHz~5850MHz		
Supported Bandwidth:	20MHz: 802.11n, 802.11a, 802.11ac 40MHz: 802.11n, 802.11ac 80MHz: 802.11ac		
Antenna type:	Integral antenna		

Bluetooth	
Version:	Supported BT4.0+EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	Integral antenna
Bluetooth-BLE	
Version:	Supported BT4.0+BLE
Modulation:	GFSK
Operation frequency:	2402MHz~2480MHz
Channel number:	40
Channel separation:	2MHz
Antenna type:	Integral antenna
<i>Remark:</i>	
1. <i>The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power</i>	

3. Test Environment

3.1. Test laboratory

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

3.2. Test Facility

CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025:2005 General Requirements) for the Competence of Testing and Calibration Laboratories

A2LA-Lab Cert. No. 3902.01

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

FCC-Registration No.: 762235

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files.

IC-Registration No.: 5377B

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No.: 5377B

ACA

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
Data Acquisition Electronics DAEx	SPEAG	DAE4	1549	2018/04/25	2019/04/24
E-field Probe	SPEAG	EX3DV4	7494	2018/02/26	2019/02/25
System Validation Dipole	SPEAG	D2450V2	1009	2018/02/05	2021/02/04
System Validation Dipole	SPEAG	D5GHzV2	1273	2018/02/21	2021/02/20
Dielectric Assessment Kit	SPEAG	DAK-3.5	1267	2018/03/01	2019/02/28
Network analyzer	Agilent	N9923A	MY51491493	2017/09/05	2018/09/04
Power meter	Agilent	N1914A	MY52090010	2018/03/22	2019/03/21
Power sensor	Agilent	E9304A	MY52140008	2018/03/22	2019/03/21
Power sensor	Agilent	E9301H	MY54470001	2017/06/02	2018/06/01
Signal Generator	ROHDE & SCHWARZ	SMB100A	175248	2017/09/02	2018/09/01
Dual Directional Coupler	Agilent	772D	MY46151257	2018/03/22	2019/03/21
Power Amplifier	Mini-Circuits	ZHL-42W	QA1202003	2017/11/27	2018/11/26
Power Amplifier	Mini-Circuits	ZVE-8G+	421401127	2018/03/22	2019/03/21

Note:

1. The Probe, Dipole and DAE calibration reference to the Appendix A and B.
2. Referring to KDB865664 D01, the dipole calibration interval can be extended to 3 years with justification. The dipole are also not physically damaged or repaired during the interval.

5. Measurement Uncertainty

Measurement Uncertainty										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.0%	N	1	1	1	6.0%	6.0%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evaluation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Test Sample Related										
15	Test sample positioning	A	1.86%	N	1	1	1	1.86%	1.86%	∞
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70%	∞
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	9.79%	9.67%	∞
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$		R	K=2	/	/	19.57%	19.34%	∞

System Check Uncertainty										
No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	6.0%	N	1	1	1	6.0%	6.0%	∞
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	∞
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	∞
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	∞
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	∞
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	∞
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	∞
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	∞
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	∞
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	∞
14	Max.SAR evalution	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
System validation source-dipole										
15	Deviation of experimental dipole from numerical dipole	A	1.58%	N	1	1	1	1.58%	1.58%	∞
16	Dipole axis to liquid distance	A	1.35%	N	1	1	1	1.35%	1.35%	∞
17	Input power and SAR drift	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	∞
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	∞
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	∞
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	8.80%	8.79%	∞
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$		R	K=2	/	/	17.59%	17.58%	∞

6. SAR Measurements System Configuration

6.1. SAR Measurement Set-up

The DASY5 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

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.

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.

A unit to operate the optical surface detector which is connected to the EOC.

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.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

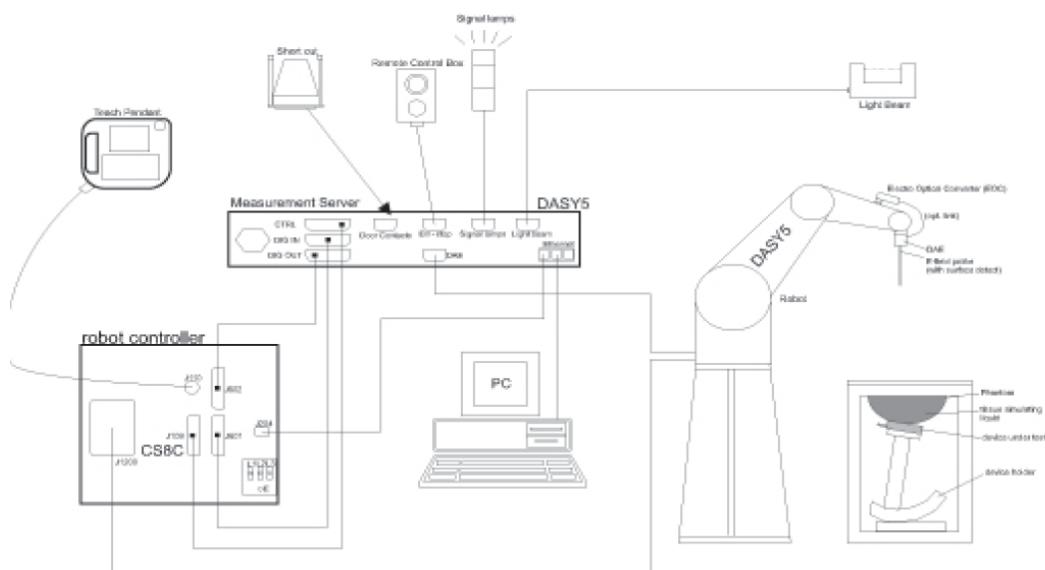
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld Mobile Phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



6.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

● Probe Specification

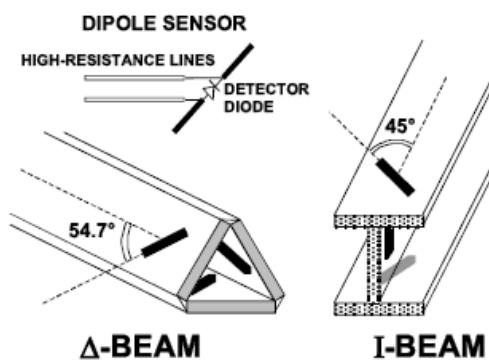
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 μ W/g to > 100 W/kg; Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1.0 mm
Application	General dosimetry up to 6 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI



● Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



6.3. Phantoms

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with standard and all known tissue simulating liquids. ELI 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. The phantom is compatible with all SPEAG dosimetric probes and dipoles.



ELI4 Phantom

6.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

7. SAR Test Procedure

7.1. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. $\pm 5\%$.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above $\pm 0.1\text{mm}$). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within $\pm 30^\circ$.)

Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan

After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm.

Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.

Extrapolation routines require at least 10 measurement points in 3-D space.

They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

Table 1: Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v04

		≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface		$5 \text{ mm} \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \text{ mm} \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location		$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$		$\leq 2 \text{ GHz: } \leq 15 \text{ mm}$ $2 - 3 \text{ GHz: } \leq 12 \text{ mm}$	$3 - 4 \text{ GHz: } \leq 12 \text{ mm}$ $4 - 6 \text{ GHz: } \leq 10 \text{ mm}$
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$		$\leq 2 \text{ GHz: } \leq 8 \text{ mm}$ $2 - 3 \text{ GHz: } \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz: } \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz: } \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$\leq 5 \text{ mm}$ $3 - 4 \text{ GHz: } \leq 4 \text{ mm}$ $4 - 5 \text{ GHz: } \leq 3 \text{ mm}$ $5 - 6 \text{ GHz: } \leq 2 \text{ mm}$
	graded grid	$\Delta z_{\text{Zoom}}(1):$ between 1 st two points closest to phantom surface	$\leq 4 \text{ mm}$ $3 - 4 \text{ GHz: } \leq 3 \text{ mm}$ $4 - 5 \text{ GHz: } \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz: } \leq 2 \text{ mm}$
		$\Delta z_{\text{Zoom}}(n>1):$ between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$
Minimum zoom scan volume	x, y, z	$\geq 30 \text{ mm}$	$3 - 4 \text{ GHz: } \geq 28 \text{ mm}$ $4 - 5 \text{ GHz: } \geq 25 \text{ mm}$ $5 - 6 \text{ GHz: } \geq 22 \text{ mm}$
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.			
* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB Publication 447498 is $\leq 1.4 \text{ W/kg}$, $\leq 8 \text{ mm}$, $\leq 7 \text{ mm}$ and $\leq 5 \text{ mm}$ zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.			

7.2. Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [W/kg], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

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

Probe parameters:	Sensitivity:	Normi, ai0, ai1, ai2
	Conversion factor:	ConvFi
	Diode compression point:	Dcp <i>i</i>
Device parameters:	Frequency:	f
	Crest factor:	cf
Media parameters:	Conductivity:	σ
	Density:	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

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

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

$$E - \text{fieldprobes} : \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$H - \text{fieldprobes} : \quad H_i = \sqrt{V_i \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}}$$

Vi: compensated signal of channel (i = x, y, z)
 Norm*i*: sensor sensitivity of channel (i = x, y, z),
 [mV/(V/m)²] for E-field Probes
 ConvF: sensitivity enhancement in solution
 aij: sensor sensitivity factors for H-field probes
 f: carrier frequency [GHz]
 Ei: electric field strength of channel i in V/m
 Hi: magnetic field strength of channel i in A/m

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

SAR: local specific absorption rate in W/kg

Etot: total field strength in V/m

σ : conductivity in [mho/m] or [Siemens/m]

ρ : equivalent tissue density in g/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

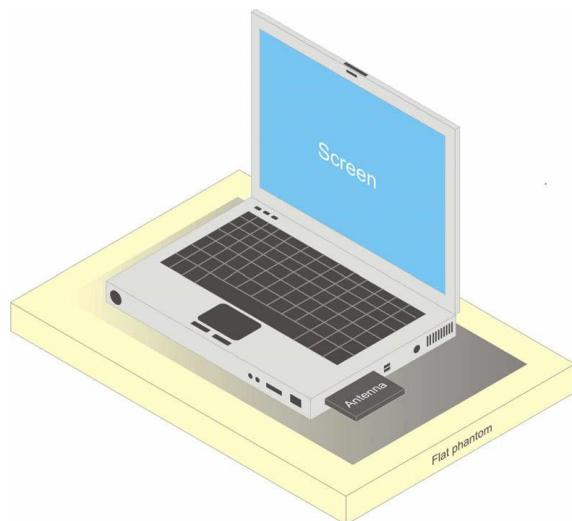
8. **Position of the wireless device in relation to the phantom**

8.1. **Body Exposure conditions**

A typical example of a body supported device is a wireless enabled laptop device that among other orientations may be supported on the thighs of a sitting user. To represent this orientation, the device shall be positioned with its base against the flat phantom. Other orientations may be specified by the manufacturer in the user instructions. If the intended use is not specified, the device shall be tested directly against the flat phantom in all usable orientations.

The screen portion of the device shall be in an open position at a 90° angle as seen in Figure, or at an operating angle specified for intended use by the manufacturer in the operating instructions. Where a body supported device has an integral screen required for normal operation, then the screen-side will not need to be tested if it ordinarily remains 200 mm from the body.

The required minimum test separation distance for incorporating transmitters and antennas into laptop, notebook and netbook computer displays is determined with the display screen opened at an angle of 90 to the keyboard compartment. If a computer has other operating configurations that require a different or more conservative display to keyboard angle for normal use, a KDB inquiry should be submitted to determine the test requirements. When antennas are incorporated in the keyboard section of a laptop computer, SAR is required for the bottom surface of the keyboard.



Picture Test positions for Hotspot Mode

9. System Check

9.1. Tissue Dielectric Parameters

It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

Tissue dielectric parameters for head and body phantoms		
Target Frequency		Body
(MHz)	ϵ_r	$\sigma(\text{s/m})$
2450	52.7	1.95
5200	49.01	5.30
5800	48.2	6.00

Check Result:

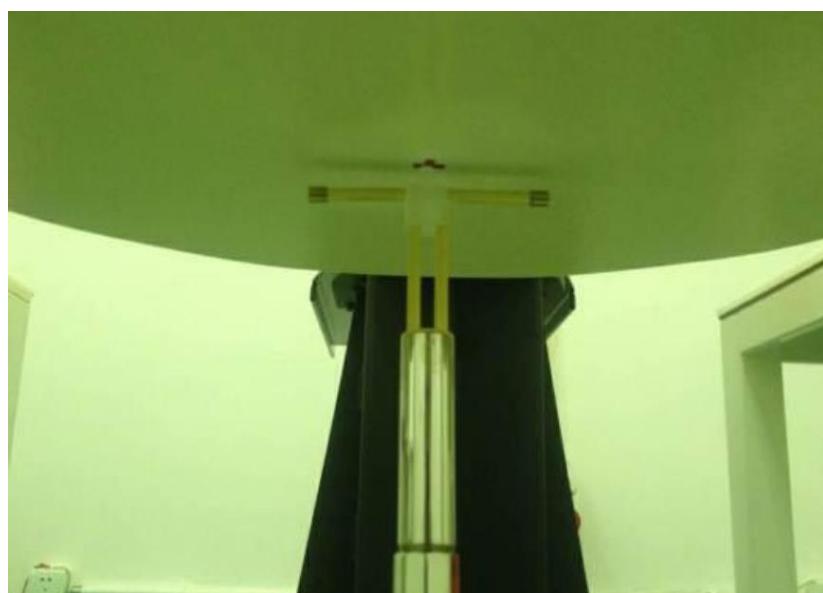
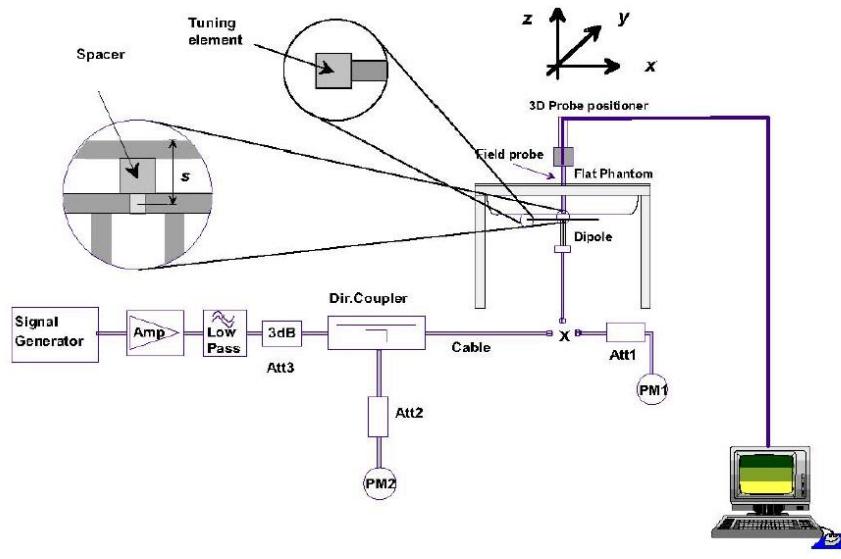
Dielectric performance of Body tissue simulating liquid									
Frequency (MHz)	ϵ_r		$\sigma(\text{s/m})$		Delta (ϵ_r)	Delta (σ)	Limit	Temp (°C)	Date
	Target	Measured	Target	Measured					
2450	52.70	53.03	1.95	2.00	0.63%	2.56%	±5%	22	2018-07-20
5200	49.01	48.15	5.30	5.38	-1.75%	1.53%	±5%	22	2018-07-23
5800	48.20	46.94	6.00	6.27	-2.61%	4.50%	±5%	22	2018-07-24

9.2. SAR System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ($\pm 10\%$).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



Check Result:

Bdoy											
Frequency (MHz)	1g SAR			10g SAR			Delta (1g)	Delta (10g)	Limit	Temp (°C)	Date
	Target 1W	Normalize to 1W	Measured 250mW	Target 1W	Normalize to 1W	Measured 250mW					
2450	49.40	50.00	12.50	23.30	23.32	5.83	1.21%	0.09%	±10%	22	2018-07-20

Bdoy											
Frequency (MHz)	1g SAR			10g SAR			Delta (1g)	Delta (10g)	Limit	Temp (°C)	Date
	Target 1W	Normalize to 1W	Measured 100mW	Target 1W	Normalize to 1W	Measured 100mW					
5200	73.60	70.70	7.07	20.40	20.00	2.00	-3.94%	-1.96%	±10%	22	2018-07-23
5800	76.50	72.80	7.28	21.10	20.20	2.02	-4.84%	-4.27%	±10%	22	2018-07-24

Plots of System Performance Check

SystemPerformanceCheck-Body 2450MHz

DUT: D2450V2; Type: D2450V2; Serial: 1009

Date: 2018-07-20

Communication System: UID 0, CW (0); Frequency: 2450 MHz

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.001$ S/m; $\epsilon_r = 53.03$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.08, 8.08, 8.08); Calibrated: 2/26/2018;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 31.0$
- Electronics: DAE4 Sn1549; Calibrated: 4/25/2018
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Body/d=10mm,Pin=250mW/Area Scan (71x71x1):

Interpolated grid: $dx=1.200$ mm,

$dy=1.200$ mm

Maximum value of SAR (interpolated) = 21.1 W/kg

Body/d=10mm,Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

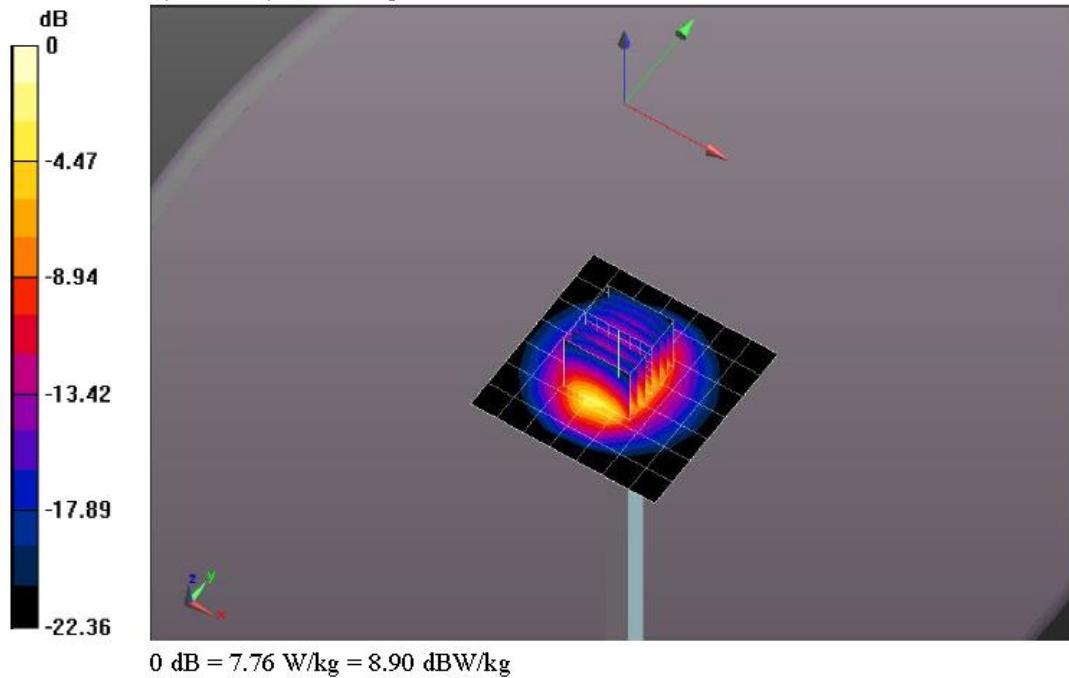
Measurement grid: $dx=5$ mm,
 $dy=5$ mm, $dz=5$ mm

Reference Value = 105.6 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.7 W/kg

SAR(1 g) = 12.5 W/kg; SAR(10 g) = 5.83 W/kg

Maximum value of SAR (measured) = 20.7 W/kg



System Performance Check-Body 5200MHz

DUT: D5GHzV2; Type: D5GHzV2; Serial: 1273

Date: 2018-07-23

Communication System: UID 0, A-CW (0); Frequency: 5200 MHz

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.381$ S/m; $\epsilon_r = 48.152$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(5.3, 5.3, 5.3); Calibrated: 2/26/2018;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 25.0$
- Electronics: DAE4 Sn1534; Calibrated: 2/23/2018
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- DASY52 52.10.0(1446); SEMCAD X 14.6.11(7437)

Body/d=10mm, Pin=100mW/Area Scan (61x61x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 16.4 W/kg

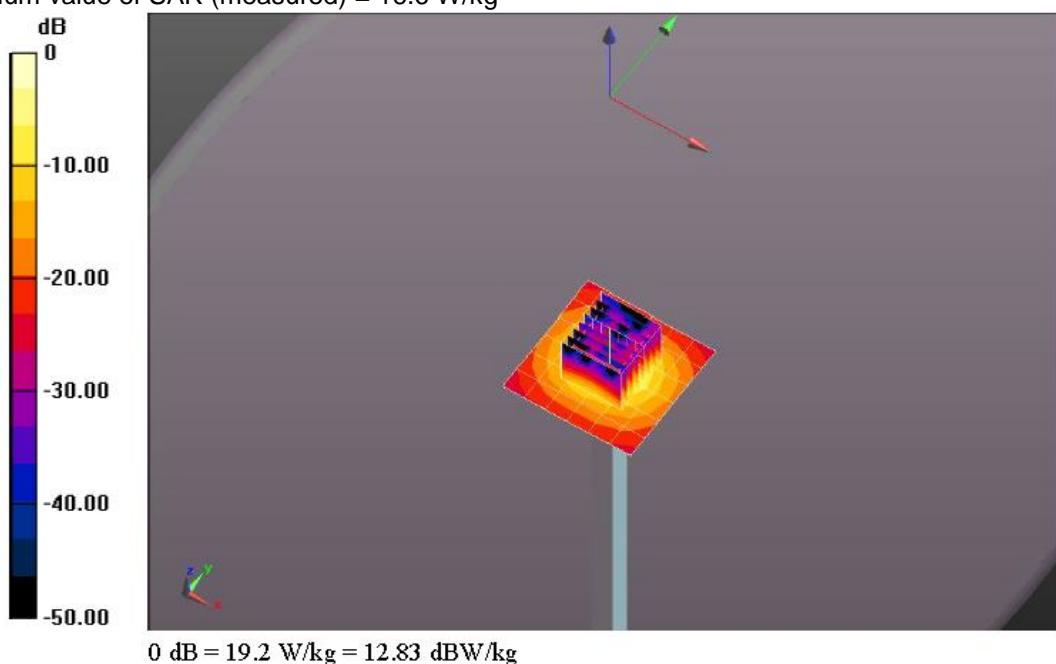
Body/d=10mm, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 64.23 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.3 W/kg

SAR(1 g) = 7.07 W/kg; SAR(10 g) = 2 W/kg

Maximum value of SAR (measured) = 16.6 W/kg



System Performance Check-Body 5800MHz

DUT: D5GHzV2; Type: D5GHzV2; Serial: 1273

Date: 2018-07-24

Communication System: UID 0, A-CW (0); Frequency: 5800 MHz

Medium parameters used: $f = 5800$ MHz; $\sigma = 6.27$ S/m; $\epsilon_r = 46.943$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(4.61, 4.61, 4.61); Calibrated: 2/26/2018;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection), $z = 1.0, 25.0$
- Electronics: DAE4 Sn1549; Calibrated: 4/25/2018
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- DASY52 52.10.0(1446); SEMCAD X 14.6.11(7437)

Body/d=10mm, Pin=100mW/Area Scan (91x91x1): Interpolated grid: $dx=1.000$ mm, $dy=1.000$ mm

Maximum value of SAR (interpolated) = 17.9 W/kg

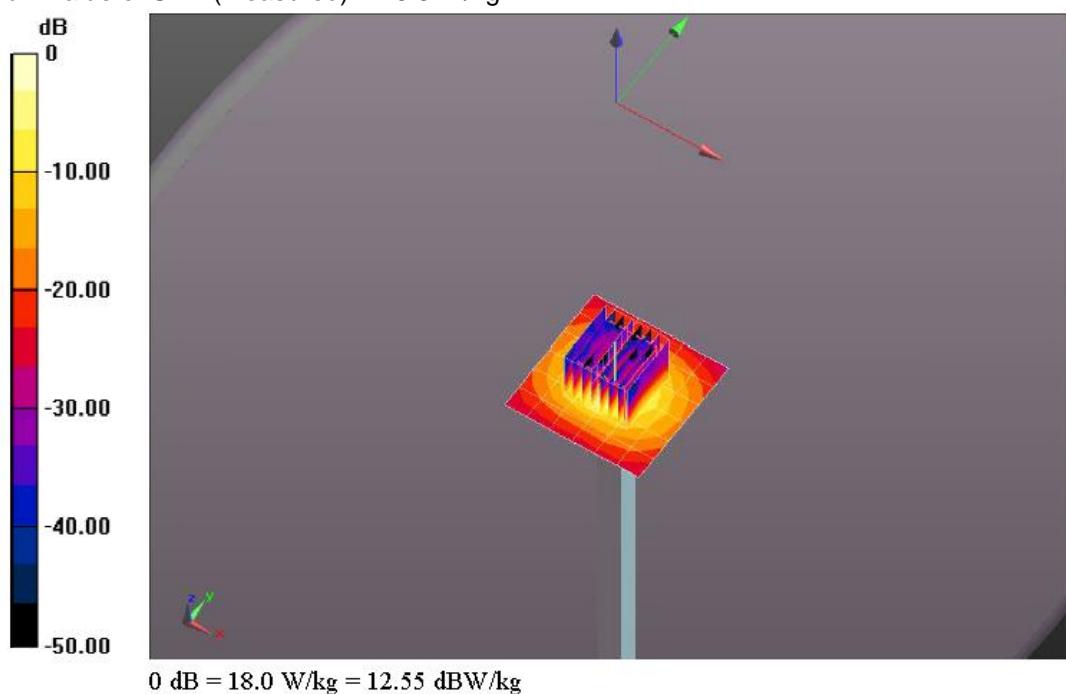
Body/d=10mm, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: $dx=4$ mm, $dy=4$ mm, $dz=1.4$ mm

Reference Value = 62.07 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 36.2 W/kg

SAR(1 g) = 7.28 W/kg; SAR(10 g) = 2.02 W/kg

Maximum value of SAR (measured) = 18.8 W/kg



10. SAR Exposure Limits

SAR assessments have been made in line with the requirements of ANSI/IEEE C95.1-1992

Type Exposure	Limit (W/kg)	
	General Population / Uncontrolled Exposure Environment	Occupational / Controlled Exposure Environment
Spatial Average SAR (whole body)	0.08	0.4
Spatial Peak SAR (1g cube tissue for head and trunk)	1.6	8.0
Spatial Peak SAR (10g for limb)	4.0	20.0

Population/Uncontrolled Environments: are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments: are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

11. Conducted Power Measurement Results

WLAN Conducted Power

For 2.4GHz WLAN SAR testing, highest average RF output power channel for the lowest data rate for 802.11b were for SAR evaluation. 802.11g/n were not investigated since the average output powers over all channels and data rates were not more than 0.25dB higher than the tested channel in the lowest data rate of 802.11b mode.

The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures

WIFI 2.4G 1Tx				
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
			ANT a	ANT b
802.11b	1	2412	14.90	14.88
	6	2437	14.74	14.97
	11	2462	14.81	14.91
802.11g	1	2412	12.31	12.35
	6	2437	12.06	12.24
	11	2462	12.28	12.34
802.11n(HT20)	1	2412	11.02	11.09
	6	2437	11.06	11.12
	11	2462	11.04	11.13
802.11n(HT40)	3	2422	10.10	9.94
	6	2437	9.75	9.90
	9	2452	9.69	9.93

WIFI 2.4G 2Tx				
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
			ANT a	ANT b
802.11n(HT20)	1	2412	11.02	11.09
	6	2437	11.06	11.12
	11	2462	11.04	11.13
802.11n(HT40)	3	2422	10.10	9.94
	6	2437	9.75	9.90
	9	2452	9.69	9.93

WIFI 5G U-NII-1 1Tx					
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
				ANT a	ANT b
20	802.11ac	36	5180	14.18	12.97
		40	5200	14.42	13.16
		48	5240	14.38	13.19
	802.11n	36	5180	13.98	13.12
		40	5200	14.31	13.25
		48	5240	14.38	13.27
	802.11a	36	5180	14.77	14.10
		40	5200	15.06	14.16
		48	5240	15.19	14.08
40	802.11ac	38	5190	12.14	12.11
		46	5230	12.47	12.23
	802.11n	38	5190	12.07	11.98
		46	5230	12.62	12.13
80	802.11ac	42	5210	10.32	10.34

WIFI 5G U-NII-1 2Tx					
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
				ANT a	ANT b
20	802.11ac	36	5180	14.18	12.97
		40	5200	14.42	13.16
		48	5240	14.38	13.19
	802.11n	36	5180	13.98	13.12
		40	5200	14.31	13.25
		48	5240	14.38	13.27
40	802.11ac	38	5190	12.14	12.11
		46	5230	12.47	12.23
	802.11n	38	5190	12.07	11.98
		46	5230	12.62	12.13
80	802.11ac	42	5210	10.32	10.34

WIFI 5G U-NII-3 1Tx					
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
				ANT a	ANT b
20	802.11ac	149	5745	14.33	13.46
		157	5785	14.26	13.32
		165	5825	13.97	13.23
	802.11n	149	5745	13.94	13.33
		157	5785	14.23	13.20
		165	5825	13.96	13.20
	802.11a	149	5745	14.59	13.97
		157	5785	14.68	13.85
		165	5825	14.57	13.80
40	802.11ac	151	5755	11.47	10.76
		159	5795	11.52	10.68
	802.11n	151	5755	11.64	10.75
		159	5795	11.71	10.77
80	802.11ac	155	5775	9.78	8.94

WIFI 5G U-NII-3 2Tx					
Bandwidth	Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)	
				ANT a	ANT b
20	802.11ac	149	5745	14.33	13.46
		157	5785	14.26	13.32
		165	5825	13.97	13.23
	802.11n	149	5745	13.94	13.33
		157	5785	14.23	13.20
		165	5825	13.96	13.20
40	802.11ac	151	5755	11.47	10.76
		159	5795	11.52	10.68
	802.11n	151	5755	11.64	10.75
		159	5795	11.71	10.77
80	802.11ac	155	5775	9.78	8.94

Bluetooth Conducted Power

Bluetooth(ANT a)			
Mode	Channel	Frequency (MHz)	Conducted power (dBm)
GFSK	0	2402	5.15
	39	2441	5.81
	78	2480	4.18
$\pi/4$ QPSK	0	2402	4.82
	39	2441	5.73
	78	2480	4.23
8DPSK	0	2402	4.22
	39	2441	5.05
	78	2480	3.52
BLE	0	2402	1.03
	19	2440	1.53
	39	2480	-0.15

12. Maximum Tune-up Limit

WLAN 2.4G		
Mode	Maximum Tune-up (dBm) Burst Average Power	
	ANT a	ANT b
802.11b	15.00	15.00
802.11g	12.50	12.50
802.11n(HT20)	11.50	11.50
802.11n(HT40)	10.50	10.00

WLAN 5G U-NII-1		
Mode	Maximum Tune-up (dBm) Burst Average Power	
	ANT a	ANT b
802.11ac(HT20)	14.50	13.50
802.11n(HT20)	14.50	13.50
802.11a	15.50	14.50
802.11ac(HT40)	12.50	12.50
802.11n(HT40)	13.00	12.50
802.11ac(HT80)	10.50	10.50

WLAN 5G U-NII-3		
Mode	Maximum Tune-up (dBm) Burst Average Power	
	ANT a	ANT b
802.11ac(HT20)	14.50	13.50
802.11n(HT20)	14.50	13.50
802.11a	15.00	14.00
802.11ac(HT40)	12.00	11.00
802.11n(HT40)	12.00	11.00
802.11ac(HT80)	10.00	9.00

Note:

When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band.

Bluetooth(ANT a)	
Mode	Maximum Tune-up (dBm)
GFSK	5.90
$\pi/4$ QPSK	5.90
8DPSK	5.50
BLE	2.00

Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances \leq 50mm are determined by:

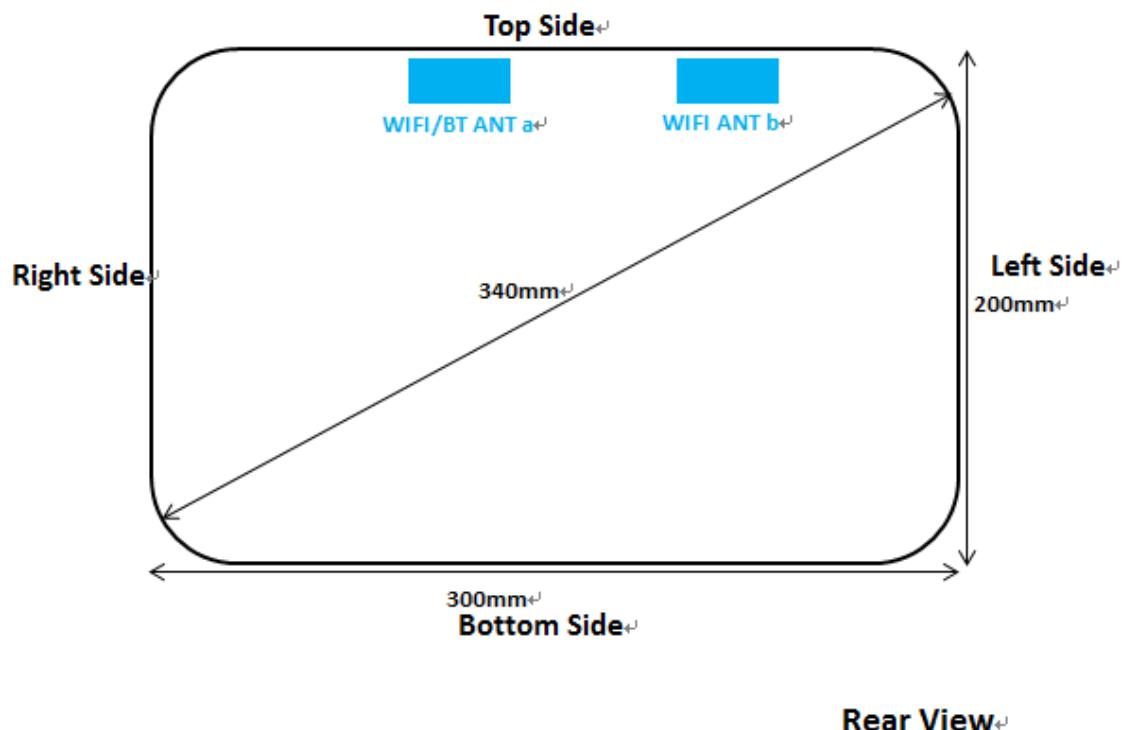
$[(\text{max. Power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] ^ *$
 $[\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR

Band/Mode	F(GHz)	Position	SAR test exclusion threshold (mW)	RF output power		SAR test exclusion
				dBm	mW	
Bluetooth	2.45	Body	10	5.90	3.89	Yes

Per KDB 447498 D01, when the minimum test separation distance is <5mm, a distance of 5mm is applied to determine SAR test exclusion.

The test exclusion thereshold is \leq 3, SAR testing is not required.

13. Antenna Location



14. SAR Measurement Results

Body SAR

WIFI 2.4G										
Mode	Test Position	Frequency		Conducted Power (dBm)	Tune up limit (dBm)	Tune up scaling factor	Power Drift(dB)	Measured SAR(1g) (W/kg)	Report SAR(1g) (W/kg)	Test Plot
		CH	MHz							
802.11b 1Mbps 1Tx	Rear (ANT a)	1	2412	14.90	15.00	1.02	-0.11	0.006	0.006	-
		6	2437	14.74	15.00	1.06	-	-	-	-
		11	2462	14.81	15.00	1.04	-	-	-	-
	Rear (ANT b)	1	2412	14.88	15.00	1.03	-	-	-	-
		6	2437	14.97	15.00	1.01	-0.12	0.010	0.010	B1
		11	2462	14.91	15.00	1.02	-	-	-	-
802.11n (HT20) MCS0 2Tx	Rear (ANT a)	1	2412	11.02	11.50	1.12	-	-	-	-
		6	2437	11.06	11.50	1.11	-0.11	0.004	0.004	-
		11	2462	11.04	11.50	1.11	-	-	-	-
	Rear (ANT b)	1	2412	11.09	11.50	1.10	-	-	-	-
		6	2437	11.12	11.50	1.09	-0.12	0.007	0.008	-
		11	2462	11.13	11.50	1.09	-	-	-	-

Note:

1. According to the above table, the initial test position for body is "Rear", and its reported SAR is $\leq 0.4\text{W/kg}$. Thus further SAR measurement is not required for the other (remaining) test positions. Because the reported SAR of the highest measured maximum output power channel for the exposure configuration is $\leq 0.8\text{W/kg}$, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
2. When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied. 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 $\leq 1.2\text{ W/kg}$, the 802.11g/n is not required

WIFI 2.4G- Scaled Reported SAR							
Mode	Test Position	Frequency		Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
		CH	MHz				
802.11b 1Mbps 1Tx	Rear (ANT a)	1	2412	98.99%	100%	0.006	0.006
802.11b 1Mbps 1Tx	Rear (ANT b)	6	2437	98.99%	100%	0.010	0.010
802.11n (HT20) MCS0 2Tx	Rear (ANT a)	6	2437	98.99%	100%	0.004	0.004
802.11n (HT20) MCS0 2Tx	Rear (ANT b)	6	2437	98.99%	100%	0.008	0.008

Note:

1. According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. A maximum transmission duty factor of 98.99% is achievable for WLAN in this project.

WIFI 5G										
Mode	Test Position	Frequency		Conducted Power (dBm)	Tune up limit (dBm)	Tune up scaling factor	Power Drift(dB)	Measured SAR(1g) (W/kg)	Report SAR(1g) (W/kg)	Test Plot
		CH	MHz							
U-NII-1 802.11a MCS0 1Tx	Rear (ANT a)	36	5180	14.77	15.50	1.18	-	-	-	-
		40	5200	15.06	15.50	1.11	-	-	-	-
		48	5240	15.19	15.50	1.07	-0.18	0.022	0.024	-
	Rear (ANT b)	36	5180	14.10	14.50	1.10	-	-	-	-
		40	5200	14.16	14.50	1.08	-0.16	0.035	0.038	B2
		48	5240	14.08	14.50	1.10	-	-	-	-
U-NII-3 802.11a MCS0 1Tx	Rear (ANT a)	149	5745	14.59	15.00	1.10	-	-	-	-
		157	5785	14.68	15.00	1.08	-0.15	0.023	0.025	-
		165	5825	14.57	15.00	1.10	-	-	-	-
	Rear (ANT b)	149	5745	13.97	14.00	1.01	-0.20	0.021	0.021	-
		157	5785	13.85	14.00	1.03	-	-	-	-
		165	5825	13.80	14.00	1.05	-	-	-	-
U-NII-1 8.2.11n (HT20) MCS0 2Tx	Rear (ANT a)	36	5180	13.98	14.50	1.13	-	-	-	-
		40	5200	14.31	14.50	1.04	-	-	-	-
		48	5240	14.38	14.50	1.03	-0.18	0.016	0.016	-
	Rear (ANT b)	36	5180	13.12	13.50	1.09	-	-	-	-
		40	5200	13.25	13.50	1.06	-0.16	0.030	0.032	-
		48	5240	13.27	13.50	1.05	-	-	-	-
U-NII-3 8.2.11n (HT20) MCS0 2Tx	Rear (ANT a)	149	5745	13.94	14.50	1.14	-	-	-	-
		157	5785	14.23	14.50	1.06	-0.15	0.019	0.020	-
		165	5825	13.96	14.50	1.13	-	-	-	-
	Rear (ANT b)	149	5745	13.33	13.50	1.04	-0.20	0.021	0.022	-
		157	5785	13.20	13.50	1.07	-	-	-	-
		165	5825	13.20	13.50	1.07	-	-	-	-

Note:

When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and aggregated frequency band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies.

- 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.¹⁹ 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.
- 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.

WIFI 5G- Scaled Reported SAR							
Mode	Test Position	Frequency		Actual duty factor	maximum duty factor	Reported SAR (1g)(W/kg)	Scaled reported SAR (1g)(W/kg)
		CH	MHz				
U-NII-1 802.11a MCS0 1Tx	Rear (ANT a)	48	5240	98.89%	100%	0.024	0.025
U-NII-1 802.11a MCS0 1Tx	Rear (ANT b)	40	5200	98.89%	100%	0.038	0.038
U-NII-3 802.11a MCS0 1Tx	Rear (ANT a)	157	5785	98.89%	100%	0.025	0.025
U-NII-3 802.11a MCS0 1Tx	Rear (ANT b)	149	5745	98.89%	100%	0.021	0.021
U-NII-1 8.2.11n (HT20) MCS0 2Tx	Rear (ANT a)	48	5240	98.89%	100%	0.016	0.016
U-NII-1 8.2.11n (HT20) MCS0 2Tx	Rear (ANT b)	40	5200	98.89%	100%	0.032	0.032
U-NII-3 8.2.11n (HT20) MCS0 2Tx	Rear (ANT a)	157	5785	98.89%	100%	0.020	0.020
U-NII-3 8.2.11n (HT20) MCS0 2Tx	Rear (ANT b)	149	5745	98.89%	100%	0.022	0.022

Note:

According to the KDB248227 D01, The reported SAR must be scaled to 100% transmission duty factor to determine compliance at the maximum tune-up tolerance limit. A maximum transmission duty factor of 98.89% is achievable for WLAN in this project.

SAR Test Data Plots

Test mode: WIFI 2.4G
802.11b 1Tx

Test Position: Rear(ANT b)

Test Plot: B1

Date: 2018-07-20

Communication System: UID 0, Generic WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.991$ S/m; $\epsilon_r = 53.023$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.08, 8.08, 8.08) @ 2437 MHz; Calibrated: 2/26/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 4/25/2018
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Rear/Procedure/Area Scan (61x211x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (interpolated) = 0.0176 W/kg

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

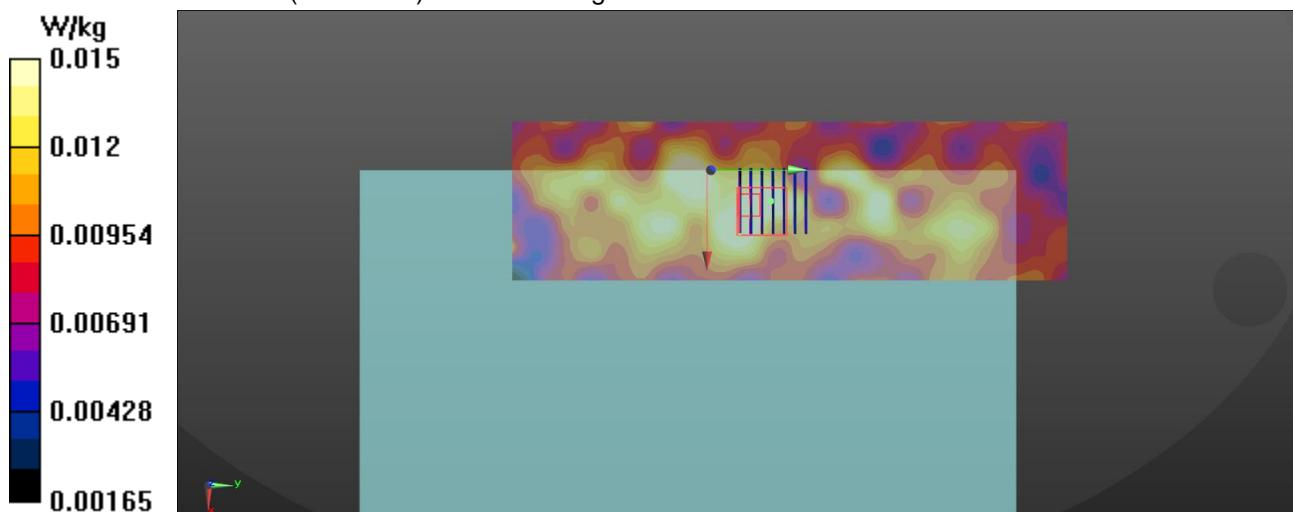
Reference Value = 2.308 V/m; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.0190 W/kg

SAR(1 g) = 0.0099 W/kg; SAR(10 g) = 0.00637 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.0148 W/kg



Test mode: WIFI 5G 802.11a 1Tx Test Position: Rear(ANT b) Test Plot: B2

Date: 2018-07-23

Communication System: UID 0, Generic WIFI (0); Frequency: 5200 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 5200$ MHz; $\sigma = 5.381$ S/m; $\epsilon_r = 48.152$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(5.3, 5.3, 5.3) @ 5200 MHz; Calibrated: 2/26/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1549; Calibrated: 4/25/2018
- Phantom: ELI V8.0 ; Type: QD OVA 004 AA ; Serial: 2078
- Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Rear/Procedure/Area Scan (81x261x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0756 W/kg

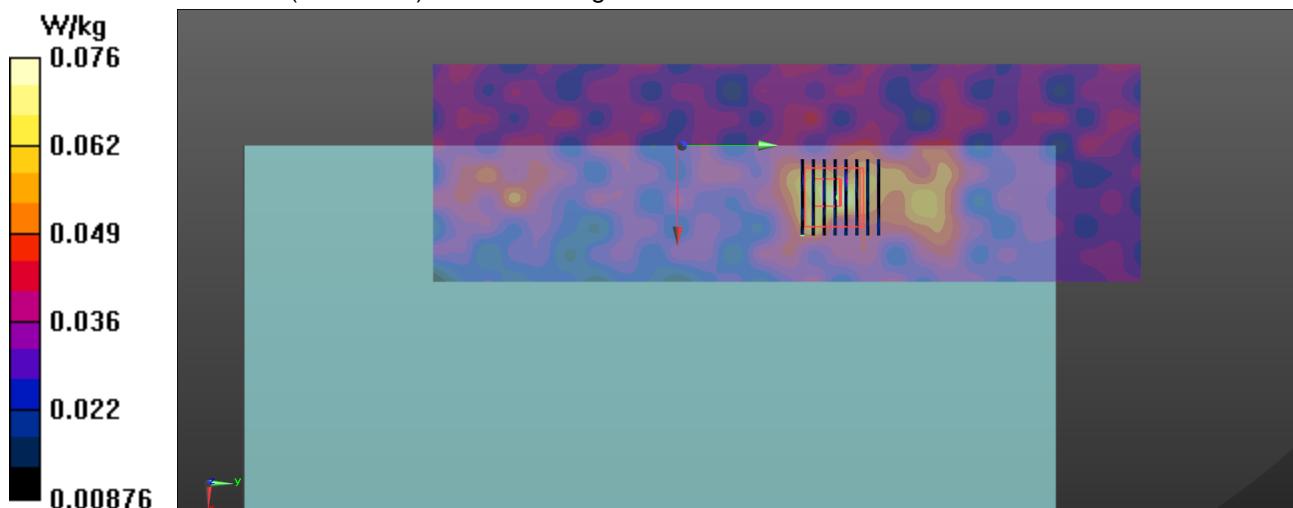
Rear/Procedure/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 1.914 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 0.354 W/kg

SAR(1 g) = 0.035 W/kg; SAR(10 g) = 0.021 W/kg

Maximum value of SAR (measured) = 0.0853 W/kg



15. Simultaneous Transmission analysis

No.	Simultaneous Transmission Configurations	Body	Note
1	WIFI (data) + Bluetooth (data)	Yes	
2	MIMO WIFI(ANT a)+ WIFI(ANT b)	Yes	

General note:

1. The reported SAR summation is calculated based on the same configuration and test position
2. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below
 - a) $[(\text{max. Power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})/x}] \text{W/kg}$ for test separation distances $\leq 50\text{mm}$; when $x=7.5$ for 1-g SAR, and $x=18.75$ for 10-g SAR.
 - b) When the minimum separation distance is $< 5\text{mm}$, the distance is used 5mm to determine SAR test exclusion
 - c) 0.4 W/kg for 1-g SAR and 1.0W/kg for 10-g SAR, when the test separation distances is $> 50\text{mm}$.

Bluetooth Max power	Exposure position	Body
	Test separation	0mm
5.90 dBm	Estimated SAR (W/kg)	0.162

Maximum reported SAR value for Body

WLAN DTS(ANT b) + Bluetooth				
WLAN Band	Exposure Position	Max SAR (W/kg)		Summed SAR
		WLAN DTS	Bluetooth	(W/kg)
WIFI 2.4G	Rear	0.010	0.162	0.172

WLAN U-NII(ANT b) + Bluetooth				
WLAN Band	Exposure Position	Max SAR (W/kg)		Summed SAR
		WLAN U-NII	Bluetooth	(W/kg)
WIFI 5G	Rear	0.038	0.162	0.200

WLAN DTS(ANT a) + WLAN DTS(ANT b)				
WLAN Band	Exposure Position	Max SAR (W/kg)		Summed SAR
				(W/kg)
WIFI 2.4G 2Tx	Rear	0.004	0.008	0.012

WLAN U-NII(ANT a) + WLAN U-NII(ANT b)				
WLAN Band	Exposure Position	Max SAR (W/kg)		Summed SAR
				(W/kg)
WIFI 5G 2Tx	Rear	0.016	0.032	0.048
	Rear	0.020	0.022	0.044

16. TestSetup Photos

Liquid depth in the Body phantom	Rear (0mm)

17. External and Internal Photos of the EUT

Please reference to the report No.: TRE1807009701.

-----*End of Report*-----