CTC Laboratories,Inc.

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TEST REPORT

Report Reference No.................... :	**CTC20192090E**
FCC ID... :	**O86-FLEX10AND**
IC .... :	**10591A-FLEX10AND**
Applicant's name .... :	**MobileDemand LC .**
Address...:	1501 Boyson Square Drive, Hiawatha, IA, 52233, USA
Manufacturer.......................................:	MobileDemand LC .
Address..:	1501 Boyson Square Drive, Hiawatha, IA, 52233, USA
Test item description .... :	**10.1" Tablet Computer With Rugged Protective Case**
Trade Mark ....:	**Commercial Markets**
Model/Type reference.......................:	FLEX10AND
Listed Model(s) ....:	-
Standard .... :	**FCC 47 CFR Part2.1093 IEEE 1528: 2013** **ANSI/IEEE C95.1: 2005** **RSS-102 Issue 5: 2015 IEC 62209-2:2010**
Date of receipt of test sample……….:	Oct.17, 2019
Date of testing………………………...:	Nov.06, 2019 to Nov.12, 2019
Date of issue………………………….:	Nov.13, 2019
Result................. …………………...:	**PASS**

Compiled by (position+printedname+signature)...:	Charley Wu	Charley Wu
Supervised by (position+printedname+signature)...:	Eric Zhang	Eric Zhang
Approved by (position+printedname+signature)...:	Walter Chen	Walter Chen

Testing Laboratory Name .... :	**CTC Laboratories,Inc.**
Address...:	2/F., Building 1 and 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Longhua District, Shenzhen, Guangdong, China

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Any objections must be raised to CTC within 15 days since the date when the report is received.It will not be taken into consideration beyond this limit. The test report merely correspond to the test sample.

Contents

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 C95.1:2005: 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.
RSS-102:2015:Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)
IEC 62209-2: 2010: Human exposure to radio frequency fields from hand-held and bodymounted wireless communication devices.Human models,instrumentation, and procedures.Part 2: Procedure to determine thespecific absorption rate (SAR) forwireless communication devices usedin close proximity to the human body(frequency range of 30 MHz to 6 GHz)
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 Guidence for IEEE 802.11(Wi-Fi)Transmitters.
616217 D04 SAR for laptop and tablets v01r02: SAR Evaluation Requirements for Laptop, Notebook, Netbook and Tablet Computers

Revision No.	Date of issue	Description
N/A	2019-11-13	Original

2. Summary

2.1. Client Information

Applicant:	MobileDemand LC .
Address:	1501 Boyson Square Drive, Hiawatha, IA, 52233, USA
Manufacturer:	MobileDemand LC .
Address:	1501 Boyson Square Drive, Hiawatha, IA, 52233, USA

2.2. Product Description

Name of EUT:	10.1” Tablet Computer With Rugged Protective Case	
Trade Mark:	Commercial Markets	
Model No.:	FLEX10AND	
Listed Model(s):	-	
Power supply:	DC 3.7V from battery	
Device Category:	Portable	
RF Exposure Environment:	General Population / Uncontrolled	
Hardware version:	FLEX10AND	
Software version:	Flex10AND_1.00	
Maximum SAR Value		
Separation Distance:	Body:	0mm
Max Report SAR Value (1g):	**Body:**	**1.024W/kg**
WIFI 2.4G		
Supported type:	802.11b/802.11g/802.11n HT20/802.11n HT40	
Modulation Type:	BPSK /QPSK /16QAM /64QAM	
Operation frequency:	2412MHz~2462MHz	
Channel separation:	5MHz	
Antenna type:	FPCB Antenna	
WIFI 5G		
Supported type:	802.11a/802.11n HT20/802.11n HT40/802.11ac VHT20/802.11ac VHT40 /802.11ac VHT80	
Modulation Type:	BPSK /QPSK /16QAM /64QAM/128QAM/256QAM	
Operation frequency:	5.180GHz~5.825GHz	
Channel Bandwidth	802.11a/n HT20/ac VHT20:20MHz 802.11n HT40/ac VHT40:40MHz 802.11ac VHT80:80MHz	
Antenna type:	FPCB Antenna	

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Bluetooth	
Version:	Supported BT4.2+EDR
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz
Antenna type:	FPCB Antenna
Bluetooth-BLE	
Version:	Bluetooth-BLE
Modulation:	GFSK
Operation frequency:	2402MHz~2480MHz
Channel number:	40
Channel separation:	2MHz
Antenna type:	FPCB Antenna

Remark:

1. *The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power*

3. Test Environment

3.1. Test laboratory

CTC Laboratories, Inc.
Add: 1-2/F., Building 2, Jiaquan Building, Guanlan High-Tech Park, Shenzhen, Guangdong, China

3.2. Test Facility

Laboratory accreditation
The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L5365
CTC Laboratories, Inc. 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.: 4340.01
CTC Laboratories, Inc. 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.

ISED Registration No.: CN0029
The 3m alternate test site of CTC Laboratories, Inc.EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration NO.: CN0029 on Dec, 2018.

FCC-Registration No.: CN1208
CTC Laboratories, Inc. 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. Registration CN1208, Sep 07, 2017

4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
Data Acquisition Electronics DAEx	SPEAG	DAE4	1423	2019/05/24	2020/05/23
E-field Probe	SPEAG	EX3DV4	3974	2019/05/21	2020/05/20
System Validation Dipole	SPEAG	D2450V2	928	2018/10/12	2021/10/11
System Validation Dipole	SPEAG	D5GHzV2	1171	2018/10/13	2021/10/12
Network analyzer	Agilent	E5071C	MY46520333	2019/08/13	2020/08/12
Signal Generator	Agilent	N5182A	MY47420864	2018/12/29	2019/12/28
Power sensor	Mini-Circuits	PWR-8GHS	11609010017	2019/08/13	2020/08/12
Power sensor	Mini-Circuits	PWR-8GHS	11607130056	2019/08/13	2020/08/12
Power Amplifier	Mini-Circuits	ZVE-8G+	103201624	2019/08/13	2020/08/12
Power Amplifier	Mini-Circuits	ZHL-42W+	051701624	2019/08/13	2020/08/12
BI-DIRECTIONAL COUPLER	Mini-Circuits	ZGBDC20-33HP+	996201615	2019/08/13	2020/08/12
BI-DIRECTIONAL COUPLER	Mini-Circuits	ZGBDC35-93HP+	415101623	2019/08/13	2020/08/12
Attenuator	MCL	BW-N20W5+	1552	2019/08/13	2020/08/12
Attenuator	MCL	BW-N3W5+	1608	2019/08/13	2020/08/12
Attenuator	MCL	/	/	2019/08/13	2020/08/12

Note:

1. *The Probe,Dipole and DAE calibration reference to the Appendix A.*

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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 evalation	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 evalation	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.

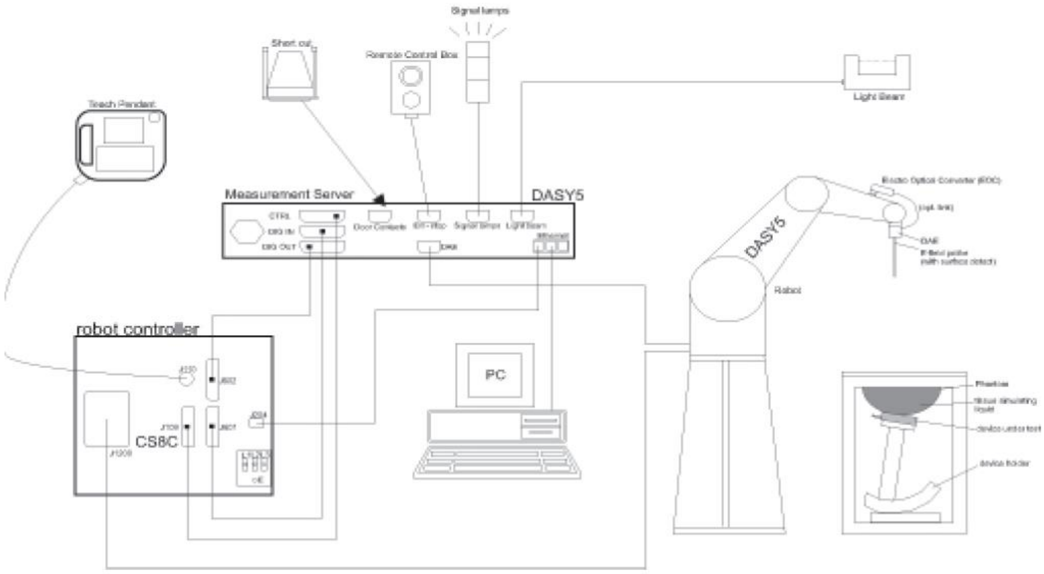
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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.

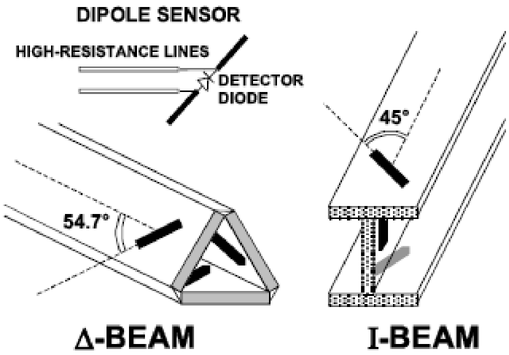
- **Probe Specification**

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	4 MHz to 10 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 µW/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

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin 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

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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. ± 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 ± 0.1mm). 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 ± 30°.)

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.

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

			$\leq$ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface			5 mm ± 1 mm	$\frac{1}{2}\cdot\delta\cdot\ln(2)$ mm ± 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}			$\leq$ 2 GHz: $\leq$ 15 mm 2 – 3 GHz: $\leq$ 12 mm	3 – 4 GHz: $\leq$ 12 mm 4 – 6 GHz: $\leq$ 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 $\leq$ 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}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm*	3 – 4 GHz: $\leq$ 5 mm* 4 – 6 GHz: $\leq$ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5\cdot\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 22 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 *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 5 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),s 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:	Dcpi
Device parameters:	Frequency:	f
	Crest factor:	cf
Media parameters:	Conductivity:	σ
	Density:	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the 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)
dcpi: diode compression point (DASY parameter)

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

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

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

Vi: compensated signal of channel (i = x, y, z)
Normi: 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.

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

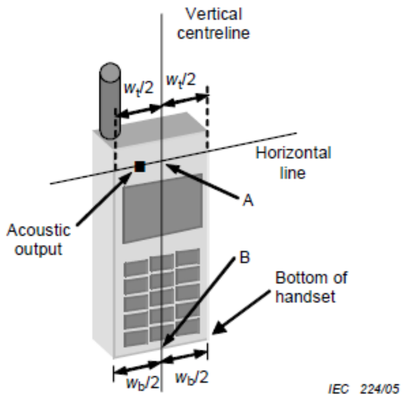
8.1. Head Position

The wireless device define two imaginary lines on the handset, the vertical centreline and the horizontal line, for the handset in vertical orientation as shown in Figures 5a and 5b.

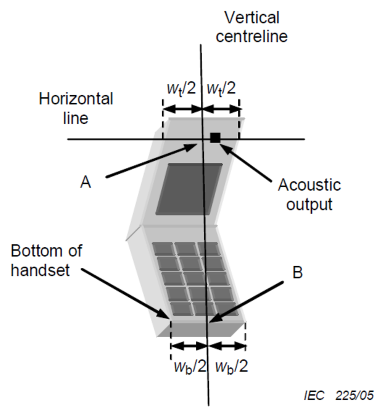
The vertical centreline passes through two points on the front side of the handset: the midpoint of the width W_t of the handset at the level of the acoustic output (point A in Figures 5a and 5b), and the midpoint of the width W_b of the bottom of the handset (point B).

The horizontal line is perpendicular to the vertical centreline and passes through the centre of the acoustic output (see Figures 5a and 5b). The two lines intersect at point A.

Note that for many handsets, point A coincides with the centre of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centreline is not necessarily parallel to the front face of the handset (see Figure 5b), especially for clam-shell handsets, handsets with flip cover pieces, and other irregularly shaped handsets.



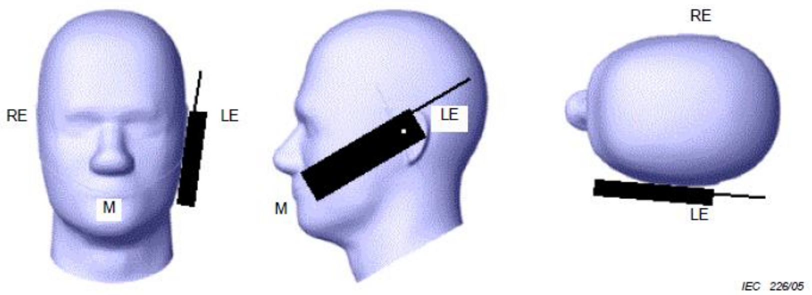
Figures 5a



Figures 5b

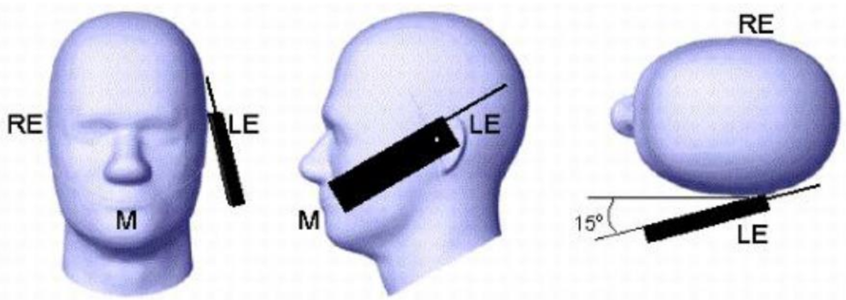
W_t	Width of the handset at the level of the acoustic
W_b	Width of the bottom of the handset
A	Midpoint of the widthwt of the handset at the level of the acoustic output
B	Midpoint of the width wb of the bottom of the handset

Cheek position



Picture 2 Cheek position of the wireless device on the left side of SAM

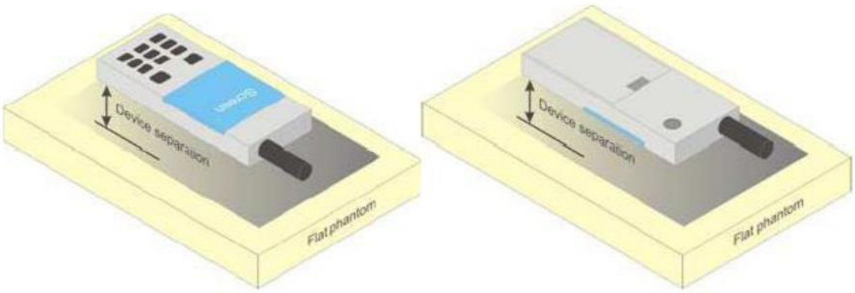
Tilt position



Picture 3 Tilt position of the wireless device on the left side of SAM

8.2. Body Position

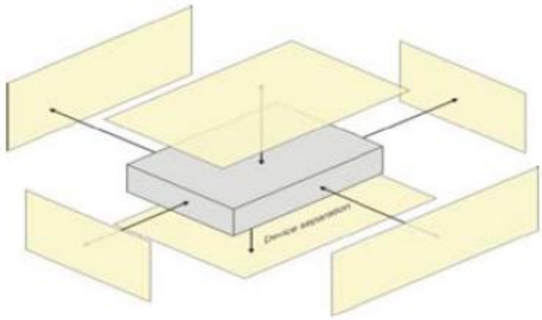
Devices that support transmission while used with body-worn accessories must be tested for body-worn accessory SAR compliance, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics.
Devices that are designed to operate on the body of users using lanyards and straps or without requiring additional body-worn accessories must be tested for SAR compliance using a conservative minimum test separation distance **≤ 10 mm** to support compliance.



Picture 4 Test positions for body-worn devices

8.3. Body-worn Exposure conditions

body-worn accessory SAR test configurations may overlap for handsets. When the same wireless mode transmission configurations for voice and data are required for SAR measurements, the more conservative configuration with a smaller separation distance should be tested for the overlapping SAR configurations. This typically applies to the back and front surfaces of a handset when SAR is required for body-worn accessory exposure conditions. Depending on the form factor and dimensions of a device, the test separation distance used for hotspot mode SAR measurement is either 10 mm or that used in the body-worn accessory configuration, whichever is less for devices with dimension > 9 cm x 5 cm. For smaller devices with dimensions ≤ 9 cm x 5 cm because of a greater potential for next to body use a test separation of ≤ 5 mm must be used.



Picture 5 Test positions for Hotspot Mode

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9. System Check

9.1. Tissue Dielectric Parameters

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case. It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

Tissue dielectric parameters for body phantoms		
Target Frequency	Body	
(MHz)	εr	σ(s/m)
2450	52.7	1.95
5250	48.95	5.36
5600	48.47	5.77
5750	48.27	5.94

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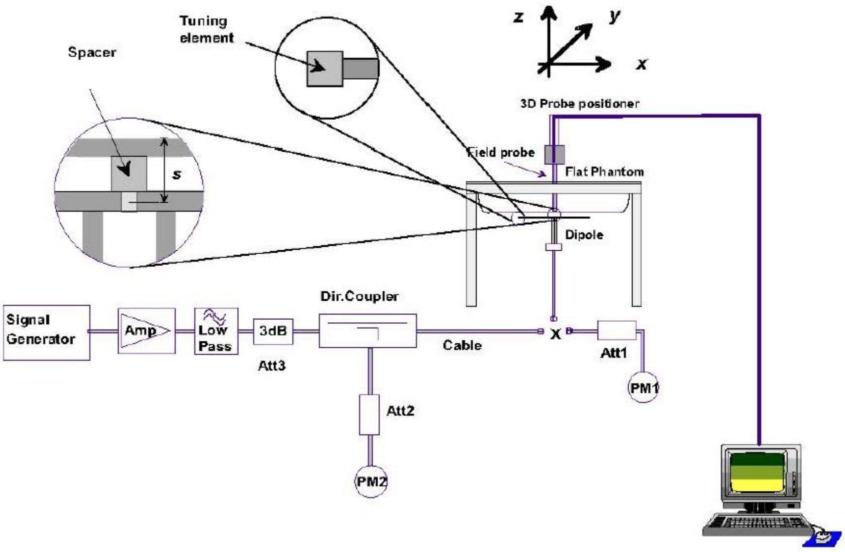
Check Result:

Dielectric performance of Body tissue simulating liquid									
Frequency (MHz)	εr		σ(s/m)		Delta (εr)	Delta (σ)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
2412	52.75	53.07	1.91	1.96	0.61%	2.62%	±5%	22	2019-11-06
2437	52.72	53.05	1.94	1.98	0.63%	2.06%	±5%	22	2019-11-06
2450	52.70	53.03	1.95	2.00	0.63%	2.56%	±5%	22	2019-11-06
2462	52.68	53.00	1.96	2.01	0.61%	2.55%	±5%	22	2019-11-06
5180	49.05	48.18	5.28	5.35	-1.77%	1.33%	±5%	22	2019-11-07
5200	49.02	48.15	5.30	5.38	-1.77%	1.51%	±5%	22	2019-11-07
5240	48.96	48.05	5.35	5.44	-1.86%	1.68%	±5%	22	2019-11-07
5250	48.95	48.04	5.36	5.45	-1.86%	1.68%	±5%	22	2019-11-07
5260	48.94	48.04	5.37	5.48	-1.84%	2.05%	±5%	22	2019-11-07
5280	48.91	47.98	5.39	5.50	-1.90%	2.04%	±5%	22	2019-11-07
5320	48.85	47.88	5.44	5.56	-1.99%	2.21%	±5%	22	2019-11-07
5500	48.61	47.52	5.65	5.82	-2.24%	3.01%	±5%	22	2019-11-08
5580	48.50	47.36	5.74	5.94	-2.35%	3.48%	±5%	22	2019-11-08
5600	48.47	47.35	5.77	5.96	-2.31%	3.29%	±5%	22	2019-11-08
5700	48.34	47.17	5.88	6.12	-2.42%	4.08%	±5%	22	2019-11-11
5745	48.28	47.06	5.94	6.19	-2.53%	4.21%	±5%	22	2019-11-11
5750	48.27	46.94	5.94	6.20	-2.76%	4.38%	±5%	22	2019-11-11
5785	48.22	46.96	5.98	6.24	-2.61%	4.35%	±5%	22	2019-11-11
5825	48.17	46.88	6.03	6.32	-2.68%	4.81%	±5%	22	2019-11-11

9.2. SAR System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice 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 (±10%).
System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



System Performance Check Setup

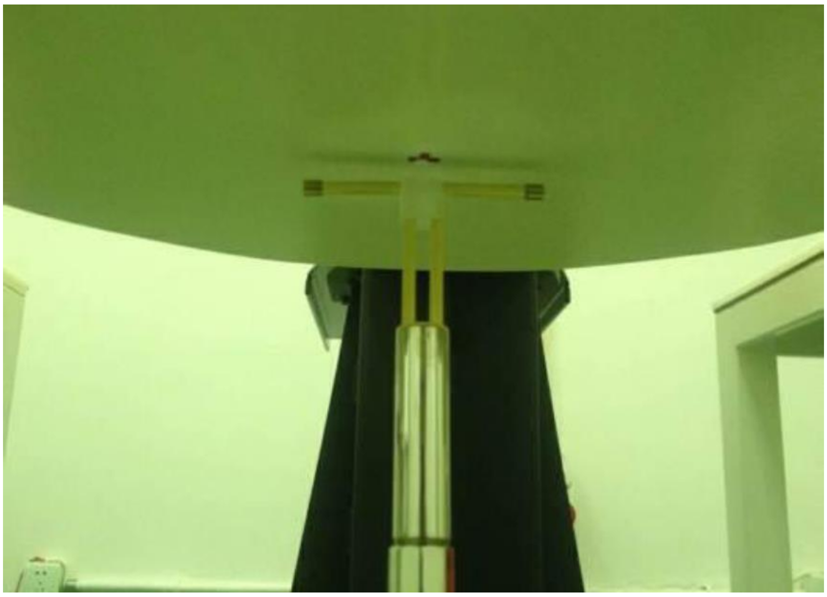


Photo of Dipole Setup

Check Result:

Body									
Frequency (MHz)	1g SAR		10g SAR		Delta (1g)	Delta (10g)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
2450	12.60	12.50	5.96	5.83	-0.79%	-2.18%	±10%	22	2019-11-06
5250	7.58	7.37	2.14	2.07	-2.77%	-3.27%	±10%	22	2019-11-07
5600	8.10	7.80	2.28	2.16	-3.70%	-5.26%	±10%	22	2019-11-08
5750	7.47	7.28	2.10	2.02	-2.54%	-3.81%	±10%	22	2019-11-11

Note:
1. the graph results see follow.

System Performance Check at 2450 MHz Body

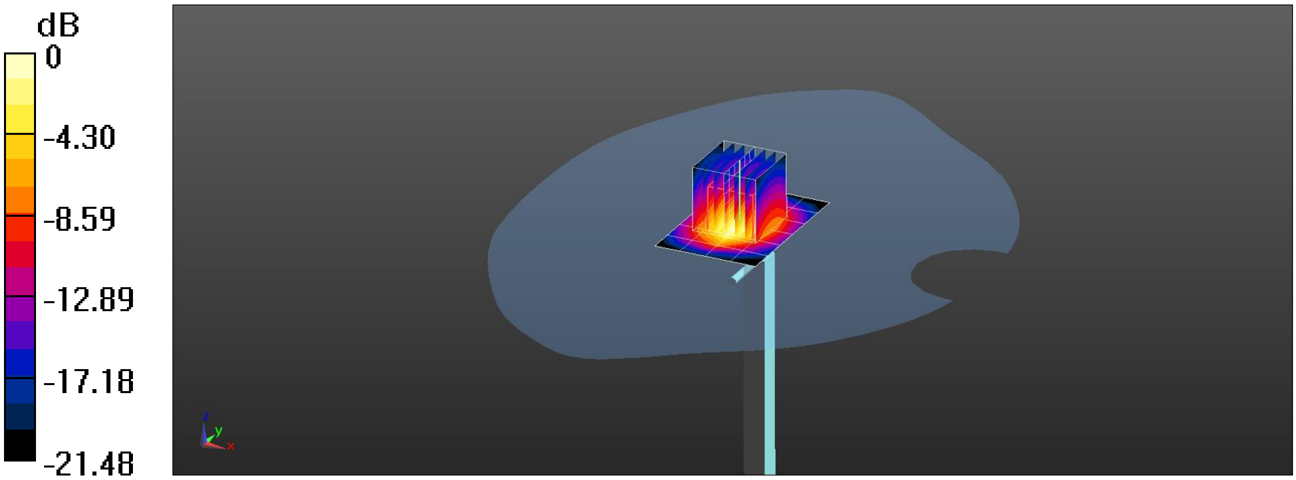
DUT: D2450V2; Type: D2450V2; Serial: 928
Date: 2019-11-06
Communication System: UID 0, CW (0); Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 2.001 S/m; εr = 53.03; ρ = 1000 kg/m3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(8.01, 8.01, 8.01); Calibrated: 2019/05/21;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM1; Type: Twin SAM V5.0; Serial: 1812
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/d=10mm,Pin=250mW/Area Scan (5x7x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 21.1 W/kg

Body/d=10mm,Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
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



0 dB = 20.7 W/kg = 13.16 dBW/kg

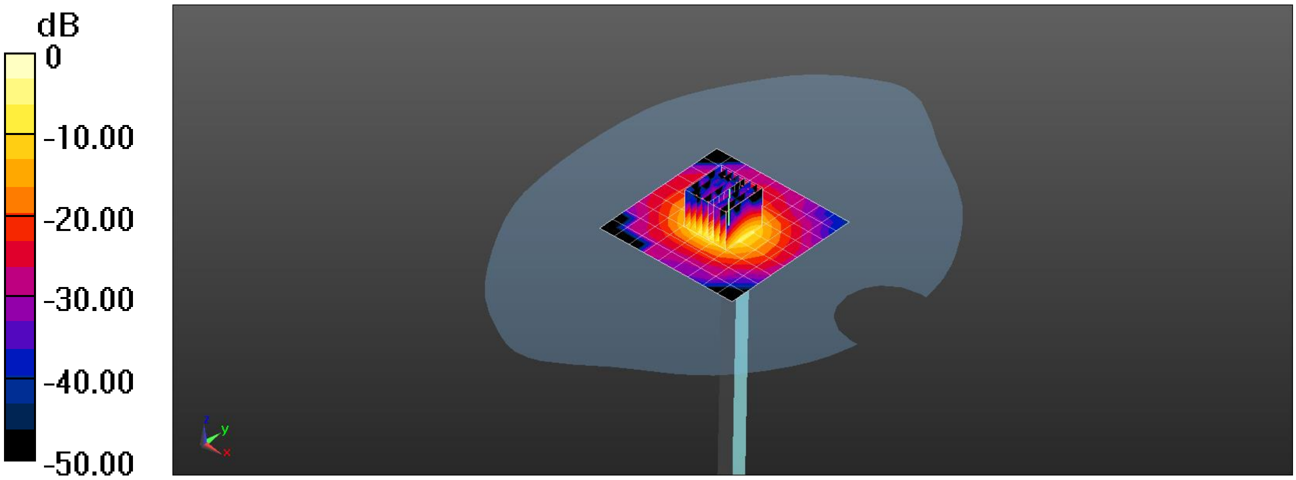
System Performance Check at 5250 MHz Body
DUT: D5GHzV2; Type: D5GHzV2; Serial: 1171
Date: 2019-11-07
Communication System: UID 0, A-CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5250 MHz; σ = 5.451 S/m; ε_r = 48.036; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(5.72, 5.72, 5.72); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM1; Type: Twin SAM V5.0; Serial: 1812
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/d=10mm, Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 11.1 W/kg

Body/d=10mm, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 65.132 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 31.6 W/kg
SAR(1 g) = 7.37 W/kg; SAR(10 g) = 2.07 W/kg
Maximum value of SAR (measured) = 17.8 W/kg



0 dB = 17.8 W/kg = 12.50 dBW/kg

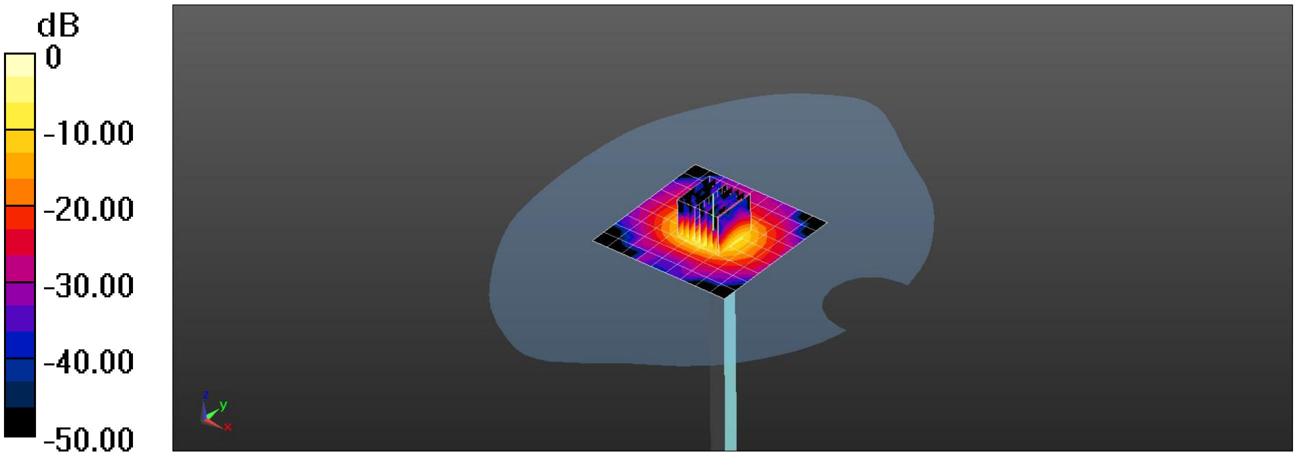
System Performance Check at 5600 MHz Body
DUT: D5GHzV2; Type: D5GHzV2; Serial: 1171
Date: 2019-11-08
Communication System: UID 0, A-CW (0); Frequency: 5600 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5600 MHz; σ = 5.963 S/m; ε_r = 47.347; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(4.85, 4.85, 4.85); Calibrated: 2019/05/21;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM2; Type: Twin SAM V5.0; Serial: 1811
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/d=10mm, Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 14.6 W/kg

Body/d=10mm, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.095 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 36.9 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.16 W/kg
Maximum value of SAR (measured) = 19.7 W/kg



0 dB = 19.7 W/kg = 12.94 dBW/kg

System Performance Check at 5725 MHz Body

DUT: D5GHzV2; Type: D5GHzV2; Serial: 1171

Date: 2019-11-11

Communication System: UID 0, A-CW (0); Frequency: 5725 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5725 MHz; σ = 6.20 S/m; ε_r = 46.943; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(5.01, 5.01, 5.01); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection),
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM1; Type: Twin SAM V5.0; Serial: 1812
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Head/d=10mm, Pin=100mW/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 12.1 W/kg

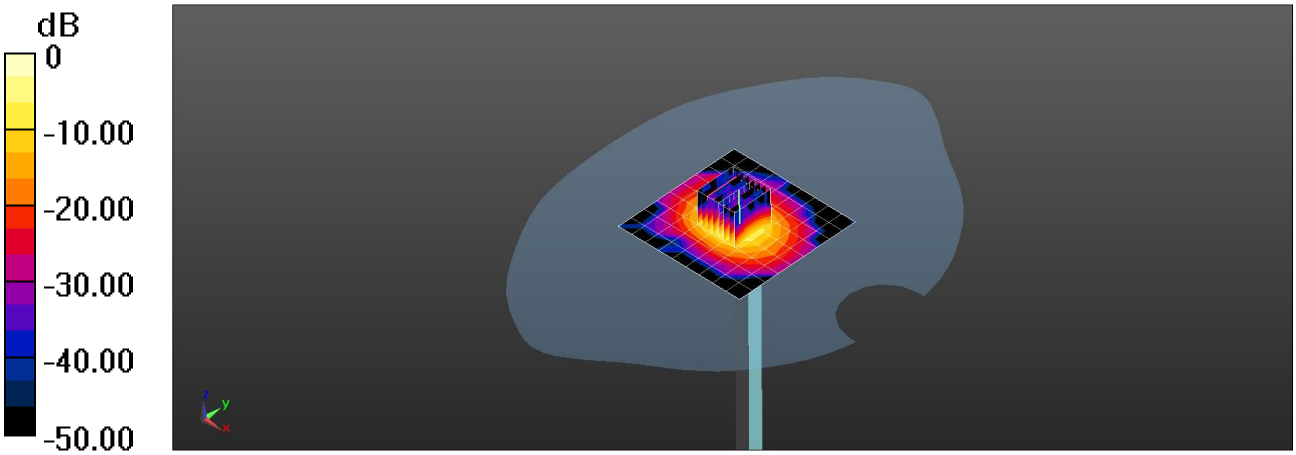
Head/d=10mm, Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 62.072 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



0 dB = 18.8 W/kg = 12.74 dBW/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).

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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 putput 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.

WIFI 2.4G			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11b	01	2412	**14.25**
	06	2437	13.97
	11	2462	13.91
802.11g	01	2412	13.06
	06	2437	12.54
	11	2462	12.76
802.11n HT20	01	2412	12.81
	06	2437	12.41
	11	2462	12.54
802.11n HT40	03	2422	11.94
	06	2437	12.21
	09	2452	11.93

U-NII-1 (WIFI 5G)			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11a	36	5180	13.24
	40	5200	12.97
	48	5240	**13.41**
802.11n HT20	36	5180	12.86
	40	5200	12.69
	48	5240	13.25
802.11ac VHT20	36	5180	12.92
	40	5200	13.04
	48	5240	13.23
802.11n HT40	38	5190	12.86
	46	5230	12.49
802.11ac VHT40	38	5190	12.12
	46	5230	13.17
802.11ac VHT80	42	5210	12.94

U-NII-2A (WIFI 5G)			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11a	52	5260	13.47
	56	5280	13.17
	64	5320	**13.63**
802.11n HT20	52	5260	13.39
	56	5280	13.13
	64	5320	13.33
802.11ac VHT20	52	5260	13.25
	56	5280	13.60
	64	5320	13.57
802.11n HT40	54	5270	13.12
	62	5310	13.46
802.11ac VHT40	54	5270	13.56
	62	5310	13.03
802.11ac VHT80	58	5290	12.28

U-NII-2C (WIFI 5G)			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11a	100	5500	**13.50**
	116	5580	13.08
	140	5700	12.93
802.11n HT20	100	5500	13.38
	116	5580	13.49
	140	5700	12.90
802.11ac VHT20	100	5500	13.40
	116	5580	13.35
	140	5700	13.41
802.11n HT40	102	5510	13.47
	110	5550	13.32
	134	5670	13.50
802.11ac VHT40	102	5510	13.12
	110	5550	12.99
	134	5670	13.13
802.11ac VHT80	106	5530	12.04
	138	5690	12.23

U-NII-3 (WIFI 5G)			
Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
802.11a	149	5745	**14.22**
	157	5785	12.71
	165	5825	13.79
802.11n HT20	149	5745	14.14
	157	5785	13.83
	165	5825	13.21
802.11ac VHT20	149	5745	14.09
	157	5785	13.69
	165	5825	13.30
802.11n HT40	151	5755	13.35
	159	5795	13.12
802.11ac VHT40	151	5755	12.42
	159	5795	13.34
802.11ac VHT80	155	5775	12.43

Note

1. *:The output power was test all data rate and recorded worst case at recorded data rate.*
2. *The power of he 4 bands of 5G is tested with 100% duty cycle.*

Bluetooth Conducted Power

Bluetooth			
Mode	Channel	Frequency (MHz)	Conducted power (dBm)
GFSK	0	2402	**7.23**
	39	2441	6.90
	78	2480	6.47
π/4QPSK	0	2402	6.40
	39	2441	6.34
	78	2480	6.15
8DPSK	0	2402	6.80
	39	2441	6.45
	78	2480	6.05
BLE	0	2402	-0.68
	19	2440	1.27
	39	2480	2.51

12. Maximum Tune-up Limit

WIFI 2.4G	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11b	14.50
802.11g	13.50
802.11n(HT20)	13.00
802.11n(HT40)	12.50

WIFI 5G		
Band	Mode	Maximum Tune-up (dBm) Burst Average Power
U-NII-1	802.11a	13.50
U-NII-2A		14.00
U-NII-2C		13.50
U-NII-3		14.50
U-NII-1	802.11n HT20	13.50
U-NII-2A		13.50
U-NII-2C		13.50
U-NII-3		14.50
U-NII-1	802.11ac VHT20	13.50
U-NII-2A		14.00
U-NII-2C		13.50
U-NII-3		14.50
U-NII-1	802.11n HT40	13.00
U-NII-2A		13.50
U-NII-2C		13.50
U-NII-3		13.50
U-NII-1	802.11ac VHT40	13.50
U-NII-2A		14.00
U-NII-2C		13.50
U-NII-3		13.50
U-NII-1	802.11ac VHT80	13.00
U-NII-2A		12.50
U-NII-2C		12.50
U-NII-3		12.50

Bluetooth	
Mode	Maximum Tune-up (dBm)
GFSK	7.50
π/4QPSK	6.50
8DPSK	7.00
BLE	3.00

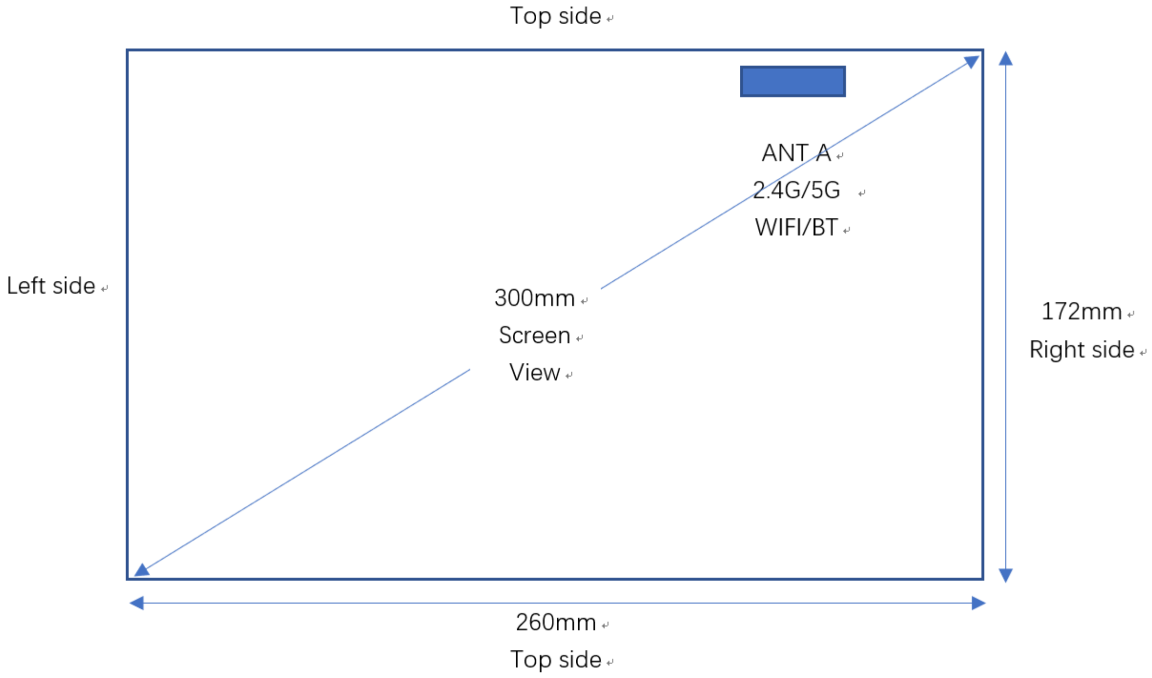
Per KDB 447498 D01, the 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances ≦50mm are determined by:

[(max. Power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)] ≦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	19	7.50	5.6	Yes

13. RF Exposure Conditions (Test Configurations)

13.1. Antenna Location



13.2. Standalone SAR test exclusion considerations

KDB 447498 with KDB 616217:

a) For 100 MHz to 6 GHz and *test separation distances* ≤ 50 mm, the 1-g *SAR test exclusion thresholds* are determined by the following:

[(*max. power of channel, including tune-up tolerance, mW*) / (*min. test separation distance, mm*)] · [√f(GHz)] ≤ 3.0 for 1-g SAR

When the minimum *test separation distance* is < 5 mm, a distance of 5 mm according is applied to determine SAR test exclusion.

b) For 100 MHz to 6 GHz and *test separation distances* > 50 mm, the 1-g and 10-g *SAR test exclusion thresholds* are determined by the following :

1) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance - 50 mm)·(f(MHz)/150)]} mW, for 100 MHz to 1500 MHz

2) {[Power allowed at *numeric threshold* for 50 mm in step a)] + [(test separation distance - 50 mm)·10]} mW, for > 1500 MHz and ≤6 GHz

Antennas ≤ 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Back side	Left side	Right side	Top side	Bottom side	Back side	Left side	Right side	Top side	Bottom side
WIFI 2.4G	2412	14.50	28	5	197	63	5	167	9 MEASURE	> 50 mm	> 50 mm	9 MEASURE	> 50 mm
U-NII-1	5180	13.50	22	5	197	63	5	167	10 MEASURE	> 50 mm	> 50 mm	10 MEASURE	> 50 mm
U-NII-2A	5320	14.00	25	5	197	63	5	167	12 MEASURE	> 50 mm	> 50 mm	12 MEASURE	> 50 mm
U-NII-2C	5500	13.50	22	5	197	63	5	167	11 MEASURE	> 50 mm	> 50 mm	11 MEASURE	> 50 mm
U-NII-3	5745	14.50	28	5	197	63	5	167	14 MEASURE	> 50 mm	> 50 mm	14 MEASURE	> 50 mm
Bluetooth	2402	7.50	6	5	197	63	5	167	2 EXEMPT	> 50 mm	> 50 mm	2 EXEMPT	> 50 mm

Antennas > 50mm to adjacent edges

Tx Interface	Frequency (MHz)	Output Power		Separation Distances (mm)					Calculated Threshold Value				
		dBm	mW	Back side	Left side	Right side	Top side	Bottom side	Back side	Left side	Right side	Top side	Bottom side
WIFI 2.4G	2412	14.50	28	5	197	63	5	167	< 50 mm	1567mW EXEMPT	227mW EXEMPT	< 50 mm	1246mW EXEMPT
U-NII-1	5180	13.50	22	5	197	63	5	167	< 50 mm	1536mW EXEMPT	196mW EXEMPT	< 50 mm	1216mW EXEMPT
U-NII-2A	5320	14.00	25	5	197	63	5	167	< 50 mm	1535mW EXEMPT	195mW EXEMPT	< 50 mm	1215mW EXEMPT
U-NII-2C	5500	13.50	22	5	197	63	5	167	< 50 mm	1534mW EXEMPT	194mW EXEMPT	< 50 mm	1213mW EXEMPT
U-NII-3	5745	14.50	28	5	197	63	5	167	< 50 mm	1533mW EXEMPT	193mW EXEMPT	< 50 mm	1213mW EXEMPT
Bluetooth	2402	7.50	6	5	197	63	5	167	< 50 mm	1567mW EXEMPT	227mW EXEMPT	< 50 mm	1246mW EXEMPT

Positions for SAR tests					
Test Configurations	Back side	Left side	Right side	Top side	Bottom side
WIFI 2.4G	Yes	No	No	Yes	No
U-NII-1	Yes	No	No	Yes	No
U-NII-2A	Yes	No	No	Yes	No
U-NII-2C	Yes	No	No	Yes	No
U-NII-3	Yes	No	No	Yes	No
Bluetooth	No	No	No	No	No

Note

1. *Some 2-in-1 tablets may operate with the display folded on top of the keyboard. Most recent tablets are designed with an interactive display that may not require a physical keyboard. Both configurations are used in similar manners and require SAR evaluation for the back surface and edges of the tablet. According to KDB 616217 D04 SAR for laptop and tablets v01r02*

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13.3. Estimated SAR

Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below:

a) [(max. Power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] * [√f(GHz)/x]W/kg for test separation distances ≦50mm; whetn x=7.5 for 1-g SAR, and x=18.75 for 10-g SAR.

b) When the minimum separation distance is <5mm, 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 >50mm.

Estimated SAR(W/kg)					
Test Configurations	Back side	Left side	Right side	Top side	Bottom side
WIFI 2.4G	-	0.400	0.400	-	0.400
U-NII-1	-	0.400	0.400	-	0.400
U-NII-2A	-	0.400	0.400	-	0.400
U-NII-2C	-	0.400	0.400	-	0.400
U-NII-3	-	0.400	0.400	-	0.400
Bluetooth	0.059	0.400	0.400	0.059	0.400

14. SAR Measurement Results

WIFI 2.4G										
Mode	Test Position (side)	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	Back	1	2412	14.25	14.50	1.06	0.05	**0.866**	**0.918**	B1
		6	2437	13.97	14.50	1.13	0.14	0.801	0.905	
		11	2462	13.91	14.50	1.15	-0.20	0.793	0.912	-
	Top	1	2412	14.25	14.50	1.06	0.17	0.333	0.353	-
		6	2437	13.97	14.50	1.13	-	-	-	-
		11	2462	13.91	14.50	1.15	-	-	-	-

U-NII-1 (WIFI 5G)										
Mode	Test Position (side)	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							
802.11a 6Mbps	Back	36	5180	13.24	13.50	1.06	0.02	0.521	0.552	
		40	5200	12.97	13.50	1.13	0.10	0.483	0.546	
		48	5240	13.41	13.50	1.02	0.15	**0.587**	**0.599**	B2
	Top	36	5180	13.24	13.50	1.06	-	-	-	-
		40	5200	12.97	13.50	1.13	-	-	-	-
		48	5240	13.41	13.50	1.02	-0.07	0.210	0.214	-

U-NII-2A (WIFI 5G)										
Mode	Test Position (side)	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							
802.11a 6Mbps	Back	52	5260	13.47	14.00	1.13	0.05	0.514	0.581	-
		56	5280	13.17	14.00	1.21	0.01	0.522	0.631	
		64	5320	13.63	14.00	1.09	-0.20	**0.623**	**0.679**	B3
	Top	52	5260	13.47	14.00	1.13	-	-	-	-
		56	5280	13.17	14.00	1.21	-	-	-	-
		64	5320	13.63	14.00	1.09	-0.14	0.164	0.179	-

U-NII-2C (WIFI 5G)										
Mode	Test Position (side)	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							
802.11a 6Mbps	Back	100	5500	13.50	13.50	1.00	-0.19	**0.861**	**0.861**	B4
		116	5580	13.08	13.50	1.10	0.07	0.764	0.840	
		140	5700	12.93	13.50	1.14	0.12	0.729	0.831	-
	Top	100	5500	13.50	13.50	1.00	-0.06	0.261	0.261	-
		116	5580	13.08	13.50	1.10	-	-	-	-
		140	5700	12.93	13.50	1.14	-	-	-	-

U-NII-3 (WIFI 5G)										
Mode	Test Position (side)	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							
802.11a 6Mbps	Back	149	5745	14.22	14.50	1.07	-0.20	**0.957**	**1.024**	B5
		157	5785	12.71	14.50	1.51	-0.14	0.611	0.923	-
		165	5825	13.79	14.50	1.18	0.09	0.808	0.953	-
	Top	149	5745	14.22	14.50	1.07	0.01	0.309	0.331	-
		157	5785	12.71	14.50	1.51	-	-	-	-
		165	5825	13.79	14.50	1.18	-	-	-	-

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SAR Test Data Plots

Test band:	WIFI 2.4G	Test Position:	Back side	Test Plot:	B1

Date:2019-11-06
Communication System: UID 0, WI-FI(2412-2462) (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.966 S/m; ε_r = 53.058; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

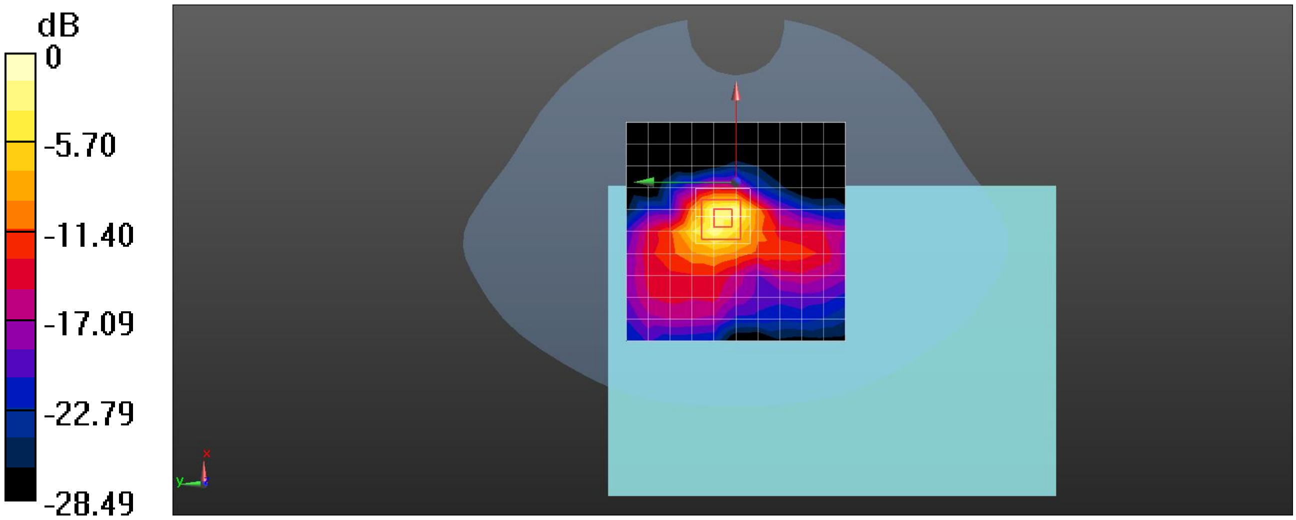
- Probe: EX3DV4 - SN3974; ConvF(8, 8, 8); Calibrated: 2019/05/21;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM1; Type: Twin SAM V5.0; Serial: 1812
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/Back side/Area Scan (11x11x1): Measurement grid: dx=12mm, dy=12mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.706 W/kg

Body/Back side/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.322 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 2.27 W/kg
SAR(1 g) = 0.866 W/kg; SAR(10 g) = 0.330 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.06 W/kg



0 dB = 1.06 W/kg = 0.25 dBW/kg

Test band:	U-NII-1 (WIFI 5G)	Test Position:	Back side	Test Plot:	B2

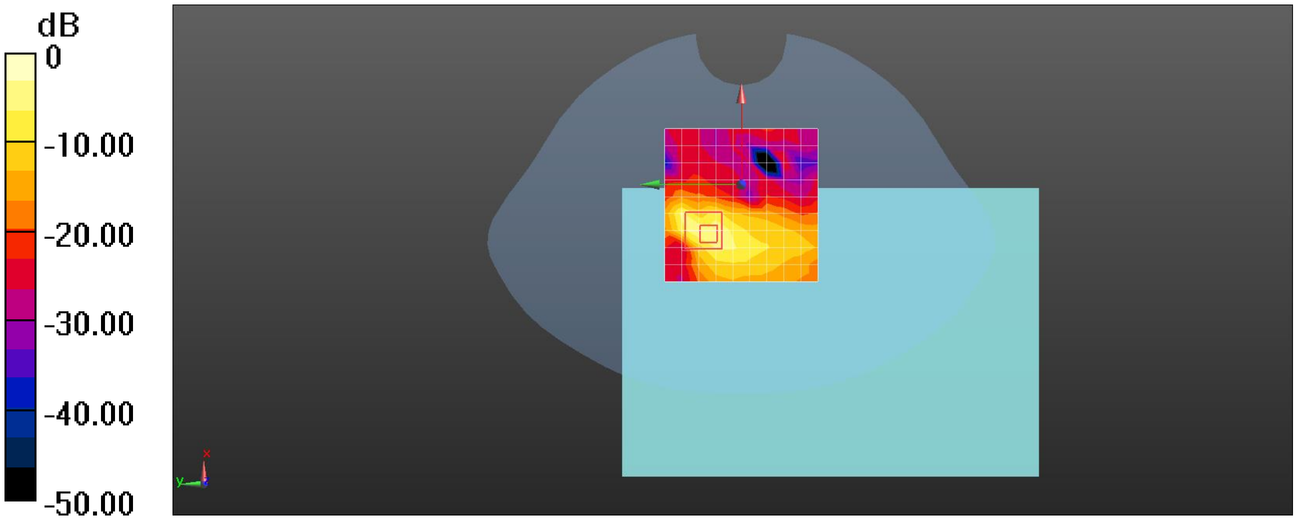
Date:2019-11-07
Communication System: UID 0, WI-FI(U-NII-1) (0); Frequency: 5240 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5240 MHz; σ = 5.441 S/m; ε_r = 48.046; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(5.24, 5.24, 5.24); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM2; Type: Twin SAM V5.0; Serial: 1811
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/Top side/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.655 W/kg

Body/Top side/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 2.357 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 3.43 W/kg
SAR(1 g) = 0.587 W/kg; SAR(10 g) = 0.190 W/kg
Maximum value of SAR (measured) = 1.40 W/kg



0 dB = 1.40 W/kg = 1.46 dBW/kg

Test band:	U-NII-2A (WIFI 5G)	Test Position:	Back side	Test Plot:	B3

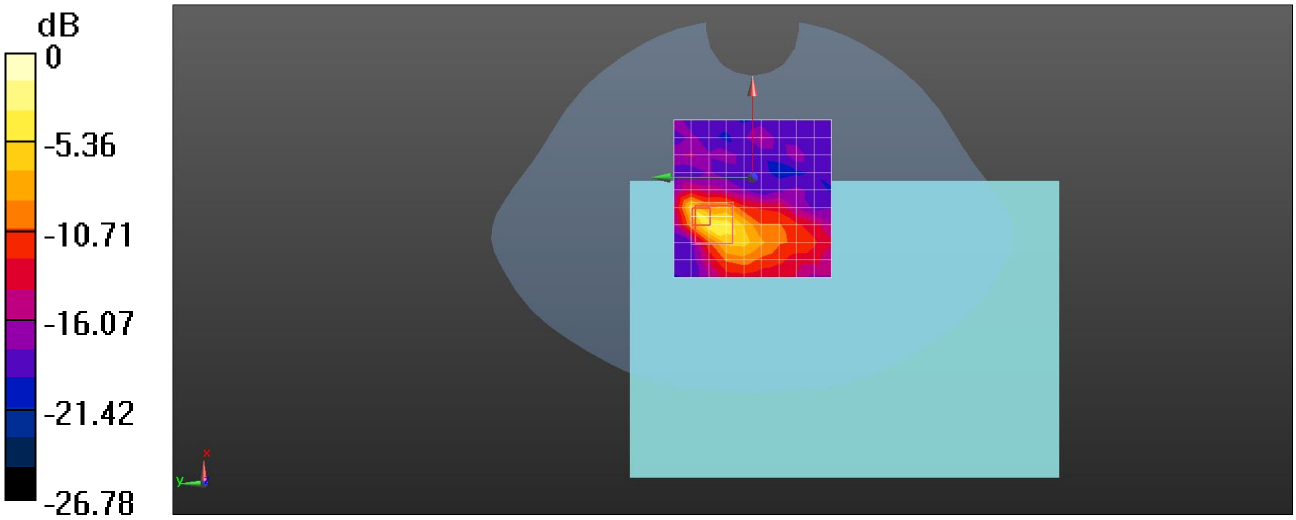
Date:2019-11-07
Communication System: UID 0, WI-FI(U-NII-2A) (0); Frequency: 5320 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5320 MHz; σ = 5.556 S/m; $ε_r$ = 47.883; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(5.15, 5.15, 5.15); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM2; Type: Twin SAM V5.0; Serial: 1811
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/Back side/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.671 W/kg

Body/Back side/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 3.418 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 3.83 W/kg
SAR(1 g) = 0.623 W/kg; SAR(10 g) = 0.212 W/kg
Maximum value of SAR (measured) = 1.45 W/kg



0 dB = 1.45 W/kg = 1.61 dBW/kg

Test band:	U-NII-2C (WIFI 5G)	Test Position:	Back side	Test Plot:	B4

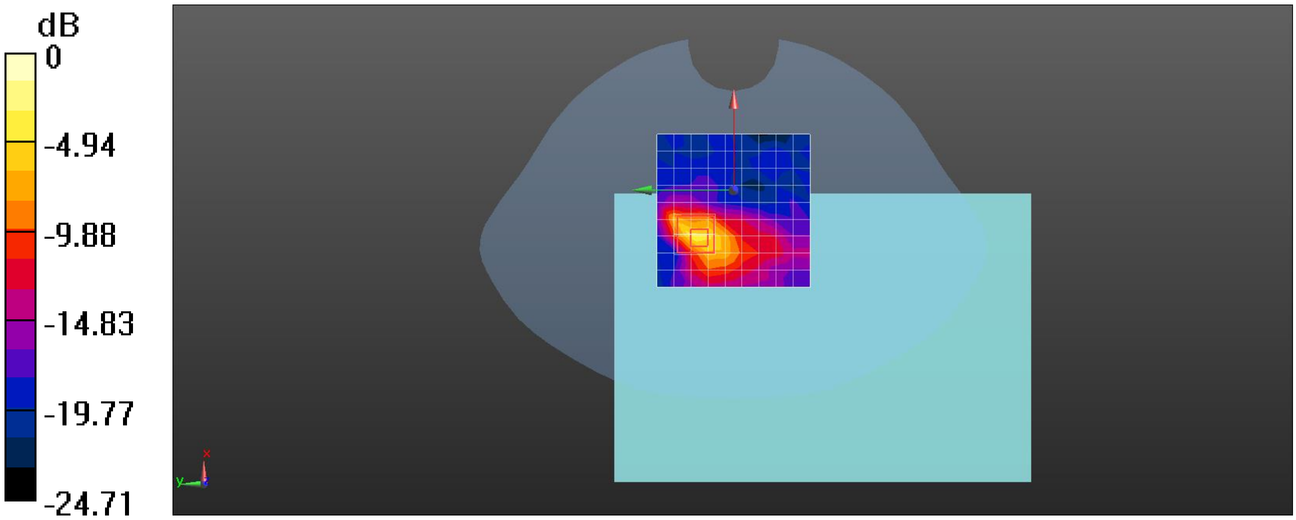
Date:2019-11-08
Communication System: UID 0, WI-FI(U-NII-2C) (0); Frequency: 5500 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5500 MHz; σ = 5.825 S/m; ε_r = 47.515; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(4.46, 4.46, 4.46); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM2; Type: Twin SAM V5.0; Serial: 1811
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Body/Back side/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.857 W/kg

Body/Back side/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 3.457 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 5.54 W/kg
SAR(1 g) = 0.861 W/kg; SAR(10 g) = 0.278 W/kg
Maximum value of SAR (measured) = 2.14 W/kg



0 dB = 2.14 W/kg = 3.30 dBW/kg

Test band:	U-NII-3 (WIFI 5G)	Test Position:	Back side	Test Plot:	B5

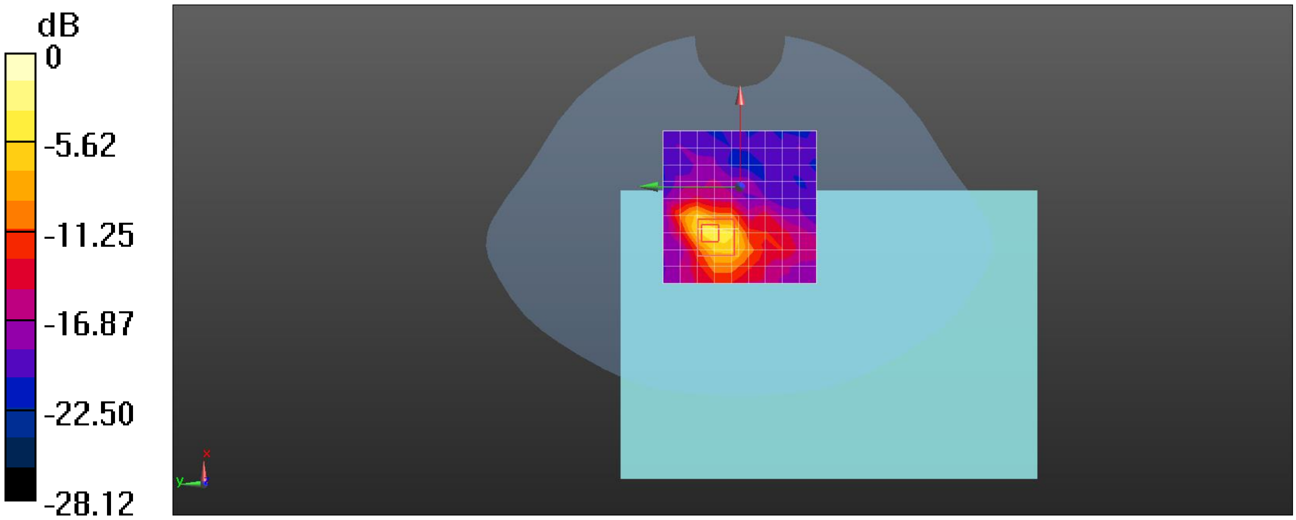
Date:2019-11-11
Communication System: UID 0, WI-FI(U-NII-3) (0); Frequency: 5745 MHz;Duty Cycle: 1:1
Medium parameters used: f = 5745 MHz; σ = 6.196 S/m; ε_r = 47.056; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3974; ConvF(4.58, 4.58, 4.58); Calibrated: 2019/05/21;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1423; Calibrated: 2019/05/24
- Phantom: SAM2; Type: Twin SAM V5.0; Serial: 1811
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

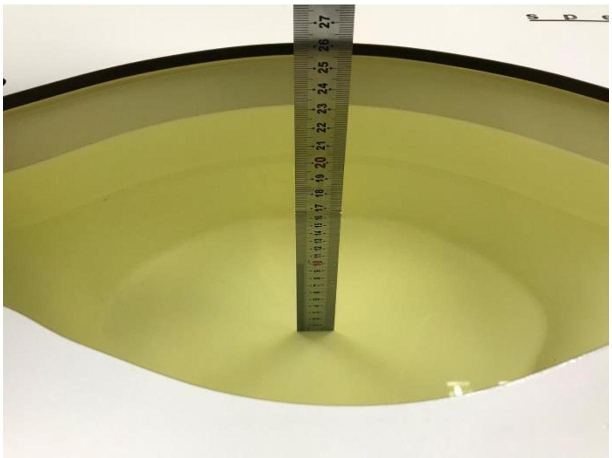
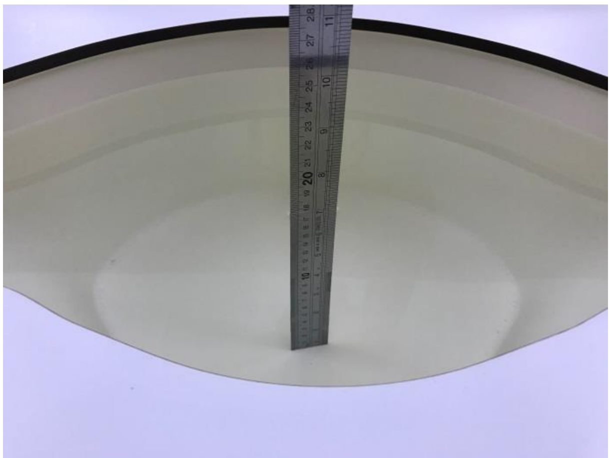
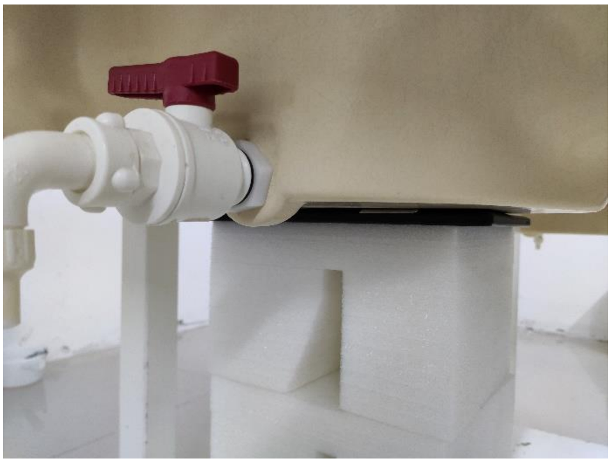
Body/Back side/Area Scan (10x10x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.916 W/kg

Body/Back side/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 3.705 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 6.39 W/kg
SAR(1 g) = 0.957 W/kg; SAR(10 g) = 0.330 W/kg
Maximum value of SAR (measured) = 2.25 W/kg



0 dB = 2.25 W/kg = 3.52 dBW/kg

15. TestSetup Photos

	
Liquid depth in the Flat of SAM1 phantom	Liquid depth in the Flat of SAM2phantom
	
Back side (0mm)	Top side(0mm)

16. External and Internal Photos of the EUT

Photo 1

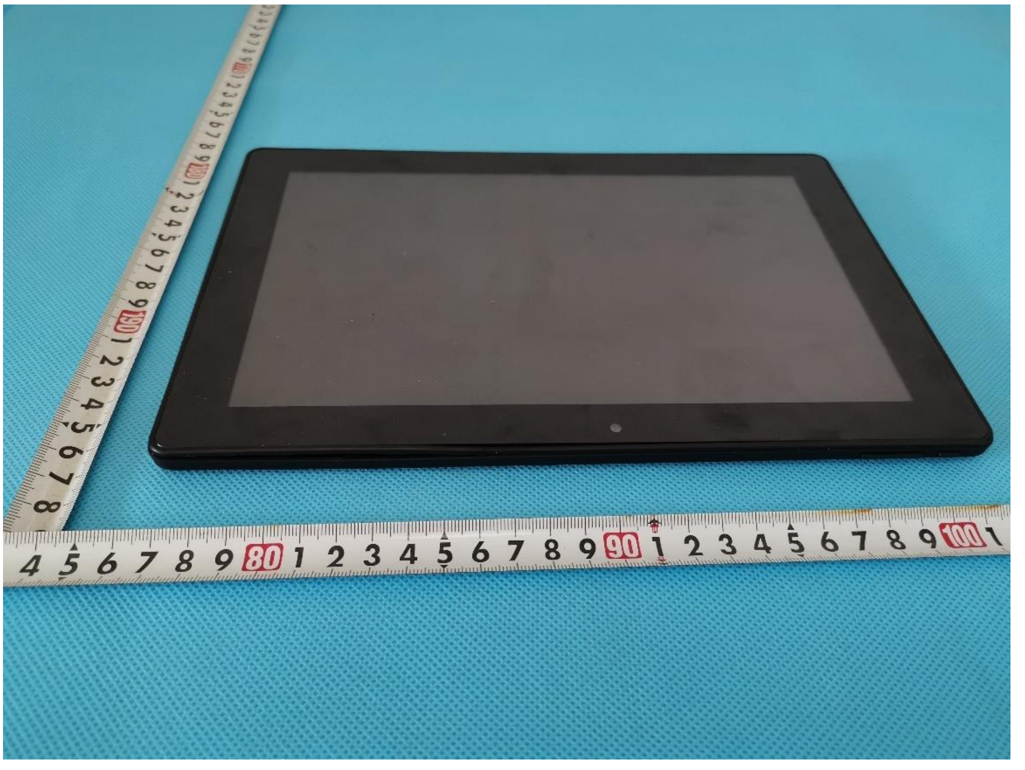


Photo 2

Photo 3

Photo 4

Photo 5

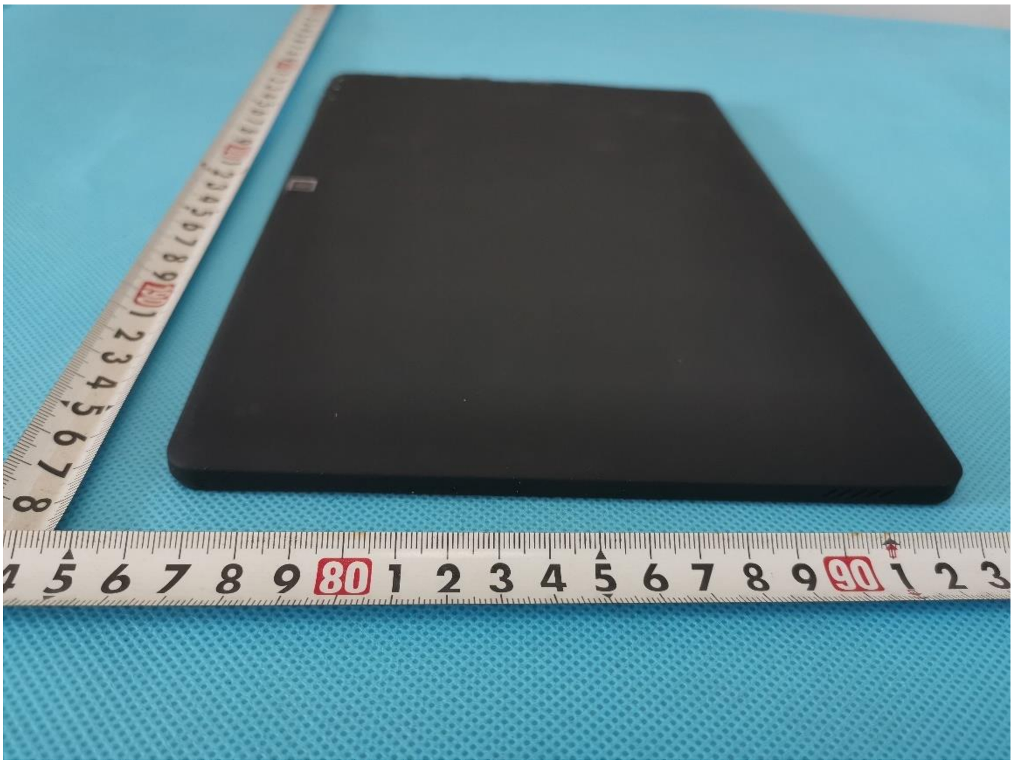


Photo 6

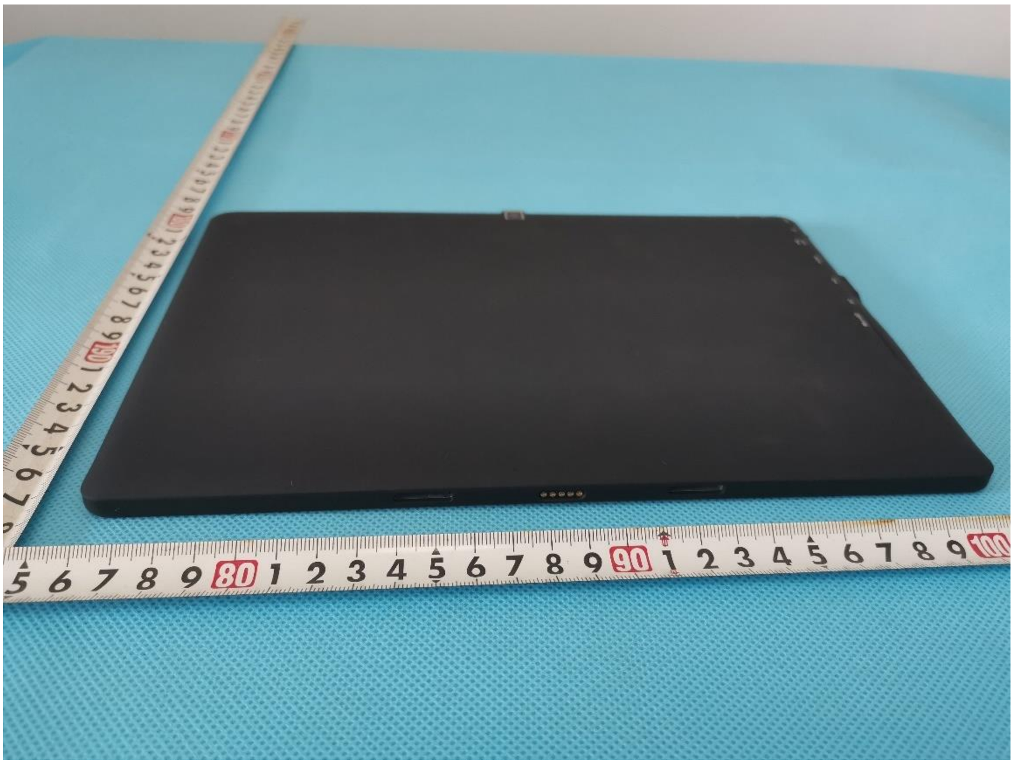


Photo 7

Photo 8

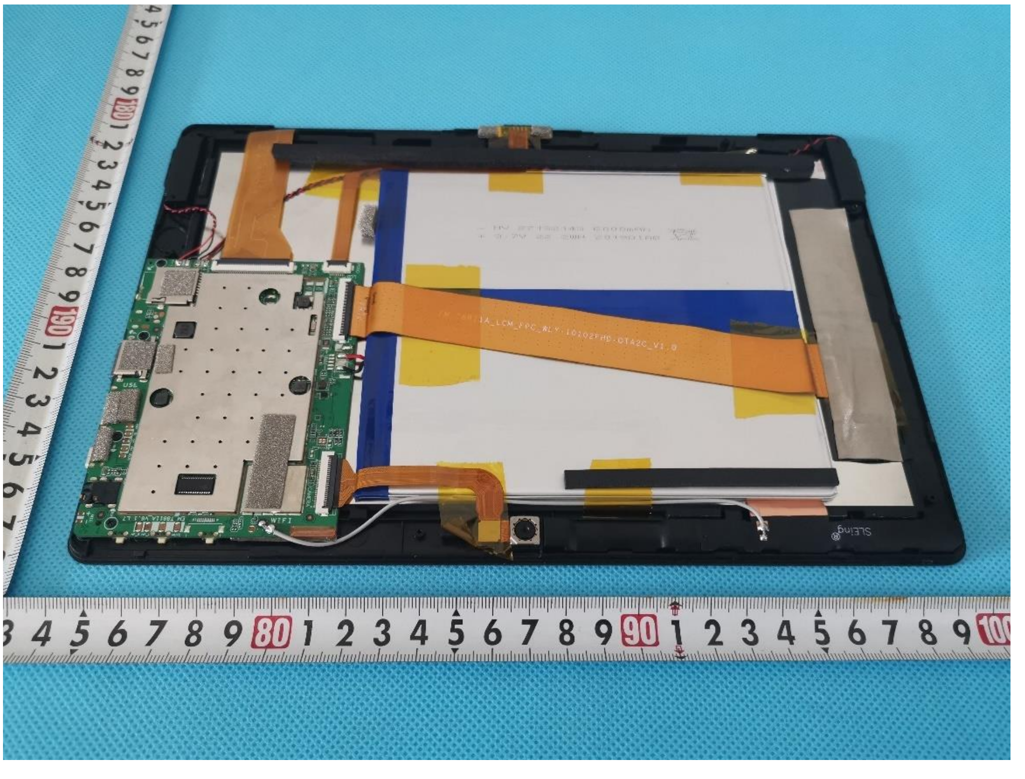


Photo 9

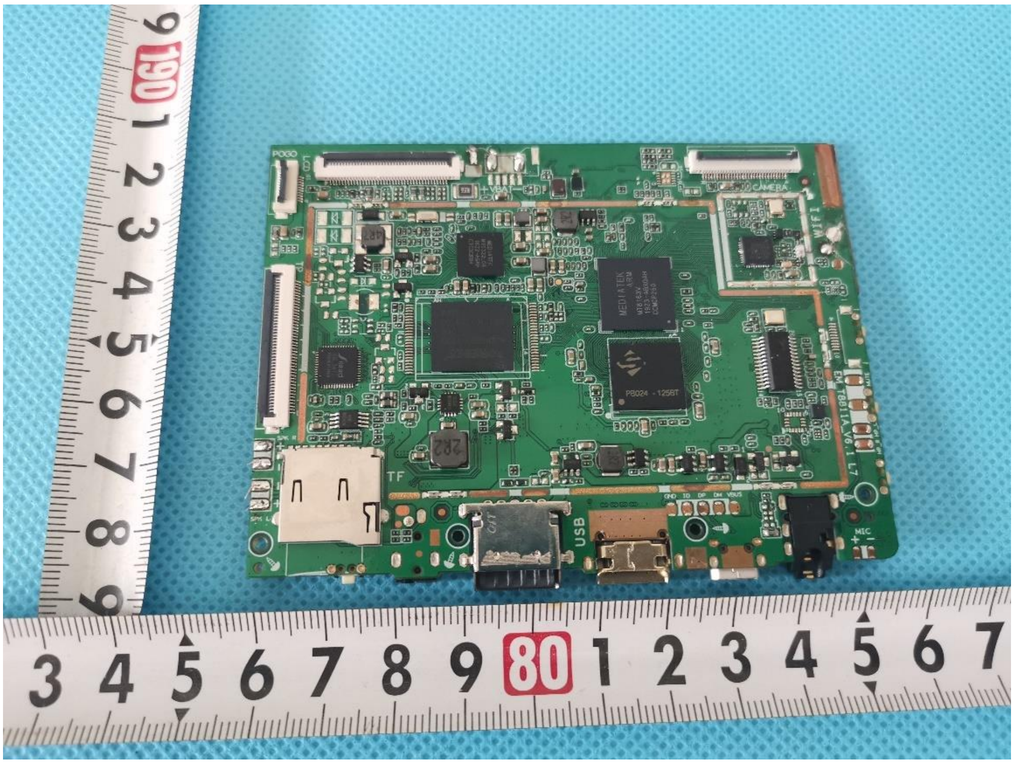


Photo 10

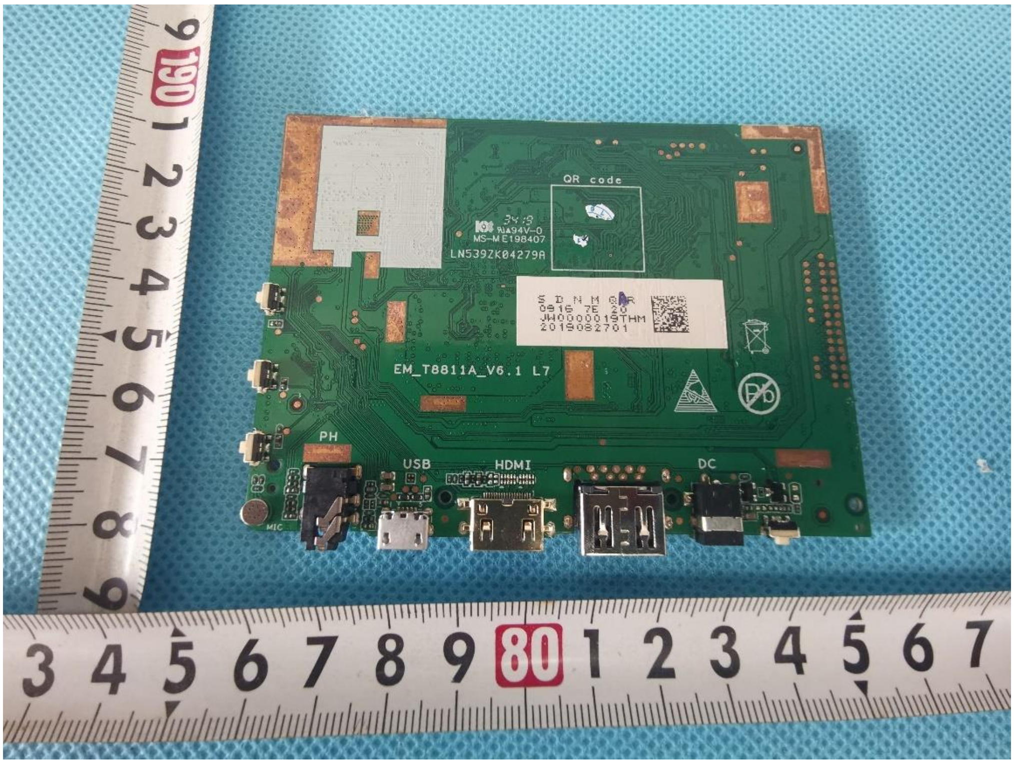


Photo 11

Photo 12

Photo 13

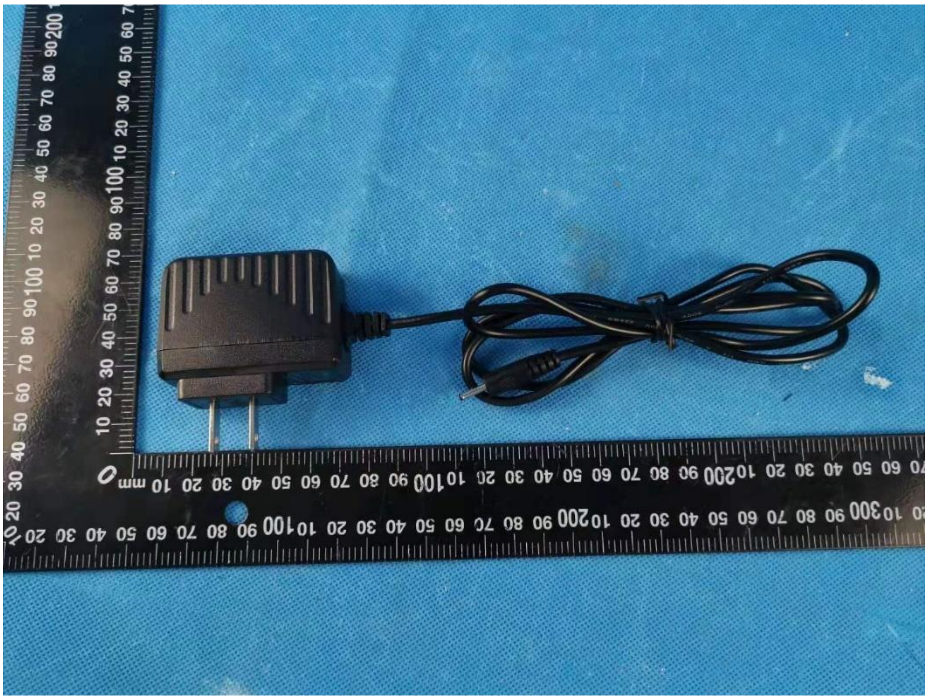


Photo 14

Photo 15

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