TEST REPORT

Report Reference No. .... :	**TRE18060029** R/C……….: 98677
FCC ID .... :	**2AHPN-HSA-15UA-AA**
Applicant's name .... :	**Harman International Industries Incorporated**
Address...:	636, Ellis St, Mountain View, CA 94043, USA
Manufacturer......................................:	Harman International Industries Incorporated
Address...:	636, Ellis St, Mountain View, CA 94043, USA
Test item description .... :	**HARMAN spark**
Trade Mark ....:	Harman
Model/Type reference.......................:	HSA-15UA-AA
Listed Model(s) ....:	-
Standard .... :	**FCC 47 CFR Part2.1093** **IEEE 1528: 2013 ANSI/IEEE C95.1: 1999**
Date of receipt of test sample……….:	Jun.05,2018
Date of testing…………………………...:	Jun.06,2018- Jun.12,2018
Date of issue…………………………….:	Jun.15,2018
Result.................. ……………………...:	**PASS**

DRAFT

Compiled by (position+printedname+signature)...:	File administrators:Xiaodong Zhao
Supervised by (position+printedname+signature)...:	Test Engineer: Xiaodong Zhao
Approved by (position+printedname+signature)...:	Manager: Hans Hu

Testing Laboratory Name .... :	**Shenzhen Huatongwei International Inspection Co., Ltd**
Address...:	1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

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 Proceduresfor802.11 a/b/g Transmitters
KDB 941225 D01 3G SAR Procedures v03r01: SAR Measurement Procedures for 3G Devices
KDB 941225 D06 Hotspot Mode v02r01: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities
KDB 941225 D05 SAR for LTE Devices v02r05: SAR Evaluation Considerations for LTE Devices

1.2. Report version

Revision No.	Date of issue	Description
N/A	2018-06-15	Original

2. Summary

2.1. Client Information

Applicant:	Harman International Industries Incorporated
Address:	636, Ellis St, Mountain View, CA 94043, USA
Manufacturer:	Harman International Industries Incorporated
Address:	636, Ellis St, Mountain View, CA 94043, USA

2.2. Product Description

Name of EUT:	HARMAN spark			
Trade Mark:	Harman			
Model No.:	HSA-15UA-AA			
Listed Model(s):	-			
Power supply:	DC 12V(SAE-J1962 TYPE B)			
Device Category:	Portable			
Product stage:	Production unit			
RF Exposure Environment:	General Population / Uncontrolled			
IMEI:	866155030077841			
Hardware version:	VI.0			
Software version:	HSA-15UA_81_LA301_R13B			
Maximum SAR Value				
Separation Distance:	Body: 5mm			
Max Report SAR Value (1g):	Test location:	PCB	DTS	Simultaneous TX
	Hotspot:	1.270 W/Kg	0.298 W/Kg	1.371 W/Kg
WCDMA				
Operation Band:	WCDMA Band II,WCDMA Band V			
Power Class:	Power Class 3			
Modulation Type:	QPSK/16QAM			
DC-HSUPA Release Version:	Not Supported			
Antenna type:	FPC Antenna			
LTE				
Operation Band:	FDD Band 2,FDD Band 4,FDD Band 5,FDD Band 12			
Modulation Type:	QPSK,16QAM			
Antenna type:	FPC Antenna			

WIFI 2.4G	
Supported type:	802.11b/802.11g/802.11n(HT20)
Modulation Type:	DSSS for 802.11b OFDM for 802.11g/802.11n(HT20)
Operation frequency:	2412MHz~2462MHz
Channel number:	11
Channel separation:	5MHz
Antenna type:	FPC 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

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. Registration 762235.

IC-Registration No.: 5377B-1

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-1.

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.	Last Cal.
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	D750V3	1180	2018/02/07	2021/02/06
System Validation Dipole	SPEAG	D835V2	4d238	2018/02/19	2021/02/18
System Validation Dipole	SPEAG	D1750V2	1164	2018/02/06	2021/02/05
System Validation Dipole	SPEAG	D1900V2	5d226	2018/02/22	2021/02/21
System Validation Dipole	SPEAG	D2450V2	1009	2018/02/05	2021/02/04
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
Universal Radio Communication Tester	ROHDE & SCHWARZ	CMW500	155690	2017/04/17	2018/04/16
Signal Generator	ROHDE & SCHWARZ	SMB100A	175248	2017/09/02	2018/09/01
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	2018/03/22	2019/03/21
Power Amplifier	Mini-Circuits	ZHL-42W	QA1202003	2017/11/27	2018/11/26
Dual Directional Coupler	Agilent	772D	MY46151257	2018/03/22	2019/03/21
Dual Directional Coupler	Agilent	778D	MY48220612	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 justifcatio. 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 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.

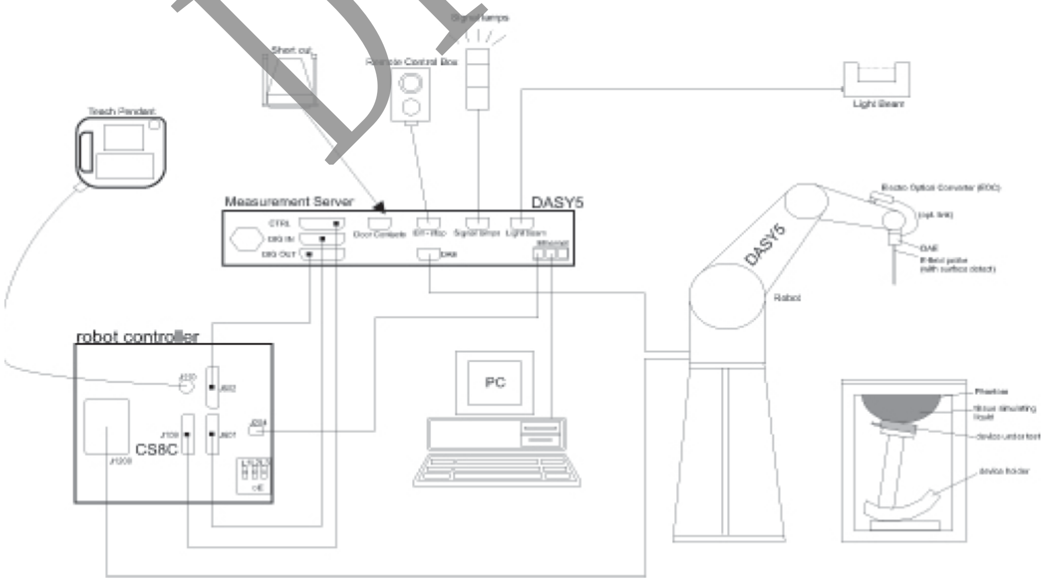
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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.

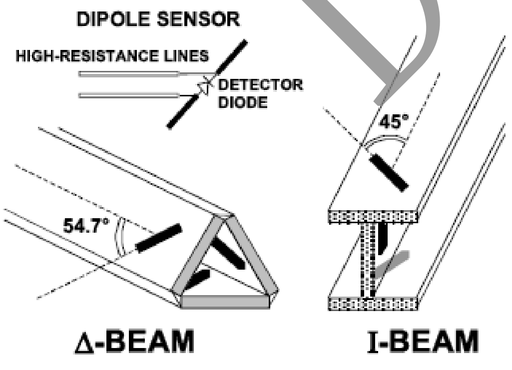
- **Probe Specification**

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**

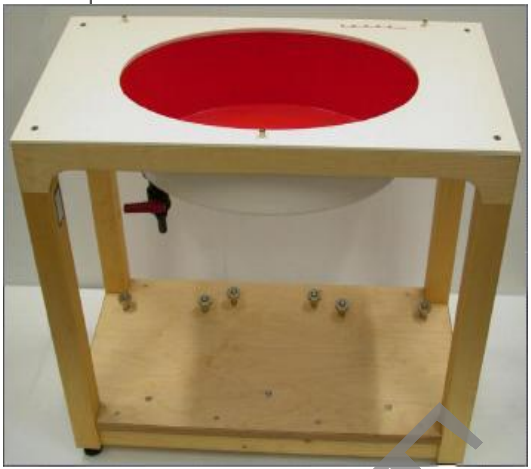
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



6.3. Phantoms

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI isfully compatible with standard and all known tissuesimulating liquids. ELI has been optimized regarding its performance and can beintegrated into our standard phantom tables. A cover prevents evaporation ofthe liquid. Reference markings on the phantom allow installation of thecomplete setup, including all predefined phantom positions and measurementgrids, by teaching three points. The phantom is compatible with all SPEAGdosimetric 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. ± 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.

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 mm ± 1 mm	½·δ·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}			≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
			When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

Note: 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 ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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:

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

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

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.

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

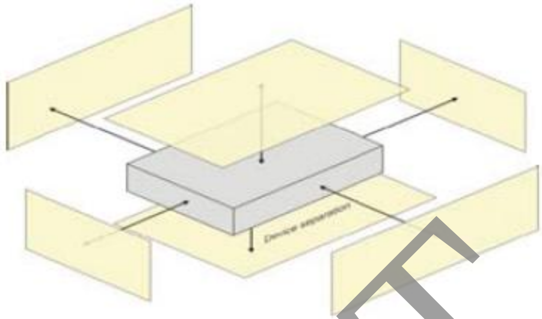
SAR: local specific absorption rate in W/kg
Etot: total field strength in V/m
σ: conductivity in [mho/m] or [Siemens/m]
ρ: equivalent tissue density in g/cm3

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.

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

8.1. Hotspot Mode Exposure conditions

The hotspot mode and 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 both hotspot mode and 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

9. System Check

9.1. Tissue Dielectric Parameters

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)
750	55.5	0.96
835	55.2	0.97
1750	53.4	1.49
1800-2000	53.3	1.52
2450	52.7	1.95

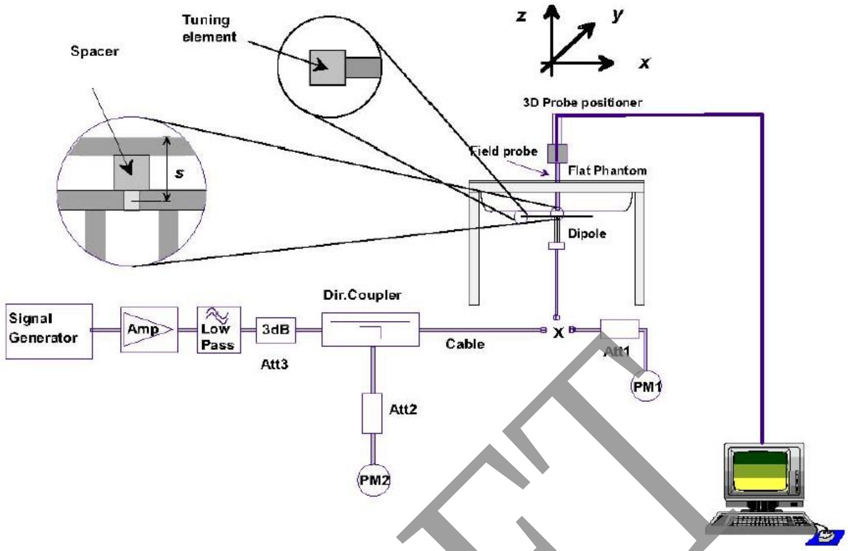
Check Result:

Dielectric performance of Body tissue simulating liquid									
Frequency (MHz)	εr		σ(s/m)		Delta (εr)	Delta (σ)	Limit	Temp (℃)	Date
	Target	Measured	Target	Measured					
750	55.50	55.63	0.96	0.94	0.23%	-2.60%	±5%	22	2018-06-06
835	55.20	55.40	0.97	0.97	0.36%	-0.41%	±5%	22	2018-06-07
1750	53.40	53.91	1.49	1.44	0.96%	-3.36%	±5%	22	2018-06-08
1900	53.30	53.72	1.52	1.55	0.79%	1.97%	±5%	22	2018-06-11
2450	52.70	53.03	1.95	2.00	0.63%	2.56%	±5%	22	2018-06-12

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 1W	Normalize to 1W	Measured 250mW	Target 1W	Normalize to 1W	Measured 250mW					
750	8.55	8.40	2.10	5.68	5.60	1.40	-1.75%	-1.41%	±10%	22	2018-06-06
835	9.64	10.08	2.52	6.32	6.64	1.66	4.56%	5.06%	±10%	22	2018-06-07
1750	36.70	37.56	9.39	19.50	20.16	5.04	2.34%	3.38%	±10%	22	2018-06-08
1900	39.80	41.60	10.40	20.90	21.68	5.42	4.52%	3.73%	±10%	22	2018-06-11
2450	49.40	50.00	12.50	23.30	23.32	5.83	1.21%	0.09%	±10%	22	2018-06-12

Note:

1. *the graph results see follow.*

Plots of System Performance Check

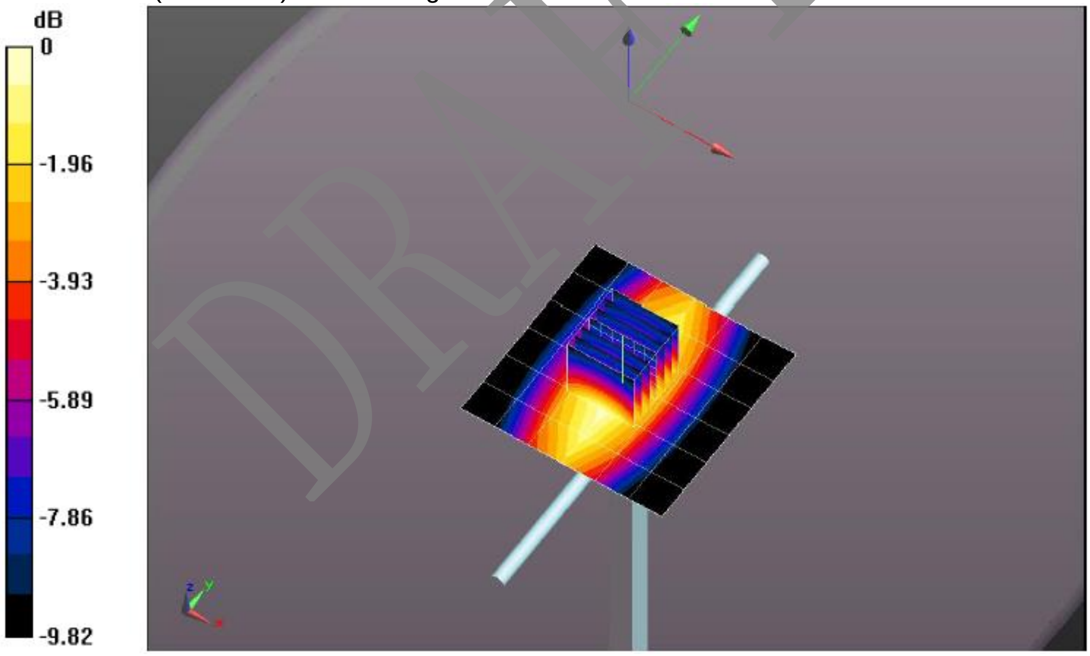
System Performance Check-Body 750MHz

DUT: D750V3; Type: D750V3; Serial: 1180
Date: 2018-06-06
Communication System: UID 0, CW (0); Frequency: 750 MHz
Medium parameters used: f = 750 MHz; σ = 0.935 S/m; ε_r = 55.625; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494;ConvF(10.87, 10.87, 10.87); 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 14.6.11(7437)

Body/d=15mm,Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 2.80 W/kg
Body/d=15mm,Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.06 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.18 W/kg
SAR(1 g) = 2.1 W/kg; SAR(10 g) = 1.4 W/kg
Maximum value of SAR (measured) = 2.81 W/kg



System Performance Check-Body 835MHz

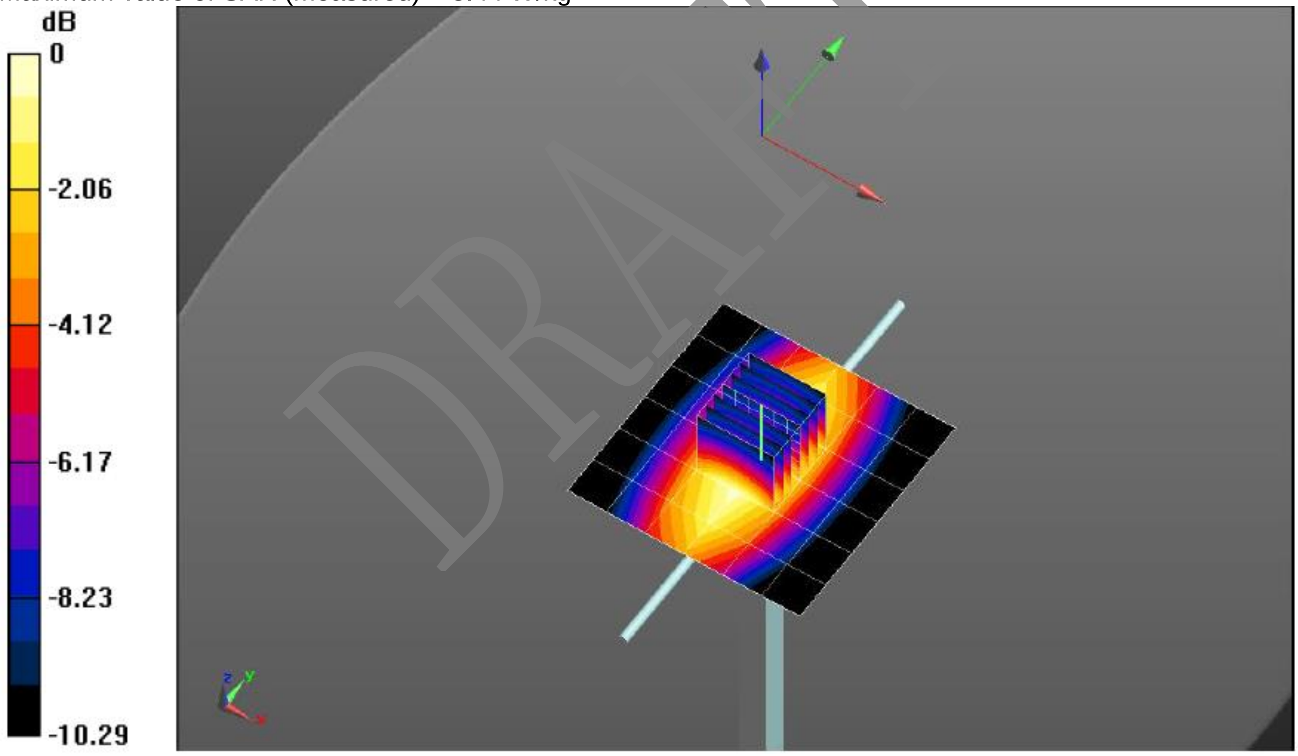
DUT: D835V2; Type: D835V2; Serial: 4d238
Date: 2018-06-07
Communication System: UID 0, CW (0); Frequency: 835 MHz
Medium parameters used: f = 835 MHz; σ = 0.966 S/m; ε_r = 55.403; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.5, 10.5, 10.5); 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=15mm,Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.40 W/kg

Body/d=15mm,Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 61.67 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.97 W/kg
SAR(1 g) = 2.52 W/kg; SAR(10 g) = 1.66 W/kg
Maximum value of SAR (measured) = 3.44 W/kg



System Performance Check-Body 1750MHz

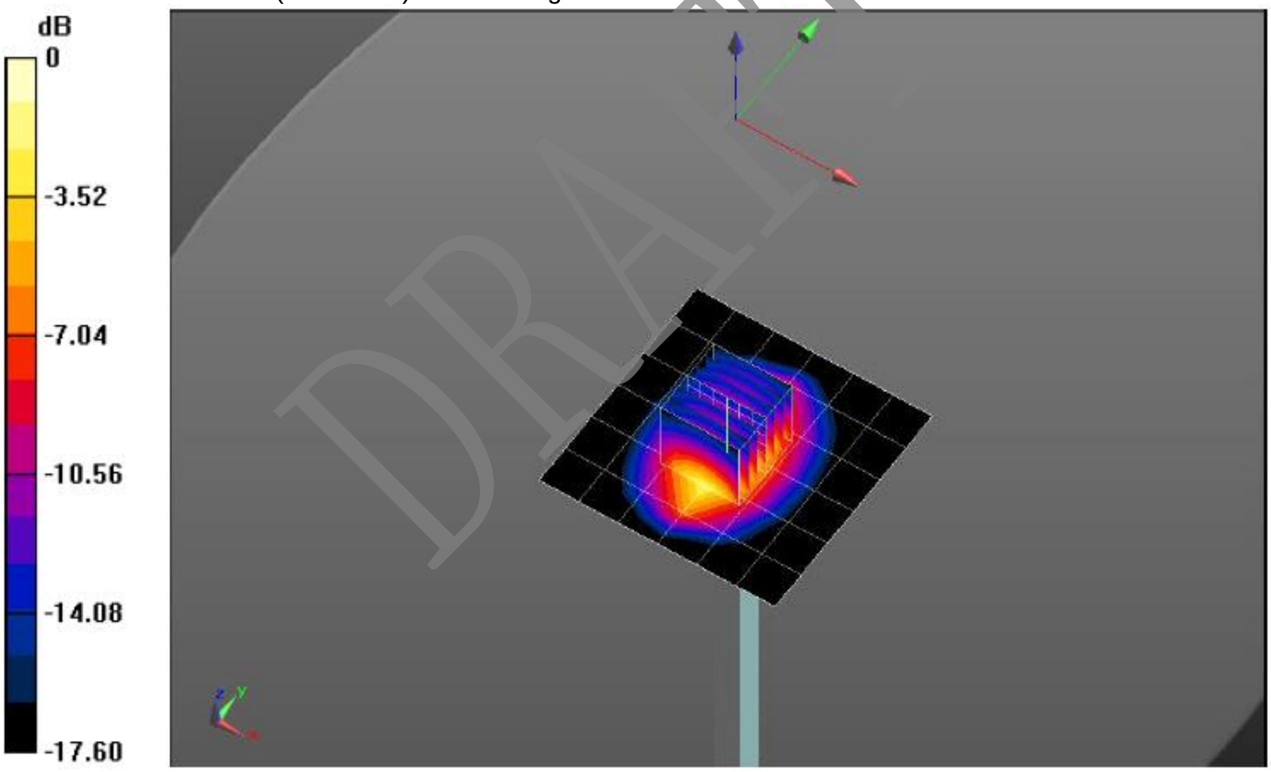
DUT: D1750V2; Type: D1750V2; Serial: 1164
Date: 2018-06-08
Communication System: UID 0, CW (0); Frequency: 1750 MHz
Medium parameters used: f = 1750 MHz; σ = 1.441 S/m; ε_r = 53.908; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.77, 8.77, 8.77); 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 (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 14.7 W/kg

Body/d=10mm,Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 102.2 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 16.8 W/kg
SAR(1 g) = 9.39 W/kg; SAR(10 g) = 5.04 W/kg
Maximum value of SAR (measured) = 14.1 W/kg



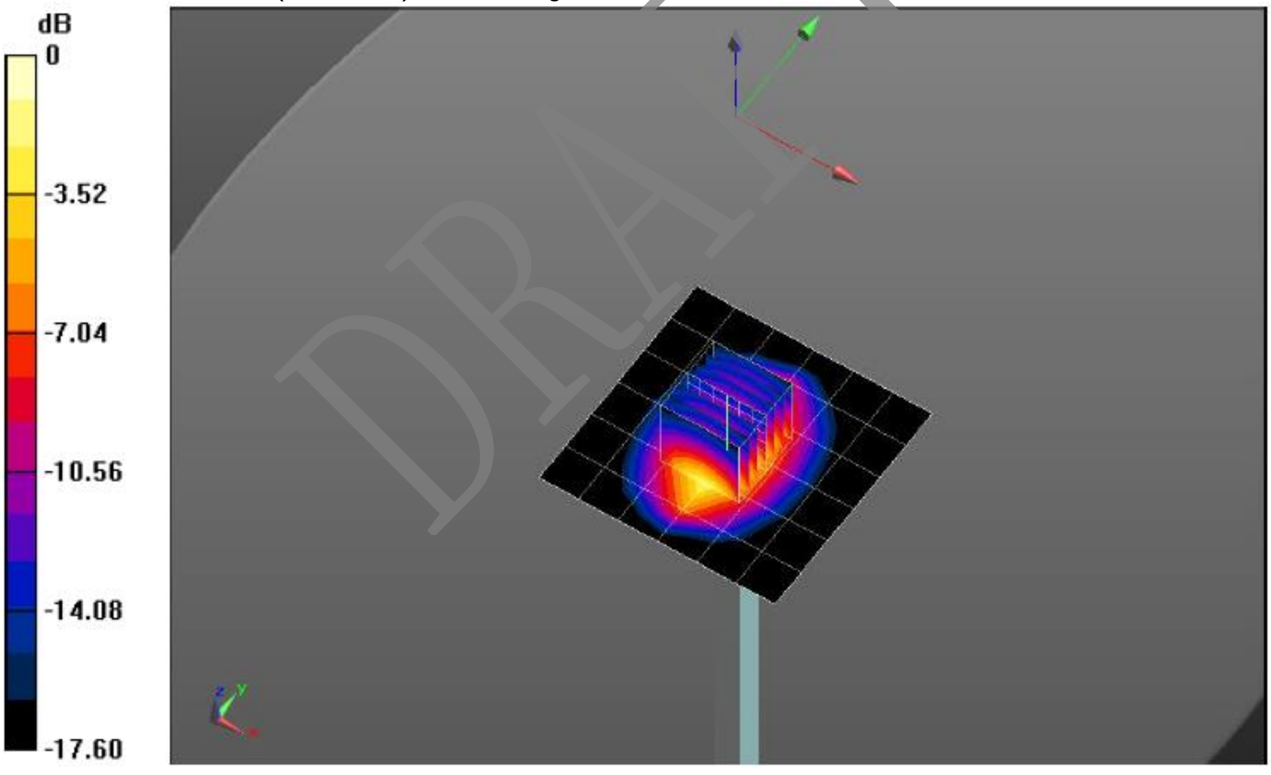
System Performance Check-Body 1900MHz

DUT: D1900V2; Type: D1900V2; Serial: 5d226
Date:2018-06-11
Communication System: UID 0, CW (0); Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.553 S/m; ε_r = 53.719; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.42, 8.42, 8.42); 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 (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 16.4 W/kg
Body/d=10mm,Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 105.9 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 18.9 W/kg
SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.42 W/kg
Maximum value of SAR (measured) = 15.7 W/kg



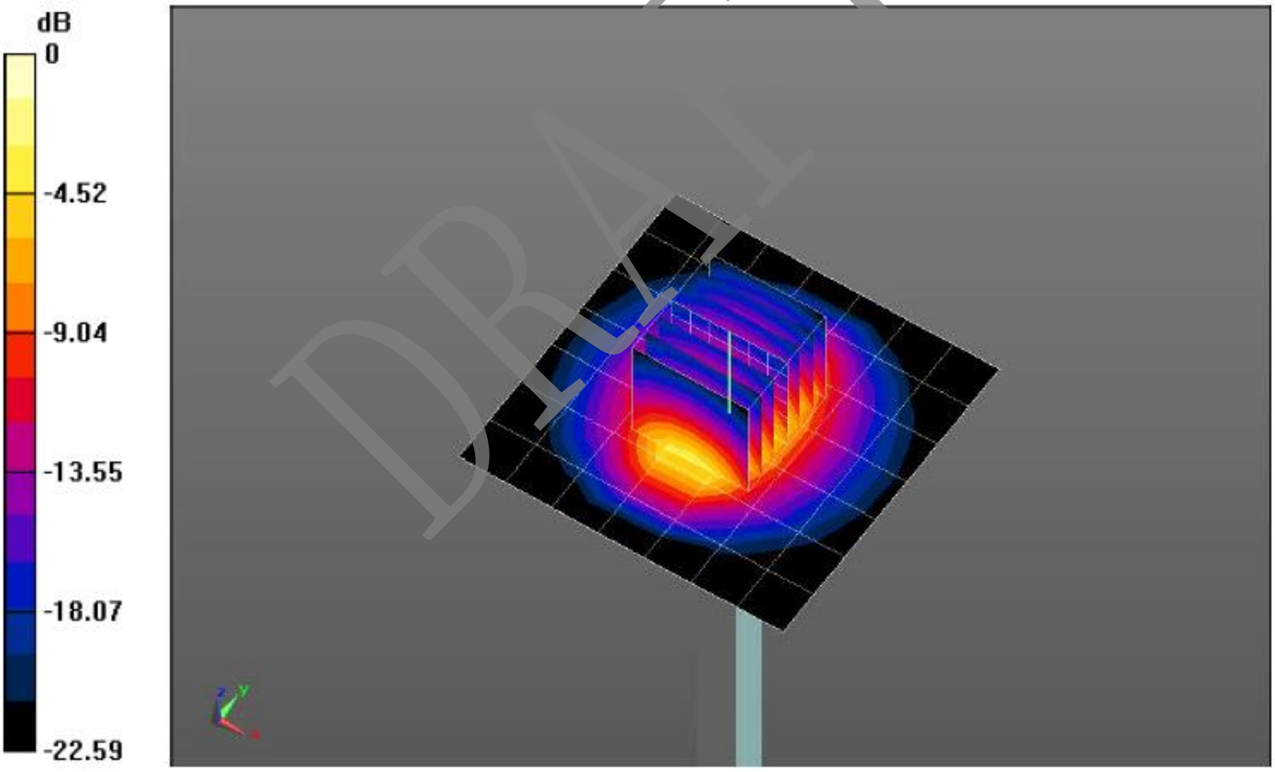
SystemPerformanceCheck-Body 2450MHz

DUT: D2450V2; Type: D2450V2; Serial: 1009
Date:2018-06-12
Communication System: UID 0, CW (0); Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 2.001 S/m; ε_r = 53.03; ρ = 1000 kg/m^3
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=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



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

WCDMA Conducted Power

1. *The following tests were conducted according to the test requirements outlines in 3GPP TS34.121 specification.*
2. *The procedures in KDB 941225 D01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode to determine SAR test exclusion*

A summary of thest setting are illustrated belowe:

HSDPA Setup Configureation:

a) The EUT was connected to base station RS CMU200 referred to the setup configuration
b) The RF path losses were compensated into the measurements
c) A call was established between EUT and base station with following setting:
   i. Set Gain Factors (βc and βd) and parameters were set according to each specific sub-test in the following table, C10.1.4, Quoted from the TS 34.121
   ii. Set RMC 12.2Kbps + HSDPA mode
   iii. Set Cell Power=-86dBm
   iv. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
   v. Select HSDPA uplink parameters
   vi. Set Delta ACK, Delta NACK and Delta CQI=8
   vii. Set Ack-Nack repetition Factor to 3
   viii. Set CQI Feedback Cycle (K) to 4ms
   ix. Set CQI repetition factor to 2
   x. Power ctrl mode= all up bits
d) The transmitter maximum output power waw recorded.

Table C.10.1.4: β values for transmitter characteristics tests with HS-DPCCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$.

Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, Δ_{ACK} and Δ_{NACK} = 30/15 with $\beta_{hs} = 30/15 * \beta_c$, and Δ_{CQI} = 24/15 with $\beta_{hs} = 24/15 * \beta_c$.

Note 3: CM = 1 for β_c/β_d = 12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.

Note 4: For subtest 2 the β_c/β_d ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 11/15 and β_d = 15/15.

Setup Configuration

HSUPA Setup Configureation:

a) The EUT was connected to base station RS CMU200 referred to the setup configuration
b) The RF path losses were compensated into the measurements
c) A call was established between EUT and base station with following setting:
   i. Call configs = 5.2b, 5.9b, 5.10b, and 5.13.2B with QPSK
   ii. Set Gain Factors (βc and βd) and parameters (AG index) were set according to each specific sub-test in the following table, C11.1.3, Quoted from the TS 34.121
   iii. Set Cell Power=-86dBm
   iv. Set channel type= 12.2Kbps + HSPA mode
   v. Set UE Target power
   vi. Set Ctrl mode=Alternating bits
   vii. Set and observe the E-TFCI
   viii. Confirm that E-TFCI is equal the target E-TFCI of 75 for Sub-test 1, and other subtest's E-TFCI
d) The transmitter maximum output power waw recorded.

Table C.11.1.3: β values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	β_{HS} (Note 1)	β_{ec}	β_{ed} (Note 5) (Note 6)	β_{ed} (SF)	β_{ed} (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/225	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	β_{ed}1: 47/15 β_{ed}2: 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK}, Δ_{NACK} and Δ_{CQI} = 30/15 with β_{hs} = 30/15 * β_c .

Note 2: CM = 1 for β_c/β_d =12/15, β_{hs}/β_c=24/15. For all other combinations of DPDCH, DPCCH, HS- DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 10/15 and β_d = 15/15.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to β_c = 14/15 and β_d = 15/15.

Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly, it is set by Absolute Grant Value.

Setup Configuration

General Note:

1. Per KDB 941225 D01, SAR for Head / Hotsport / Body-worn Exposure is measured using a 12.2Kbps RMC with TPC bit ocnfigured to all 1s
2. Per KDB 941225 D01 RMC12.2Kbps setting is used to evaluate SAR. If the maximum output power and Tune-up tolerance specified for production units in HSDPA/HSUPA is ≦1/4dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio fo specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC 12.2Kbps and the adjusted SAR is ≦1.2 W/kg, SAR measurement is not required for HSDPA / HSUPA.

Mode	WCDMA Band II			WCDMA Band V		
	Conducted Power (dBm)			Conducted Power (dBm)		
	CH9262	CH9400	CH9538	CH4132	CH4183	CH4233
	1852.4	1880.0	1907.6	826.4	836.6	846.6
QPSK	23.36	23.45	23.37	23.20	23.11	23.11

LTE Conducted Power

General Note:

1. CMW500 base station simulator was used to setup the connection with EUT; the frequency band, channel,bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUTtransmitting at maximum power and at different configurations which are requested to be reported to FCC, forconducted power measurement and SAR testing.
2. Per KDB 941225 D05v02r03, when a properly configured base station simulator is used for the SAR and powermeasurements, spectrum plots for each RB allocation and offset configuration is not required.
3. Per KDB 941225 D05v02r03, start with the largest channel bandwidth and measure SAR for QPSK with 1 RBallocation, using the RB offset and required test channel combination with the highest maximum output power for RBoffsets at the upper edge, middle and lower edge of each required test channel.
4. Per KDB 941225 D05v02r03, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
5. Per KDB 941225 D05v02r03, for QPSK with 100% RB allocation, SAR is not required when the highest maximumoutput power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations andthe highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highestoutput power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also betested.
6. Per KDB 941225 D05v02r03, 16QAM output power for each RB allocation configuration is > not ½ dB higher than thesame configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225D05v02r03, 16QAM SAR testing is not required.
7. Per KDB 941225 D05v02r03, smaller bandwidth output power for each RB allocation configuration is > not ½ dBhigher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supportedbandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.

LTE-FDD Band 2				Actual output Power (dBm)		
Band-width	Modulation	RB allocation	RB offset	Low	Middle	High
1.4	QPSK	1	0	22.16	22.41	21.89
			2	22.18	22.40	21.93
			5	22.06	22.33	21.86
		3	0	22.27	22.24	22.01
			1	22.31	22.32	22.30
			3	22.30	22.14	21.99
		6	0	21.00	21.23	21.09
3	QPSK	1	0	22.14	22.33	22.15
			8	22.15	22.21	22.12
			14	22.18	22.21	22.23
		8	0	21.11	21.15	20.97
			4	21.10	21.11	21.09
			7	21.09	21.10	20.96
		15	0	21.10	21.13	21.07
5	QPSK	1	0	22.00	22.49	22.03
			12	22.06	22.20	21.92
			24	22.29	22.41	22.09
		12	0	21.11	21.24	21.21
			6	21.10	21.09	21.10
			13	21.17	21.10	21.10
		25	0	21.10	21.13	21.20
10	QPSK	1	0	22.33	22.42	22.46
			24	22.19	22.42	22.28
			49	22.25	22.36	22.20
		25	0	21.16	21.30	21.19
			12	21.20	21.31	21.21
			25	21.22	21.22	21.21
		50	0	21.22	21.26	21.18

15	QPSK	1	0	22.34	22.39	22.35
			38	22.00	22.13	21.96
			74	22.24	22.30	22.28
		38	0	21.27	21.23	21.20
			18	21.21	21.22	21.20
			37	21.09	21.11	21.20
		75	0	21.13	21.19	21.12
20	QPSK	1	0	22.37	22.57	22.42
			49	22.24	22.47	22.16
			99	22.79	22.29	22.04
		50	0	21.20	21.38	21.26
			25	21.20	21.32	21.21
			50	21.17	21.20	21.25
		100	0	21.15	21.33	21.12

LTE-FDD Band 4				Actual output Power (dBm)		
Band-width	Modulation	RB allocation	RB offset	Low	Middle	High
1.4	QPSK	1	0	21.37	21.63	21.53
			2	21.47	21.61	21.87
			5	21.41	21.45	21.56
		3	0	21.49	21.52	21.64
			1	21.42	21.51	21.37
			3	21.42	21.39	21.62
		6	0	20.37	20.51	20.54
3	QPSK	1	0	21.56	21.67	21.60
			8	21.53	21.51	21.49
			14	21.77	21.59	21.59
		8	0	20.52	20.58	20.52
			4	20.50	20.52	20.51
			7	20.55	20.49	20.47
		15	0	20.45	20.49	20.49
5	QPSK	1	0	21.27	21.88	21.41
			12	21.57	21.46	21.53
			24	21.68	21.64	21.40
		12	0	20.60	20.59	20.59
			6	20.58	20.57	20.55
			13	20.62	20.47	20.53
		25	0	20.58	20.57	20.53
10	QPSK	1	0	21.68	21.65	21.74
			24	21.55	21.49	21.60
			49	21.50	21.57	21.55
		25	0	20.68	20.59	20.56
			12	20.56	20.58	20.55
			25	20.39	20.45	20.47
		50	0	20.54	20.57	20.53

15	QPSK	1	0	20.73	21.69	21.68
			38	21.41	21.42	21.38
			74	21.54	21.58	21.72
		38	0	20.53	20.66	20.62
			18	20.51	20.62	20.60
			37	20.61	20.42	20.57
		75	0	20.58	20.54	20.57
20	QPSK	1	0	22.02	21.89	21.87
			49	21.55	21.60	21.60
			99	21.31	21.79	21.85
		50	0	20.62	20.61	20.59
			25	20.60	20.60	20.58
			50	20.57	20.47	20.61
		100	0	20.56	20.61	20.55

LTE-FDD Band 5				Actual output Power (dBm)		
Band-width	Modulation	RB allocation	RB offset	Low	Middle	High
1.4	QPSK	1	0	22.38	22.44	22.56
			2	22.43	22.83	22.49
			5	22.29	22.36	22.60
		3	0	22.36	22.30	22.40
			1	22.34	22.31	22.38
			3	22.35	22.40	22.29
		6	0	21.34	21.29	21.35
3	QPSK	1	0	22.38	22.49	22.32
			8	22.28	22.25	22.40
			14	22.29	22.33	22.49
		8	0	21.39	21.33	21.31
			4	21.20	21.24	21.19
			7	21.28	21.38	21.22
		15	0	21.34	21.27	21.36
5	QPSK	1	0	22.09	22.54	22.18
			12	21.88	22.25	22.14
			24	22.14	22.39	22.32
		12	0	21.37	21.41	21.24
			6	21.33	21.35	21.29
			13	21.25	21.36	21.30
		25	0	21.36	21.29	21.27
10	QPSK	1	0	22.35	22.51	22.43
			24	22.45	22.63	22.19
			49	22.35	22.42	22.34
		25	0	21.37	21.35	21.43
			12	21.30	21.32	21.30
			25	21.31	21.31	21.30
		50	0	21.31	21.34	21.30

LTE-FDD Band 12				Actual output Power (dBm)		
Band-width	Modulation	RB allocation	RB offset	Low	Middle	High
1.4	QPSK	1	0	22.33	22.15	22.31
			2	22.45	22.36	22.40
			5	22.42	22.21	22.28
		3	0	22.33	22.25	22.33
			1	22.20	22.21	22.30
			3	22.35	22.30	22.33
		6	0	21.23	21.34	21.16
3	QPSK	1	0	22.52	22.39	22.26
			8	22.34	22.21	22.21
			14	22.51	22.35	22.35
		8	0	21.38	21.27	21.29
			4	21.35	21.20	21.25
			7	21.40	21.32	21.22
		15	0	21.38	21.25	21.22
5	QPSK	1	0	22.24	22.58	22.25
			12	22.25	22.37	22.33
			24	22.16	22.31	22.33
		12	0	21.27	21.24	21.21
			6	21.25	21.22	21.23
			13	21.22	21.12	21.31
		25	0	21.28	21.15	21.29
10	QPSK	1	0	22.25	22.25	22.42
			24	22.34	22.43	22.35
			49	22.35	22.31	22.49
		25	0	21.25	21.32	21.34
			12	21.24	21.30	21.31
			25	21.32	21.21	21.27
		50	0	21.26	21.15	21.29

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	11.81
	06	2437	11.85
	11	2462	11.49
802.11g	01	2412	13.22
	06	2437	13.79
	11	2462	13.75
802.11n(HT20)	01	2412	12.71
	06	2437	12.17
	11	2462	12.51

*Note:*The output power was test all data rate and recorded worst case at recorded data rate.

12. Maximum Tune-up Limit

WCDMA		
Mode	Maximum Tune-up (dBm)	
	WCDMA Band II	WCDMA Band V
AMR 12.2Kbps	23.50	23.50

LTE				
Fequency Band	Band-width(MHz)	Modulation	RB allocation	Maximum Tune-up (dBm)
LTE Band 2	1.4	QPSK	1	22.50
			3	22.50
			6	21.50
	3	QPSK	1	22.50
			8	21.50
			15	21.50
	5	QPSK	1	22.50
			12	21.50
			25	21.50
	10	QPSK	1	22.50
			25	21.50
			50	21.50
	15	QPSK	1	22.50
			38	21.50
			75	21.50
	20	QPSK	1	23.00
			50	21.50
			100	21.50

LTE				
Fequency Band	Band-width(MHz)	Modulation	RB allocation	Maximum Tune-up (dBm)
LTE Band 4	1.4	QPSK	1	22.00
			3	22.00
			6	21.00
	3	QPSK	1	22.00
			8	21.00
			15	20.50
	5	QPSK	1	22.00
			12	21.00
			25	21.00
	10	QPSK	1	22.00
			25	21.00
			50	21.00
	15	QPSK	1	22.00
			38	21.00
			75	21.00
	20	QPSK	1	22.50
			50	21.00
			100	21.00

LTE				
Fequency Band	Band-width(MHz)	Modulation	RB allocation	Maximum Tune-up (dBm)
LTE Band 5	1.4	QPSK	1	23.00
			3	22.50
			6	21.50
	3	QPSK	1	22.50
			8	21.50
			15	21.50
	5	QPSK	1	22.50
			12	21.50
			25	21.50
	10	QPSK	1	23.00
			25	21.50
			50	21.50

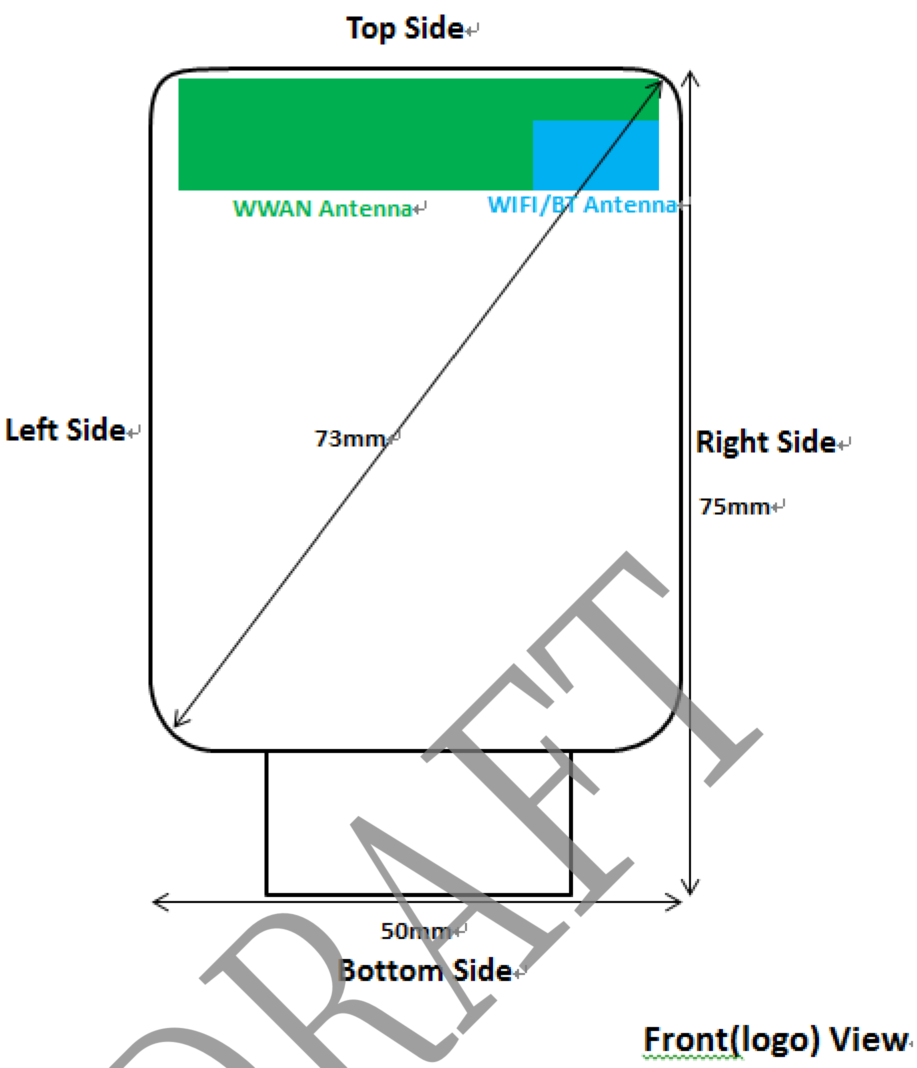
LTE				
Fequency Band	Band-width(MHz)	Modulation	RB allocation	Maximum Tune-up (dBm)
LTE Band 4	1.4	QPSK	1	22.50
			3	22.50
			6	21.50
	3	QPSK	1	23.00
			8	21.50
			15	21.50
	5	QPSK	1	22.50
			12	21.50
			25	21.50
	10	QPSK	1	22.50
			25	21.50
			50	21.50

LTE MPR will followup 3GPP setting as below:

Modulation	Channel bandwidth / Transmission bandwidth (NRB)						MPR (dB)
	1.4MHz	3.0MHz	5MHz	10MHz	15MHz	20MHz	
QPSK	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	0
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	2

WIFI 2.4G	
Mode	Maximum Tune-up (dBm) Burst Average Power
802.11b	12.00
802.11g	14.00
802.11n(HT20)	13.00

13. Antenna Location



Distance of the Antenna to the EUT surface/edge(mm)						
Antenna	Rear	Front	Top side	Bottom side	Right side	Left side
WWAN	2	2	3	/	4	4
WIFI/BT	2	19	11	/	4	36

Positions for SAR tests; Hotspot mode						
Antenna	Rear	Front	Top side	Bottom side	Right side	Left side
WWAN	Yes	Yes	Yes	No	Yes	Yes
WIFI/BT	Yes	Yes	Yes	No	Yes	No

General note:
Referring to KDB941225 D06, when the overall device length and width are >9cm*5cm, the test distance is 10mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

14. SAR Measurement Results

Hotspot SAR

WCDMA Band II										
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							
RMC 12.2Kbps	Front	9262	1852.4	23.36	23.50	1.03	0.07	1.170	1.208	B1
		9400	1880.0	23.45	23.50	1.01	0.04	1.090	1.103	-
		9538	1907.6	23.37	23.50	1.03	0.09	1.070	1.103	-
	Back	9262	1852.4	23.36	23.50	1.03	-0.08	1.030	1.064	-
		9400	1880.0	23.45	23.50	1.01	0.12	0.995	1.007	-
		9538	1907.6	23.37	23.50	1.03	0.01	0.990	1.020	-
	Left	9262	1852.4	23.36	23.50	1.03	0.01	0.645	0.666	-
	Right	9262	1852.4	23.36	23.50	1.03	0.00	0.255	0.263	-
	Top	9262	1852.4	23.36	23.50	1.03	-0.13	1.030	1.064	-
		9400	1880.0	23.45	23.50	1.01	0.06	0.992	1.003	-
		9538	1907.6	23.37	23.50	1.03	0.02	0.986	1.016	-

WCDMA Band V										
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							
RMC 12.2Kbps	Front	4183	836.6	23.11	23.50	1.09	0.16	0.259	0.283	-
	Back	4132	826.4	23.20	23.50	1.07	0.06	0.788	0.844	-
		4183	836.6	23.11	23.50	1.09	0.11	0.785	0.859	B2
		4233	846.6	23.11	23.50	1.09	-0.13	0.783	0.857	-
	Left	4183	836.6	23.11	23.50	1.09	0.01	0.313	0.342	-
	Right	4183	836.6	23.11	23.50	1.09	0.09	0.434	0.475	-
	Top	4183	836.6	23.11	23.50	1.09	0.04	0.168	0.184	-

Note:
Per KDB865664 D01v01r04, Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg

LTE Band 2										
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							
20M_1RB	Front	18700	1860.0	22.37	23.00	1.16	0.11	1.098	1.269	-
		18900	1880.0	22.57	23.00	1.10	0.09	1.150	1.270	B3
		19100	1900.0	22.42	23.00	1.14	-0.17	1.077	1.231	-
	Back	18700	1860.0	22.37	23.00	1.16	0.06	0.986	1.140	-
		18900	1880.0	22.57	23.00	1.10	0.11	1.000	1.104	-
		19100	1900.0	22.42	23.00	1.14	0.14	0.980	1.120	-
	Left	18900	1880.0	22.57	23.00	1.10	-0.06	0.665	0.734	-
	Right	18900	1880.0	22.57	23.00	1.10	0.04	0.310	0.342	-
	Top	18700	1860.0	22.37	23.00	1.16	0.11	0.894	1.034	-
		18900	1880.0	22.57	23.00	1.10	0.17	0.944	1.042	-
		19100	1900.0	22.42	23.00	1.14	0.06	0.877	1.002	-
20M_50RB	Front	18900	1880.0	21.38	21.50	1.03	0.11	0.724	0.744	-
	Back	18900	1880.0	21.38	21.50	1.03	0.18	0.700	0.720	-
	Left	18900	1880.0	21.38	21.50	1.03	-0.05	0.326	0.335	-
	Right	18900	1880.0	21.38	21.50	1.03	-0.04	0.177	0.182	-
	Top	18900	1880.0	21.38	21.50	1.03	0.15	0.686	0.705	-

Note:

1. Per KDB865664 D01v01r04, Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg
2. Per KDB 941225 D05v02r03, for QPSK with 100% RB allocation, SAR is not required when the highest maximumoutput power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations andthe highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highestoutput power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also betested.

LTE Band 4

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							
20M_1RB	Front	20050	1720.0	22.02	22.50	1.12	0.11	0.724	0.809	-
		20175	1732.5	21.89	22.50	1.15	0.14	0.721	0.830	B4
		20300	1745.0	21.87	22.50	1.16	0.09	0.712	0.823	-
	Back	20175	1732.5	21.89	22.50	1.15	0.10	0.675	0.777	-
	Left	20175	1732.5	21.89	22.50	1.15	-0.08	0.408	0.470	-
	Right	20175	1732.5	21.89	22.50	1.15	0.01	0.277	0.319	-
	Top	20175	1732.5	21.89	22.50	1.15	-0.12	0.685	0.788	-
20M_50RB	Front	20175	1732.5	20.61	21.00	1.09	-0.02	0.516	0.564	-
	Back	20175	1732.5	20.61	21.00	1.09	0.11	0.496	0.543	-
	Left	20175	1732.5	20.61	21.00	1.09	-0.07	0.246	0.269	-
	Right	20175	1732.5	20.61	21.00	1.09	0.01	0.108	0.118	-
	Top	20175	1732.5	20.61	21.00	1.09	0.08	0.476	0.521	-

LTE Band 5

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							
10M_1RB	Front	20525	836.5	22.63	23.00	1.09	-0.04	0.125	0.136	-
	Back	20525	836.5	22.63	23.00	1.09	0.07	0.185	0.201	B5
	Left	20525	836.5	22.63	23.00	1.09	-0.02	0.131	0.142	-
	Right	20525	836.5	22.63	23.00	1.09	0.03	0.080	0.087	-
	Top	20525	836.5	22.63	23.00	1.09	0.04	0.112	0.122	-
10M_25RB	Front	20525	836.5	21.35	21.50	1.04	-0.09	0.087	0.090	-
	Back	20525	836.5	21.35	21.50	1.04	0.14	0.100	0.104	-
	Left	20525	836.5	21.35	21.50	1.04	-0.11	0.066	0.068	-
	Right	20525	836.5	21.35	21.50	1.04	0.05	0.043	0.045	-
	Top	20525	836.5	21.35	21.50	1.04	0.02	0.055	0.057	-

Note:

1. Per KDB865664 D01v01r04, Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg
2. Per KDB 941225 D05v02r03, for QPSK with 100% RB allocation, SAR is not required when the highest maximumoutput power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations andthe highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highestoutput power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also betested.

LTE Band 12										
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							
10M_1RB	Front	23095	707.5	22.43	22.50	1.02	-0.10	0.566	0.575	-
	Back	23095	707.5	22.43	22.50	1.02	0.15	0.675	0.686	B6
	Left	23095	707.5	22.43	22.50	1.02	-0.05	0.477	0.485	-
	Right	23095	707.5	22.43	22.50	1.02	0.05	0.293	0.298	-
	Top	23095	707.5	22.43	22.50	1.02	0.09	0.409	0.415	-
10M_25RB	Front	23095	707.5	21.32	21.50	1.04	-0.09	0.231	0.241	-
	Back	23095	707.5	21.32	21.50	1.04	0.14	0.423	0.441	-
	Left	23095	707.5	21.32	21.50	1.04	-0.11	0.279	0.291	-
	Right	23095	707.5	21.32	21.50	1.04	0.05	0.184	0.192	-
	Top	23095	707.5	21.32	21.50	1.04	0.12	0.232	0.241	-

Note:

1. Per KDB865664 D01v01r04, Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg
2. Per KDB 941225 D05v02r03, for QPSK with 100% RB allocation, SAR is not required when the highest maximumoutput power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations andthe highest reported SAR for 1 RB and 50% RB allocation are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highestoutput power channel; and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also betested.

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	Front	6	2437	11.85	12.00	1.04	-0.19	0.096	0.099	-
	Back	6	2437	11.85	12.00	1.04	0.07	0.128	0.132	-
	Right	6	2437	11.85	12.00	1.04	0.13	0.192	0.199	-
	Top	6	2437	11.85	12.00	1.04	0.10	0.283	0.293	B7

Note:

1. According to the above table, the initial test position for body is “Back”, and its reported SAR is≤ 0.4W/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 exposureconfiguration is ≤ 0.8W/kg, no further SAR testing is required for 802.11b DSSS in that exposureconfiguration.
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 ≤ 1.2 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	Front	6	2437	98.23%	100%	0.099	0.101
	Back	6	2437	98.23%	100%	0.132	0.135
	Right	6	2437	98.23%	100%	0.199	0.202
	Top	6	2437	98.23%	100%	0.293	0.298

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 98.23% is achievable for WLAN in this project.

SAR Test Data Plots

Test mode:	WCDMA Band II	Test Position:	Front	Test Plot:	B1

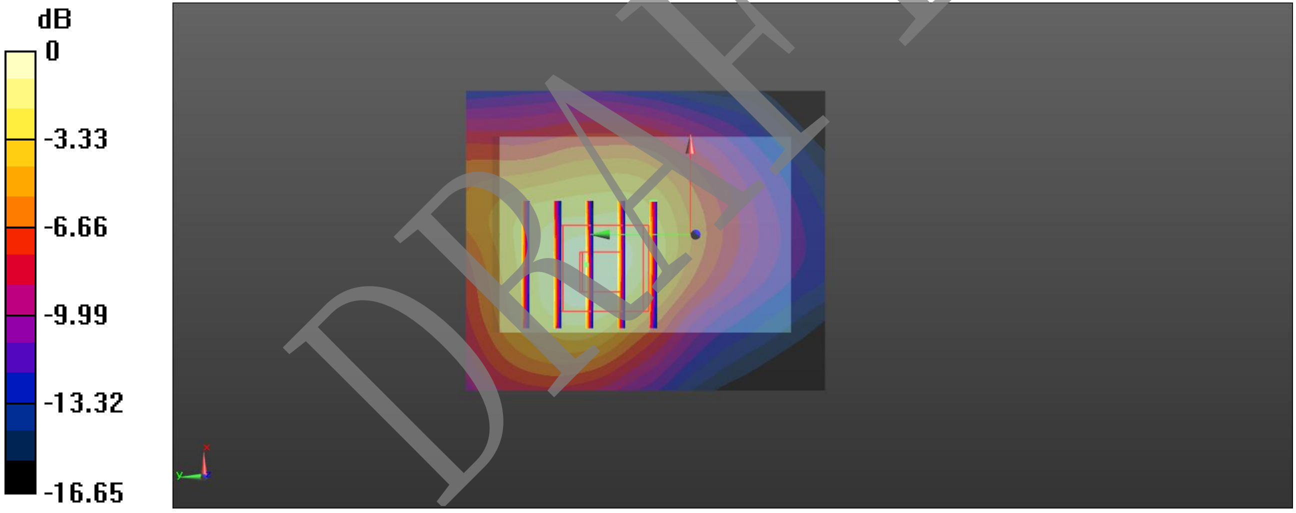
Date:2018-06-11
Communication System: UID 0, Generic UMTS (0); Frequency: 1852.4 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 1852.4 MHz; σ = 1.518 S/m; ε_r = 53.77; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.42, 8.42, 8.42) @ 1852.4 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)

Front/Procedure/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.74 W/kg

Front/Procedure/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.08 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 2.31 W/kg
SAR(1 g) = 1.17 W/kg; SAR(10 g) = 0.622 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.71 W/kg



0 dB = 1.71 W/kg = 2.33 dBW/kg

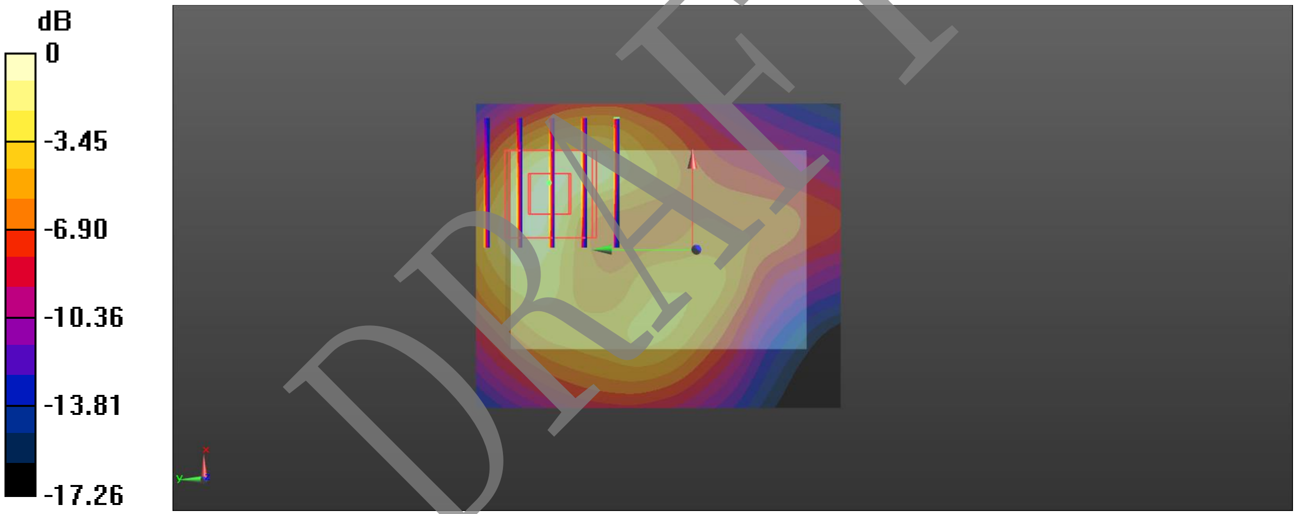
Test mode:	WCDMA Band V	Test Position:	Rear	Test Plot:	B2

Date:2018-06-07
Communication System: UID 0, Generic UMTS (0); Frequency: 836.6 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.6 MHz; σ = 0.967 S/m; ε_r = 55.399; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.5, 10.5, 10.5) @ 836.6 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 (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.07 W/kg
Rear/Procedure/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.86 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.78 W/kg
SAR(1 g) = 0.785 W/kg; SAR(10 g) = 0.401 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.31 W/kg



0 dB = 1.31 W/kg = 1.17 dBW/kg

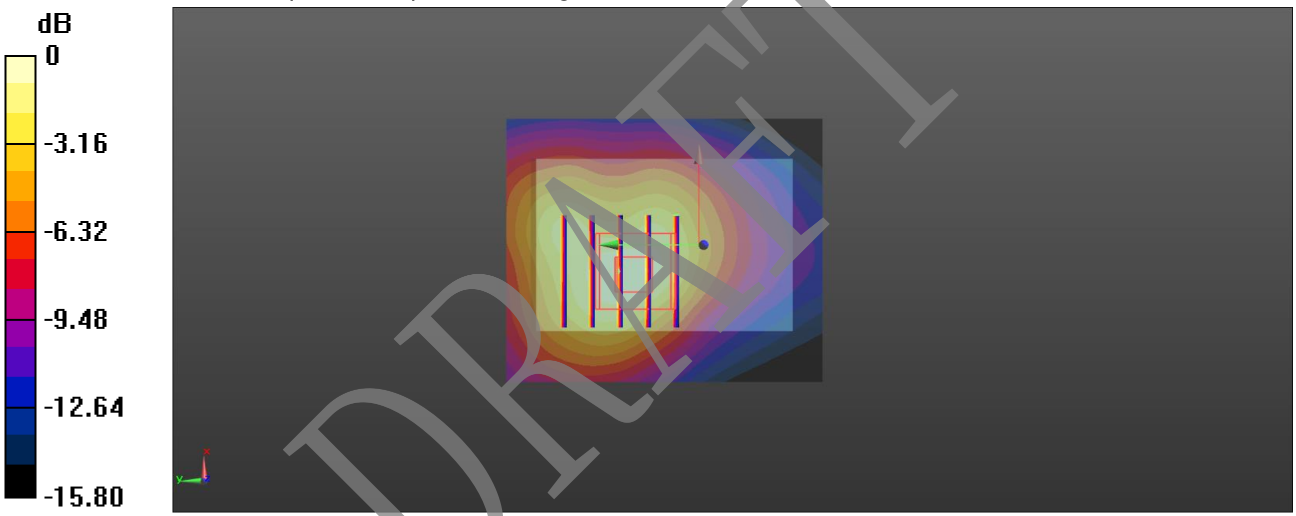
Test mode:	LTE Band 2	Test Position:	Front	Test Plot:	B3

Date:2018-06-11
Communication System: UID 0, Generic LTE-FDD (0); Frequency: 1880 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1880 MHz; σ = 1.539 S/m; ε_r = 53.741; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.42, 8.42, 8.42) @ 1880 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)

Front/Procedure/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.62 W/kg
Front/Procedure/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.69 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 2.25 W/kg
SAR(1 g) = 1.15 W/kg; SAR(10 g) = 0.626 W/kg
Maximum value of SAR (measured) = 1.71 W/kg



0 dB = 1.71 W/kg = 2.33 dBW/kg

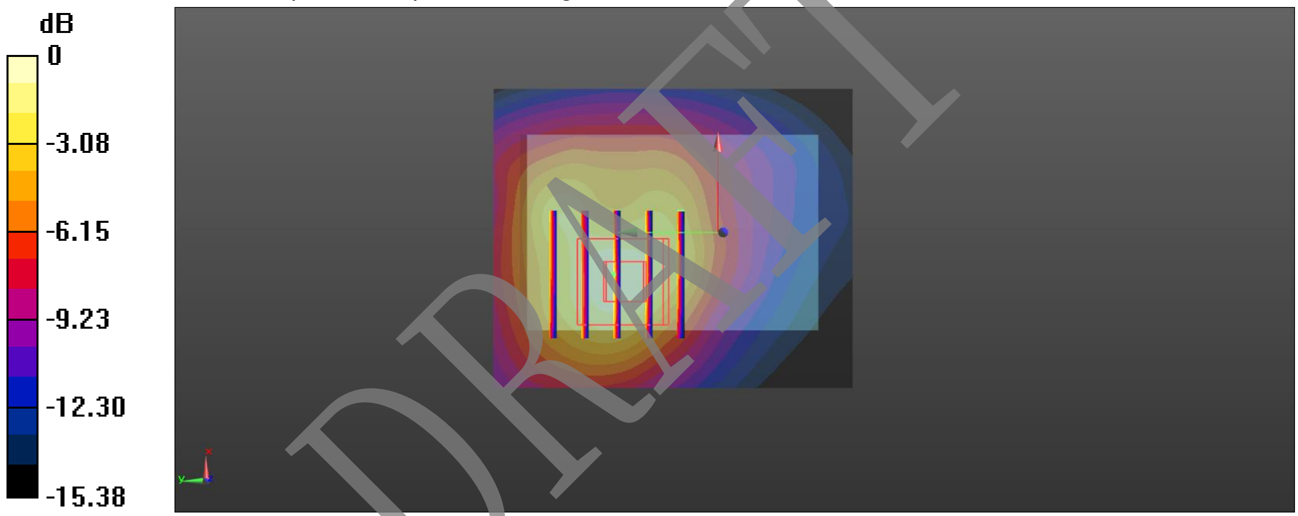
Test mode:	LTE Band 4	Test Position:	Front	Test Plot:	B4

Date:2018-06-08
Communication System: UID 0, Generic LTE-FDD (0); Frequency: 1710 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1710 MHz; σ = 1.416 S/m; ε_r = 53.91; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(8.77, 8.77, 8.77) @ 1710 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)

Front/Procedure/Area Scan (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 1.22 W/kg
Front/Procedure/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 22.34 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 1.72 W/kg
SAR(1 g) = 0.721 W/kg; SAR(10 g) = 0.459 W/kg
Maximum value of SAR (measured) = 1.28 W/kg



0 dB = 1.28 W/kg = 1.07 dBW/kg

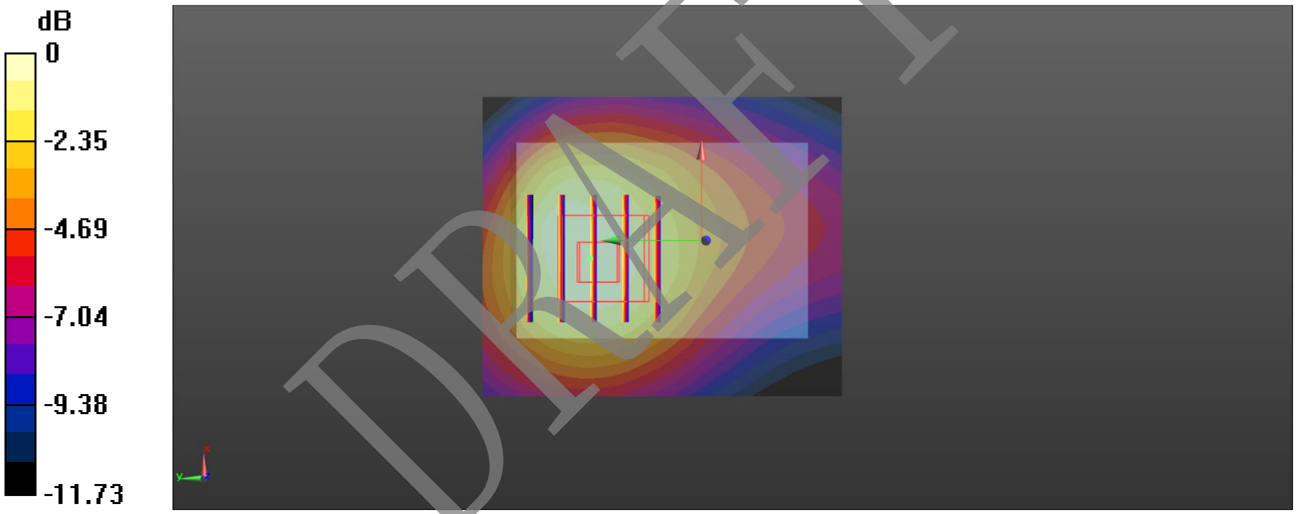
Test mode:	LTE Band 5	Test Position:	Rear	Test Plot:	B5

Date:2018-06-07
Communication System: UID 0, Generic LTE-FDD (0); Frequency: 836.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 836.5 MHz; σ = 0.967 S/m; ε_r = 55.399; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.5, 10.5, 10.5) @ 836.5 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 (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.264 W/kg
Rear/Procedure/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.83 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.310 W/kg
SAR(1 g) = 0.185 W/kg; SAR(10 g) = 0.122 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.258 W/kg



0 dB = 0.258 W/kg = -5.88 dBW/kg

Test mode:	LTE Band 12	Test Position:	Rear	Test Plot:	B6

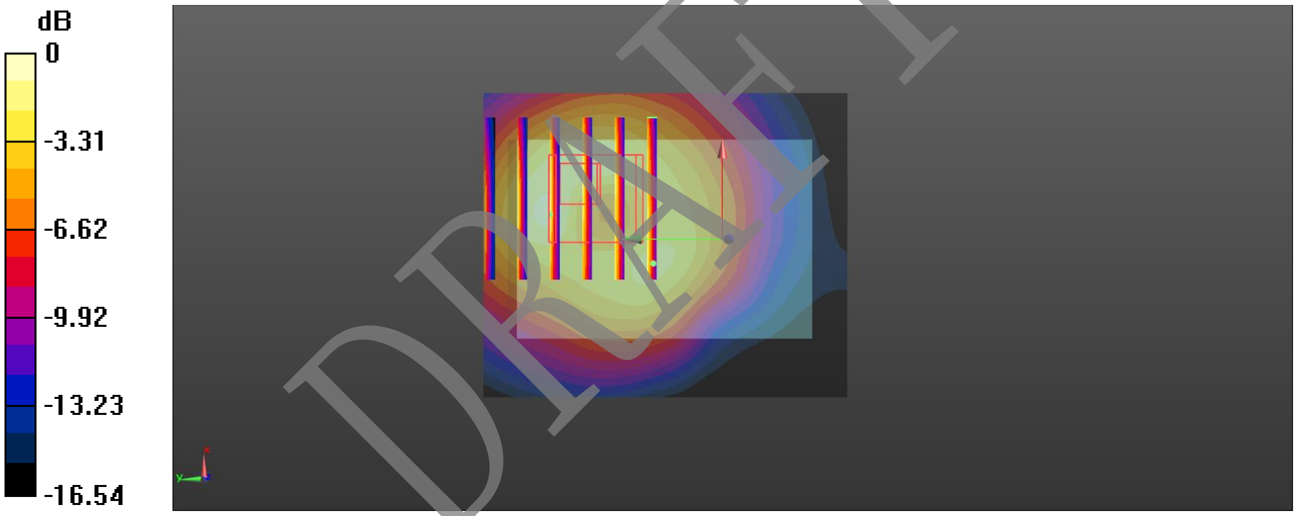
Date:2018-06-06
Communication System: UID 0, Generic LTE-FDD (0); Frequency: 707.5 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.919 S/m; ε_r = 55.74; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7494; ConvF(10.87, 10.87, 10.87) @ 707.5 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 (51x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.59 W/kg

Rear/Procedure/Zoom Scan (6x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 37.81 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 2.48 W/kg
SAR(1 g) = 1.14 W/kg; SAR(10 g) = 0.666 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.88 W/kg



0 dB = 1.88 W/kg = 2.74 dBW/kg

Test mode:	WLAN 802.11b	Test Position:	Top	Test Plot:	B7

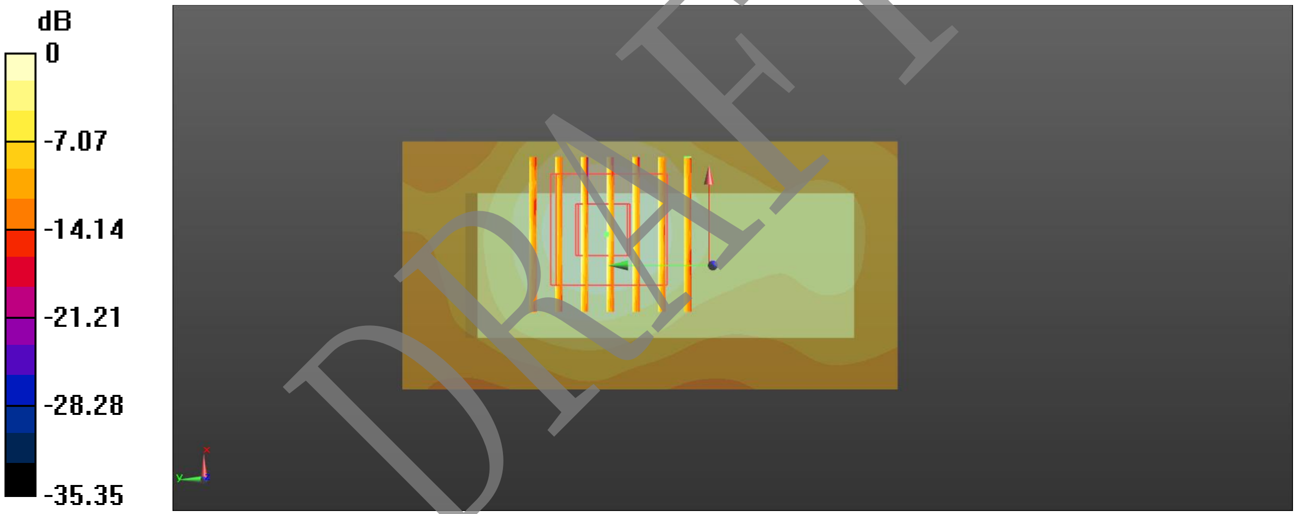
Date:2018-06-12
Communication System: UID 0, Generic WIFI (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 2437 MHz; σ = 1.991 S/m; ε_r = 53.023; ρ = 1000 kg/m^3
Phantom section: Flat Section

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)

Top/Procedure/Area Scan (41x61x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 0.559 W/kg

Top/Procedure/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.121 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.544 W/kg
SAR(1 g) = 0.283 W/kg; SAR(10 g) = 0.142 W/kg
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.433 W/kg



0 dB = 0.301 W/kg = -5.21 dBW/kg

15. SAR Measurement Variability

In accordance with published RF Exposure KDB 865664 D01 SAR measurement 100 MHz to 6 GHz. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

1) Repeated measurement is not required when the original highest measured SAR is <0.8 or 2 W/kg (1-g or 10-g respectively); steps 2) through 4) do not apply.
2) When the original highest measured SAR is ≥ 0.8 or 2 W/kg (1-g or 10-g respectively), repeat that measurement once.
3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 or 3.6 W/kg (~ 10% from the 1-g or 10-g respective SAR limit).
4) Perform a third repeated measurement only if the original, first, or second repeated measurement is ≥ 1.5 or 3.75 W/kg (1-g or 10-g respectively) and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

Band	Test Position	Frequency		Highest Measured SAR (W/kg)	First Repeated		Second Repeated	
		CH	MHz		Measured SAR(W/kg)	Largest to Smallest SAR Ratio	Measured SAR(W/kg)	Largest to Smallest SAR Ratio
WCDMA Band II	Front	9262	1852.40	1.170	1.15	1.02	N/A	N/A
LTE Band 2	Front	18900	1880	1.150	1.13	1.02	N/A	N/A

16. Simultaneous Transmission analysis

No.	Simultaneous Transmission Configurations	Hotspot	Note
1	WCDMA(data) + WIFI(data)	Yes	
2	LTE(data) + WIFI(data)	Yes	

General note:

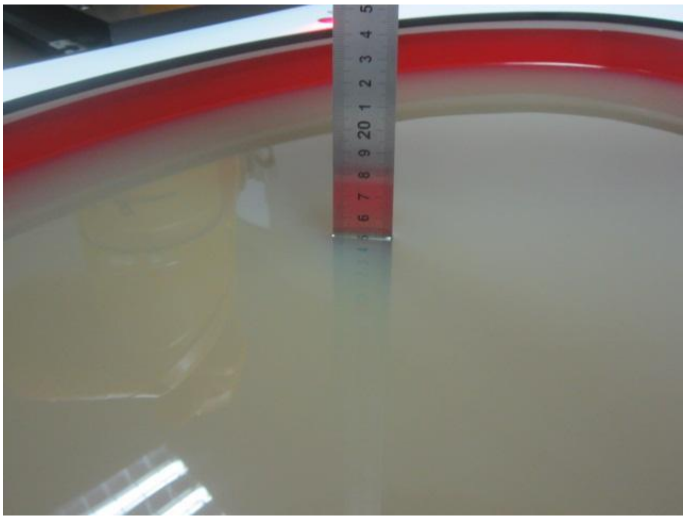
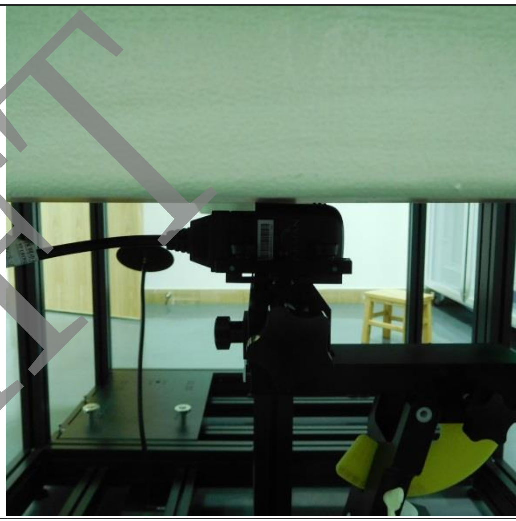
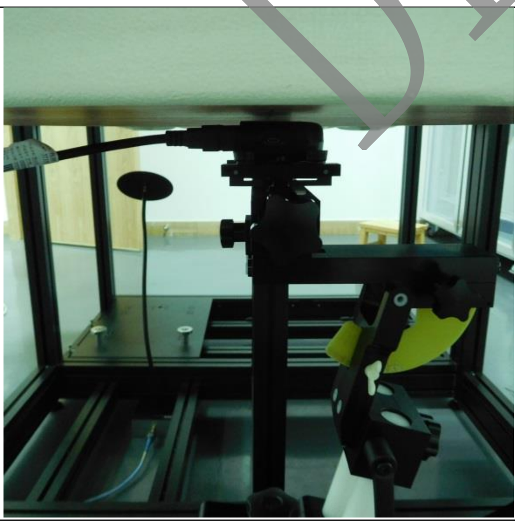
1. EUT will choose either GSM or WCDMA LTE according to the network signal condition; therefore, they will not operate simultaneously at any moment.
2. The reported SAR summation is calculated based on the same configuration and test position

Maximum reported SAR value for Hotspot mode

WWAN PCB + WLAN DTS					
WWAN Band		Exposure Position	Max SAR (W/kg)		Summed SAR
			WWAN PCB	WLAN DTS	(W/kg)
WCDMA	Band II	Front	1.208	0.101	1.309
		Back	1.064	0.135	1.199
		Left side	0.666	-	0.666
		Right side	0.263	0.202	0.466
		Top side	1.064	0.298	1.362
	Band V	Front	0.283	0.101	0.384
		Back	0.859	0.135	0.994
		Left side	0.342	-	0.342
		Right side	0.475	0.202	0.677
		Top side	0.184	0.298	0.482
LTE	B2 1RB	Front	1.270	0.101	**1.371**
		Back	1.140	0.135	1.275
		Left side	0.734	-	0.734
		Right side	0.342	0.202	0.545
		Top side	1.042	0.298	1.340
	B2 50RB	Front	0.744	0.101	0.845
		Back	0.720	0.135	0.854
		Left side	0.335	-	0.335
		Right side	0.182	0.202	0.384
		Top side	0.705	0.298	1.003
	B4 1RB	Front	0.830	0.101	0.931
		Back	0.777	0.135	0.912
		Left side	0.470	-	0.470
		Right side	0.319	0.202	0.521
		Top side	0.788	0.298	1.087
	B4 50RB	Front	0.564	0.101	0.666
		Back	0.543	0.135	0.677
		Left side	0.269	-	0.269
		Right side	0.118	0.202	0.320
		Top side	0.521	0.298	0.819

LTE	B5 1RB	Front	0.136	0.101	0.237
		Back	0.201	0.135	0.336
		Left side	0.142	0.000	0.142
		Right side	0.087	0.202	0.290
		Top side	0.122	0.298	0.420
	B5 25RB	Front	0.090	0.101	0.191
		Back	0.104	0.135	0.238
		Left side	0.068	-	0.068
		Right side	0.045	0.202	0.247
		Top side	0.057	0.298	0.355
	B12 1RB	Front	0.575	0.101	0.676
		Back	0.686	0.135	0.821
		Left side	0.485	-	0.485
		Right side	0.298	0.202	0.500
		Top side	0.415	0.298	0.713
	B12 25RB	Front	0.241	0.101	0.342
		Back	0.441	0.135	0.576
		Left side	0.291	-	0.291
		Right side	0.192	0.202	0.394
		Top side	0.241	0.298	0.540

17. TestSetup Photos

	
Liquid depth in the ELI Phantom	Front (5mm)
	
Rear (5mm)	Left Side (5mm)
	
Right Side (5mm)	Top Side (5mm)

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