SAR TEST REPORT

For

Qingdao Hisense Intelligent Commercial System Co., Ltd.

Tablet POS

Model No.:HM518

Prepared for	:	Qingdao Hisense Intelligent Commercial System Co., Ltd.
Address	:	Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample	:	August 10, 2015
Number of tested samples	:	1
Serial number	:	Prototype
Date of Test	:	August 10, 2015 - October 16, 2015
Date of Report	:	October 16, 2015

SAR TEST REPORT

Report Reference No.................:	**LCS1509140634E**
Date Of Issue...............................:	October 16, 2015
Testing Laboratory Name ....:	**Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address..:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure ....:	Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name ....:	**Qingdao Hisense Intelligent Commercial System Co., Ltd.**
Address..:	Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China
Test Specification:	
Scaled SAR Max. Values is ....:	Body: 1.154 W/Kg (1g).
TestStandard................................:	ANSI/IEEE C95.1:2005/ANSI/IEEE C95.3 :2002 IEEE1528 :2013
Test Report Form No. ....:	LCSEMC-1.0
TRF Originator............................:	Shenzhen LCS Compliance Testing Laboratory Ltd.

Test Item Description................:	**Tablet POS**
Trade Mark..................................:	Hisense
Model/Type Reference................:	HM518
Ratings ....:	DC 7.4V by li-ion polymer battery(4000mAh) Recharged Voltage: DC 12V/3.33A
Result ....:	**Positive**

Compiled by:	**Supervised by:**	**Approved by:**
Dick Su	Glin Lu	Gavin Liang
Dick Su/ File administrators	Glin Lu/ Technique principal	Gavin Liang/ Manager

SAR -- TEST REPORT

Test Report No. : LCS1509140634E	October 16, 2015 Date of issue

Type / Model.........................	:	HM518
EUT.......................................	:	Tablet POS
Applicant..............................	**:**	**Qingdao Hisense Intelligent Commercial System Co., Ltd.**
Address.................................	:	Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China
Telephone.............................	:	/
Fax..	:	/
Manufacturer.......................	:	**Qingdao Hisense Intelligent Commercial System Co., Ltd.**
Address.................................	:	Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China
Telephone.............................	:	/
Fax..	:	/
Factory.................................	**:**	**Qingdao Hisense Intelligent Commercial System Co., Ltd.**
Address.................................	:	Bldg 3, 151 Zhuzhou Lu, Laoshan, Qingdao, China
Telephone.............................	:	/
Fax..	:	/

Test Result	**Positive**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

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1.TEST STANDARDS AND TEST DESCRIPTION

1.1. Test Standards

The tests were performed according to following standards:

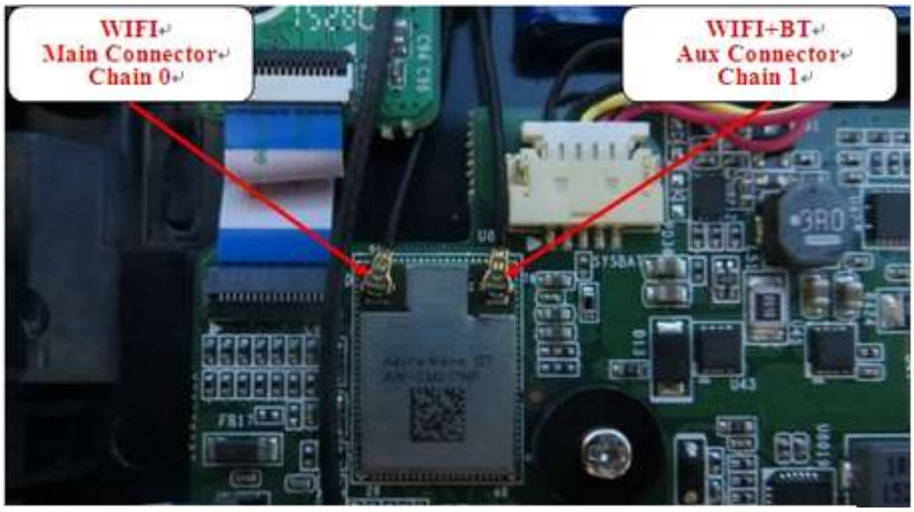
ANSI/IEEE C95.1: 2005:IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fileds,3 kHz to 300 GHz.
ANSI/IEEE C95.3: 2002:IEEE Recommended Practice for Measurements and Computations of Radio Frequency Electromagnetic Fields With Respect to Human Exposure to SuchFields,100 kHz—300 GHz.
IEEE1528:2013:Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate.
KDB447498 D01v05r02:General RF Exposure Guidance.
KDB248227 D01 802.11 Wi-Fi SAR v02:SAR measure for 802.11 a/b/g.
KDB865664 D01v01r03:SAR measurement 100MHz to 6GHz.
KDB865664 D02v01r01:SAR Report.
KDB690783 D01v01r03:SAR lisitings on Grants.
KDB616217 D04v01r01: SAR for laptop and tablets v01r01
FCC Part 2:2012: frequency alloca-tions and radio treaty mat-ters; general rules and reg-ulations

1.2. Test Description

The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power .
And Test device is identical prototype.

1.3. Product Description

Product Name:	Tablet POS
Trade Mark:	Hisense
Model/Type reference:	HM518
Listed Model(s):	HM518
Hardware Version	I1170D0P3V1.0
Software Version:	BIOS:BTPHS140.BIN
Power supply:	DC 7.4V by li-ion polymer battery(4000mAh) Recharged Voltage: DC 12V/3.33A
2.4G WIFI	
Supported type:	802.11b/802.11g/802.11n(HT20&HT40)
Modulation:	802.11b: DSSS 802.11g/802.11n:OFDM
Operation frequency:	802.11b/802.11g/802.11n(HT20):2412MHz~2462MHz; 802.11n(HT40):2422MHz~2452MHz
Channel number:	802.11b/802.11g/802.11n(HT20):11; 802.11n(HT40):7
Channel separation:	5MHz
5G WIFI	
Supported type:	802.11a/n/ac
Modulation:	802.11a/n/ac: OFDM
Operation frequency:	5180.00-5240.00MHz / 5745.00-5825.00MHz
Channel number:	9 Channel for 20MHz Bandwidth 4 channels for 40MHz Bandwidth 2 channels for 80MHz Bandwidth
Bluetooth	
Version:	V4.1
Modulation:	GFSK, Pi/4-DQPSK, 8-DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	40/79
Channel separation:	2MHz/1MHz
Antenna	



1.4. Summary SAR Results

Table 1:Max. SAR Measured(1g)

Exposure Configuration	Technolohy Band	Highest Measured SAR 1g(W/Kg)
Body-worn (Separation Distance 0mm)	WLAN2450	**1.133**
	WLAN5200	**0.490**
	WLAN5800	**0.589**

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6W/Kg as averaged over any 1g tissue accordintg to the ANSI C95.1-1999.
For body worn operation,this devices has been tested and meets FCC RF exposure guidelines when used with any accessory that conrtains no metal and which provides a minimum separation distance of 0mm between this devices and the body of the user.User of other accessories may not ensure compliance with FCC RF exposure guidelines.
In the front of EUT has two speakers,just used to public.
The EUT battery must be fully charged and checked periodically during the test to ascertain iniform power output

1.5. EUT operation mode

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

1.6. EUT configuration

The following peripheral devices and interface cables were connected during the measurement:

● - supplied by the manufacturer

○ - supplied by the lab

○	Power Cable	Length (m) :	/
		Shield :	/
		Detachable :	/
○	Multimeter	Manufacturer :	/
		Model No. :	/

2.TEST ENVIRONMENT

2.1. Test Facility

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

Site Description

EMC Lab. : CNAS Registration Number. is L4595.
FCC Registration Number. is 899208.
Industry Canada Registration Number. is 9642A-1.
VCCI Registration Number. is C-4260 and R-3804.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001

2.2. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

2.3. SAR Limits

FCC Limit (1g Tissue)

EXPOSURE LIMITS	SAR (W/kg) (General Population / Uncontrolled Exposure Environment)
Spatial Average(averaged over the whole body)	0.08
Spatial Peak(averaged over any 1 g of tissue)	1.6
Spatial Peak(hands/wrists/ feet/anklesaveraged over 10 g)	4.0

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).

2.4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Calibration Date	Calibration Due
PC	Lenovo	G5005	MY42081102	N/A	N/A
Signal Generator	Angilent	E4438C	MY42081396	09/25/2015	09/24/2016
Multimeter	Keithley	MiltiMeter 2000	4059164	10/01/2015	09/30/2016
S-parameter Network Analyzer	Agilent	8753ES	US38432944	09/25/2015	09/24/2016
Power Meter	R&S	NRVS	100444	06/18/2015	06/17/2016
Power Meter	R&S	NRVS	100469	06/18/2015	06/17/2016
Power Sensor	R&S	NRV-Z51	100458	06/18/2015	06/17/2016
Power Sensor	R&S	NRV-Z32	100657	06/18/2015	06/17/2016
E-Field PROBE	SATIMO	SSE5	SN 17/14 EP220	10/01/2015	09/30/2016
E-Field PROBE	SATIMO	SSE5	SN 17/14 EP221	09/01/2015	08/31/2016
DIPOLE 2450	SATIMO	SID 2450	SN 07/14 DIP 2G450-306	10/01/2015	09/30/2016
COMOSAR OPEN Coaxial Probe	SATIMO	OCPG 68	SN 40/14 OCPG68	10/01/2015	09/30/2016
Communication Antenna	SATIMO	ANTA57	SN 39/14 ANTA57	10/01/2015	09/30/2016
Mobile Phone POSITIONING DEVICE	SATIMO	MSH98	SN 40/14 MSH98	N/A	N/A
DUMMY PROBE	SATIMO	DP60	SN 03/14 DP60	N/A	N/A
SAM PHANTOM	SATIMO	SAM117	SN 40/14 SAM117	N/A	N/A
Simulated Tissue 2450 MHz Body and Head	SATIMO	SAM-24-H	SN 21/14 HLJ445	Each Time	N/A
PHANTOM TABLE	SATIMO	TABP98	SN 40/14 TABP98	N/A	N/A
6 AXIS ROBOT	KUKA	KR6-R900	501217	N/A	N/A
High Power Solid State Amplifier (80MHz~1000MHz)	Instruments for Industry	CMC150	M631-0627	09/25/2015	09/24/2016
Medium Power Solid State Amplifier (0.8~4.2GHz)	Instruments for Industry	S41-25	M629-0539	09/25/2015	09/24/2016
Wave Tube Amplifier 48 GHz at 20Watt	Hughes Aircraft Company	1277H02F000	102	09/25/2015	09/24/2016

3.SAR MEASUREMENTS SYSTEM CONFIGURATION

3.1. SARMeasurement Set-up

The OPENSAR system for performing compliance tests consist of the following items:

A standard high precision 6-axis robot (KUKA) with controller and software.

KUKA Control Panel (KCP)

A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with a Video Positioning System(VPS).

The stress sensor is composed with mechanical and electronic when the electronic part detects a change on the electro-mechanical switch,It sends an “Emergency signal” to the robot controller that to stop robot’s moves

A computer operating Windows XP.

OPENSAR software

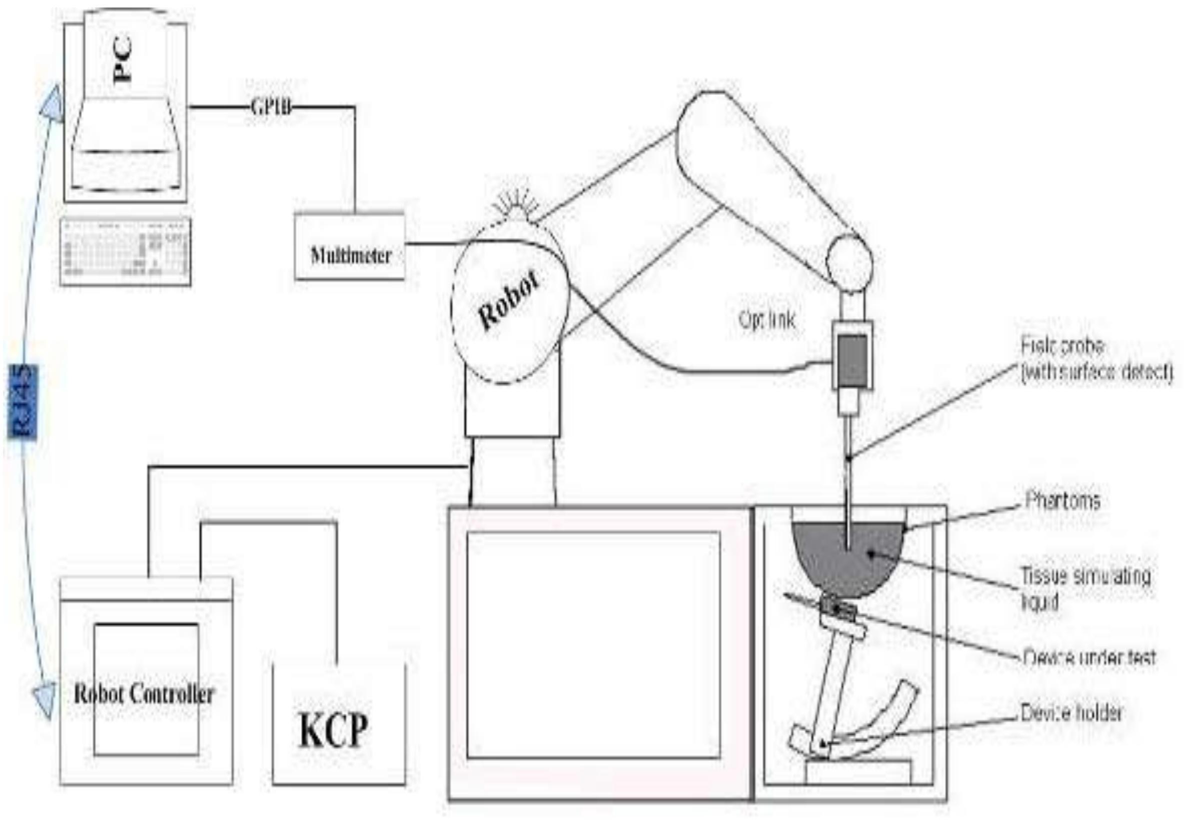
Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.

The SAM phantom enabling testing left-hand right-hand and body usage.

The Position device for handheld EUT

Tissue simulating liquid mixed according to the given recipes .

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



3.2. OPENSAR E-field Probe System

The SAR measurements were conducted with the dosimetric probe EP220 (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation.

Probe Specification

ConstructionSymmetrical design with triangular core
Interleaved sensors
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g., DGBE)

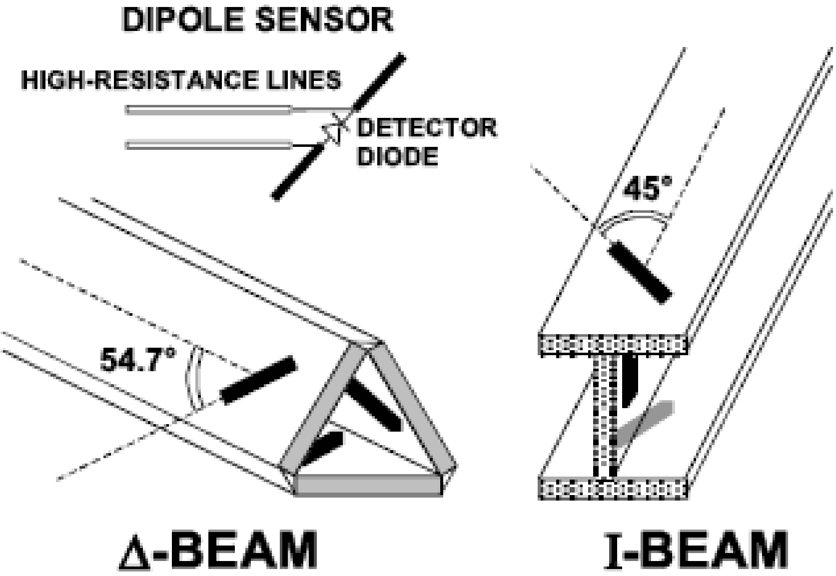
CalibrationISO/IEC 17025 calibration service available.

Frequency	700 MHz to 3 GHz; Linearity:0.25dB(700 MHz to 3GHz)
Directivity	0.25 dB in HSL (rotation around probe axis) 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	0.01W/kg to > 100 W/kg; Linearity: 0.25 dB
Dimensions	Overall length: 330 mm (Tip: 16mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to sensor centers: 2.5 mm
Application	General dosimetry up to 3 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones

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:



3.3. Phantoms

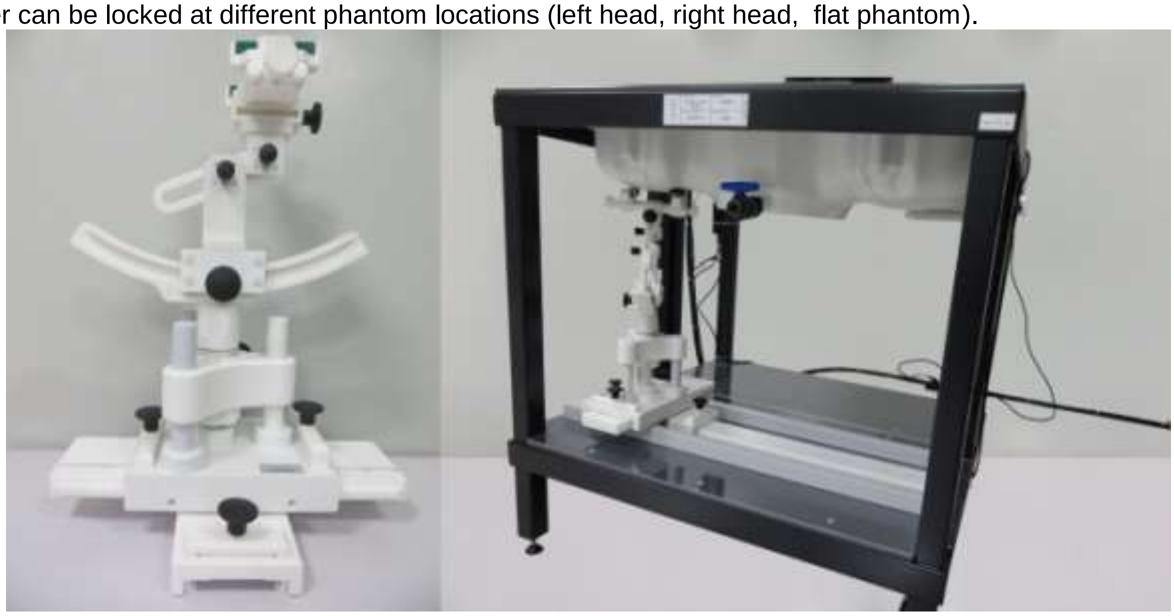
The SAM Phantom SAM117 is constructed of a fiberglass shell ntegrated in a wooden table. The shape of the shell is in compliance with the specification set in IEEE P1528 and CENELEC EN62209-1 , EN62209-2:2010.The phantom enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of allpredefined phantom positions and measurement grids by manually teaching three points in the robo

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

3.4. Device Holder

In combination with the Generic Twin PhantomSAM117, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).



Device holder supplied by SATIMO

3.5. Scanning Procedure

The procedure for assessing the peak spatial-average SAR value consists of the following steps

Power Reference Measurement
The referenceand drift jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.

Area Scan
The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot.Thesophisticated interpolation routines implemented in OPENSAR software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at to 15 mm by 15 mm and can be edited by a user.

Zoom Scan
Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 7 x 7 x 7 points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more then one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

Power Drift measurement
The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have OPENSAR software stop the measurements if this limit is exceeded.

3.6. Data Storage and Evaluation

Data Storage
The OPENSAR software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files . 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], [mW/g], [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 OPENSAR 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 OPENSAR 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:

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

With Vi = compensated signal of channel i (i = x, y, z)
Ui = input signal of channel i (i = x, y, z)
cf = crest factor of exciting field
dcpi = diode compression point

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

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

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

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (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.

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

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

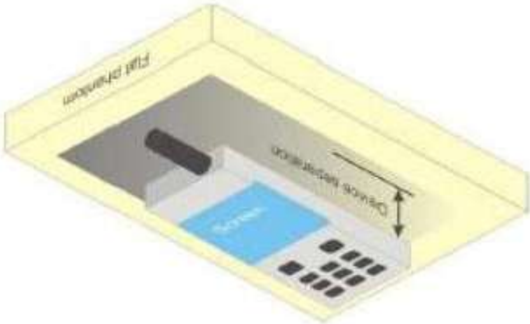
Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

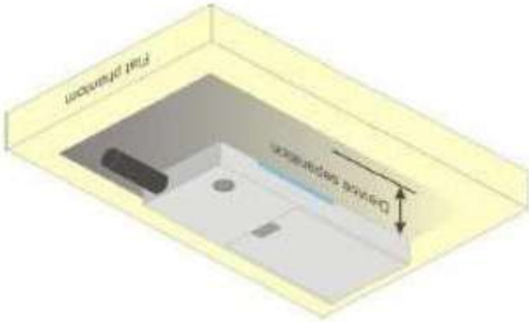
Body worn Position

(1) To position the EUT parallel to the phantom surface.

(2) To adjust the EUT parallel to the flat phantom.

(3) To adjust the distance between the EUT surface and the flat phantom to **0mm.**





For body SAR test we applied to FCC KDB447498 D01v05r02, KDB248227 D01v01r02, KDB616217 D04v01r01, KDB 447498 D01

3.7. Tissue Dielectric Parameters for Head and Body

The liquid used for the frequency range of 100MHz-6G consisted of water, sugar, salt and Cellulose. The liquid has been previously proven to be suited for worst-case. The folowing Tableshows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the determine of the dielectric parameter are within the tolerances of the specified target values.The measured cond-uctivity and relative permittivity should be within ±5% of the target values.

The folowing materials are used for producing the tissue-equivalent materials.

Table 2. Composition of the Head Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)				
	835	900	1800	2000	2450
Water	41.45	40.92	16.33	54.89	46.70
Sugar	56.0	56.5	/	/	/
Salt	4.45	1.48	0.41	0.18	/
Preventol	0.19	0.1	/	/	/
Cellulose	0.1	0.4	/	/	/
Clycol Monobutyl	/	/	65.3	44.93	53.3
Dielectric ParametersTarget Value	f=835MHz ε =41.5 σ =0.90	f=900MHz ε =41.5 σ =0.97	f=1800MHz ε =40.0 σ =1.40	f=1950 MHz ε =40.0 σ =1.40	f=2450 MHz ε =39.2 σ =1.80

Table 3. Composition of the Body Tissue Equivalent Matter

Ingredients (% by weight)	Frequency (MHz)					
	835	1800	1900	2450	2600	5000
Water	52.4	69.91	69.91	73.2	64.493	64-78
Sugar	45.0	0.0	0.0	0.0	0.0	0.0
Salt	1.4	0.13	0.13	0.04	0.024	2-3
HEC	1.0	0.0	0.0	0.0	0.0	0.0
Bactericide	0.1	0.0	0.0	0.0	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0
DGBE	0.0	29.96	29.96	26.7	32.252	0.0
Emulsifiers	0.0	0.0	0.0	0.0	0.0	9-15
Mineral Oil	0.0	0.0	0.0	0.0	0.0	11-18
Dielectric ParametersTarget Value	f=835MHz ε =55.2 σ =0.97	f=1800MHz ε =53.30 σ =1.52	f=1900MHz ε =53.30 σ =1.52	f=2450 MHz ε =52.7 σ =1.95	f=2450 MHz ε =52.5 σ =2.16	f=5200 MHz ε =49.01 σ =5.30

Table 4. Targets for tissue simulating liquid

Frequency (MHz)	Liquid Type	Liquid Type (σ)	± 5% Range	Permittivity (ε)	± 5% Range
150	Head	0.76	0.72～0.80	52.3	49.69～54.92
300	Head	0.87	0.83～0.91	45.3	43.04～47.57
450	Head	0.87	0.83～0.91	43.5	41.33～45.68
835	Head	0.90	0.86～0.95	41.5	39.43～43.58
900	Head	0.97	0.92～1.02	41.5	39.43～43.58
915	Head	0.98	0.93～1.03	41.5	39.43～43.58
1450	Head	1.20	1.14～1.26	40.5	38.48～42.53
1610	Head	1.29	1.23～1.35	40.3	38.29～42.32
1800-2000	Head	1.40	1.33～1.47	40.0	38.00～42.00
2450	Head	1.80	1.71～1.89	39.2	37.24～41.16
3000	Head	2.40	2.28～2.52	38.5	36.58～40.43
5800	Head	5.27	5.01～5.53	35.3	33.54～37.07
150	Body	0.80	0.76～0.84	61.9	58.81～65.00
300	Body	0.92	0.87～0.97	58.2	55.29～61.11
450	Body	0.94	0.89～0.99	56.7	53.87～59.54
835	Body	0.97	0.92～1.02	55.2	52.44～57.96
900	Body	1.05	1.00～1.10	55.0	52.25～57.75
915	Body	1.06	1.01～1.11	55.0	52.25～57.75
1450	Body	1.30	1.24～1.37	54.0	51.30～56.70
1610	Body	1.40	1.33～1.47	53.8	51.11～56.49
1800-2000	Body	1.52	1.44～1.60	53.3	50.64～55.97
2450	Body	1.95	1.85～2.05	52.7	50.07～55.34
3000	Body	2.73	2.59～2.87	52.0	49.40～54.60
5200	Body	5.30	5.04～5.57	49.01	46.56～51.46
5800	Body	6.00	5.70～6.30	48.2	45.79～50.61

3.8. Dielectric Performance

Dielectric Performance of Head and Body Tissue Simulating Liquid

Measurement is made at temperature 22.0℃and relative humidity 52%.		
Liquid temperature during the test: 22.0℃		
Measurement Date: 2450 MHz September 28, 2015;		
Frequency (MHz)	Body Tissue	
	Ơ(S/m)	εr
2450	1.93	53.61
5200	5.46	48.27
5800	5.93	49.21

3.9. Basic SAR system validation requirements

The SAR syetem must be validated against its performance specifications before it is deployed.when SAR probe and system component or sorftware are changed,upgraded or recalibrated,these must be validated with the SAR system(s) that operates with such component. Reference dipoles are used with the required tissure-equivalent media for system validation

The detailed syetem validation result are maintained by each test laboratory,which are normally not required for equip-ment approval. Only a tabulated summary of the system validation status, according to the validation date(s)measure-ment frequencies,SAR probe and tissue dielectric parameters is required in the SAR report.

LCS lab has performed the system validation at 10/28/2014,and all the measured results within ±10% of the system calibrated SAR targets.

3.10. System setup

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected.It is recommended that the system performance check be performed prior to any usage of system in order to guarantee reproducieble results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensivity to all parameters that might fail or vary over time. The system check does not intend to replace the cali-bration of component, but indicates situations where the system uncertainty is exceeded due to drift or failure.

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

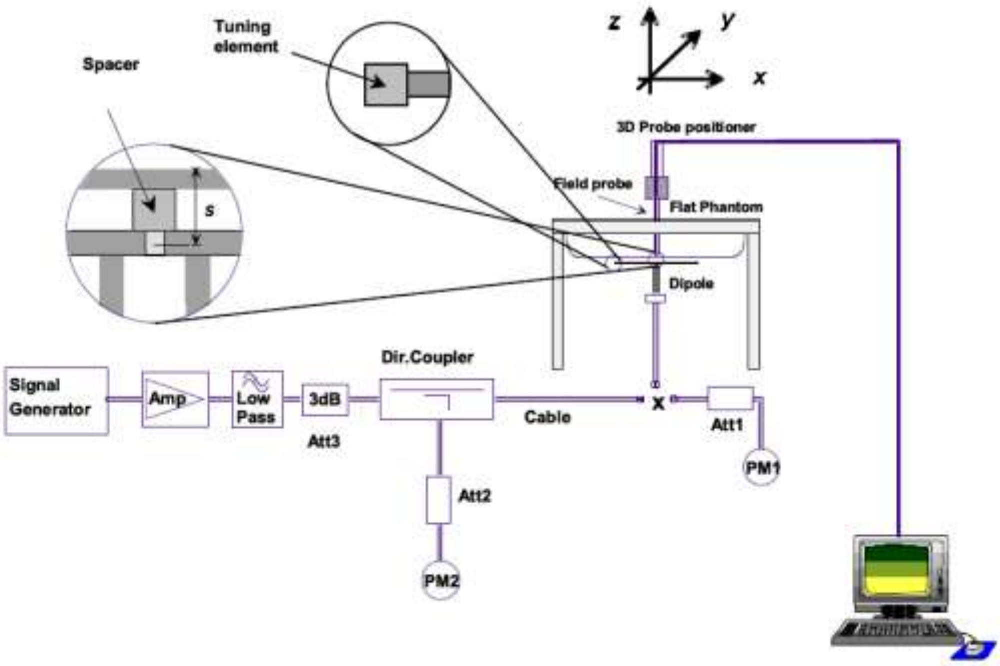


Photo of Dipole Setup

System Validation of Body

Measurement is made at temperature 22.0 ℃ and relative humidity 52%.							
Measurement Date: 2450 MHz September 28, 2015; 2450 MHz September 29, 2015; 2450 MHz September 30, 2015							
Verification Results	Frequency (MHz)	Target value (W/kg)		Measured value(W/kg)		Deviation(%)	
		1 g Average	10 g Average	1 g Average	10 g Average	1 g Average	10 g Average
Body	2450	54.65	24.58	54.56	25.11	0.165	2.16
Body	5200	74.20	20.80	69.67	19.18	6.10	7.79
Body	5800	73.30	20.20	68.25	19.23	6.89	4.80

3.11. Measurement procedure

The following procedure shall be performed for each of the test conditions

1. Measure the local SAR at a test point within 4 mm or less in the normal direction from the inner surface of the phantom.
2. Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of localmaximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδIn(2)/2 mm for frequencies of 3 GHz and greater, whereδis theplane wave skin depth and In(x) is the natural logarithm. The maximum variation of thesensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm forfrequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect tothe line normal to the surface should be less than 5°. If this cannot be achieved for ameasurement distance to the phantom inner surface shorter than the probe diameter, additionalmeasurement distance to the phantom inner surface shorter than the probe diameter, additional
3. From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
4. Measure the three-dimensional SAR distribution at the local maxima locations identified in step
5. The horizontal grid step shall be (24 / f[GHz]) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be (8-f[GHz]) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδIn(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and In(x)is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima foundin step c). Uncertainties due to field distortion between the media boundary and the dielectricenclosure of the probe should also be minimized, which is achieved is the distance between thephantom surface and physical tip of the probe is larger than probe tip diameter. Other methodsmay utilize correction procedures for these boundary effects that enable high precisionmeasurements closer than half the probe diameter. For all measurement points, the angle of theprobe with respect to the flat phantom surface shall be less than 5. If this cannot be achievedan additional uncertainty evaluation is needed.
6. Use post processing(e.g. interpolation and extrapolation) procedures to determine the localSAR values at the spatial resolution needed for mass averaging.

4.OUTPUT POWER VERIFICATION

4.1. Test condition:

1. All test measurements carried out are traceable to national standard. The uncertainty of the measurement at a confidence level of approximately 95%(in the case where distributions are nomal),with a coverage factor of 2, In the range of 30MHz-40GHz is±1.5dB.
2. Evironment conditions:

   Temperature 23℃
   Relative Humidy 53%
   Atmospheric Pressure 1019mbar
3. Test Date: August 10, 2015 - October 16, 2015
   Tested By:Dick

4.2. Test Procedure:

EUT radio output power measurement

1. Select lowest, middle, and highest channels for each band and different possible test mode.
2. Measure the conducted average bust power from EUT antenna port.

4.3. Conducted Power Measurement

Conducted power measurements of Wifi 2.4GHz

Mode	channel	Frequency (MHz)	Conducted output AVG power(dBm)		Test Rate Date
			(dBm,Chain 0)	(dBm,Chain 1)	
802.11b	1	2412	16.19	15.81	1Mbps
	6	2437	16.05	15.13	1Mbps
	11	2462	15.65	15.22	1Mbps
802.11g	1	2412	15.56	15.19	6Mbps
	6	2437	15.39	15.07	6Mbps
	11	2462	15.34	15.01	6Mbps
802.11n 20MHz	1	2412	14.98	14.42	6.5Mbps
	6	2437	14.61	14.31	6.5Mbps
	11	2462	14.46	14.22	6.5Mbps
802.11n 40MHz	3	2422	12.10	11.74	11Mbps
	6	2437	12.28	11.89	11Mbps
	9	2452	12.87	12.03	11Mbps

Note:

According to the KDB248227, for WiFi 2.4G, highest average RF output power channel for the lowest date rate of 802.11b mode was selected for SAR evaluation. SAR test at higher date rates and higher order modulations(including 802.11g/n) were not required since the maximum average output powerfor each of these configurations is not more than 1/4dB higher than the tested channnel for the lowest date rate of 802.11b mode.

***The conducted power measurement results for WLAN*(5180~5240MHz)**

Mode	Channel	Frequency (MHz)	Conducted Output Power	
			(dBm,Chain 0)	(dBm,Chain 1)
802.11a	36	5180	11.01	10.87
	40	5200	11.15	10.93
	48	5240	11.13	11.01
802.11n(20MHz)	36	5180	9.91	9.46
	40	5200	9.95	9.51
	48	5240	10.03	9.54
802.11n(40MHz)	38	5190	7.57	7.52
	46	5230	7.61	7.57
802.11ac(20MHz)	36	5180	7.71	7.64
	40	5200	7.76	7.71
	48	5240	7.81	7.77
802.11ac(40MHz)	38	5190	8.87	8.79
	46	5230	8.93	8.86
802.11ac(80MHz)	42	5210	9.61	9.53

***The conducted power measurement results for WLAN*(5745~5825MHz)**

Mode	Channel	Frequency (MHz)	Conducted Output Power	
			(dBm,Chain 0)	(dBm,Chain 1)
802.11a	149	5745	12.31	12.16
	157	5785	12.37	12.21
	165	5825	12.30	12.28
802.11n(20MHz)	149	5745	10.91	10.76
	157	5785	10.64	10.69
	165	5825	10.80	10.73
802.11n(40MHz)	151	5755	9.20	9.15
	159	5795	9.09	9.01
802.11ac(20MHz)	149	5745	8.91	8.84
	157	5785	8.67	8.61
	165	5825	8.83	8.75
802.11ac(40MHz)	151	5755	8.89	8.81
	159	5795	8.73	8.66
802.11ac(80MHz)	155	5775	10.15	10.03

Conducted power measurement of BluetoothV4.1

Mode	channel	Frequency (MHz)	Conducted output power
			(dBm)
BLE	1	2402	-0.81
	20	2440	0.17
	40	2480	-0.51
GFSK	1	2402	-6.70
	40	2441	-5.61
	79	2480	-5.04
Pi/4-DQPSK	1	2402	-6.97
	40	2441	-6.52
	79	2480	-6.17
8-DPSK	1	2402	-6.64
	40	2441	-6.35
	79	2480	-6.03

Note:

According to KDB447498 D01 General RF Exposure Guidence v05r01 standalone SAR test exclusion considerations,SAR test is not required in 100MHz to 6GHz at test separation distances≤50mm , if the output of EUT satisfay the fllowing eqation:

[(max power of channel,including tune-up tolerance,mW)/(min test separation distance,mm)].[$f^{1/2}_{(GHz)}$].≤3.0 For 1-g SAR and ≤7.5 for 10-g extremity SAR.

a. $f_{(GHz)}$is the RF channel transmit frequency in GHz.
b. Power and distance are rounded to the nearest mW and mm before calculation
c. The result is rounded to one decimal place for comparison
d. 3.5 and 7.5 are referred to as the numeric thresholds

5.SAR TEST RESULT

5.1. Test condition:

1. SAR Measuremnt
   The distance between the EUT and the antenna of the emulator is more than 50cm and the out put power radiated from the emulator antenna is at least 30dB less than the output power of EUT.
2. Measurement Uncertainty: See page 36and37 for detail
3. Environmental Conditions

Temperature	23℃
Relative Humidity	53%
Atmospheric Pressure	1019mbar

4. Test Date: August 10, 2015 - October 16, 2015
   Test By：Dick

5.2. Operation Mode

・According to KDB 447498 D01 v05r02 ,for each exposure position, if the highest 1-g SAR is ≤0.8 W/kg, testing for low and high channel is optional.

・Per KDB 865664 D01 v01r03,for each frequency band, if the measured SAR is ≥0.8W/Kg, testing for repeated SAR measurement is required , that the highest measured SAR is only to be tested. When the SAR results are near the limit, the following procedures are required for each device to verify these types of SAR measurement related variation concerns by repeating the highest measured SAR configuration in each frequency band.

(1) When the original highest measured SAR is ≥0.8W/Kg, repeat that measurement once.

(2) 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 W/Kg.

(3) Perform a third repeated measurement only if the original, first and second repeated measurement is ≥ 1.5 W/Kg and ratio of largest to smallest SAR for the original, first and second measurement is ≥1.20.

・According to 616217 D04 the procedures are applicable only when the overall diagonal dimen of the keyboard and/or display section of a laptop or tablet is＞20cm.

・According to 248227 D01, SAR is not required for 802.11g channels when the maximum average output power is less than 1/4dB higher than measured on the corresponding 802.11b channels.

・Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:

Maximum Scaling SAR =tested SAR (Max.) ×[maximum turn-up power (mw)/ maximum measurement output power(mw)]

5.3. SAR summary Test result

***SAR Values for WLAN2450 Band –Body*(Chain 0)**

Frequency		Mode/Band	Test Position	SAR(1g) (W/kg)	Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1g(W/kg)	Limit 1g(W/kg)
MHz	Channel								
2437	6	802.11b	Left	0.955	0.10	16.05	16.50	0.982	1.60
2412	**1**	**802.11b**	**Left**	**1.133**	**-0.48**	**16.19**	**16.50**	**1.154**	**1.60**
2462	11	802.11b	Left	0.817	-2.07	15.65	16.50	0.861	1.60
2437	6	802.11b	Rear	0.135	-1.99	16.05	16.50	0.139	1.60

Note:
1.When the SAR measured for the middle channel is ≤ 50% of the limit, test in the low and high channel is optional.
2. The result was tested under the lowest data rate 1Mbps for 802.11b.

***SAR Values for WLAN5200 Band -Body*(Chain 0)**

Frequency		Mode/Band	Test Position	SAR(1g) (W/kg)	Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1g(W/kg)	Limit 1g(W/kg)
MHz	Channel								
5200	**40**	**802.11a**	**Left**	**0.490**	**-3.36**	**11.15**	**11.50**	**0.505**	**1.60**
5200	40	802.11a	Rear	0.312	2.61	11.15	11.50	0.322	1.60

Note:
1.When the SAR measured for the middle channel is ≤ 50% of the limit, test in the low and high channel is optional.
2. The result was tested under the lowest data rate 6Mbps for 802.11a.

***SAR Values for WLAN5800 Band -Body*(Chain 0)**

Frequency		Mode/Band	Test Position	SAR(1g) (W/kg)	Power Drift(%)	Conducted Power (dBm)	Tune-up Power (dBm)	Scaled SAR 1g(W/kg)	Limit 1g(W/kg)
MHz	Channel								
5785	**157**	**802.11a**	**Left**	**0.589**	**-0.90**	**12.37**	**12.50**	**0.595**	**1.60**
5785	157	802.11a	Rear	0.395	1.59	12.37	12.50	0.399	1.60

Note:
1.When the SAR measured for the middle channel is ≤ 50% of the limit, test in the low and high channel is optional.
2. The result was tested under the lowest data rate 6Mbps for 802.11a.

SAR Measurement Variability Results

Test Position	Channel/ Frequency (MHz)	Measured SAR_{1-g}	1st Repeated SAR_{1-g}	Ratio(%)	2nd Repeated SAR_{1-g}	3rd Repeated SAR_{1-g}
Left Side	1/2412	1.133	1.105	1.03	N/A	N/A

Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.
4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

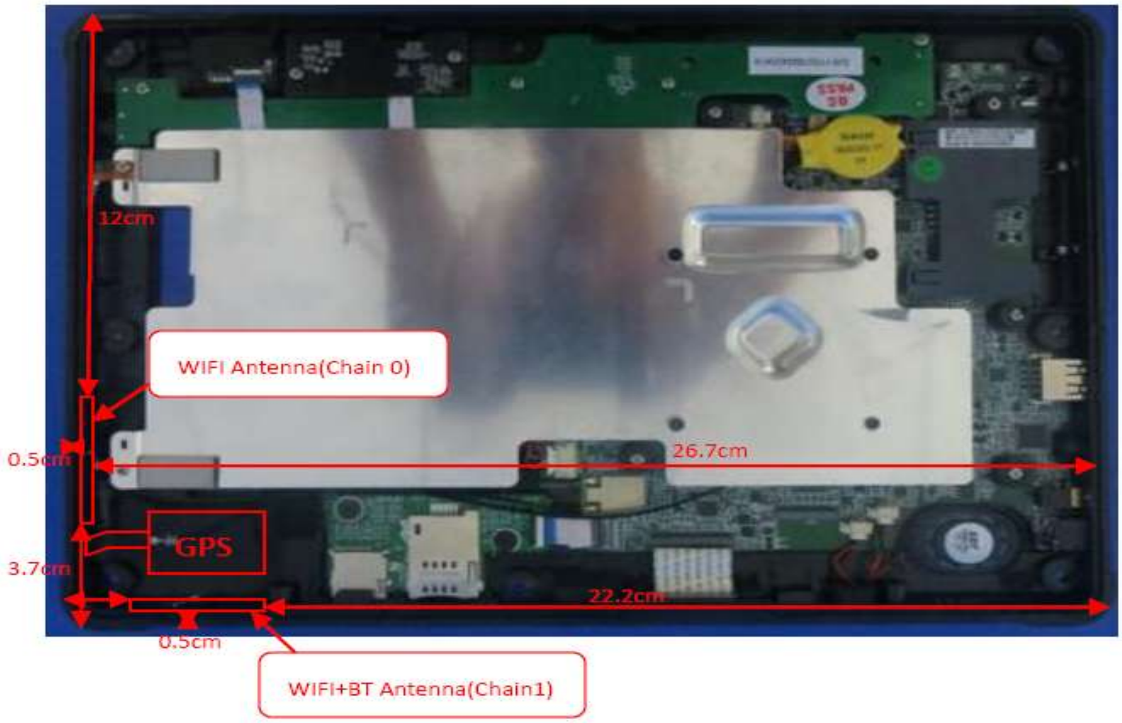
Note: The SAR result complies with the ANSI/IEEE C95.1:2005, ANSI/IEEE C95.3 :2002, so pass.

5.4. Testreduction procedure

The following picture showed that the antenna position of the DUT.So according to KDB447498 and KDB 616217 for SAR testing.

TOP

LEFT



Right

BOTTOM

Figure 1:The diagonal dimension of the DUT

Per KDB941225 D06,for the antenna-to-edge distance is greater than 2.5cm sides do not need to be tested.

Simultaneous Transmission SAR Analysis

For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r02 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≦50 mm; where 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 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm.

d) Bluetooth estimated SAR is conservatively determined by 5mm separation, for all applicable exposure positions.

BT's maximum turn up conducted power is 1.0dBm(1.26mW) and the estimated SAR is listed below.

Test position	Body (0mm)
BT Estimated SAR(W/kg)	0.052

For Bluetooth the Estimated SAR body at 5mm for estimate and 0mm to Estimated Wrist-Worn SAR

Estimated SAR_{Body}=((1.26mW)/5mm)*(1.5498/7.5)=0.052W/Kg

5.5. Simultaneous multi-band transmission

For the DUT, the WLAN and BT sharing a single module, and so BT and WIFI cannot transmit together. And the 2.4G wifi and 5Gwifi cannot transmit together.So there is no Simultaneous multi-band transmission.

5.6. Measurement Uncertainty (700MHz-3GHz)

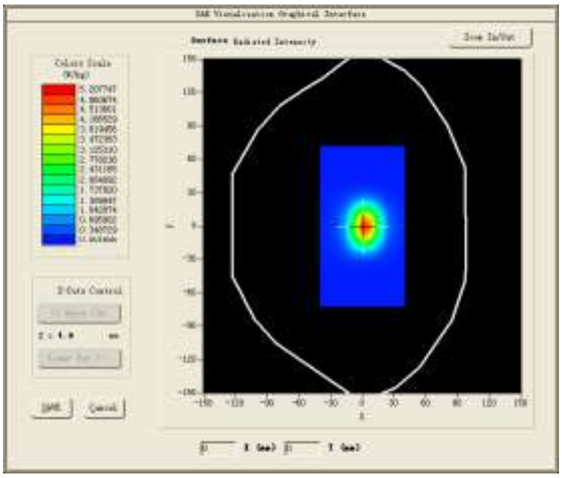
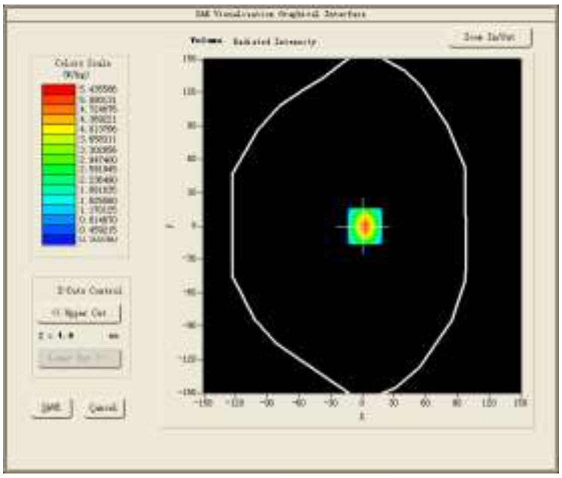
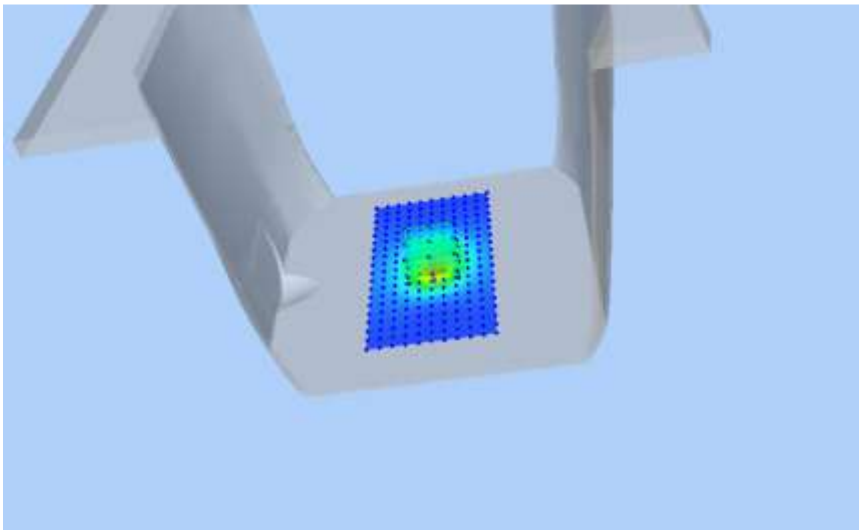
UNCERTAINTY FOR SYSTEM PERFORMANCE CHECK									
Uncertainty Component		Tol. (± %)	Prob. Dist.	Div.	c_i (1 g)	c_i (10 g)	1 g u_i (± %)	10 g u_i (± %)	v_i
Measurement System									
Probe Calibration	7.2.1	5.8	N	1	1	1	5.80	5.80	∞
Axial Isotropy	7.2.1.1	3.5	R	√3	$(1-c_p)^{1/2}$	$(1-c_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	7.2.1.1	5.9	R	√3	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	7.2.1.4	1	R	√3	1	1	0.58	0.58	∞
Linearity	7.2.1.2	4.7	R	√3	1	1	2.71	2.71	∞
System Detection Limits	7.2.1.2	1	R	√3	1	1	0.58	0.58	∞
Modulation response	7.2.1.3	0	N	1	1	1	0.00	0.00	∞
Readout Electronics	7.2.1.5	0.5	N	1	1	1	0.50	0.50	∞
Response Time	7.2.1.6	0	R	√3	1	1	0.00	0.00	∞
Integration Time	7.2.1.7	1.4	R	√3	1	1	0.81	0.81	∞
RF Ambient Conditions - Noise	7.2.3.7	3	R	√3	1	1	1.73	1.73	∞
RF Ambient Conditions - Reflections	7.2.3.7	3	R	√3	1	1	1.73	1.73	∞
Probe Positioner Mechanical Tolerance	7.2.2.1	1.4	R	√3	1	1	0.81	0.81	∞
Probe Positioning with respect to Phantom Shell	7.2.2.3	1.4	R	√3	1	1	0.81	0.81	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	7.2.4	2.3	R	√3	1	1	1.33	1.33	∞
Dipole									
Deviation of experimental source from numerical source		4	N	1	1	1	4.00	4.00	∞
Input Power and SAR drift measurement	7.2.3.6	5	R	√3	1	1	2.89	2.89	∞
Dipole Axis to Liquid Distance		2	R	√3	1	1			∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)		4	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	7.2.6	2	N	1	1	0.84	2.00	1.68	∞
Liquid Conductivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	5
Liquid Conductivity - measurement uncertainty	7.2.3.3	4	N	1	0.23	0.26	0.92	1.04	5
Liquid Permittivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid Permittivity - measurement uncertainty	7.2.3.4	5	N	1	0.23	0.26	1.15	1.30	∞
Combined Standard Uncertainty			RSS				10.15	10.05	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			k				20.29	20.10	

UNCERTAINTY EVALUATION FOR HANDSET SAR TEST

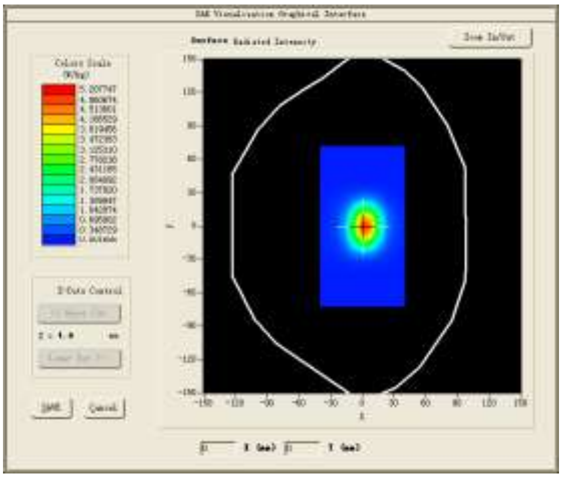
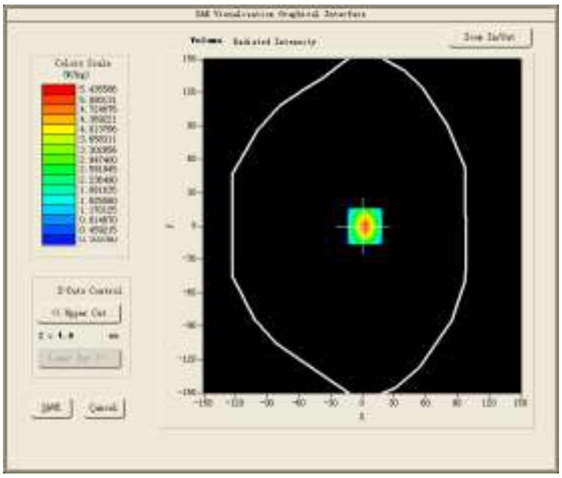
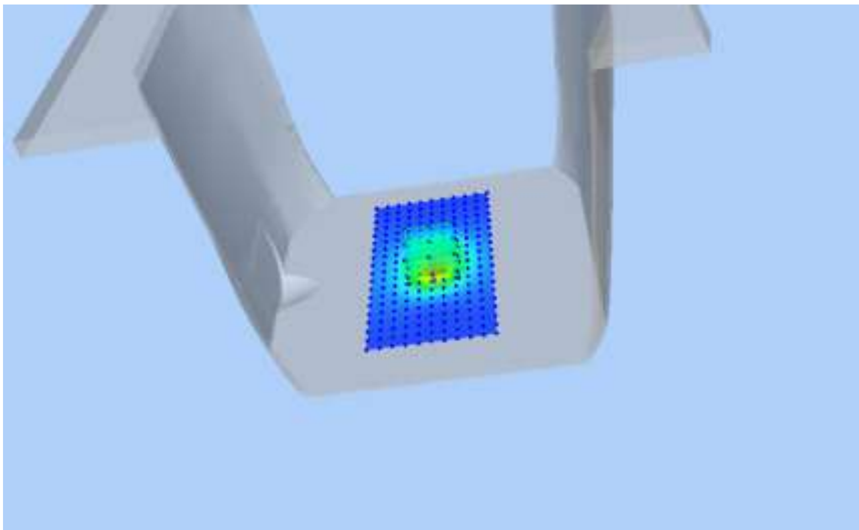
Uncertainty Component	Description	Tol. (± %)	Prob. Dist.	Div.	c_i (1 g)	c_i (10 g)	1 g u_i (± %)	10 g u_i (± %)	v_i
Measurement System									
Probe Calibration	7.2.1	5.8	N	1	1	1	5.8	5.8	∞
Axial Isotropy	7.2.1.1	3.5	R	√3	$(1-c_p)^{1/2}$	$(1-c_p)^{1/2}$	1.43	1.43	∞
Hemispherical Isotropy	7.2.1.1	5.9	R	√3	$\sqrt{C_p}$	$\sqrt{C_p}$	2.41	2.41	∞
Boundary Effect	7.2.1.4	1	R	√3	1	1	0.58	0.58	∞
Linearity	7.2.1.2	4.7	R	√3	1	1	2.71	2.71	∞
System Detection Limits	7.2.1.2	1	R	√3	1	1	0.58	0.58	∞
Modulation response	7.2.1.3	3	N	1	1	1	3.00	3.00	∞
Readout Electronics	7.2.1.5	0.5	N	1	1	1	0.50	0.50	∞
Response Time	7.2.1.6	0	R	√3	1	1	0.00	0.00	∞
Integration Time	7.2.1.7	1.4	R	√3	1	1	0.81	0.81	∞
RF Ambient Conditions - Noise	7.2.3.7	3	R	√3	1	1	1.73	1.73	∞
RF Ambient Conditions - Reflections	7.2.3.7	3	R	√3	1	1	1.73	1.73	∞
Probe Positioner Mechanical Tolerance	7.2.2.1	1.4	R	√3	1	1	0.81	0.81	∞
Probe Positioning with respect to Phantom Shell	7.2.2.3	1.4	R	√3	1	1	0.81	0.81	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	7.2.4	2.3	R	√3	1	1	1.33	1.33	∞
Test sample Related									
Test Sample Positioning	7.2.2.4.4	2.6	N	1	1	1	2.60	2.60	11
Device Holder Uncertainty	7.2.2.4.2 7.2.2.4.3	3	N	1	1	1	3.00	3.00	7
Output Power Variation - SAR drift measurement	7.2.3.6	5	R	√3	1	1	2.89	2.89	∞
SAR scaling	7.2.5	2	R	√3	1	1	1.15	1.15	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	7.2.2.2	4	R	√3	1	1	2.31	2.31	∞
Uncertainty in SAR correction for deviation (in permittivity and conductivity)	7.2.6	2	N	1	1	0.84	2.00	1.68	∞
Liquid Conductivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	5
Liquid Conductivity - measurement uncertainty	7.2.3.3	4	N	1	0.23	0.26	0.92	1.04	5
Liquid Permittivity (temperature uncertainty)	7.2.3.5	2.5	N	1	0.78	0.71	1.95	1.78	∞
Liquid Permittivity - measurement uncertainty	7.2.3.4	5	N	1	0.23	0.26	1.15	1.30	∞
Combined Standard Uncertainty			RSS				10.63	10.54	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			k				21.26	21.08	

5.7. System Check Results

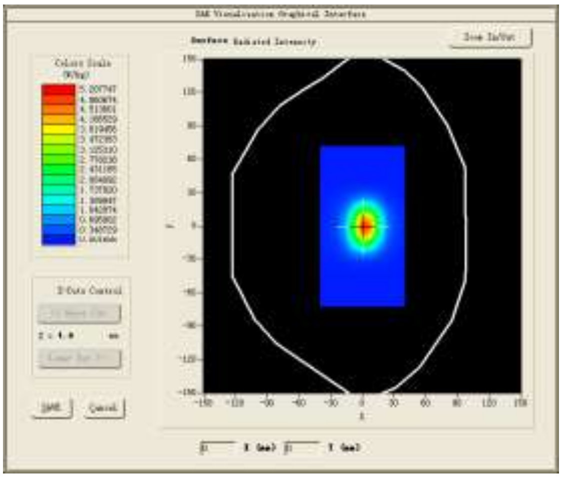
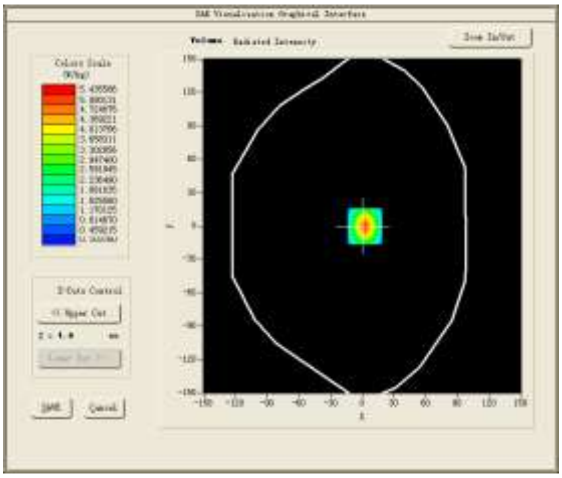
Test mode:2450MHz(Body)
Product Description:Validation
Model:Dipole SID2450
E-Field Probe:SSE5(SN17/14 EP220)
Test Date:September 28, 2015

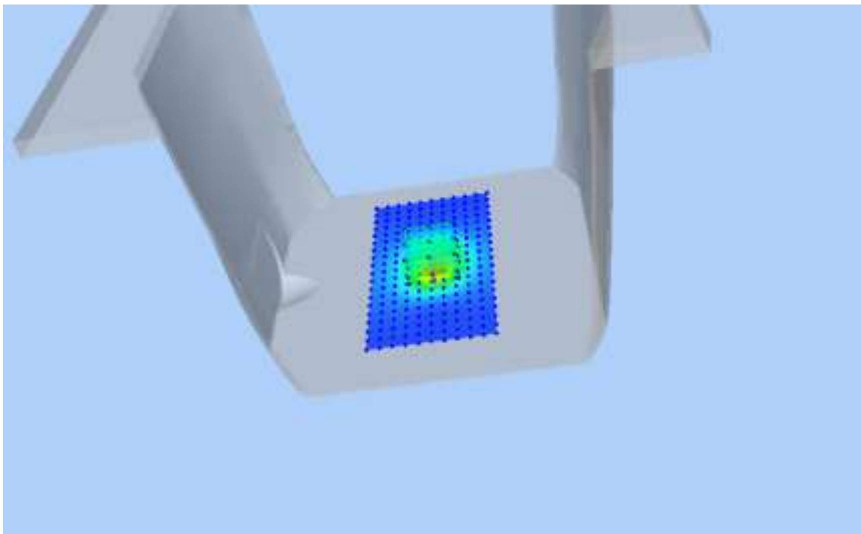
Medium(liquid type)	MSL_2450
Frequency (MHz)	2450.0000
Relative permittivity (real part)	53.61
Conductivity (S/m)	1.93
Input power	100mW
Crest Factor	1.0
Conversion Factor	4.05
Variation (%)	-1.230000
SAR 10g (W/Kg)	2.510042
SAR 1g (W/Kg)	5.45639
SURFACE SAR	**VOLUME SAR**
	
	

Test mode:5200MHz(Body)
Product Description:Validation
Model:Dipole SID5200
E-Field Probe:SSE5(SN17/14 EP221)
Test Date:September 29, 2015

Medium(liquid type)	MSL_5200
Frequency (MHz)	5200.0000
Relative permittivity (real part)	48.27
Conductivity (S/m)	5.46
Input power	100mW
Crest Factor	1.0
Conversion Factor	4.47
Variation (%)	3.160000
SAR 10g (W/Kg)	1.918034
SAR 1g (W/Kg)	6.96725
SURFACE SAR	**VOLUME SAR**
	
	

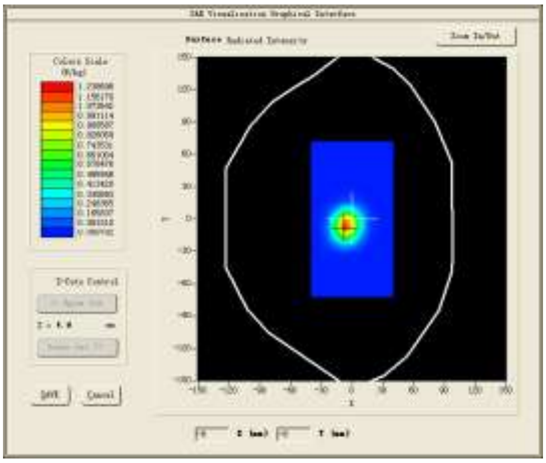
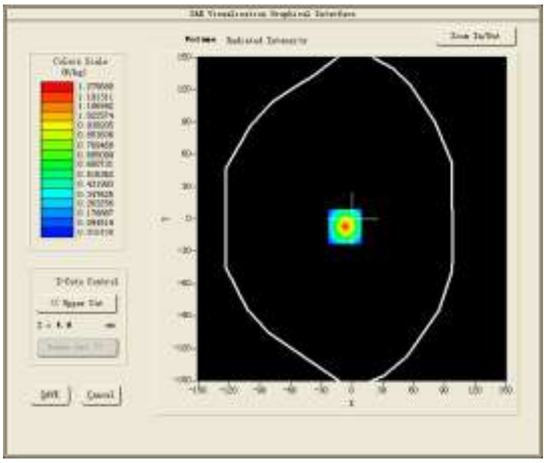
Test mode:5800MHz(Body)
Product Description:Validation
Model:Dipole SID5800
E-Field Probe:SSE5(SN17/14 EP221)
Test Date:September 30, 2015

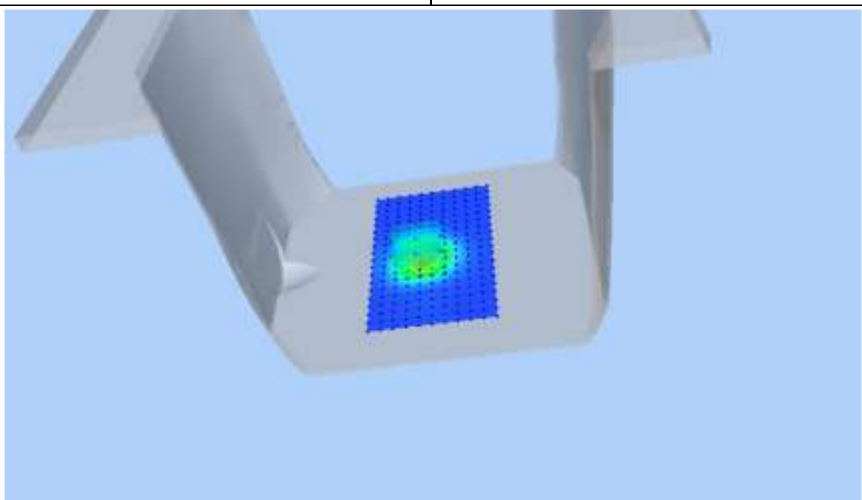
Medium(liquid type)	MSL_5800
Frequency (MHz)	5800.0000
Relative permittivity (real part)	49.21
Conductivity (S/m)	5.93
Input power	100mW
Crest Factor	1.0
Conversion Factor	4.20
Variation (%)	2.540000
SAR 10g (W/Kg)	1.923126
SAR 1g (W/Kg)	6.825128
SURFACE SAR	**VOLUME SAR**
	



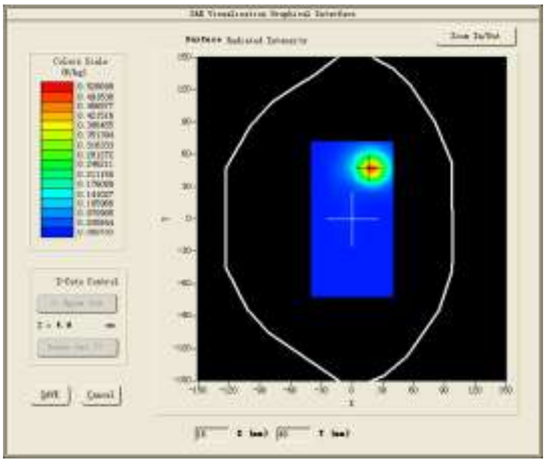
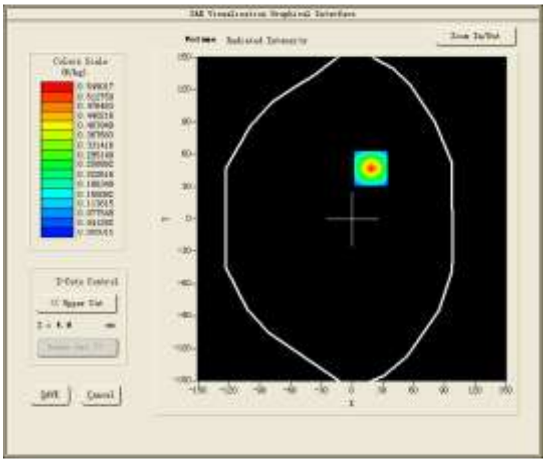
5.8. SAR Test Graph Results

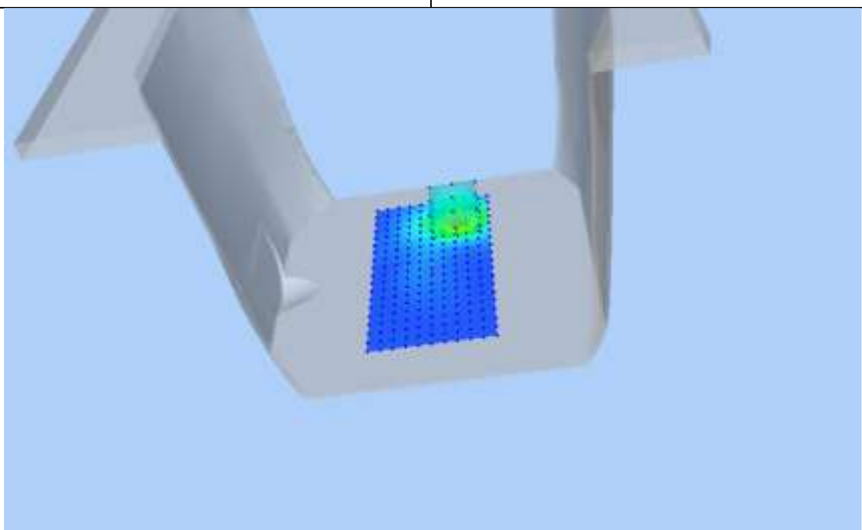
Test Mode:802.11b,Low channel(Body SAR-LCD DOWN)
Product Description: Tablet POS
Model:HM518
Test Date: September 28, 2015

Medium(liquid type)	MSL_2450
Frequency (MHz)	2412.000000
Relative permittivity (real part)	53.61
Conductivity (S/m)	1.93
E-Field Probe	SN 17/14 EP220
Crest Factor	1.0
Conversion Factor	4.05
Sensor	4mm
Area Scan	Surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm
Variation (%)	-0.480000
SAR 10g (W/Kg)	0.486202
SAR 1g (W/Kg)	1.133377
SURFACE SAR	**VOLUME SAR**
	

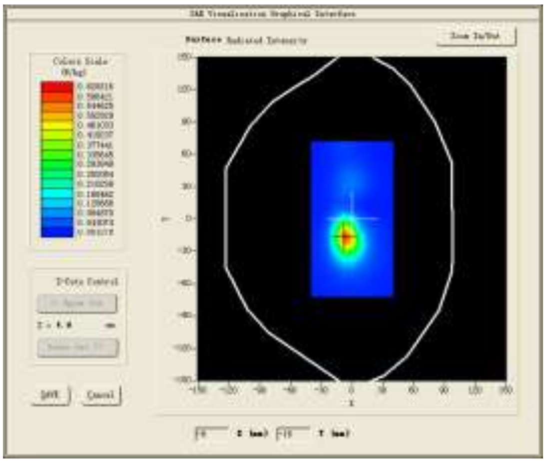
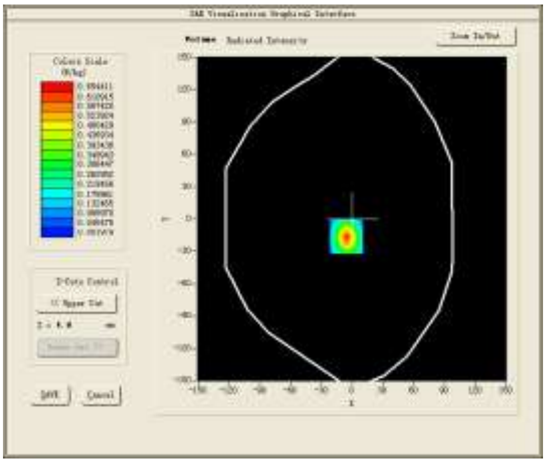


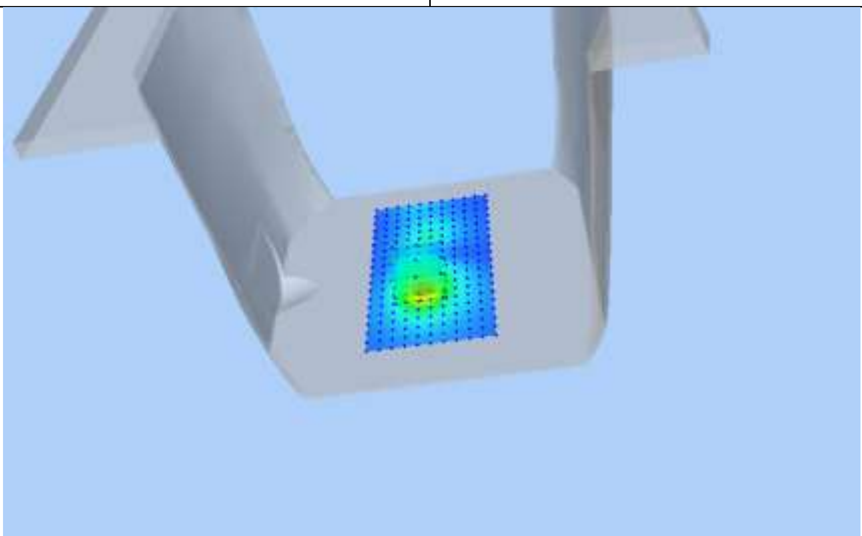
Test Mode:802.11A,MID channel(Body SAR-LCD DOWN)
Product Description: Tablet POS
Model:HM518
Test Date: September 29, 2015

Medium(liquid type)	MSL_5200
Frequency (MHz)	5200.000000
Relative permittivity (real part)	48.27
Conductivity (S/m)	5.46
E-Field Probe	SN 17/14 EP220
Crest Factor	1.0
Conversion Factor	4.30
Sensor	4mm
Area Scan	Surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm
Variation (%)	-3.360000
SAR 10g (W/Kg)	0.215442
SAR 1g (W/Kg)	0.490321
SURFACE SAR	**VOLUME SAR**
	



Test Mode:802.11A,MID channel(Body SAR-LCD DOWN)
Product Description: Tablet POS
Model:HM518
Test Date: September 30, 2015

Medium(liquid type)	MSL_5800
Frequency (MHz)	5787.000000
Relative permittivity (real part)	49.21
Conductivity (S/m)	5.93
E-Field Probe	SN 17/14 EP220
Crest Factor	1.0
Conversion Factor	4.75
Sensor	4mm
Area Scan	Surf_sam_plan.txt
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm
Variation (%)	-0.900000
SAR 10g (W/Kg)	0.262635
SAR 1g (W/Kg)	0.588825
SURFACE SAR	**VOLUME SAR**
	



6.CALIBRATION CERTIFICATES

SARTIMO Calibration Certificate-Extended Dipole Calibrations

According to KDB 450824 D02, Dipoles must be recalibrated at least once every three years; however, immediate re-calibration is required for following conditions. The test laboratory must ensure that the required supporting information and documentation have been included in the SAR report to qualify for extended 3-year calibration interval.

1) When the most recent return-loss, measured at least annually, deviates by more than 20% from theprevious measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification
2) When the most recent measurement of the real or imaginary parts of the impedance, measured at least annually, deviates by more than 5 ∩ from the previous measurement

Summary Result:

SID 2450			
Frquency	Return Loss(dB)	Requirement(dB)	Impedence
2450	-25.61	-20	44.9Ω-0.9jΩ

6.1. Probe Calibration Ceriticate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.287.1.14.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 17/14 EP220

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2246-02

10/01/2014

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/14/2014	
Checked by :	Jérôme LUC	Product Manager	10/14/2014	
Approved by :	Kim RUTKOWSKI	Quality Manager	10/14/2014	

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/14/2014	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 17/14 EP220
Product Condition (new / used)	New
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.179 MΩ Dipole 2: R2=0.175 MΩ Dipole 3: R3=0.180 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

Figure 1 – *Satimo COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

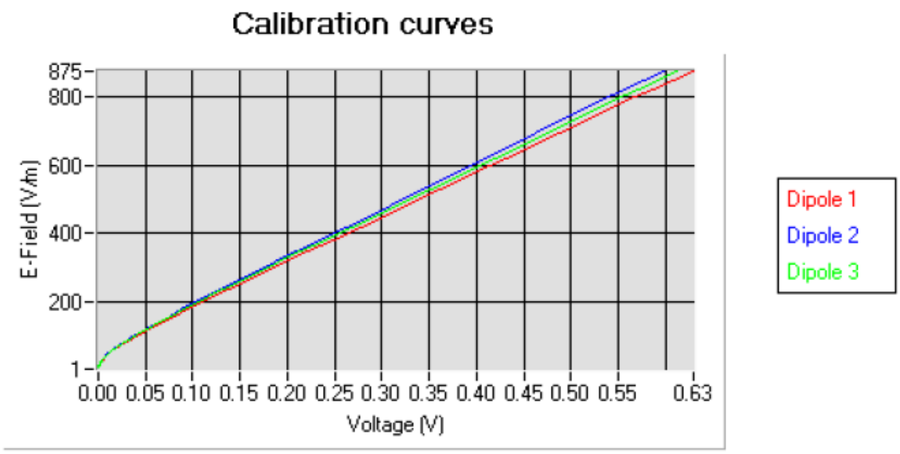
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
6.02	5.52	5.72

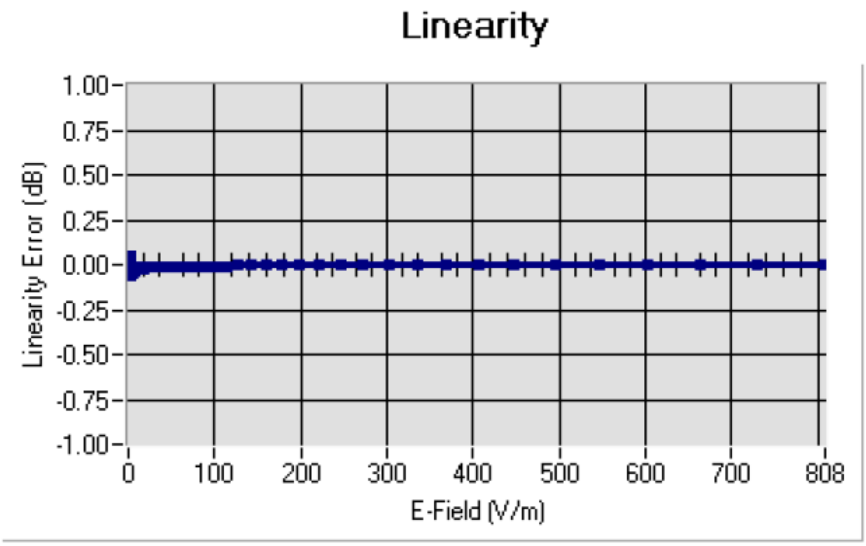
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
99	98	99

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity: +/-1.47% (+/-0.06dB)

5.3 SENSITIVITY IN LIQUID

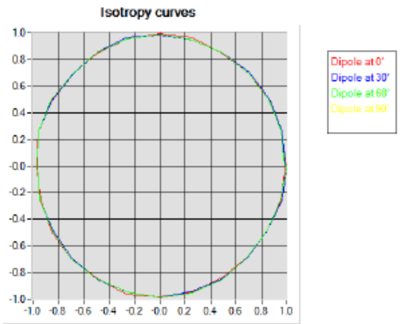
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL750	750	42.06	0.89	4.58
BL750	750	56.57	0.99	4.71
HL850	835	42.81	0.89	4.86
BL850	835	53.46	0.96	5.04
HL900	900	42.47	0.96	4.74
BL900	900	56.69	1.08	4.92
HL1800	1800	41.31	1.38	4.16
BL1800	1800	53.27	1.51	4.29
HL2000	2000	39.72	1.43	4.19
BL2000	2000	53.91	1.53	4.28
HL2450	2450	39.05	1.77	3.94
BL2450	2450	52.97	1.93	4.05

LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

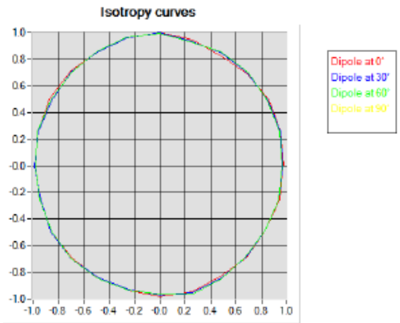
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



HL1800 MHz

- Axial isotropy: 0.06 dB
- Hemispherical isotropy: 0.08 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	Satimo	EP 94 SN 37/08	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

COMOSAR E-Field Probe Calibration Report

Ref : ACR.262.1.14.SATU.A

SHENZHEN STS TEST SERVICES CO., LTD.
1/F, BUILDING 2, ZHUOKE SCIENCE PARK, CHONGQING ROAD
FUYONG, BAO' AN DISTRICT, SHENZHEN,CHINA
SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE
SERIAL NO.: SN 17/14 EP221

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration CERT #2248-02

09/01/2014

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	9/19/2014	JS
Checked by :	Jérôme LUC	Product Manager	9/19/2014	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	9/19/2014	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen STS Test Services Co., Ltd.

Issue	Date	Modifications
A	9/19/2014	Initial release

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref: ACR.262.1.14.SATU.A

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 17/14 EP221
Product Condition (new / used)	New
Frequency Range of Probe	0.4 GHz- 6 GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.179 MΩ Dipole 2: R2=0.167 MΩ Dipole 3: R3=0.178 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

Figure 1 – *Satimo COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

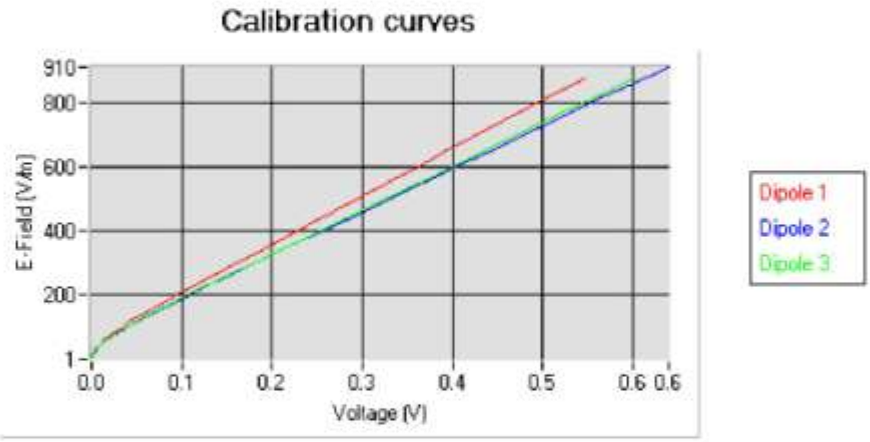
5.1 SENSITIVITY IN AIR

Normx dipole 1 (µV/(V/m)^2)	Normy dipole 2 (µV/(V/m)^2)	Normz dipole 3 (µV/(V/m)^2)
4.81	6.15	6.02

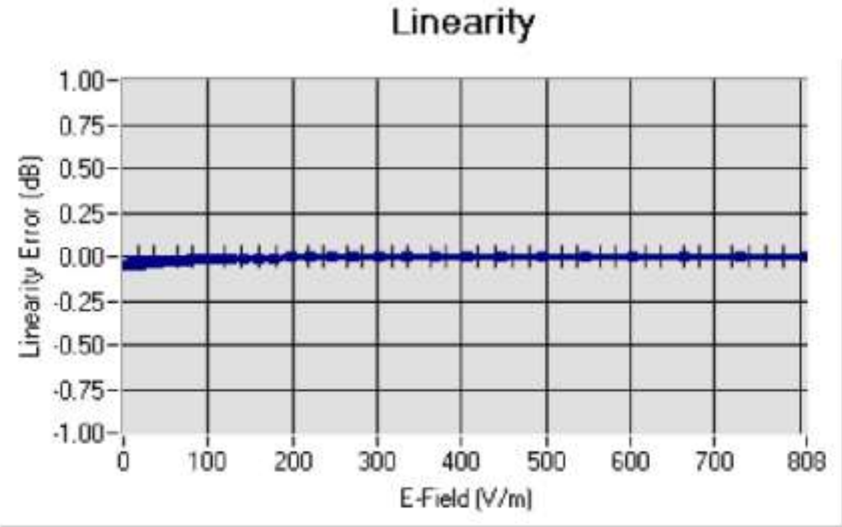
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
95	100	90

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity:+/-1.16% (+/-0.05dB)

5.3 SENSITIVITY IN LIQUID

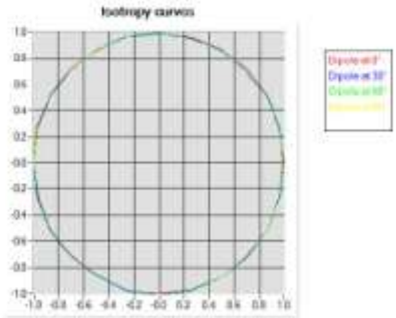
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	43.90	0.87	4.84
BL450	450	58.63	0.98	4.98
HL750	750	42.06	0.89	4.53
BL750	750	56.57	0.99	4.70
HL850	835	42.81	0.89	4.83
BL850	835	53.46	0.96	5.02
HL900	900	42.47	0.96	4.74
BL900	900	56.69	1.08	4.89
HL1800	1800	41.31	1.38	4.25
BL1800	1800	53.27	1.51	4.34
HL1900	1900	41.09	1.42	4.71
BL1900	1900	54.20	1.54	4.85
HL2000	2000	39.72	1.43	4.27
BL2000	2000	53.91	1.53	4.44
HL2450	2450	39.05	1.77	4.11
BL2450	2450	52.97	1.93	4.25
HL2600	2600	38.35	1.92	4.20
BL2600	2600	51.81	2.19	4.32

LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

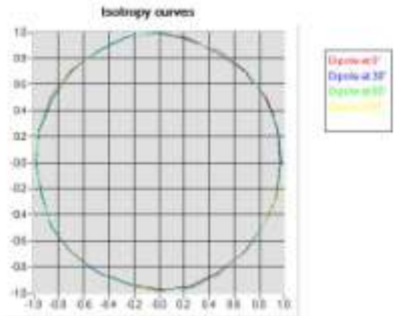
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



HL1800 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.08 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Reference Probe	Satimo	EP 94 SN 37/08	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

6.2. SID2450 Dipole Calibration Ceriticate

SATIMO
The microwave vision company

SAR Reference Dipole Calibration Report

Ref : ACR.287.8.14.SATU.A

SHENZHEN LCS COMPLIANCE TESTING LABORATORY LTD.
1F., XINGYUAN INDUSTRIAL PARK, TONGDA ROAD, BAO'AN BLVD
BAO'AN DISTRICT, SHENZHEN, GUANGDONG, CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 07/14 DIP 2G450-306

Calibrated at SATIMO US
2105 Barrett Park Dr. - Kennesaw, GA 30144

10/01/2014

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	10/14/2014	
Checked by :	Jérôme LUC	Product Manager	10/14/2014	
Approved by :	Kim RUTKOWSKI	Quality Manager	10/14/2014	Kim Rutkowski

	Customer Name
Distribution :	Shenzhen LCS Compliance Testing Laboratory Ltd.

Issue	Date	Modifications
A	10/14/2014	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 2450 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID2450
Serial Number	SN 07/14 DIP 2G450-306
Product Condition (new / used)	New

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *Satimo COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

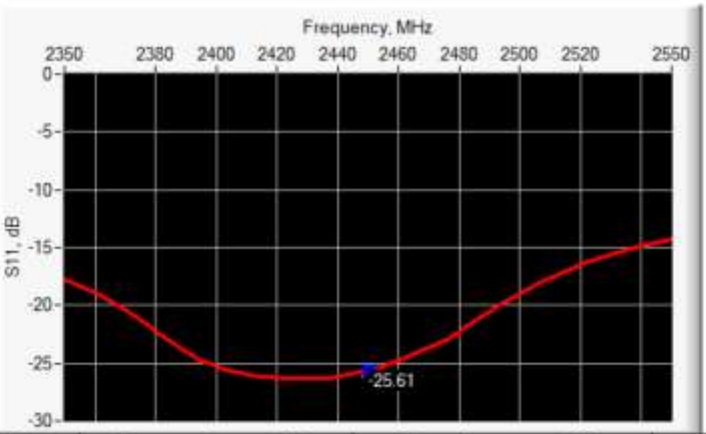
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-25.61	-20	44.9 Ω - 0.9 jΩ

6.2 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	290.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	
2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

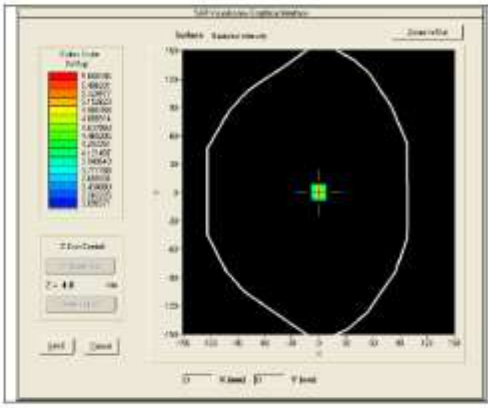
The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

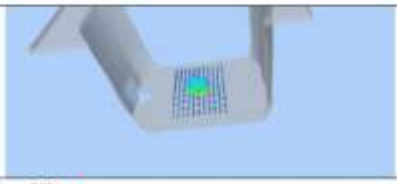
Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 39.0 sigma : 1.77
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm

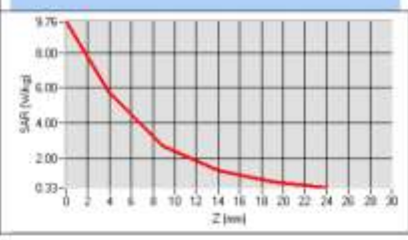
SATIMO **SAR REFERENCE DIPOLE CALIBRATION REPORT** Ref: ACR.287.8.14.SATU.A

Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	53.89 (5.39)	24	24.15 (2.42)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	







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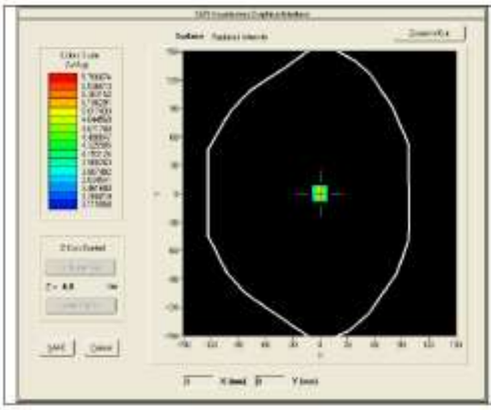
7.3 BODY LIQUID MEASUREMENT

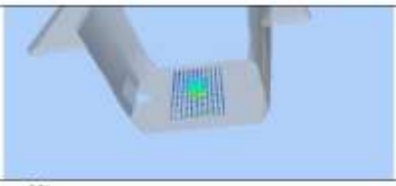
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %	PASS	1.95 ±5 %	PASS
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	
5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

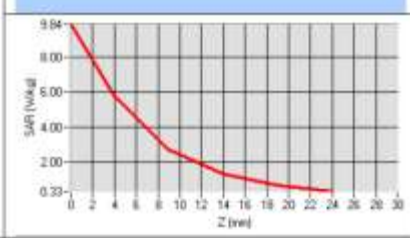
7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 53.0 sigma : 1.93
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
2450	54.65 (5.46)	24.58 (2.46)





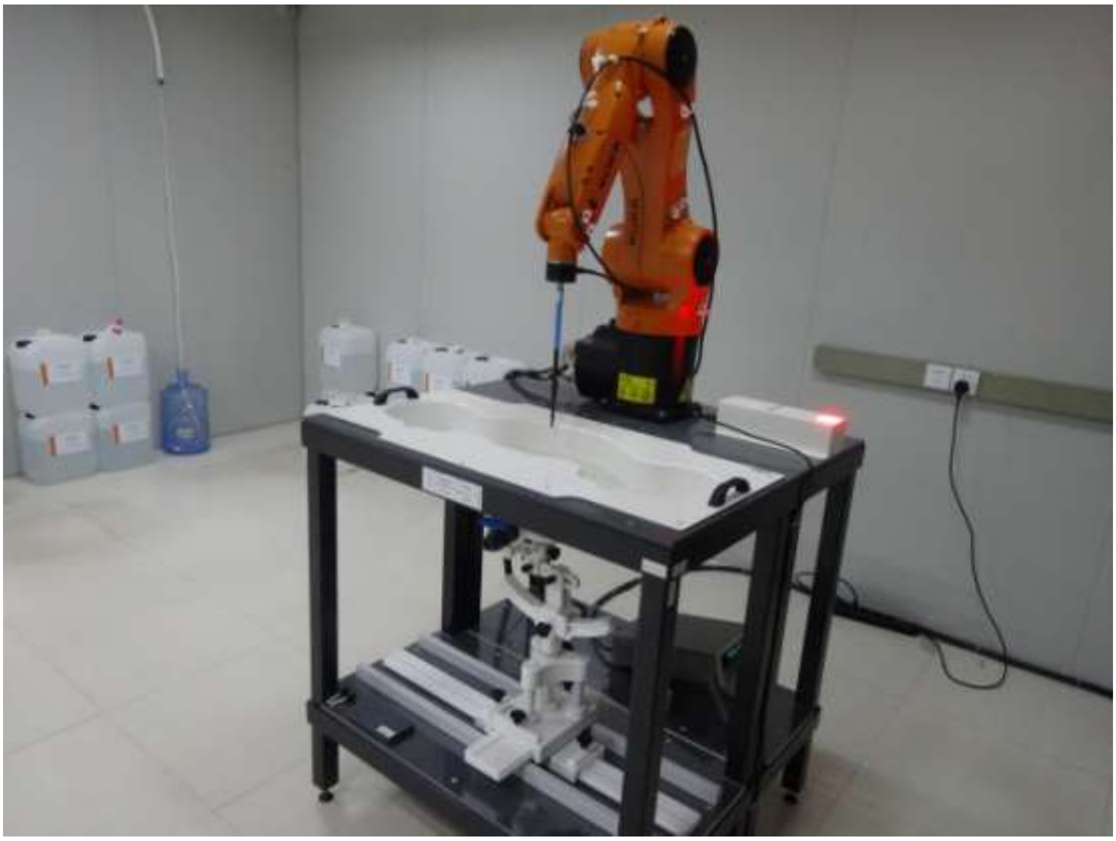


8 LIST OF EQUIPMENT

Equipment Summary Sheet

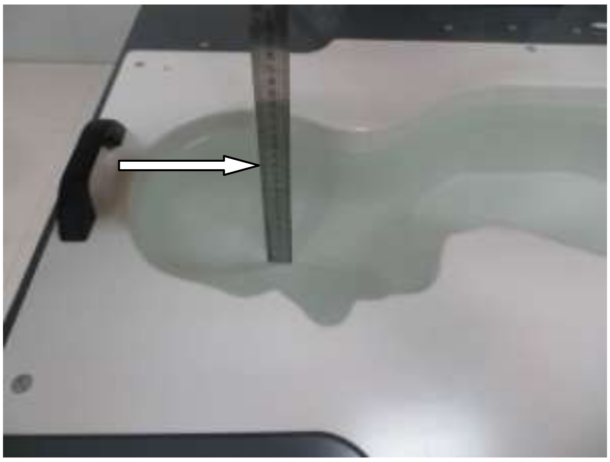
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	Satimo	EPG122 SN 18/11	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

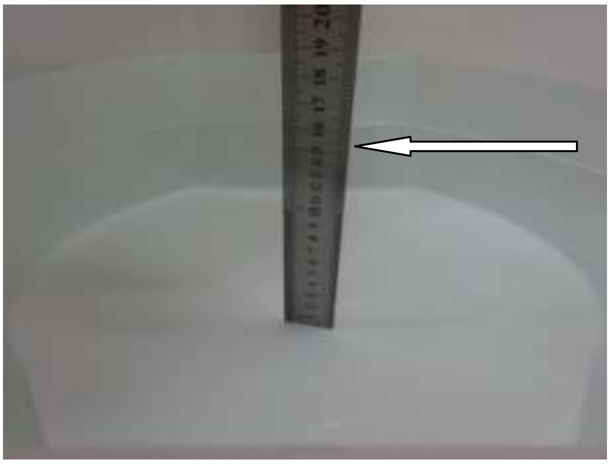
7. SAR System PHOTOGRAPHS



DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

Note:The position used in the measurement were according to IEEE1528-2013



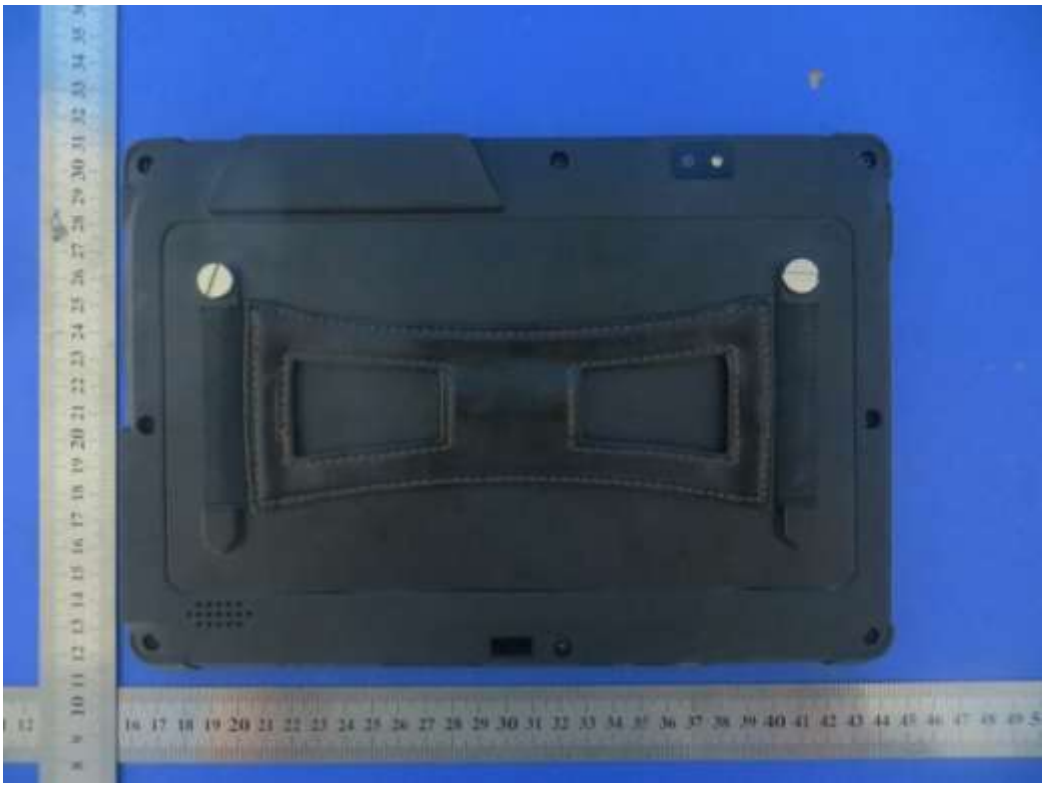


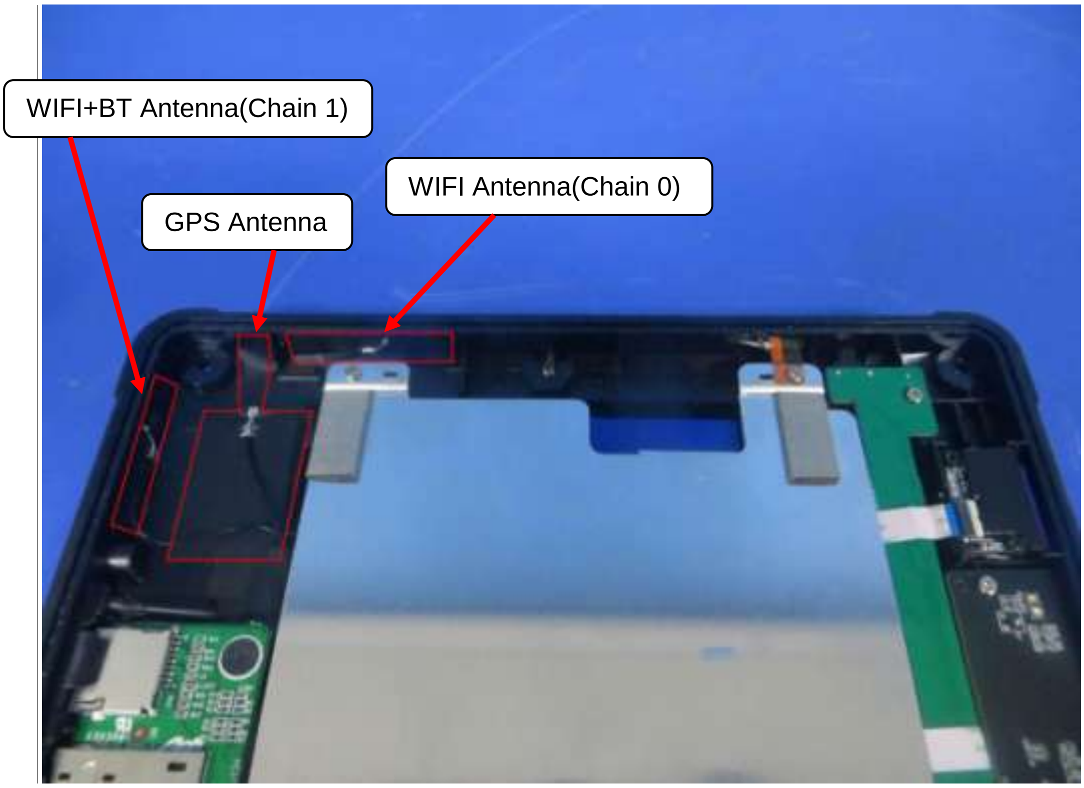
8. SETUP PHOTOGRAPHS

0mm body-worn Back Side Setup Photo

0mm body-worn Left Side Setup Photo

9. EUTPHOTOGRAPHS





....................The End of Test Report.....................