SAR TEST REPORT



Report No.: 15071059-FCC-H

Supersede Report No.: N/A

Applicant	Kobian Canada INC.	
Product Name	Notebook	
Model No.	14DTB1	
Standards	FCC 47 CFR Part2(2.1093) ANSI/IEEE C95.1-1999 IEEE 1528-2013 & Published RF Exp	posure KDB Procedures
Test Date	November 18, 2015	
Issue Date	December 7, 2015	
Test Result	PASS	
Equipment complied with the specification		
Equipment did not comply with the specification		

Wiky.Jam	David Huang	
Wiky Jam Test Engineer	David Huang Checked By	
This to	est report may be reproduced in full o	nly
Test result presented	in this test report is applicable to the t	tested sample only

Issued by:

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Laboratory Introduction

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Accreditations for Conformity Assessment



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1 EUT INFORMATION

EUT Information	
EUT Description	Notebook
Model No	14DTB1
Input Power	Rechargeable Li-polymer Battery Model: N14PL3710398P*2POCT Charging Voltage:4.2V, 10000mAh,37Wh
Maximum Conducted Output Power to Antenna	2.4GHz: 16.59dBm
Highest Reported SAR Level(s)	0.58 W/Kg 1g Body Tissue
Classification Per Stipulated Test Standard	Portable Device
Multi-SIM	NA
Co-located TX	NA
Antenna Separation distances	NA
Antenna Type(s)	Integral Antenna
Accessory	NA

	Highest Report	ed SAR (W/kg)
Equipment Class	Head	Body
Notebook	NA	0.58
Max Simultaneous sum SAR	Ν	A



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2 TECHNICAL DETAILS

Purpose	Compliance testing of Notebook model 14DTB1 with stipulated standard
Applicant / Client	Kobian Canada INC. 560 Denison Street, Unit 5, Markham, Ontario, L3R 2M8, Canada
Manufacturer	Kobian Canada INC. 560 Denison Street, Unit 5, Markham, Ontario, L3R 2M8, Canada
Laboratory performing the tests	SIEMIC(China-Shenzhen) Laboratories Zone A, Floor 1, Building 2, Wan Ye Long Technology Park, South Side of Zhoushi Road, Bao'an District, Shenzhen 518108, Guangdong, P.R.C. Tel: +(86) 0755-26014629 VIP Line:950-4038-0435
Test report reference number	15071059-FCC-H
Date EUT received	November 9, 2015
Standard applied	See Page 37
Dates of test (from – to)	November 18, 2015
No of Units:	1
Equipment Category:	Portable Device
Trade Name:	Hipstreet
Model Name:	14DTB1
RF Operating Frequency	WIFI:802.11b/g/n(20M): 2412-2462 MHz(TX/RX) WIFI:802.11n(40M): 2422-2452 MHz(TX/RX)
Modulation:	802.11b:CCK, DQPSK, DBPSK 802.11g: 64 QAM, 16 QAM, QPSK, BPSK 802.11n:64 QAM, 16 QAM, QPSK, BPSK
FCC ID	YH5-14DTB1



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3 INTRODUCTION

Introduction

This measurement report shows compliance of the EUT with ANSI/IEEE C95.1-1999 and FCC 47 CFR Part2 (2.1093)

The test procedures, as described in IEEE 1528-2013 Standard for IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques(300MHz~6GHz) and Published RF Exposure KDB Procedures

SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (p).

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

SAR is expressed in units of watts per kilogram (W/kg). SAR can be related to the electric field at a point by

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

where:

 σ = conductivity of the tissue (S/m)

 ρ = mass density of the tissue (kg/m3)

E = rms electric field strength (V/m)



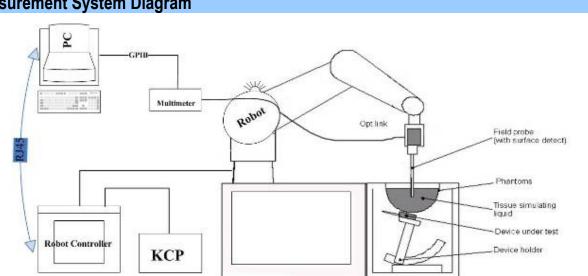
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4 SAR MEASUREMENT SETUP

Dosimetric Assessment System

These measurements were performed with the automated near-field scanning system OPENSAR from SATIMO. The system is based on a high precision robot (working range: 850 mm), which positions the probes with a positional repeatability of better than \pm 0.02 mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit.

The SAR measurements were conducted with dosimetric probe (manufactured by SATIMO), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in SAR standard with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in SAR starndard and found to be better The phantom used was the SAM Phantom as described in FCC supplement C, IEEE P1528 than ±0.25 dB. and CENELEC EN62209-1.



Measurement System Diagram

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

- 1. A standard high precision 6-axis robot (KUKA) with controller and software.
- 2. KUKA Control Panel (KCP).
- 3. 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.
- 4. The functions of the PC plug-in card are to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.



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- 5. A computer operating Windows XP.
- 6. OPENSAR software.
- 7. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
- 8. The SAM phantom enabling testing left-hand right-hand and body usage.
- 9. The Position device for handheld EUT.
- 10. Tissue simulating liquid mixed according to the given recipes (see Application Note).
- 11. System validation dipoles to validate the proper functioning of the system.



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EP100 Probe





Construction Symmetrical design with triangular Core. Built-in shielding against static charges Calibration in air from 100 MHz to 2.5 GHz. In brain and muscle simulating tissue at frequencies from 800 to 6000 MHz (accuracy of 8%).

Frequency 100 MHz to 6 GHz; Linearity ; 0.25 dB (100 MHz to 6 GHz) , Directivity : 0.25 dB in brain tissue (rotation around probe axis) 0.5 dB in brain tissue (rotation normal probe axis) Dynamic : 0.001W/kg to > 100W/kg; Range Linearity: 0.25 dB Surface : 0.2 mm repeatability in air and liquids Dimensions Overall length: 330 mm Tip length: 16 mm Body diameter: 8 mm Tip diameter: 2.6 mm Distance from probe tip to dipole centers: <1.5 mm Application General dosimetric up to 6 GHz Compliance tests of GSM Notebooks Fast automatic scanning in arbitrary phantoms

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique, with printed resistive lines on ceramic substrates.

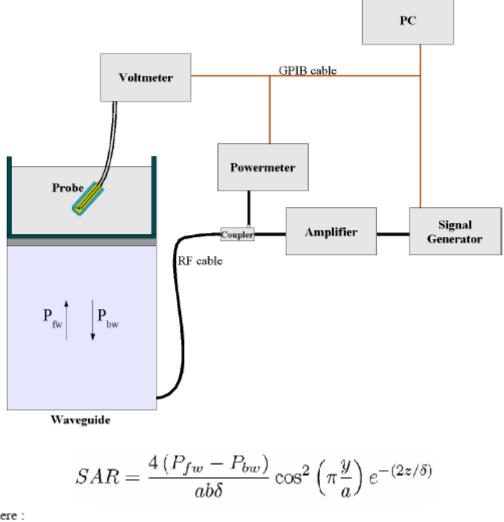


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It is connected to the KRC box on the robot arm and provides an automatic detection of the phantom surface. The 3D file of the phantom is include in OpenSAR software. The Video Positioning System allow the system to take the automatic reference and to move the probe safely and accurately on the phantom.

E-Field Probe Calibration Process

Probe calibration is realized, in compliance with CENELEC EN50361; CEI/IEC 62209 and IEEE 1528 std, with CALISAR, SATIMO proprietary calibration system. The calibration is performed with the technique using reference waveguide.



Where :

 P_{fw} = Forward Power = Backward Power P_{bw} a and b = Waveguide dimensions = Skin depth δ

Keithley configuration:

Rate = Medium; Filter =ON; RDGS=10; FILTER TYPE =MOVING AVERAGE; RANGE AUTO

After each calibration, a SAR measurement is performed on a validation dipole and compared with a NPL calibrated probe, to verify it.



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Each probe is calibrated according to a dosimetric assessment procedure described in SAR standard with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in SAR standard and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 0.8 GHz, and in a waveguide above 0.8 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. E-field correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue.

SAM Phantom

The SAM Phantom SAM29 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 1528 and CENELEC EN62209-1, IEC62209-2.

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 all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness: 2 0.2 mm

Filling Volume: Approx. 25 liters

Dimensions (H x L x W): 810 x 1000 x 500 mm

Liquid is filled to at least 15mm from the bottom of Phantom.





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Device Holder

In combination with the Generic Twin Phantom V3.0, 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).



Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Data Evaluation

Probe Parameters	- Sensitivity	Norm _i
	- Conversion factor	ConvFi
	- Diode compression point Dcpi	
Device Parameter	- Frequency	f
	- Crest factor	cf
Media Parametrs	- Conductivity	σ
	- Density	ρ

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

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the OPENSAR components.

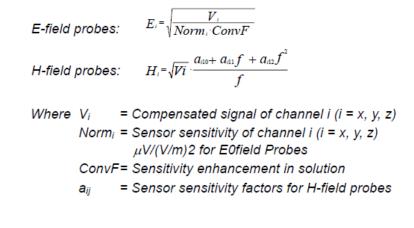
The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting 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

$$\begin{split} V_{i} = U_{i} + U_{i}^{2} \cdot \frac{cf}{dcp_{i}} \\ Where \quad V_{i} &= Compensated \ signal \ of \ channel \ i \ (i = x, \ y, \ z) \\ U_{i} &= Input \ signal \ of \ channel \ i \ (i = x, \ y, \ z) \\ cf &= Crest \ factor \ of \ exciting \ field (DASY \ parameter) \\ dcp_{i} &= Diode \ compression \ point (DASY \ parameter) \end{split}$$



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



- f = Carrier frequency (GHz)
- *E_i* = *Electric field strength of channel i in V/m*
- H_i = Magnetic field strength of channel i in A/m

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

 $E_{uv} - \sqrt{E_{z}^{2} + E_{y}^{2} + E_{z}^{2}}$

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

$$SAR - E_{in}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

where 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.

The power flow density is calculated assuming the excitation field as a free space field.

$$\begin{array}{lll} P_{pw} = \frac{E_{ax}^2}{3770} & \text{or} & P_{pw} = H_{ba}^2 \cdot 37.7 \\ \text{where } P_{pwe} &= Equivalent \text{ power density of a plane wave in mW/cm2} \\ E_{tot} &= total \text{ electric field strength in V/m} \\ H_{tot} &= total \text{ magnetic field strength in A/m} \end{array}$$



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SAR Evaluation – Peak Spatial - Average

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

Power Reference Measurement

The reference and 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. The sophisticated 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 5 x 5 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.

SAR Evaluation – Peak SAR

The procedure for spatial peak SAR evaluation has been implemented according to the IEEE1529 standard. It can be conducted for 1 g and 10 g. The OPENSAR 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 maximum 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.



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Extrapolation

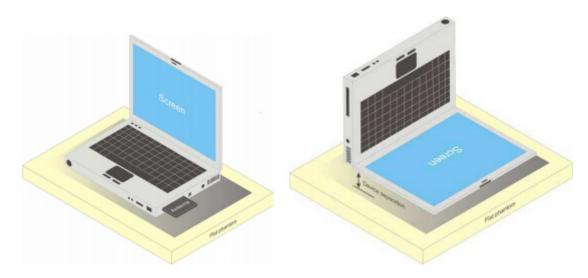
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation.

They are used in the Cube Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the fourth order least square polynomial method for extrapolation. For a grid using 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.

Test Position – Body Worn Configurations

Body Worn Position

- (a) To position the device parallel to the phantom surface with either keypad up or down.
- (b) To adjust the device parallel to the flat phantom.
- (c) To adjust the distance between the device surface and the flat phantom to 1.5 cm or holster surface and the flat phantom to 0 cm.





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5 ANSI/IEEE C95.1 – 1999 RF EXPOSURE LIMIT

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure over his or her exposure by leaving the area or by some other appropriate means.

Table 8.1 Human Exposure Limits

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIROMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR ¹ Brain	1.60	8.00
SPATIAL AVERAGE SAR ² Whole Body	0.08	0.40
SPATIAL PEAK SAR ³ Hands, Feet, Ankles, Wrists	4.00	20.00

¹ The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

² The Spatial Average value of the SAR averaged over the whole body.

³ The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.



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SYSTEM AND LIQUID VERIFICATION 6

Basic SAR system validation requirements

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components. Reference dipoles are used with the required tissue-equivalent media for system validation.

The detailed system validation results are maintained by each test laboratory, which are normally not required for equipment approval. Only a tabulated summary of the system validation status, according to the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters is required in the SAR report.

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 the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

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 beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:

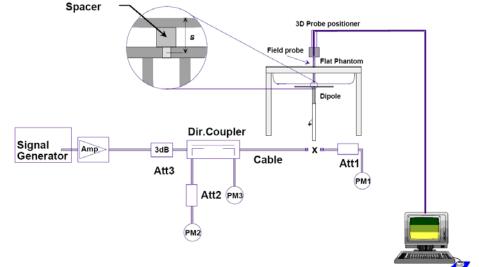


Fig 8.1 System Setup for System Evaluation

- 1. Signal Generator
- 2. Amplifier
- 3. Directional Coupler
- 4. Power Meter
- 5. Calibrated Dipole

Note: The output power on dipole port must be calibrated to 30 dBm (1000 mW) before dipole is connected.



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System Verification Results

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (above feed-point)	Local SAR at surface (y = 2 cm offset from feed-point) ^a
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	4.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2000	41.1	21.1	74.6	6.5
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

Prior to SAR assessment, the system is verified to 10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in ANNEX A

Target and measurement SAR after Normalized (1W):

Measurement Date	Frequency (MHz)	Liquid Type (head/body)	Target SAR1g (W/kg)	Measured SAR1g (W/kg)	Normalized SAR1g (W/kg)	Deviation (%)
November 18, 2015	2450	body	56.05	0.551	55.1	-0.95

Note: system check input power: 10mW



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Liquid Verification

The dielectric parameters were checked prior to assessment using the HP85070C dielectric probe kit. The dielectric parameters measured are reported in each correspondent section.

KDB 865664 recommended Tissue Dielectric Parameters

The head and body tissue parameters given in this below table should be used to measure the SAR of transmitters operating in 100 MHz to 6 GHz frequency range. The tissue dielectric parameters of the tissue medium at the test frequency should be within the tolerance required in this document. The dielectric parameters should be linearly interpolated between the closest pair of target frequencies to determine the applicable dielectric parameters corresponding to the device test frequency.

The head tissue dielectric parameters recommended by IEEE Std 1528-2003 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in 1528 are derived from tissue dielectric parameters computed from the 4-Cole-Cole equations described above and extrapolated according to the head parameters specified in 1528.

Target Frequency	He	ead	В	ody
(MHz)	ε _r	σ (S/m)	ε _r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 - 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ϵ_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m³)

Liquid Confirmation Result:

Date	Freq.(MHz)	Liquid Parameters	Measured	Target	Delta (%)	Limit±(%)
November	2450	Relative Permittivity (ɛr):	52.78	52.70	0.15	5
18, 2015	2450	Conductivity (σ):	1.97	1.95	1.03	5



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System Verification Plots Product Description: Dipole Model: SID2450

Test Date: November 18, 2015

Medium(liquid type) Frequency (MHz)	MSL_2450 2450.00
Relative permittivity (real part)	52.78
Conductivity (S/m)	1.97
Input power	10mW
Crest factor	1.0
E-Field Probe	SN 27/15 EPGO262
Conversion Factor	2.29
Area Scan	dx=8mm dy=8mm
Zoom Scan	5x5x7,dx=8mm dy=8mm dz=5mm
Variation (%)	3.300000
SAR 10g (W/Kg)	0.320642
SAR 1g (W/Kg)	0.551273 SAR Waxdedon Graphical Interface
$\begin{tabular}{ c c c c c c } \hline Surface Radiated Intervalsy & Committed Intervalsy & Com$	Columa Scale Volume Radiade (laveral) Zom In/Out Columa Scale 0.51482 0.025076 0.025076 0.025076 0.025076 0.025076 0.025076 0.015077 0.015077 0.015077 100 100 100 Columa Scale 0.01507 0.015077 00 00 00 00 Columa Scale 0.015070 00 00 00 00 00 Columa Columa 0.016070 00 00 00 00 00 Savet pan 0.016070 00 00 00 00 00 00 Savet pan 0.016070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00



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7 UNCERTAINTY ASSESSMENT

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table below :

Uncertainty Distribution	Normal	Rectangle	Triangular	U Shape
Multi-plying Factor ^(a)	1/k ^(b)	1 / √3	1 / √6	1 / √2

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type -sum-by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %.

The COMOSAR Uncertainty Budget is show in below table:

The following table includes the uncertainty table of the IEEE 1528 from 300MHz to 3GHz and KDB865664 to 6GHZ too, The values are determined by Satimo.



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UNCERTAINTY FOR SYSTEM PERFORMANCE CHECK

	Г <u> </u>	T			1	1	1	
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	ci (1 g)	ci (10 g)	1 g ui (± %)	10 g ui (± %)	Vi
Measurement System								
Probe Calibration	5,8	N	1	1	1	5,8	5,8	∞
Axial Isotropy	3,5	R	√3	(1- cp)1/2	(1- cp)1/2	1,42887	1,42887	×
Hemispherical Isotropy	5,9	R	√3	√Ср	√Ср	2,40866	2,40866	∞
Boundary Effect	1	R	√3	1	1	0,57735	0,57735	∞
Linearity	4,7	R	√3	1	1	2,71355	2,71355	∞
System Detection Limits	1	R	√3	1	1	0,57735		∞
Readout Electronics	0,5	Ν	1	1	1	0,5	0,5	∞
Response Time	0	R	√3	1	1	0	0	∞
Integration Time	1,4	R	√3	1	1	0,80829	0,80829	∞
RF Ambient Conditions	3	R	√3	1	1	1,73205	1,73205	∞
Probe Positioner Mechanical Tolerance	1,4	R	√3	1	1	0,80829	0,80829	×
Probe Positioning with respect to Phantom Shell	1,4	R	√3	1	1	0,80829	0,80829	8
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	2,3	R	√3	1	1	1,32791	1,32791	∞
Dipole								
Dipole Axis to Liquid Distance	2	Ν	√3	1	1	1,1547	1,1547	N-1
Input Power and SAR drift measurement	5	R	√3	1	1	2,88675	2,88675	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	√3	1	1	2,3094	2,3094	∞
Liquid Conductivity - deviation from target values	5	R	√3	0,64	0,43	1,84752	1,2413	∞
Liquid Conductivity - measurement uncertainty	4	Ν	1	0,64	0,43	2,56	1,72	М
Liquid Permittivity - deviation from target values	5	R	√3	0,6	0,49	1,73205	1,41451	∞
Liquid Permittivity - measurement uncertainty	5	N	1	0,6	0,49	3	2,45	М
Combined Standard Uncertainty		RSS				9,6671	9,1645	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)		k				19,3342	18,3290	



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UNCERTAINTY EVALUATION FOR HANDSET SAR TEST

		-						
Uncertainty Component	Tol. (± %)	Prob. Dist.	Div.	c _i (1 g)	c _i (10 g)	1 g u _i (± %)	10 g u _i (± %)	Vi
Measurement System								·
Probe Calibration	5,8	Ν	1	1	1	5,8	5,8	8
Axial Isotropy	3,5	R	√3	$(1-c_p)^{1/2}$	$(1-c_p)^{1/2}$	1,43	1,43	∞
Hemispherical Isotropy	5,9	R	√3	√Cp	$\sqrt{C_p}$	2,41	2,41	∞
Boundary Effect	1	R	√3	1	1	0,58	0,58	∞
Linearity	4,7	R	√3	1	1	2,71	2,71	8
System Detection Limits	1	R	√3	1	1	0,58	0,58	∞
Readout Electronics	0,5	Ν	1	1	1	0,50	0,50	8
Response Time	0	R	√3	1	1	0,00	0,00	8
Integration Time	1,4	R	√3	1	1	0,81	0,81	∞
RF Ambient Conditions	3	R	√3	1	1	1,73	1,73	∞
Probe Positioner Mechanical Tolerance	1,4	R	√3	1	1	0,81	0,81	∞
Probe Positioning with respect to Phantom Shell	1,4	R	√3	1	1	0,81	0,81	8
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	2,3	R	√3	1	1	1,33	1,33	∞
Test sample Related						-		
Test Sample Positioning	2,6	Ν	1	1	1	2,60	2,60	N-1
Device Holder Uncertainty	3	Ν	1	1	1	3,00	3,00	N-1
Output Power Variation - SAR drift measurement	5	R	√3	1	1	2,89	2,89	∞
Phantom and Tissue Parameters								
Phantom Uncertainty (shape and thickness tolerances)	4	R	√3	1	1	2,31	2,31	8
Liquid Conductivity - deviation from target values	5	R	√3	0,64	0,43	1,85	1,24	×
Liquid Conductivity - measurement uncertainty	4	N	1	0,64	0,43	2,56	1,72	М
Liquid Permittivity - deviation from target values	5	R	√3	0,6	0,49	1,73	1,41	∞
Liquid Permittivity - measurement uncertainty	5	Ν	1	0,6	0,49	3,00	2,45	М
Combined Standard Uncertainty		RSS				10,39	9,92	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)		k				20,78	19,84	



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8 TEST INSTRUMENT

TEST INSTRUMENT	TATION				
Name of Equipment	Manufacturer	Type/Model	Serial Number	Calibration Date	Calibration Due
PC	Compaq	PV 3.06GHz	375052-AA1	N/A	N/A
Signal Generator	Agilent	8665B-008	3744A10293	05/15/2015	05/15/2016
MultiMeter	Keithley	MiltiMeter 2000	1259033	06/21/2015	06/21/2016
S-Parameter Network Analyzer	Agilent	8753ES	US39173518	08/04/2015	08/04/2016
Wireless Communication Test Set	R&S	CMU200	111078	07/22/2015	07/22/2016
Power Meter	HP	437B	3038A03648	05/17/2015	05/17/2016
E-field PROBE	MVG	SSE2	SN 27/15 EPGO262	07/09/2015	07/09/2016
DIPOLE 2450	SATIMO	SID 2450	SN 31/10 DIPJ138	06/13/2015	06/13/2016
Communication Antenna	SATIMO	ANTA3	SN 20/11 ANTA 3	06/21/2015	06/20/2016
Laptop POSITIONING DEVICE	SATIMO	LSH15	SN 24/11 LSH15	N/A	N/A
e\POSITIONING DEVICE	SATIMO	MSH73	SN 24/11 MSH73	N/A	N/A
DUMMY PROBE	ANTENNESSA		DP41	N/A	N/A
SAM PHANTOM	SATIMO	SAM87	SN 24/11 SAM87	N/A	N/A
Elliptic Phantom	SATIMO	ELLI20	SN 20/11ELLI20	N/A	N/A
PHANTOM TABLE	SATIMO	N/A	N/A	N/A	N/A
6 AXIS ROBOT	KUKA	KR5	949272	N/A	N/A
high Power Solid State Amplifier (80MHz~1000MHz)	Instruments for Industry	CMC150	M631-0408	N/A	N/A
Medium Power Solid State Amplifier (0.8~4.2GHz)	Instruments for Industry	S41-25	M629-0408	N/A	N/A
Wave Tube Amplifier 4- 8 GHz at 20Watt	Hughes Aircraft Company	1277H02F000	81	N/A	N/A



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9 OUTPUT POWER VERIFICATION

Test Condition:

1. 2	Conducted Measurement EUT was set for low, mid, high char The base station simulator was con Conducted Emissions Measuremer		t RF output power.
L	All test measurements carried out a	re traceable to national standards. Th	ne uncertainty of the measurement at a re normal), with a coverage factor of 2, in the
3	Environmental Conditions	Temperature	23°C
		Relative Humidity	53%
		Atmospheric Pressure	1019mbar
4	Test Date : November 18, 2015 Tested By :Wiky Jam		

Test Result:

2.4G Mode

Mode	Channel number	Frequency (MHz)	Data rate(Mbps)	Average Output Power(dBm)	Average Tune up limited(dBm)
	1	2412	1	16.54	16±1
802.11b	6	2437	1	16.59	16±1
	11	2462	1	16.48	16±1
	1	2412	6	15.33	15±1
802.11g	6	2437	6	15.67	15±1
	11	2462	6	15.46	15±1
	1	2412	MCS0	13.44	13±1
802.11n(HT20)	6	2437	MCS0	13.59	13±1
	11	2462	MCS0	13.23	13±1
	3	2422	MCS0	11.45	12±1
802.11n(HT40)	6	2437	MCS0	11.53	12±1
	9	2452	MCS0	11.32	12±1



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23°C

53%

1019mbar

-

10 SAR TEST RESULTS

Test Condition:

1. SAR Measurement

The distance between the EUT and the antenna of the emulator is more than 50 cm and the output power radiated from the emulator antenna is at least 30 dB less than the output power of EUT.

- 2 Measurement Uncertainty: See page 26 for detail
- Environmental Conditions
 Temperature Relative Humidity Atmospheric Pressure
 Test Date : November 18, 2015 Tested By : Wiky Jam

SAR Summary Test Result:

2.4 G (802.11b)

Date of Measured : November 18, 2015					Body Separation Distance:0cm		
Position	Channel	SAR 1g(W/kg)	Limit (W/kg)	Power Drift (%)	Maximum Turn-up Power(dBm)	measured output power (dBm)	Scaled Maximum SAR(W/kg)
Body-UP	Mid	0.175	1.6	-1.1	17	16.59	0.19
Body-Back	Mid	0.527	1.6	-0.13	17	16.59	0.58

Note: 1. KDB447498, SAR was performed at the highest power channel of each frequency, when the 1-g SAR result was <0.8W/kg, testing for other channel is optional.

Measurement variability consideration

According to KDB 865664 D01v01 section 2.8.1, repeated measurements are required following the procedures as below:

- 1. Repeated measurement is not required when the original highest measured SAR is < 0.80W/kg; steps 2) through 4) do not apply.
- 2. When the original highest measured SAR is \ge 0.80 W/kg, repeat that measurement once.
- 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 (~ 10% from the 1-g SAR limit).
- Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20. Measured SAR (W/Kg)

Repeated SAR:

Simultaneous Transmission SAR Analysis.

Note: No Simultaneous SAR was required



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11 SAR MEASUREMENT REFERENCES

References

- 1. FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- 2. IEEE Std. C95.1-1991, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz", 1991
- 3. 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", June 2013
- 4. IEC 62209-2, "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices—Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate(SAR) for wireless communication devices used in close proximity to the human body(frequency range of 30MHz to 6GHz)", April 2010
- 5. FCC KDB 447498 D01 v05r02, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Feb 7th, 2014
- 6. FCC KDB 865664 D01 v01 r03, "SAR Measurement Requirements 100MHz to 6GHz", Feb 7th, 2014
- 7. FCC KDB 941225 D06 V02, SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities, Oct 16th, 2014.



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Maximum SAR measurement Plots

Test mode: 2.4G (802.11b), Mid Channel (Body-UP) Product Description: Notebook Model: 14DTB1 Test Date: November 18, 2015

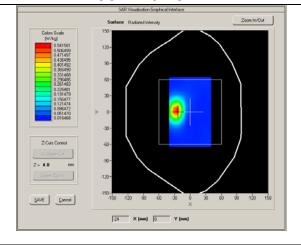
Test Date: November 18, 2015	
Medium(liquid type)	MSL_2450
Frequency (MHz)	2437.0000
Relative permittivity (real part)	52.78
Conductivity (S/m)	1.97
E-Field Probe	SN 27/15 EPGO262
Crest factor	1.0
Conversion Factor	2.29
Sensor-Surface	4mm
Area Scan	dx=8mm dy=8mm
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm
Variation (%)	-1.100000
SAR 10g (Ŵ/Kg)	0.092923
SAR 1g (W/Kg)	0.175379
SURFACE SAR	VOLUME SAR
SAR Visualization Graphical Interface	SAR Visualization Graphical Interface
0//Agii 0///Agii <t< td=""><td>(M/Ag) 120-1 1 107-14 00-1 1 107-14 00-1 0 10744 00-1 0 10744 00-1 0 10744 00-1 0 10744 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 004153 00-1 2Cas Control 00-1 2SAVE Consel SAVE Consel 150 120 40 40 150 120 40 40 40 150 120 40 40 40 150 120 40 40 40 40</td></t<>	(M/Ag) 120-1 1 107-14 00-1 1 107-14 00-1 0 10744 00-1 0 10744 00-1 0 10744 00-1 0 10744 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 00747 00-1 0 004153 00-1 2Cas Control 00-1 2SAVE Consel SAVE Consel 150 120 40 40 150 120 40 40 40 150 120 40 40 40 150 120 40 40 40 40

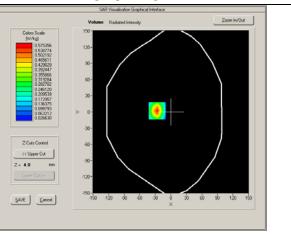


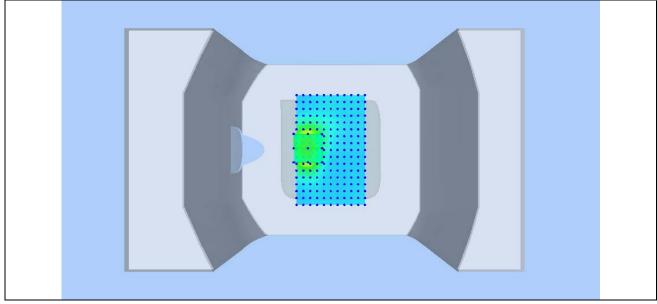
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Test mode: 2.4G(802.11b), Mid Channel (Body-Down) Product Description: Notebook Model: 14DTB1 Test Date: November 18, 2015

SAR 1g (W/Kg) SURFACE SAR	0.526929 VOLUME SAR
SAR 10g (W/Kg)	0.273261
Variation (%)	-0.130000
Zoom Scan	7x7x7,dx=5mm dy=5mm dz=5mm
Area Scan	dx=8mm dy=8mm
Sensor-Surface	4mm
Conversion Factor	2.29
Crest factor	1.0
E-Field Probe	SN 27/15 EPGO262
Conductivity (S/m)	1.97
Relative permittivity (real part)	52.78
Frequency (MHz)	2437.0000
Medium(liquid type)	MSL_2450









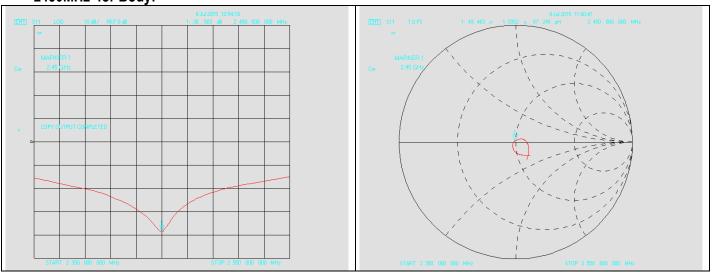
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Annex A CALIBRATION REPORTS

SARTIMO Calibration Certificate-Extended Dipole Calibrations

According to KDB865664 D01, 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.

- When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous 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 5Ω from the previous measurement



Dipole Verification plot: SID 2450 SN 18/11 DIPJ155 2450MHz for Body:

SID 2450 SN 18	SID 2450 SN 18/11 DIPJ155 For Body				
Return- Loss (dB)	Deviate (dB)	Real Impedance (Ω)	Imaginary Impedance (Ω)	Deviate (Ω)	Calibrate Date
-38.8			50		06/18/2014
-38.503	0.297	49.463	50	-0.537	07/08/2015

According to up table, the return loss is <-20dB, deviates by less than 20% from the previous measurement; the real Impedance are all within 5 Ω compared to the required Impedance (50 Ω).



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COMOSAR E-Field Probe Calibration Report

Ref : ACR.265.1.15.SATU.A

SIEMIC TESTING AND CERTIFICATION SERVICES

ZONE A,FLOOR 1,BUILDING 2,WAN YE LONG TECHNOLOGY PARK,SOUTH SIDE OF ZHOUSHI ROAD, SHIYAN STREET,BAO'AN DISTRICT, SHENZHEN 518108, GUANGDONG, P.R.C.

MVG COMOSAR DOSIMETRIC E-FIELD PROBE SERIAL NO.: SN 27/15 EPG0262

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



Calibration Date: 07/09/2015

Summary:

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



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mvg"	COMOSAR E-FIELD PRO	BE CALIBRATION REPOR	г	Ref ACR.265.1.15.SATU.A
	Name	Function	Date	Signature
Prepared by :	Name Jérôme LUC	Function Product Manager	Date 9/22/2015	Signature JS
Prepared by : Checked by :				Signature J SS J SS

	Customer Name
Distribution :	SIEMIC TESTING AND CERTIFICATION SERVICES

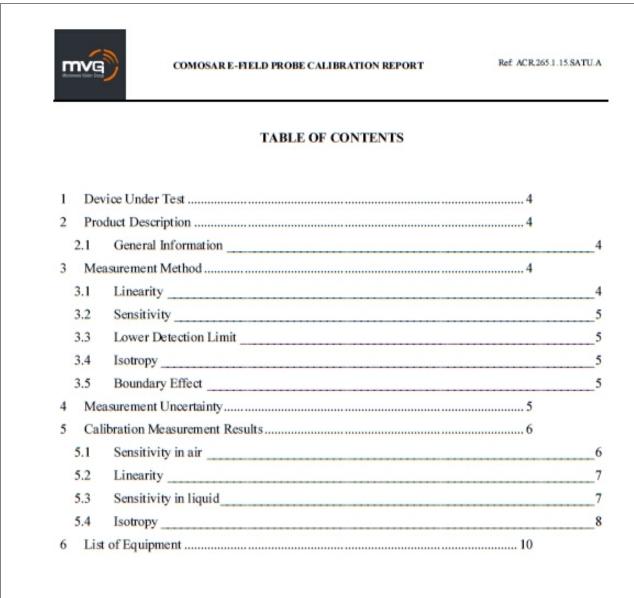
Issue	Date	Modifications	
A	9/22/2015	Initial release	

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1

COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref ACR,265.1.15.SATU.A

DEVICE UNDER TEST

Device Under Test		
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE	
Manufacturer	MVG	
Model	SSE2	
Serial Number	SN 27/15 EPGO262	
Product Condition (new / used)	New	
Frequency Range of Probe	0.7 GHz-6GHz	
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.222 MΩ	
	Dipole 2: R2=0.200 MΩ	
	Dipole 3: R3=0.200 MΩ	

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

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



Figure 1 – MVG COMOSAR Dosimetric E field Dipole

Probe Length	330 mm
Length of Individual Dipoles	2 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	2.5 mm
Distance between dipoles / probe extremity	1 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.

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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.

ERROR SOURCES	Uncertainty value (%)	Probability Distribution	Divisor	ci	Standard Uncertainty (%)
Incident or forward power	3.00%	Rectan gular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectan gular	<u></u> √3	1	1.732%
Liquid conductivity	5.00%	Rectan gular	<u></u> √3	1	2.887%
Liquid permittivity	4.00%	Rectan gular	<u></u>	1	2.309%
Field homogeneity	3.00%	Rectangular	<u> </u>	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref ACR,265.1.15.SATU.A

Field probe linearity	3.00%	Rectan gular	√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 %	

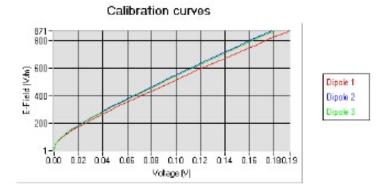
5.1 SENSITIVITY IN AIR

Normx dipole 1 (µV/(V/m) ²)		Normz dipole 3 $(\mu V/(V/m)^2)$
0.78	0.70	0.72

DCP dipole 1	DCP dipole 2	DCP dipole 3
(mV)	(mV)	(mV)
92	90	90

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

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



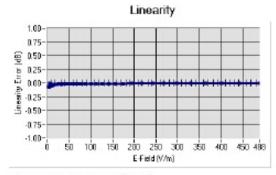
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5.2 LINEARITY



Linearity:1+/-1.78% (+/-0.08dB)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL750	750	41.82	0.90	1.68
BL750	750	56.28	0.98	1.74
HL850	835	42.59	0.90	1.90
BL850	835	53.19	0.97	1.97
HL900	900	42.05	0.98	1.75
BL900	900	56.41	1.08	1.81
HL1800	1800	41.82	1.38	2.01
BL1800	1800	53.00	1.52	2.05
HL1900	1900	40.38	1.41	2.26
BL1900	1900	53.93	1.55	2.32
HL2000	2000	40.12	1.43	2.16
BL2000	2000	53.65	1.54	2.25
HL2450	2450	38.34	1.80	2.22
BL2450	2450	52.70	1.94	2.29
HL2600	2600	38.16	1.93	2.28
BL2600	2600	51.55	2.21	2.34
HL3500	3500	37.01	2.89	2.31
BL3500	3500	52.99	3.20	2.40
HL5200	5200	36.44	4.79	1.96
BL5200	5200	50.70	5.11	2.04
HL5400	5400	35.99	4.91	2.11
BL5400	5400	50.01	5.64	2.22
HL5600	5600	35.22	5.18	2.15
BL5600	5600	49.34	5.85	2.21
HL5800	5800	34.95	5.42	2.13
BL5800	5800	48.54	6.22	2.18

LOWER DETECTION LIMIT: 8mW/kg

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COMOSAR E-FIELD PROBE CALIBRATION REPORT

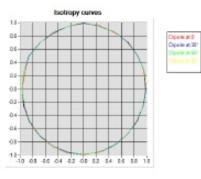
Ref. ACR.265.1.15.SATU.A

5.4 ISOTROPY

HL5600 MHz

- Axial isotropy:
- Hemispherical isotropy:

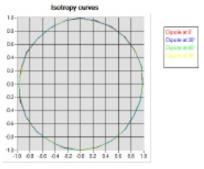
0.04 dB 0.05 dB



HL5600 MHz

- Hemispherical isotropy:

0.04 dB 0.07 dB



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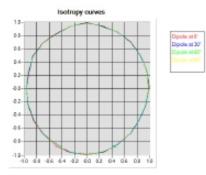
COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR,265.1.15.SATU.A

HL5600 MHz

- Axial isotropy:
- Hemispherical isotropy:

0.06	dB
0.10	dB



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COMOSAR E-FIELD PROBE CALIBRATION REPORT

Ref. ACR.265.1.15.SATU.A

6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
Flat Phantom	MVG	SN-20/09-SAM71	Validated. No cal required.	Validated. No cai required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No ca required.
Network Analyzer	Rhode & Schwarz ZVA	SN 100132	02/2013	02/2016
Reference Probe	MVG	EP 94 SN 37/08	10/2014	10/2015
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

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SAR Reference Dipole Calibration Report

Ref : ACR.170.6.14.SATU.A

SIEMIC TESTING AND CERTIFICATION SERVICES ZONE A,FLOOR 1,BUILDING 2,WAN YE LONG TECHNOLOGY PARK,SOUTH SIDE OF ZHOUSHI ROAD, SHIYAN STREET,BAO'AN DISTRICT, SHENZHEN 518108, GUANGDONG, P.R.C. SATIMO COMOSAR REFERENCE DIPOLE FREQUENCY: 2450 MHZ SERIAL NO.: SN 18/11 DIPJ155

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



06/18/2014

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.



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	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	6/19/2014	JS
Checked by :	Jérôme LUC	Product Manager	6/19/2014	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	6/19/2014	thim Authowski

	Customer Name
Distribution :	SIEMIC Testing and Certification Services

Issue	Date	Modifications
Α	6/19/2014	Initial release

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SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.170.6.14.SATU.A

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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 18/11 DIPJ155		
Product Condition (new / used) used			

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

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SAR REFERENCE DIPOLE CALIBRATION REPORT

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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 %

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SATIMO

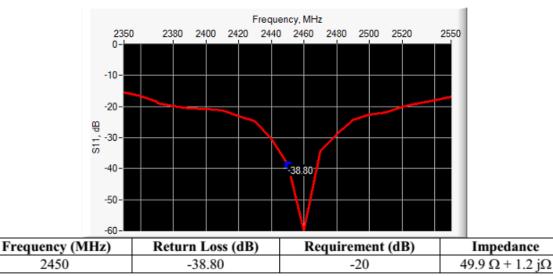
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6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



6.2 MECHANICAL DIMENSIONS

Frequency MHz	Lmm		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 %.	

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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 MEASUREMENT CONDITION

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 39.1 sigma : 1.78
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 %

7.2 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative per	mittivity (ɛ,')	Conductiv	ity (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 %	

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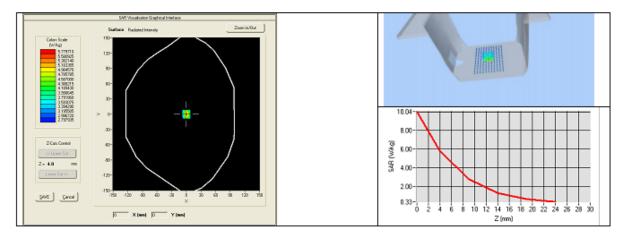


Ref: ACR.170.6.14.SATU.A

7.3 MEASUREMENT RESULT

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.

Frequency MHz	1 g SAR (W/kg/W)			10 g SAR	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	55.06 (5.51)	24	24.17 (2.42)		
2600	55.3		24.6			
3000	63.8		25.7			
3500	67.1		25			



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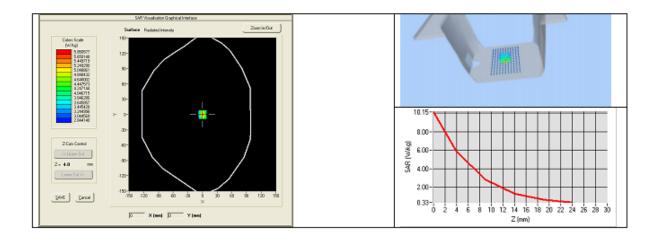


Ref: ACR.170.6.14.SATU.A

7.4 BODY MEASUREMENT RESULT

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.2 sigma : 1.90
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	56.05 (5.60)	24.71 (2.47)	



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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	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
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	

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SAR REFERENCE WAVEGUIDE CALIBRATION REPORT

Ref: ACR.170.8.14.SATU.A

8 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	
Calipers	Carrera	CALIPER-01	12/2013	12/2016	
Reference Probe	Satimo	EPG122 SN 18/11	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.	
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	

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Annex B SAR System PHOTOGRAPHS



Liquid depth \ge 15cm





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Annex C SETUP PHOTOGRAPHS

Body Setup Photo (Body Up)





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Body Setup Photo (Body Back)

