SAR Test Report

Report No.: AGC00665150401FH01

FCC ID	:	AJZDWO-4
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	Bluetooth Helmet Headset
BRAND NAME	:	N/A
MODEL NAME	:	DWO-4
CLIENT	:	Jiangmen Pengcheng Helmets Ltd.
DATE OF ISSUE	:	Apr. 25, 2015
STANDARD(S)	:	IEEE Std. 1528:2003 IEEE1528a:2005 47CFR § 2.1093 IEEE/ANSI C95.1
REPORT VERSION	:	V1.0

Attestation of Global Compliance(Shenzhen) Co., Ltd.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Apr. 25, 2015	Valid	Original Report

The test plans were performed in accordance with IEEE Std. 1528:2003; 47CFR § 2.1093; IEEE/ANSI C95.1 and the following specific FCC Test Procedures:

・KDB 447498 D01 General RF Exposure Guidance v05r02

・KDB 648474 D04 Handset SAR v01r02

・KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r03

Test Report Certification

Applicant Name	:	Jiangmen Pengcheng Helmets Ltd.
Applicant Address	:	Dong Sheng Road No.1-7, Gonghe Town, Heshan City, China
Manufacturer Name	:	Shenzhen XinLangRui Electronic Co., Ltd.
Manufacturer Address	:	C Building, Nanhu industrial district, Shahu street, Pingshan new district Longgang, Shenzhen City, China
Product Designation	:	Bluetooth Helmet Headset
Brand Name	:	N/A
Model Name	:	DWO-4
Different Description		N/A
EUT Voltage	:	DC3.7V by battery
Applicable Standard	:	IEEE Std. 1528:2003 IEEE1528a:2005 47CFR § 2.1093 IEEE/ANSI C95.1
Test Date	:	Apr. 24, 2015
Performed Location		Attestation of Global Compliance(Shenzhen) Co., Ltd. 2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China
Report Template		AGCRT-US-2G4/SAR (2015-04-03)

Tested By: Bobby Wang — Apr. 25, 2015

Checked By: Angela Li — Apr. 25, 2015

Authorized By: Solger Zhang — Apr. 25, 2015

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1. SUMMARY OF MAXIMUM SAR VALUE

The maximum results of Specific Absorption Rate (SAR) found during testing for EUT are as follows:

Highest Tested & Reported SAR Summary

Exposure Position	Frequency Band	Highest Tested Maximum SAR(W/Kg)	Highest Reported SAR(W/Kg)
Body	2.4G Band	**0.239**	**0.309**

This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/Kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with measurement methods and procedures specified in IEEE 1528-2003 and the relevant KDB files like KDB 941225 D01 ,KDB 865664 D02….etc.

2. GENERAL INFORMATION

2.1. EUT Description

General Information	
Product Designation	Bluetooth Helmet Headset
Test Model	DWO-4
Hardware Version	DWO-4_M1A2
Software Version	DWO_REV:02
Device Category	Portable
RF Exposure Environment	Uncontrolled
Antenna Type	Internal
Bluetooth	
Bluetooth Version	☐V2.0 ☐V2.1 ☐V2.1+EDR ☒V3.0 ☐V3.0+HS ☐V4.0
Operation Frequency	2402~2480MHz
Type of modulation	☒GFSK ☒∏/4-DQPSK ☒8-DPSK
Avg. Burst Power	19.01dBm
Antenna Gain	0dBi
Accessories	
Battery	Brand name: N/A Model No. : CPL602046-530mah Voltage and Capacitance: 3.7 V & 530mAh

Product	Type	
	☒ Production unit	☐ Identical Prototype

2.2. Test Procedure

1	Setup the EUT and simulators as shown on above.
2	Turn on the power of all equipment.
3	EUT Communicate with BT equipment , and test them respectively at BT bands

2.3. Test Environment

Ambient conditions in the laboratory:

Items	Required	Actual
Temperature (°C)	18-25	21± 2
Humidity (%RH)	30-70	55±2

3. SAR MEASUREMENT SYSTEM

3.1. Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and occupational/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of given mass density (ρ). The equation description is as below:

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

SAR is expressed in units of Watts per kilogram (W/Kg)
SAR can be obtained using either of the following equations:

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

$$SAR = c_h \left.\frac{dT}{dt}\right|_{t=0}$$

Where

SAR	is the specific absorption rate in watts per kilogram;
E	is the r.m.s. value of the electric field strength in the tissue in volts per meter;
σ	is the conductivity of the tissue in siemens per metre;
ρ	is the density of the tissue in kilograms per cubic metre;
c_h	is the heat capacity of the tissue in joules per kilogram and Kelvin;
$\frac{dT}{dt} \mid t = 0$	is the initial time derivative of temperature in the tissue in kelvins per second

3.2. SAR Measurement Procedure

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

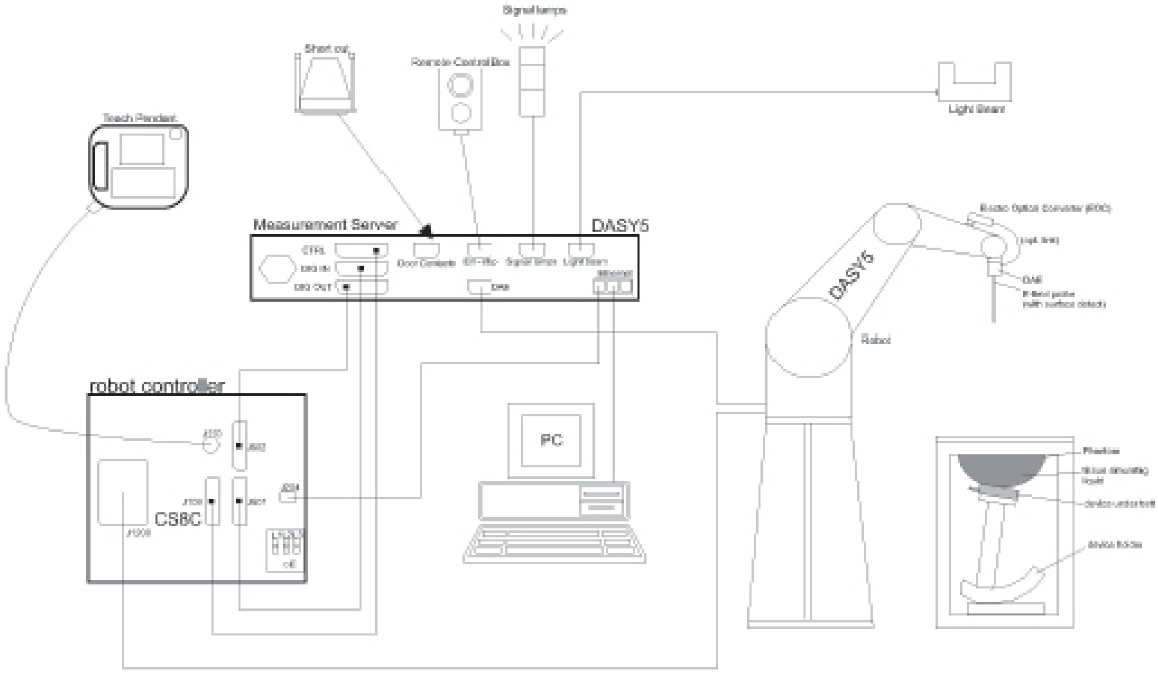
Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the SAM twin phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at $1mm^2$) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at $1mm^3$).

When multiple peak SAR location were found during the same configuration or test mode, Zoom scan shall performed on each peak SAR location, only the peak point with maximum SAR value will be reported for the configuration or test mode.

3.3. DASY5 System Description



DASY5 System Configurations

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

(1)A standard high precision 6-axis robot with controller, teach pendant and software.

(2)A data acquisition electronics (DAE) which attached to the robot arm extension. The DAE consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit.
The mechanical probe mounting device includes two different sensor systems frontal and side-ways probe c ontacts. They are used for mechanical surface detection and probe collision detection.

(3)The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital Communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server..\

(4) A Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.

(5) A computer running WinXP .

(6) DASY software.

(7)Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.

(8) Phantoms, device holders and other accessories according to the targeted measurement.

3.3.1. Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g. IEEE 1528, ANSI C95.1,relevant KDB files and TCB files.

3.3.2. Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for applications utilize a 10mm² step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments. When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003 and relevant KDB files, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

3.3.3. Zoom Scan (Cube Scan Averaging)

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. A density of 1000 kg/m³ is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm. The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications utilize a physical step of 7x7x7 (5mmx5mmx5mm) providing a volume of 30mm in the X & Y axis, and 30mm in the Z axis.

3.3.4. Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Post processor, DASY 5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528.The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets. The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x,y,z) = Ae^{-\frac{z}{2a}}\cos^2\left(\frac{\pi}{2}\frac{\sqrt{x'^2+y'^2}}{5a}\right)$$

$$f_2(x,y,z) = Ae^{-\frac{z}{a}}\frac{a^2}{a^2+x'^2}\left(3-e^{-\frac{2z}{a}}\right)\cos^2\left(\frac{\pi}{2}\frac{y'}{3a}\right)$$

$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4}+x'^2+y'^2}\left(e^{-\frac{2z}{a}}+\frac{a^2}{2(a+2z)^2}\right)$$

3.4. DASY5 E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528 and relevant KDB files.) The calibration data are in Appendix D.

3.5. Isotropic E-Field Probe Specification

<table>
<tr><td>Model</td><td colspan="2">EX3DV4</td></tr>
<tr><td>Manufacture</td><td colspan="2">SPEAG</td></tr>
<tr><td>frequency</td><td>0.3GHz-6 GHz
Linearity:±0.2dB(300 MHz-6 GHz)</td><td rowspan="3"></td></tr>
<tr><td>Dynamic Range</td><td>0.01W/Kg-100W/Kg
Linearity:±0.2dB</td></tr>
<tr><td>Dimensions</td><td>Overall length:337mm
Tip diameter:2.5mm
Typical distance from probe tip to dipole centers:1mm</td></tr>
<tr><td>Application</td><td colspan="2">High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.</td></tr>
</table>

3.6. Robot

<table>
<tr><td>The DASY system uses the high precision robots (DASY5:TX60) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from is used.
The XL robot series have many features that are important for our application:
High precision (repeatability 0.02 mm)
High reliability (industrial design)
Jerk-free straight movements
Low ELF interference (the closed metallic construction shields against motor control fields)
6-axis controller</td><td></td></tr>
</table>

3.7. Light Beam Unit

The light beam switch allows automatic “tooling” of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned prob.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position. e, the same position will be reached with another aligned probe within 0	

3.8. Device Holder

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε=3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.	

3.9. Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chip-disk (DASY5: 128MB), RAM (DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DAYS I/O board, which is directly connected to the PC/104 bus of the CPU board. The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.	

3.10. SAM Twin Phantom

<table>
<tr>
<td>The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:
Left head
Right head
Flat phantom</td>
<td></td>
</tr>
</table>

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

4. TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 4.2

4.1. The composition of the tissue simulating liquid

Ingredient	2450MHz
(100% Weight)	Head
Water	√
Salt(Nacl)	√
Sugar	--
HEC	--
Preventol	--
DGBE	--
TWEEN	--
Triton X-100	√

4.2. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 2450MHz				
Fr. (MHz)	Dielectric Parameters (±5%)		Tissue Temp [°C]	Test time
	head			
	εr 39.2 37.24-41.16	δ[s/m] 1.80 1.71-1.89		
2402	39.98	1.77	22.1	Apr. 24, 2015
2441	39.86	1.79	22.1	Apr. 24, 2015
2450	39.75	1.81	22.1	Apr. 24, 2015
2480	39.21	1.83	22.1	Apr. 24, 2015

4.3. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE 1528 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 IEEE 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in IEEE 1528.

Target Frequency (MHz)	head		body	
	εr	σ (S/m)	εr	σ (S/m)
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	1.01	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

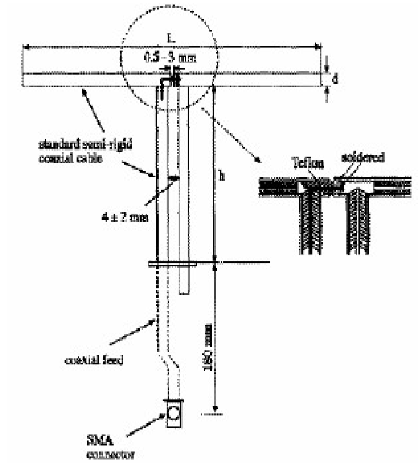
(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m3)

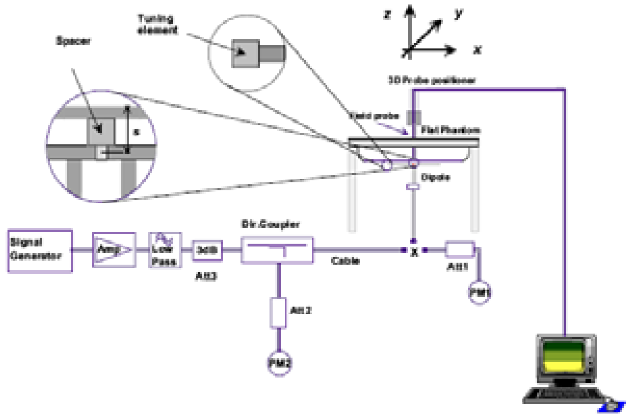
5. SAR MEASUREMENT PROCEDURE

5.1. SAR System Check Procedures

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

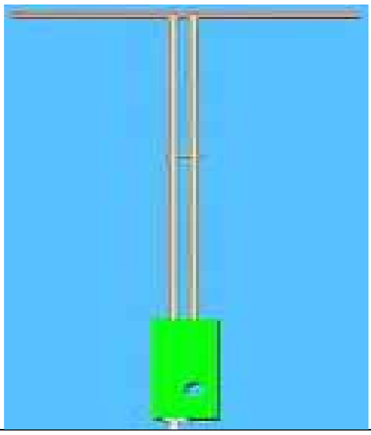
The system check verifies that the system operates within its specifications. It's performed daily or before every SAR measurement. The system check uses normal SAR measurement in the flat section of the phantom with a matched dipole at a specified distance. The system check setup is shown as below.





5.2. SAR System Check

5.2.1. Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical Specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450	51.5	30.4	3.6

5.2.2. System Check Result

System Performance Check at 2450MHz								
Validation Kit: SN46/11 DIP 2G450-189								
Frequency [MHz]	Target Value(W/Kg)		Reference Result (± 10%)		Tested Value(W/Kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g		
2450	54.40	23.75	48.96-59.84	21.375-26.125	52.96	24.32	22.1	Apr. 24, 2015

6. EUT TEST POSITION

This EUT was tested in **Body back.**

6.1. 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 **10mm.**

According to FCC Response on 07/22/2013:
Please provide SAR test data for the side that will face the user's head during operation. Apply the following guidance:
i. Use the flat phantom for testing.
ii. Use a test separation distance of 10 mm away from the phantom (This separation distance was chosen based on the information you provided regarding the minimum separation distance between the device and the user during operation).
iii. Use Head Tissue Simulating Liquid for the test.
iv. Do not use the mounting bracket during the tests (Since the mounting bracket does not contain any metal it should not significantly affect the SAR results).

7. SAR EXPOSURE LIMITS

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit (W/kg)
Spatial Peak SAR (1g cube tissue for brain or body)	1.60
Spatial Average SAR (Whole body)	0.08
Spatial Peak SAR (Limbs)	4.0

8. TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Current calibration date	Next calibration date
Stäubli Robot	Stäubli-TX60	F13/5Q2UD1/A/01	N/A	N/A
Robot Controller	Stäubli-CS8	139522	N/A	N/A
TISSUE Probe	SATIMO	SN 45/11 OCPG45	12/03/2014	12/02/2015
E-Field Probe	Speag-EX3DV4	3953	11/06/2014	11/05/2015
SAM Twin Phantom	Speag-SAM	1790	N/A	N/A
Device Holder	Speag-SD 000 H01 KA	SD 000 H01 KA	N/A	N/A
DAE4	Speag-SD 000 D04 BM	1398	03/11/2015	03/10/2016
SAR Software	Speag-DASY5	DASY52.8	N/A	N/A
Liquid	SATIMO	-	N/A	N/A
Radio Communication Tester	R&S-CMU200	069Y7-158-13-712	03/06/2015	03/05/2016
Dipole	SATIMO SID2450	SN46/11 DIP 2G450-189	11/14/2013	11/13/2016
Signal Generator	Agilent-E4438C	MY44260051	03/06/2015	03/05/2016
Power Sensor	NRP-Z23	US38261498	03/06/2015	03/05/2016
Spectrum Analyzer E4440	Agilent	US41421290	05/27/2014	05/26/2015
Network Analyzer	Rhode & Schwarz ZVL6	SN100132	03/06/2015	03/05/2016
Attenuator	Warison /WATT-6SR1211	N/A	N/A	N/A
Attenuator	Mini-circuits / VAT-10+	N/A	N/A	N/A
Amplifier	EM30180	SN060552	03/06/2015	03/05/2016
Directional Couple	Werlatone/ C6026-10	SN99482	07/30/2014	07/29/2014
Power Sensor	NRP-Z21	1137.6000.02	10/22/2014	10/21/2015
Power Viewer	R&S	V2.3.1.0	N/A	N/A

Note: Per KDB 865664Dipole SAR Validation, AGC Lab has adopted 3 years calibration intervals. On annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:
1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss is within 20% of calibrated measurement;
4. Impedance is within 5Ω of calibrated measurement.

9. MEASUREMENT UNCERTAINTY

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 knowledge of the behavior and properties of relevant materials and instruments, manufacture's 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 as follow.

Uncertainty Distributions	**Normal**	**Rectangular**	**Triangular**	**U-Shape**
Multi-plying Factor(a)	1/k(b)	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(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

Table 13.1 Standard Uncertainty for Assumed Distribution (above table)

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 B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations 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 DASY uncertainty Budget is shown in the following tables.

DAYS5 Measurement Uncertainty Measurement uncertainty for 30 MHz to 3GHz averaged over 1 gram / 10 gram.							
Error Description	Uncertainty value(±10%)	Probability Distribution	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.53	Normal	1	1	1	6.53	6.53
Axial Isotropy	4.6	Rectangular	$\sqrt{3}$	1	1	2.66	2.66
Hemispherical Isotropy	9.3	Rectangular	$\sqrt{3}$	1	1	5.37	5.37
Linearity	4.5	Rectangular	$\sqrt{3}$	1	1	2.60	2.60
Probe Modulation Response	0.2	Rectangular	$\sqrt{3}$	1	1	0.12	0.12
System Detection Limits	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
Boundary Effects	0.9	Rectangular	$\sqrt{3}$	0	0	0	0
Readout Electronics	0.2	Normal	$\sqrt{3}$	1	1	0.12	0.12
Response Time	0	Rectangular	$\sqrt{3}$	1	1	0	0
Integration Time	0	Rectangular	$\sqrt{3}$	1	1	0	0
RF Ambient Noise	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
RF Ambient Reflection	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
Probe Positioner	0.7	Rectangular	$\sqrt{3}$	1	1	0.40	0.40
Probe Positioning	6.5	Rectangular	$\sqrt{3}$	1	1	3.75	3.75
Post-processing	3.8	Rectangular	$\sqrt{3}$	1	1	2.19	2.19
Test Sample Related							
Device Positioning	3.6	Normal	1	1	1	3.6	3.6
Device Holder	2.9	Normal	1	1	1	2.9	2.9
Measurement SAR Drift	5.0	Rectangular	$\sqrt{3}$	1	1	2.89	2.89
Power Scaling	0.0	Rectangular	$\sqrt{3}$	1	1	0	0
Phantom and Setup							
Phantom Uncertainty	3.9	Rectangular	$\sqrt{3}$	1	1	2.25	2.25
Liquid Conductivity(Meas.)	2.4	Normal	1	0.78	0.71	1.87	1.70
Liquid Conductivity(Target)	4.9	Rectangular	$\sqrt{3}$	0.64	0.43	1.81	1.22
Liquid Permittivity(Meas.)	2.4	Normal	1	0.26	0.26	0.62	0.62
Liquid Permittivity((Target)	4.9	Rectangular	$\sqrt{3}$	0.6	0.49	1.70	1.39
Liquid Conductivity-temperature uncertainty	1.6	Rectangular	$\sqrt{3}$	0.78	0.71	0.72	0.66
Liquid Permittivity-temperature uncertainty	0.2	Rectangular	$\sqrt{3}$	0.23	0.26	0.026	0.03
Combined Standard Uncertainty						12.03	12.00
Coverage Factor for 95%						K=2	
Expanded Uncertainty						±24.06%	±24.00%

DAYS5 System Check Uncertainty for 30 MHz to 6GHz averaged range								
Error Description	Uncer. value (±10%)	Prob. Dist.	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) V_{eff}
Measurement System								
Probe Calibration	6.53	Normal	1	1	1	6.53	6.53	∞
Axial Isotropy	4.6	Rectangular	$\sqrt{3}$	1	1	2.66	2.66	∞
Hemispherical Isotropy	9.3	Rectangular	$\sqrt{3}$	1	1	5.37	5.37	∞
Boundary Effects	0.9	Rectangular	$\sqrt{3}$	0	0	0	0	∞
Linearity	4.5	Rectangular	$\sqrt{3}$	1	1	2.60	2.60	∞
System Detection Limits	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
Modulation Response	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
Readout Electronics	0.2	Normal	1	1	1	0.2	0.2	∞
Response Time	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
Integration Time	0	Rectangular	$\sqrt{3}$	1	1	0	0	∞
RF Ambient Noise	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
RF Ambient Reflection	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
Probe Positioner	0.7	Rectangular	$\sqrt{3}$	1	1	0.402	0.402	∞
Probe Positioning	6.5	Rectangular	$\sqrt{3}$	1	1	3.752	3.752	∞
Max. SAR Eval.	1.9	Rectangular	$\sqrt{3}$	1	1	1.10	1.10	∞
Dipole Related								
Deviation of exp. dipole	5.3	Rectangular	$\sqrt{3}$	1	1	3.06	3.06	∞
Dipole Axis to Liquid Dist.	2.0	Rectangular	$\sqrt{3}$	1	1	1.15	1.15	∞
Input power & SAR drift	3.3	Rectangular	$\sqrt{3}$	1	1	1.91	1.91	∞
Phantom and Setup								
Phantom Uncertainty	3.9	Rectangular	$\sqrt{3}$	1	1	2.25	2.25	∞
SAR correction	1.8	Rectangular	$\sqrt{3}$	1	0.84	1.04	0.87	∞
Liquid Conductivity(Meas.)	2.4	Normal	1	0.78	0.71	1.87	1.70	∞
Liquid Permittivity(Meas.)	2.4	Normal	1	0.26	0.26	0.62	0.62	∞
Temp. unc. - Conductivity	1.6	Rectangular	$\sqrt{3}$	0.78	0.71	0.72	0.66	∞
Temp. unc. - Permittivity	0.2	Rectangular	$\sqrt{3}$	0.23	0.26	0.02	0.03	∞
Combined Std. Uncertainty						11.16	11.10	
Expanded STD Uncertainty						±22.32%	±22.20%	

10. CONDUCTED POWER MEASUREMENT

Bluetooth_V3.0

Modulation	Channel	Frequency(MHz)	Average Power (dBm)
GFSK(DH1)	0	2402	**19.01**
	39	2441	18.57
	78	2480	18.53
π /4-DQPSK(2DH3)	0	2402	18.75
	39	2441	18.29
	78	2480	18.30
8-DPSK(3DH5)	0	2402	18.70
	39	2441	18.26
	78	2480	18.24

11. TEST RESULTS

11.1. SAR Test Results Summary

11.1.1. Test position and configuration

Head SAR was performed with the device configured in the positions according to IEEE1528, and Body SAR was performed with the device 10mm from the phantom.

11.1.2. Operation Mode

A non-standard setup was used for SAR testing based on guidance from the FCC. The operational description contains additional information.
According to KDB 447498 D01 General RF Exposure Guidance v05, due to the Max peak power for Bluetooth is less than 2Pref, which have to be tested. Using the head liquid with a separation of 10mm at flat phantom to test, achieving actual usage.

11.1.3. Test Result

SAR MEASUREMENT									
Depth of Liquid (cm):>15				Relative Humidity (%): 52					
Product: Bluetooth Helmet Headset									
Test Mode: BT (communication)									
Position	**Mode**	**Ch.**	**Fr. (MHz)**	**Power Drift (<±0.2db)**	**SAR (1g) (W/kg)**	**Max. Turn-up Power (dBm)**	**Meas. output Power (dBm)**	**Scaled SAR (W/Kg)**	**Limit W/kg**
Body back	DH1	0	2402	-0.20	**0.239**	20.0	19.01	0.300	1.6
Body back	DH1	39	2441	-0.16	0.222	20.0	18.57	**0.309**	1.6
Body back	DH1	78	2480	0.15	0.113	20.0	18.53	0.159	1.6
Body back	2DH3	39	2441	-0.02	0.058	20.0	18.29	0.086	1.6
Body back	3DH5	39	2441	0.15	0.082	20.0	18.26	0.122	1.6

Note:
· When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
·The test separation for body is 10mm of all above table.

APPENDIX A. SAR SYSTEM CHEEK DATA

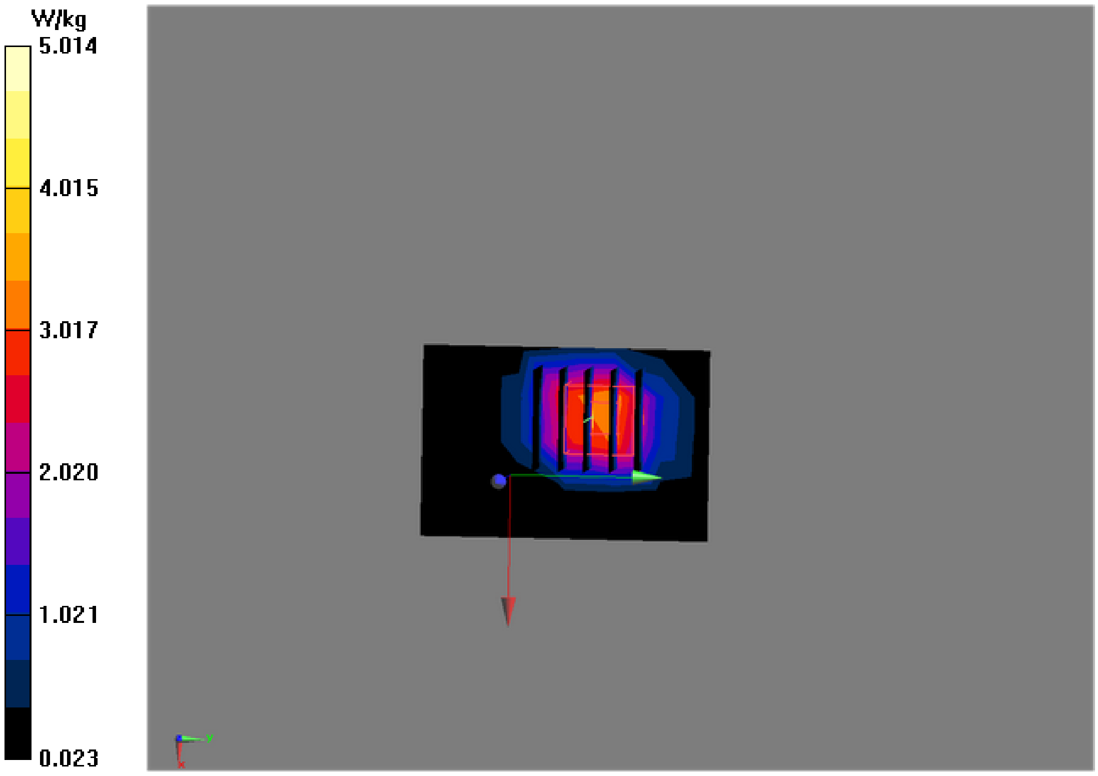
Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
System Check 2450MHz
DUT: Dipole 2450 MHz; Type: SID 2450
Communication System: CW; Communication System Band: D2450 (2450.0 MHz); Duty Cycle:1:1;
Frequency: 2450 MHz; Medium parameters used: f = 2450 MHz; σ=1.81 mho/m; εr =39.75; ρ= 1000 kg/m³ ;
Phantom section: Flat Section; Input Power=18dBm
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:

- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/System Check 2450MHz /Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 3.40 W/kg

Configuration/System Check 2450MHz /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 39.408 V/m; Power Drift =-0.09 dB
Peak SAR (extrapolated) = 7.12 W/kg
SAR(1 g) =3.31 W/kg; SAR(10 g) = 1.52 W/kg
Maximum value of SAR (measured) =5.01 W/kg



APPENDIX B. SAR MEASUREMENT DATA

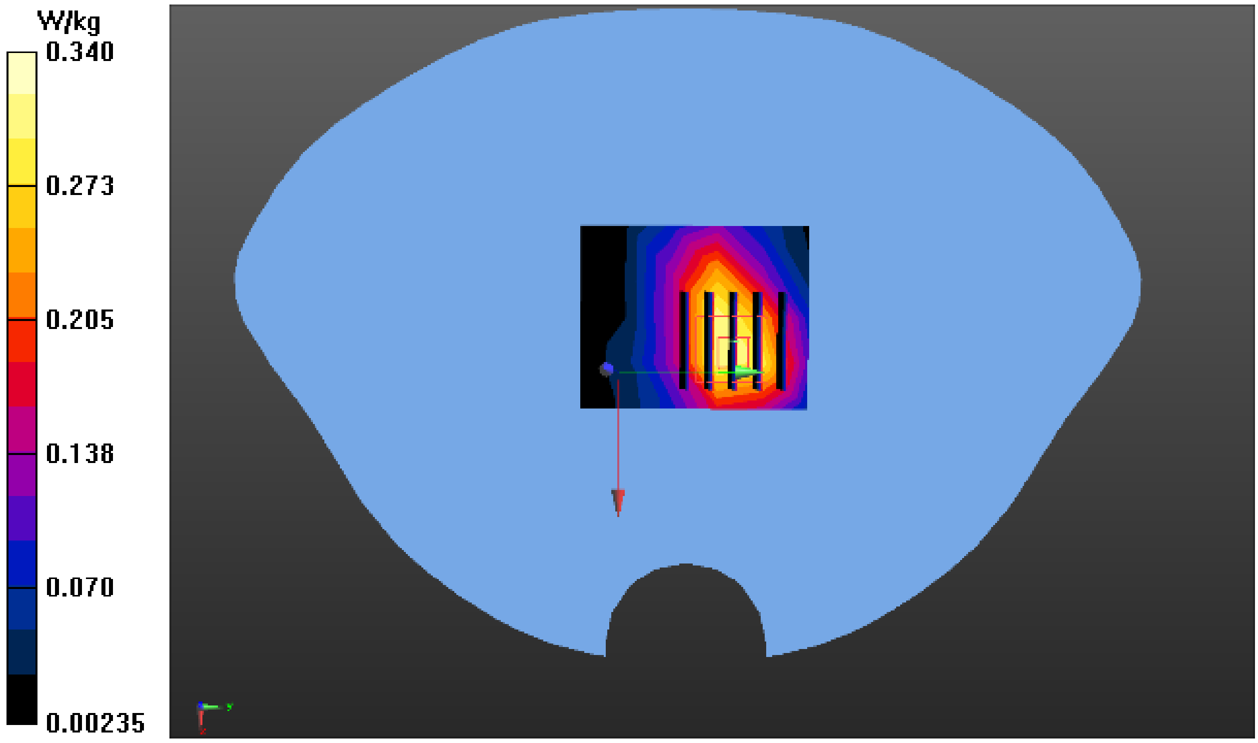
Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
BT Low-Body-Worn- Back (DH1)
DUT: Bluetooth Helmet Headset; Type: DWO-4

Communication System: Bluetooth; Communication System Band: 2.4G; Frequency: 2402 MHz;
Medium parameters used: f = 2450 MHz; σ =1.77 mho/m; εr =39.98; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:
- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

DH1/2402/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.312 W/kg

DH1/2402/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.622 V/m; Power Drift = -0.20 dB
Peak SAR (extrapolated) = 0.458 W/kg
SAR(1 g) = 0.239 W/kg; SAR(10 g) = 0.127 W/kg
Maximum value of SAR (measured) = 0.340 W/kg



Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
BT Mid-Body-Worn- Back (DH1)
DUT: Bluetooth Helmet Headset; Type: DWO-4

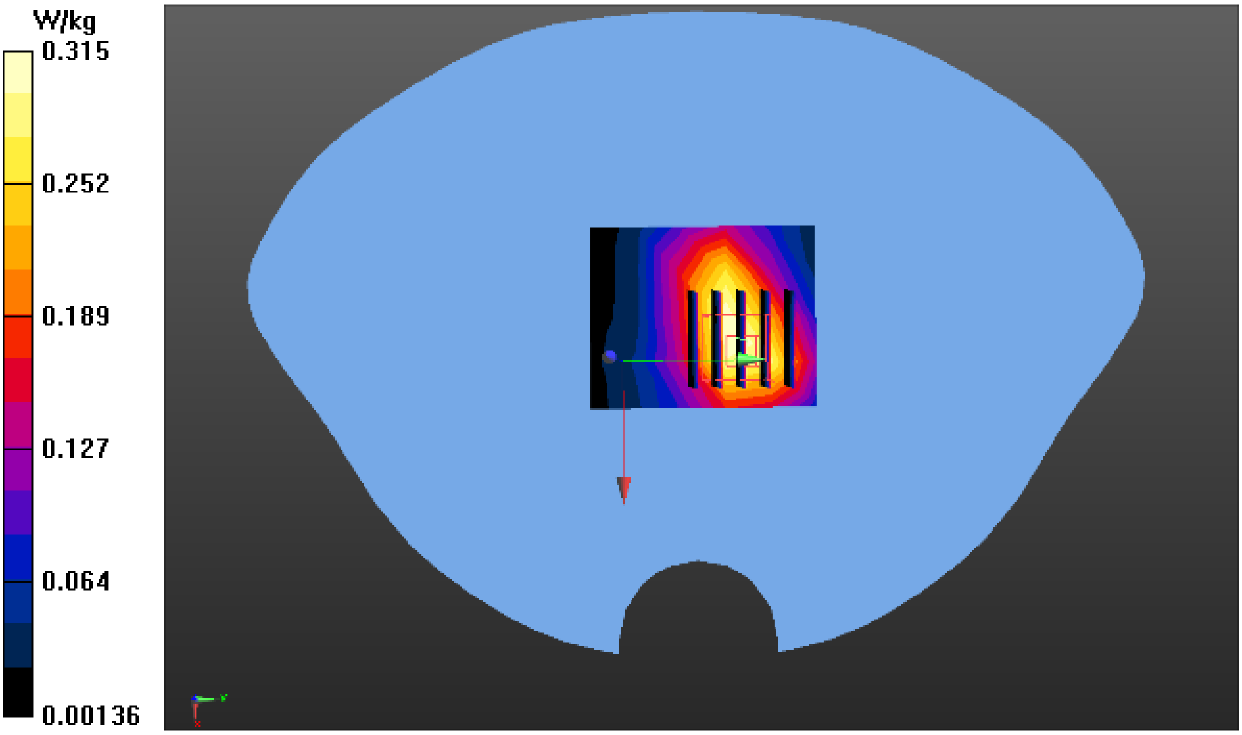
Communication System: Bluetooth; Communication System Band: 2.4G; Frequency: 2441 MHz;
Medium parameters used: f = 2450 MHz; σ =1.79 mho/m; εr =39.86; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:

- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

DH1/2441/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.313 W/kg

DH1/2441/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.724 V/m; Power Drift = -0.16 dB
Peak SAR (extrapolated) = 0.423 W/kg
SAR(1 g) = 0.222 W/kg; SAR(10 g) = 0.119 W/kg
Maximum value of SAR (measured) = 0.315 W/kg



Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
BT High-Body-Worn- Back (DH1)
DUT: Bluetooth Helmet Headset; Type: DWO-4

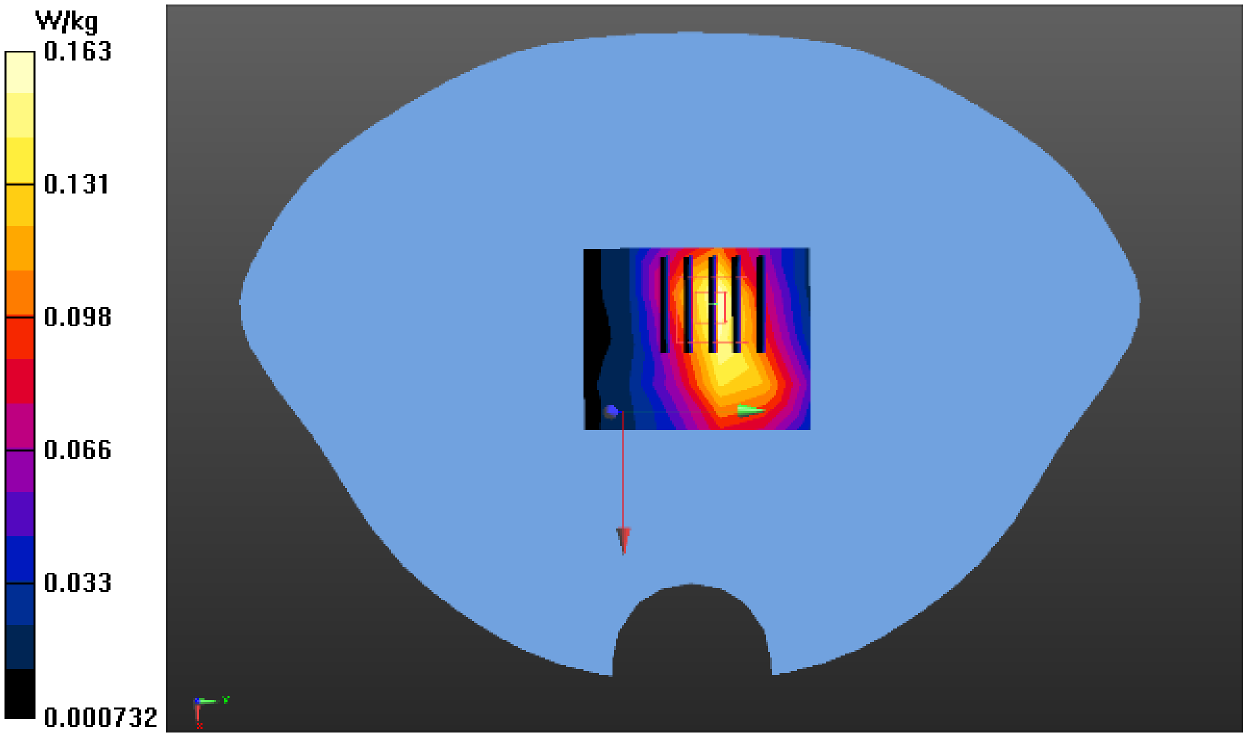
Communication System: Bluetooth; Communication System Band: 2.4G; Frequency: 2480 MHz;
Medium parameters used: f = 2450 MHz; σ =1.83 mho/m; εr =39.21; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:

- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

DH1/2480/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.162 W/kg

DH1/2480/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.402 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.220 W/kg
SAR(1 g) = 0.113 W/kg; SAR(10 g) = 0.059 W/kg
Maximum value of SAR (measured) = 0.163 W/kg



Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
BT Mid-Body-Worn- Back (2DH3)
DUT: Bluetooth Helmet Headset; Type: DWO-4

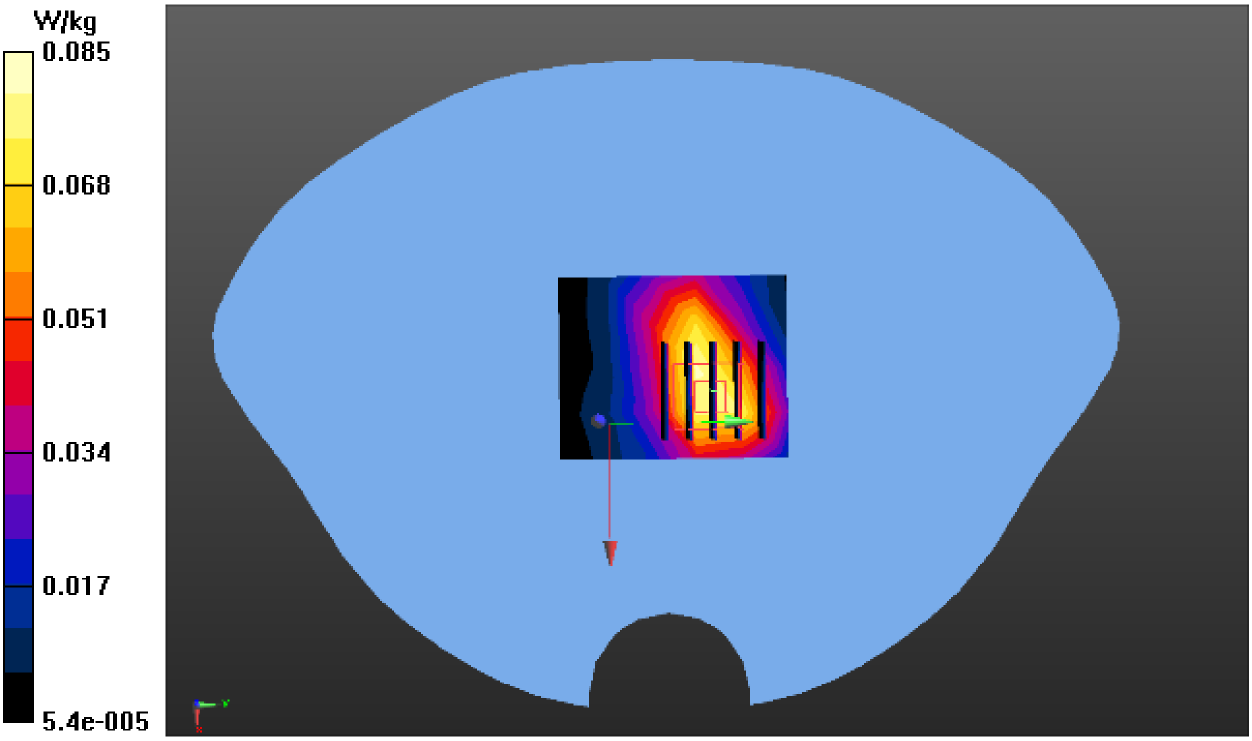
Communication System: Bluetooth; Communication System Band: 2.4G; Frequency: 2441 MHz;
Medium parameters used: f = 2450 MHz; σ =1.79 mho/m; εr =39.86; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:

- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

2DH3/2441/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0805 W/kg

2DH3/2441/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.232 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.120 W/kg
SAR(1 g) = 0.058 W/kg; SAR(10 g) = 0.031 W/kg
Maximum value of SAR (measured) = 0.0849 W/kg



Test Laboratory: AGC Lab **Date: Apr. 24, 2015**
BT Mid-Body-Worn- Back (3DH5)
DUT: Bluetooth Helmet Headset; Type: DWO-4

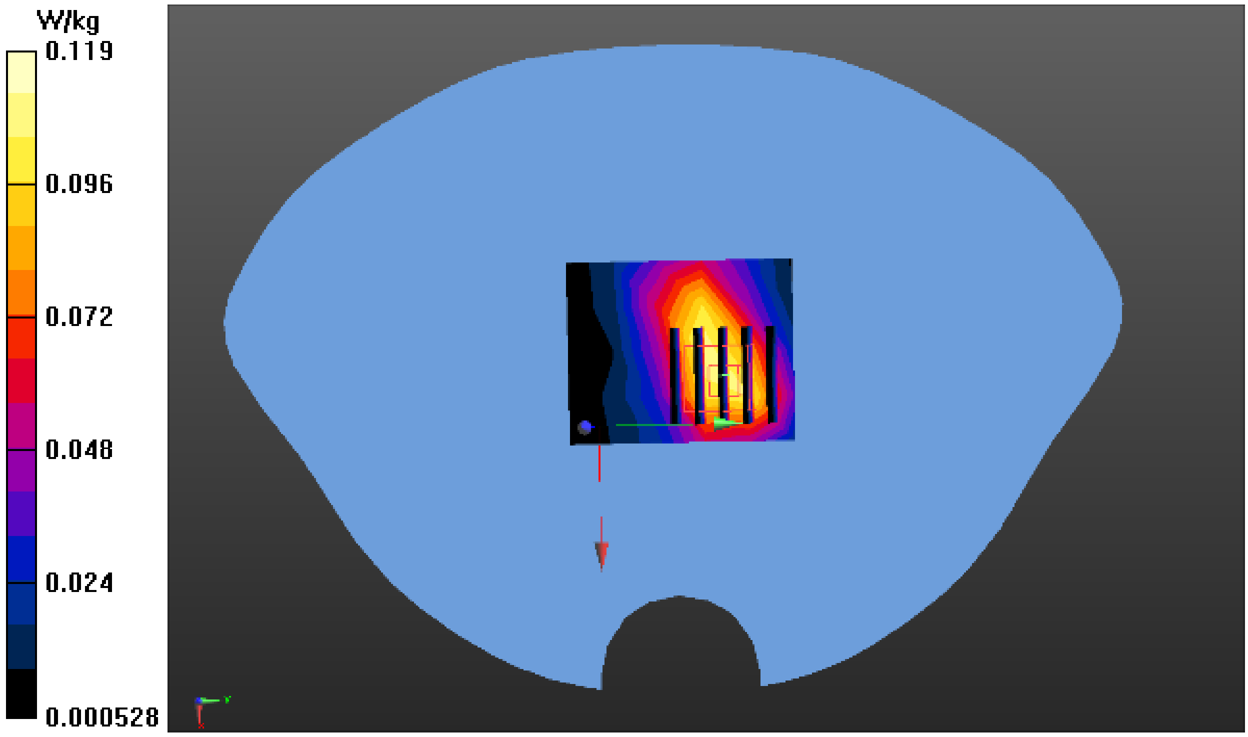
Communication System: Bluetooth; Communication System Band: 2.4G; Frequency: 2441 MHz;
Medium parameters used: f = 2450 MHz; σ =1.79 mho/m; εr =39.86; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):22.1, Liquid temperature (℃): 22.3

DASY Configuration:

- Probe: EX3DV4 - SN3953; ConvF(7.32,7.32,7.32); Calibrated: 11/06/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: SAM (20deg probe tilt) with CRP v5.0; Type: QD000P40CD;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

3DH5/2441/Area Scan (5x6x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.112 W/kg

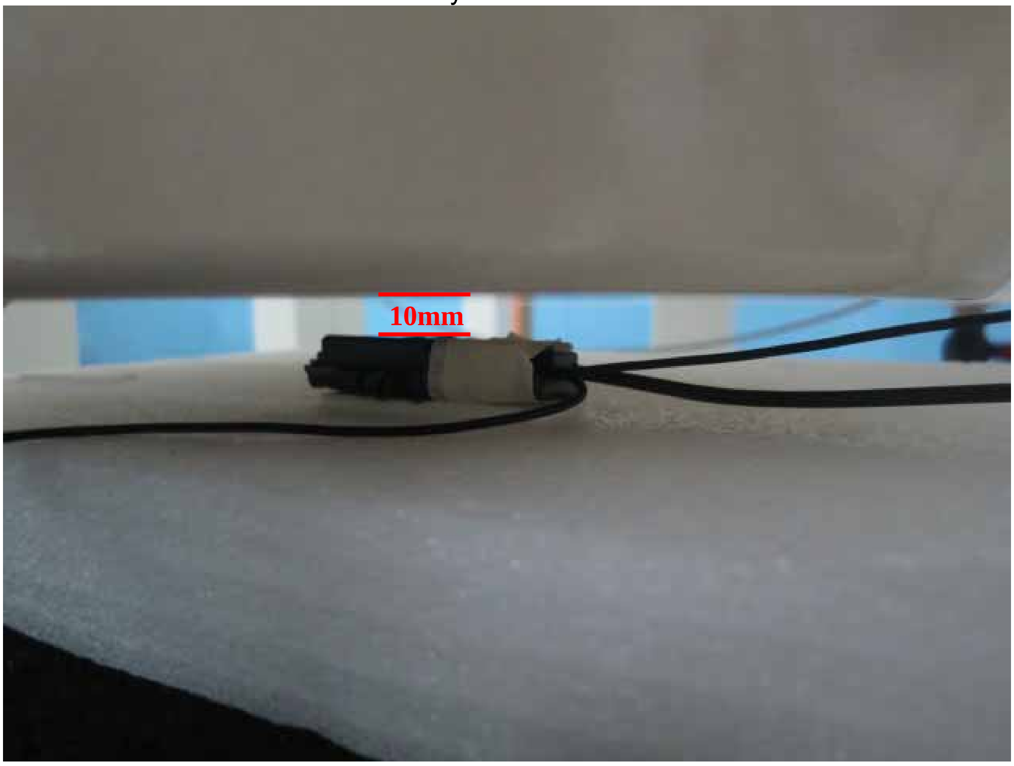
3DH5/2441/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.889 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.163 W/kg
SAR(1 g) = 0.082 W/kg; SAR(10 g) = 0.042 W/kg
Maximum value of SAR (measured) = 0.119 W/kg



APPENDIX C. TEST SETUP PHOTOGRAPHS &EUT PHOTOGRAPHS

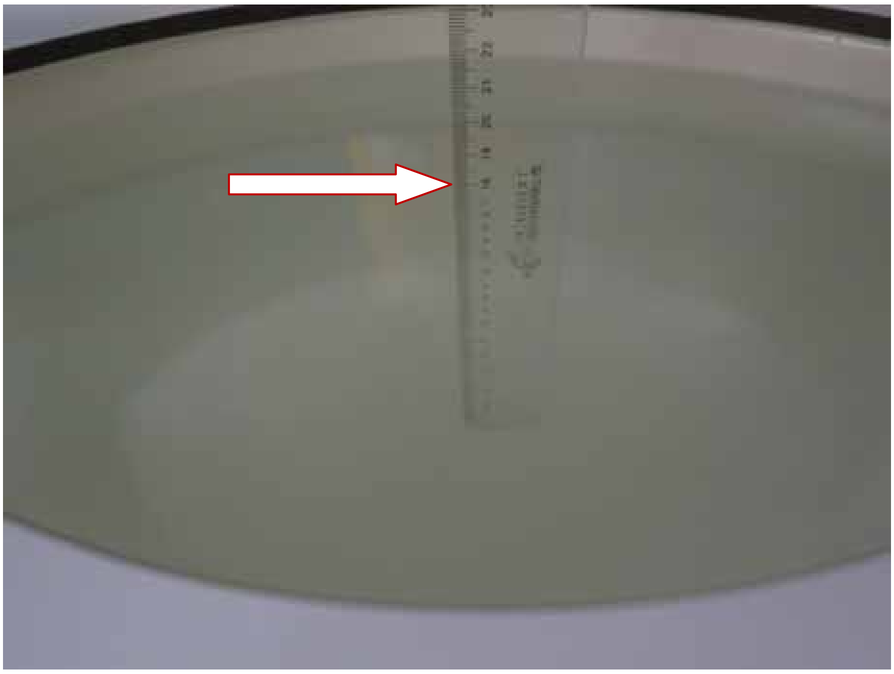
Test Setup Photographs

Body Back 10mm



DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

Note：The position used in the measurement were according to IEEE 1528-2003



EUT PHOTOGRAPHS

FRONT VIEW OF EUT

BACK VIEW OF EUT

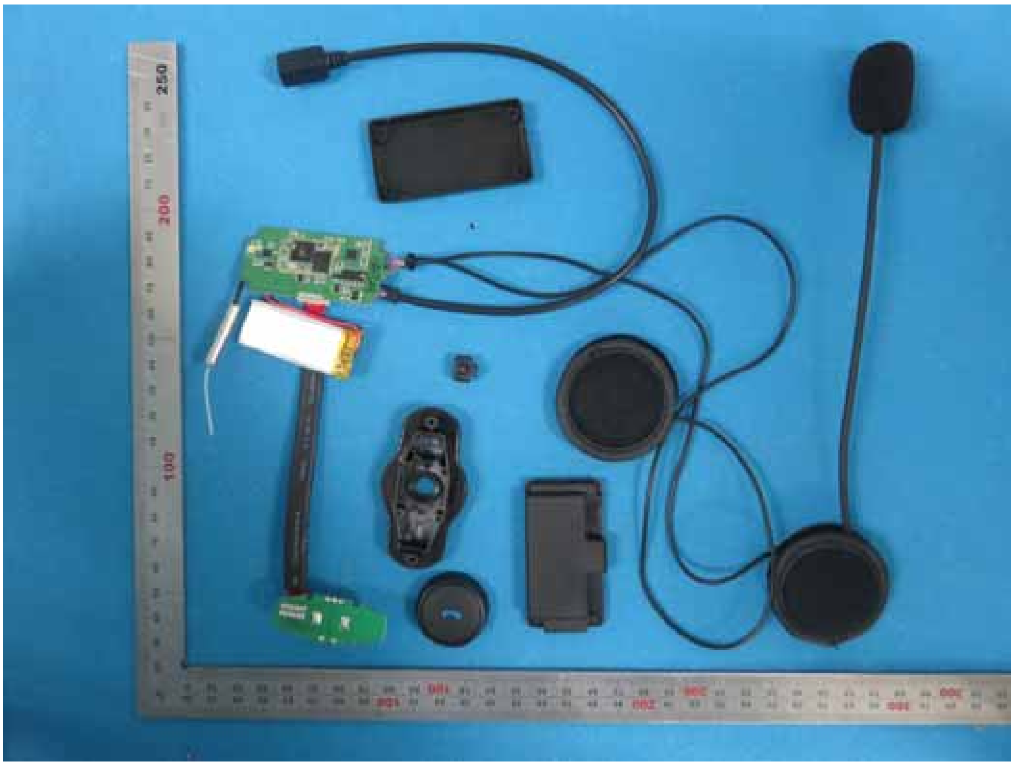
TOP VIEW OF EUT

BOTTOM VIEW OF EUT

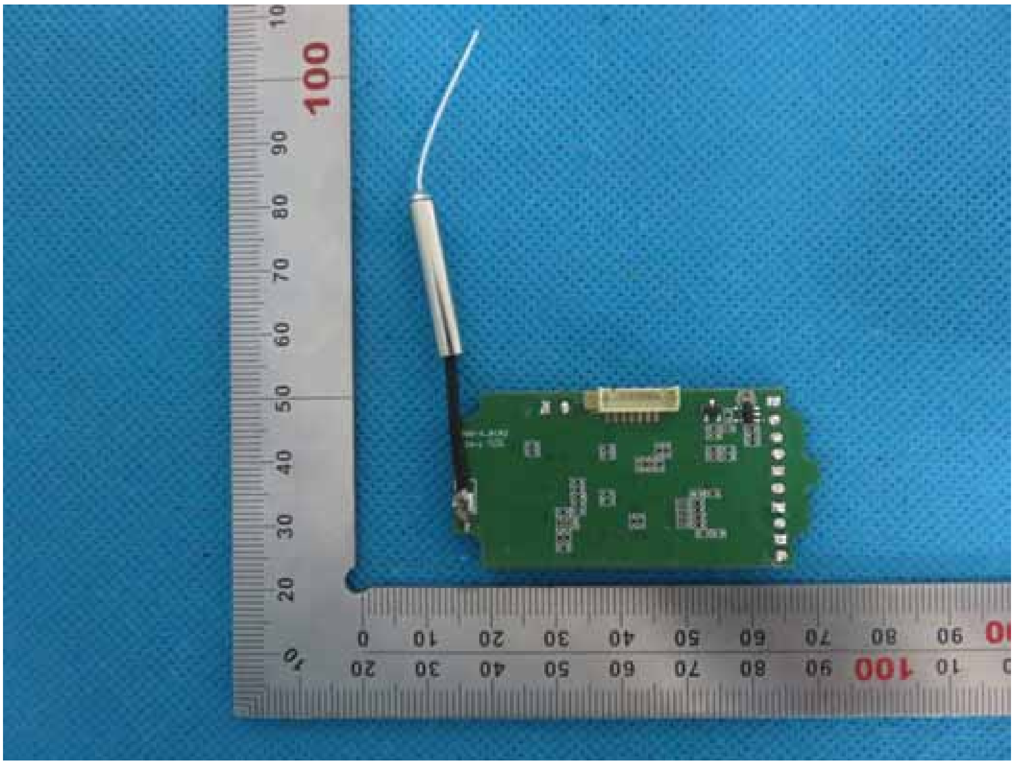
LEFT VIEW OF EUT

RIGHT VIEW OF EUT

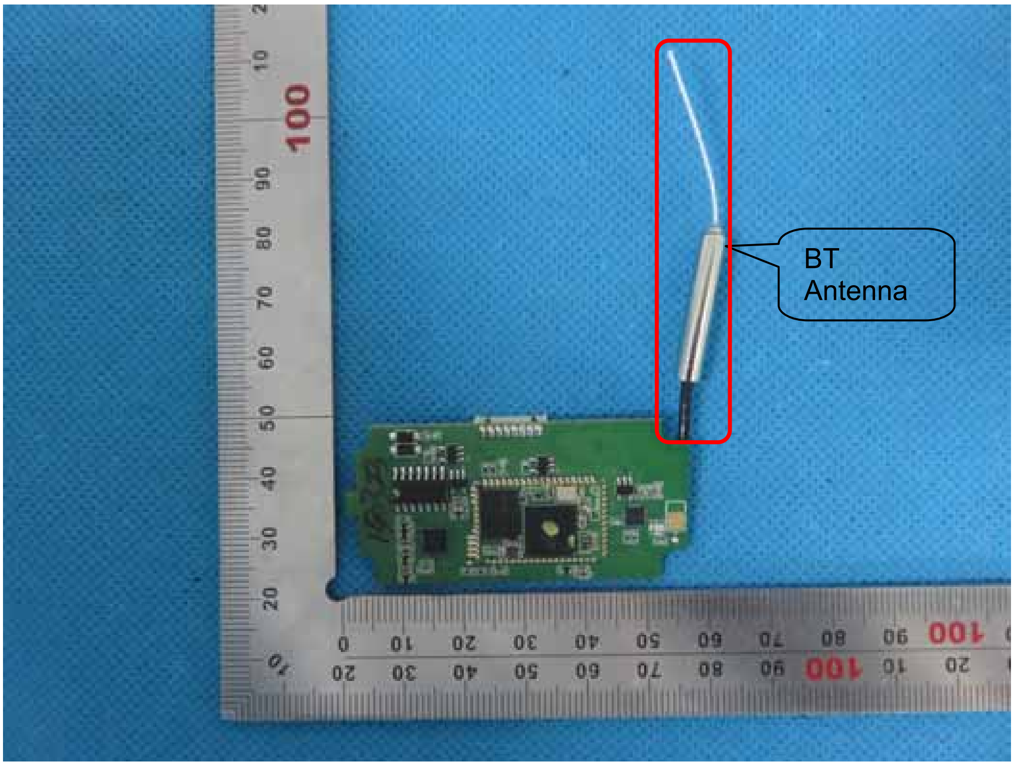
OPEN VIEW OF EUT-1



INTERNAL VIEW OF EUT-1

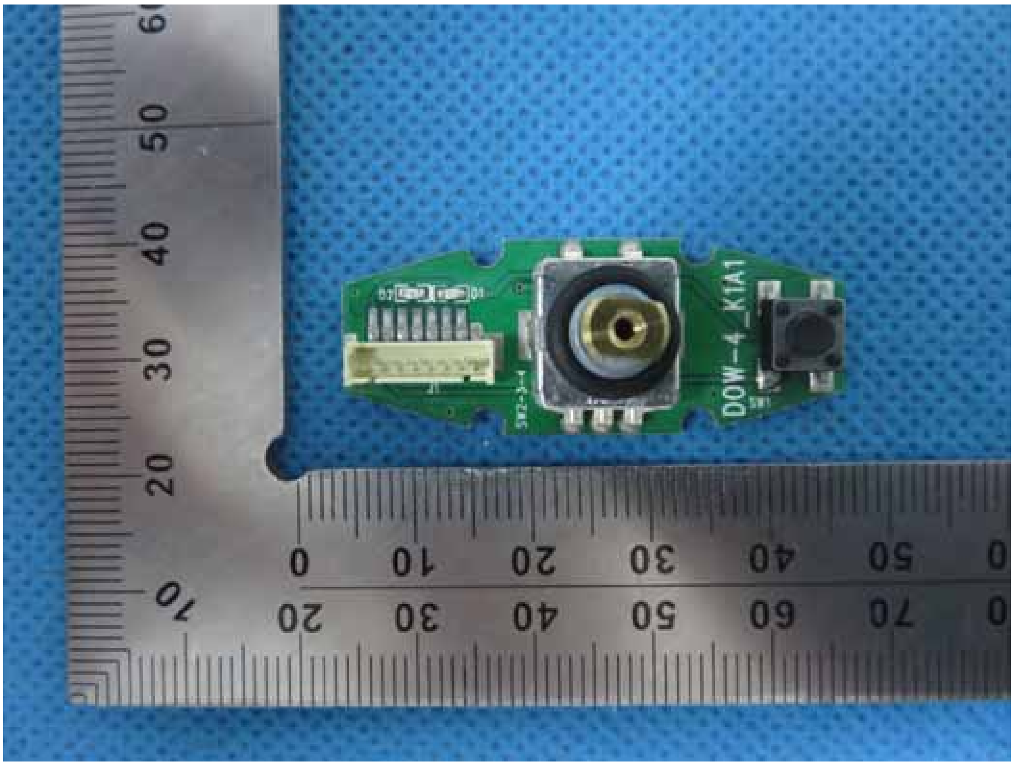


INTERNAL VIEW OF EUT-2



INTERNAL VIEW OF EUT-3

INTERNAL VIEW OF EUT-4



APPENDIX D. PROBE CALIBRATION DATA

TTL In Collaboration with s p e a g CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

ilac-MRA CNAS CALIBRATION No. L0570

Client agc-cert(鑫宇环) Certificate No: Z14-97116

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3953

Calibration Procedure(s): TMC-OS-E-02-195
Calibration Procedures for Dosimetric E-field Probes

Calibration date: November 06, 2014

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Power sensor NRP-Z91	101547	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Power sensor NRP-Z91	101548	01-Jul-14 (CTTL, No.J14X02146)	Jun-15
Reference10dBAttenuator	BT0520	12-Dec-12(TMC,No.JZ12-867)	Dec-14
Reference20dBAttenuator	BT0267	12-Dec-12(TMC,No.JZ12-866)	Dec-14
Reference Probe EX3DV4	SN 3617	28-Aug-14(SPEAG,No.EX3-3617_Aug14)	Aug-15
DAE4	SN 1331	23-Jan-14 (SPEAG, DAE4-1331_Jan14)	Jan -15
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	01-Jul-14 (CTTL, No.J14X02145)	Jun-15
Network Analyzer E5071C	MY46110673	15-Feb-14 (TMC, No.JZ14-781)	Feb-15

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 07, 2014

In Collaboration with
TTL speag
CALIBRATION LABORATORY

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Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below ConvF).
- *NORM(f)x,y,z = NORMx,y,z* frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics.
- *Ax,y,z; Bx,y,z; Cx,y,z;VRx,y,z:*A,B,C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORMx,y,z* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

TTL In Collaboration with speag CALIBRATION LABORATORY
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E-mail: cttl@chinattl.com Http://www.chinattl.cn

Probe EX3DV4

SN: 3953

Calibrated: November 06, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

In Collaboration with
speag
CALIBRATION LABORATORY

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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY – Parameters of Probe: EX3DV4 - SN: 3953

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)^2)[A]	0.53	0.54	0.48	±10.8%
DCP(mV)[B]	101.6	101.2	100.0	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	192.6	±2.5%
		Y	0.0	0.0	1.0		191.5	
		Z	0.0	0.0	1.0		179.1	

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X, Y, Z do not affect the E^2-field uncertainty inside TSL (see Page 5 and Page 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainly is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

TTL In Collaboration with speag CALIBRATION LABORATORY

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E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY – Parameters of Probe: EX3DV4 - SN: 3953

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz][C]	Relative Permittivity[F]	Conductivity (S/m)[F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
835	41.5	0.90	10.12	10.12	10.12	0.14	1.25	±12%
900	41.5	0.97	9.70	9.70	9.70	0.23	1.04	±12%
1810	40.0	1.40	8.00	8.00	8.00	0.17	1.34	±12%
1900	40.0	1.40	7.89	7.89	7.89	0.22	1.17	±12%
2100	39.8	1.49	8.05	8.05	8.05	0.16	1.42	±12%
2450	39.2	1.80	7.32	7.32	7.32	0.63	0.66	±12%
3500	37.9	2.91	7.35	7.35	7.35	0.50	0.88	±13%
3700	37.7	3.12	7.03	7.03	7.03	0.45	1.02	±13%
5200	36.0	4.66	5.64	5.64	5.64	0.29	1.53	±13%
5300	35.9	4.76	5.32	5.32	5.32	0.45	0.77	±13%
5500	35.6	4.96	4.78	4.78	4.78	0.36	0.90	±13%
5600	35.5	5.07	4.60	4.60	4.60	0.34	0.96	±13%
5800	35.3	5.27	4.40	4.40	4.40	0.32	0.84	±13%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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DASY – Parameters of Probe: EX3DV4 - SN: 3953

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz][C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha[G]	Depth[G] (mm)	Unct. (k=2)
835	55.2	0.97	10.08	10.08	10.08	0.19	1.27	±12%
900	55.0	1.05	9.84	9.84	9.84	0.25	1.11	±12%
1810	53.3	1.52	7.93	7.93	7.93	0.16	1.63	±12%
1900	53.3	1.52	7.79	7.79	7.79	0.20	1.24	±12%
2100	53.2	1.62	8.10	8.10	8.10	0.16	1.71	±12%
2450	52.7	1.95	7.48	7.48	7.48	0.48	0.84	±12%
3500	51.3	3.31	6.70	6.70	6.70	0.53	0.90	±13%
3700	51.0	3.55	6.73	6.73	6.73	0.48	0.97	±13%
5200	49.0	5.30	4.92	4.92	4.92	0.43	1.17	±13%
5300	48.9	5.42	4.74	4.74	4.74	0.42	1.20	±13%
5500	48.6	5.65	4.33	4.33	4.33	0.42	1.45	±13%
5600	48.5	5.77	4.23	4.23	4.23	0.43	1.56	±13%
5800	48.2	6.00	4.32	4.32	4.32	0.45	1.69	±13%

[C] Frequency validity of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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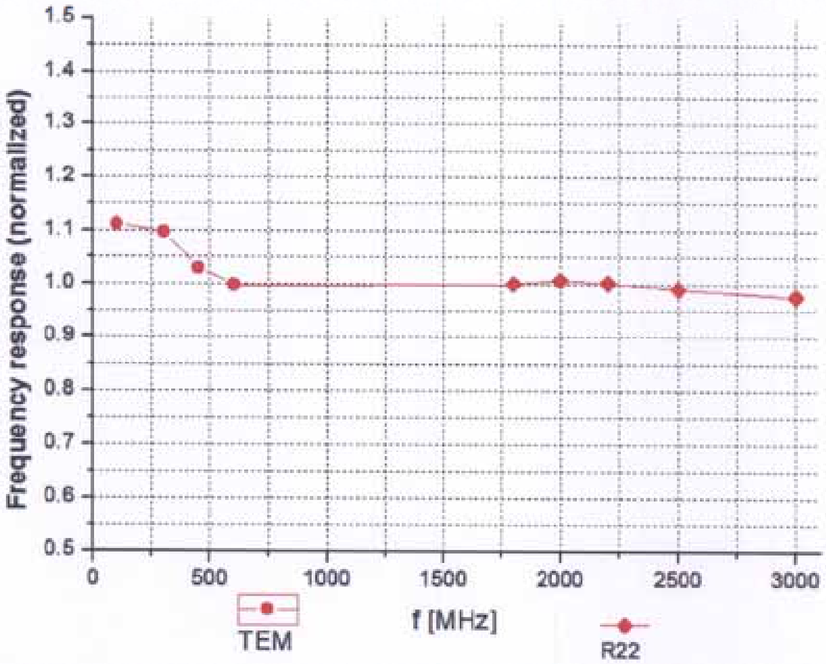
E-mail: cttl@chinatt1.com Http://www.chinattl.cn

Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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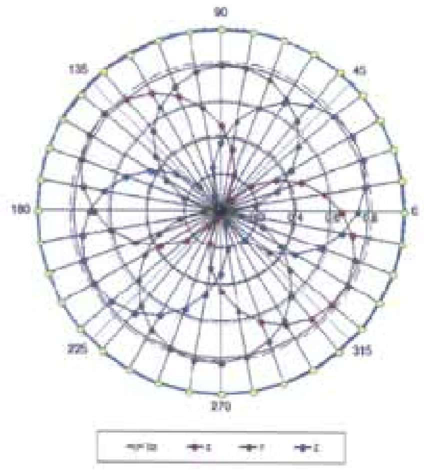
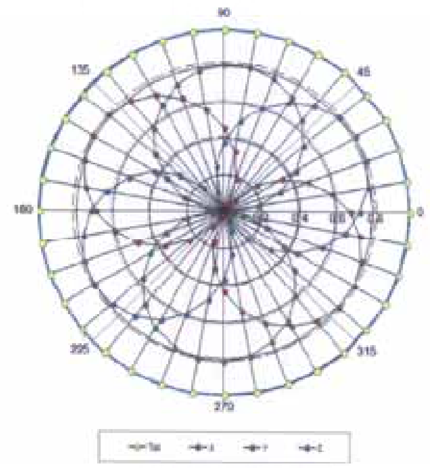
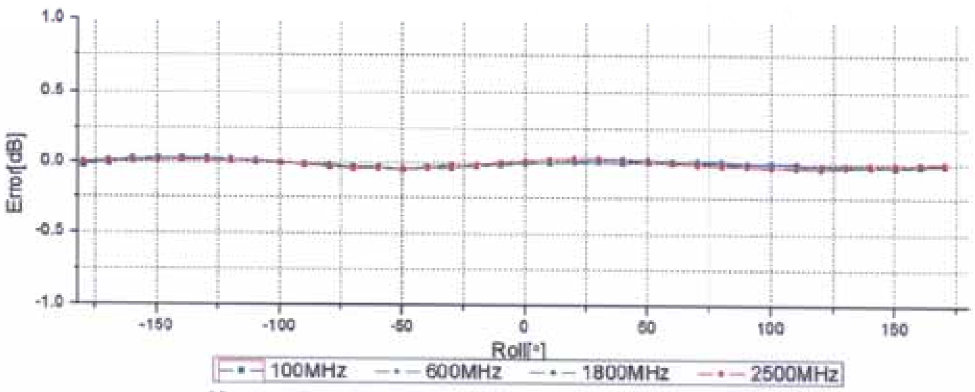
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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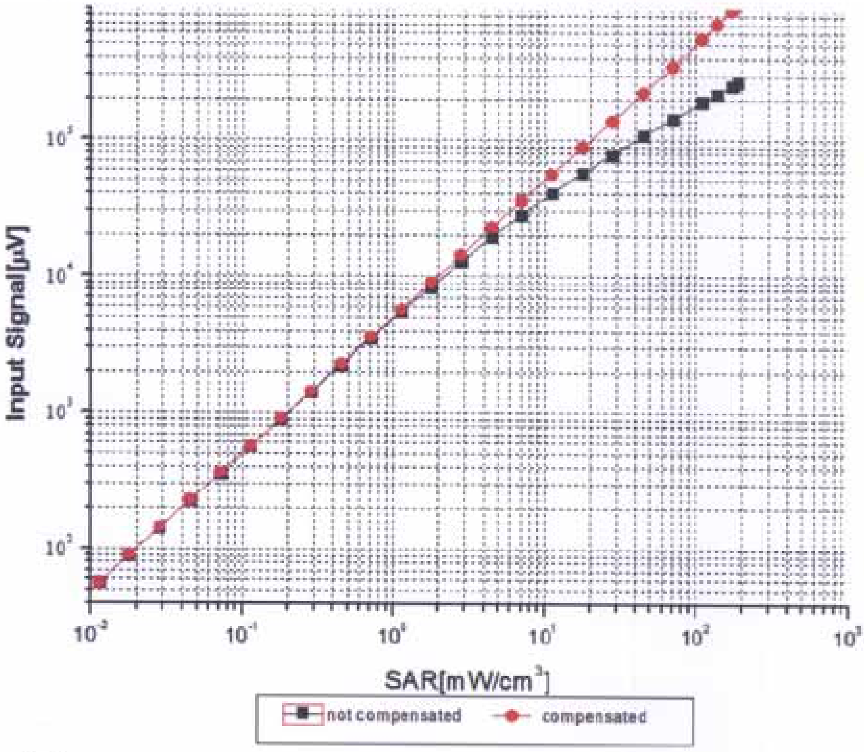
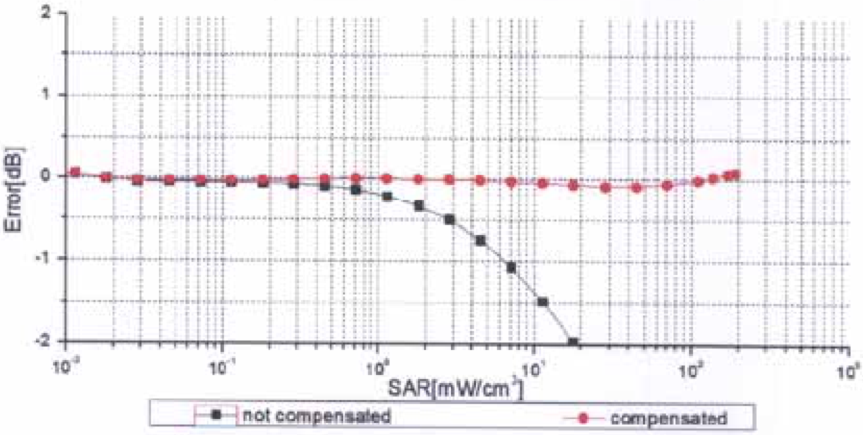
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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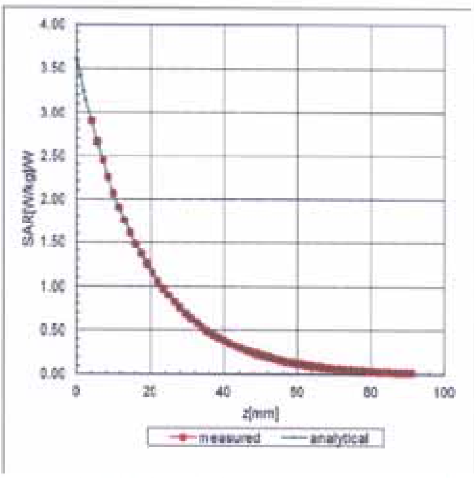
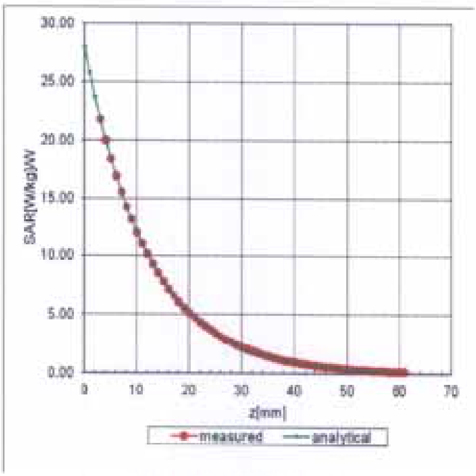
Conversion Factor Assessment

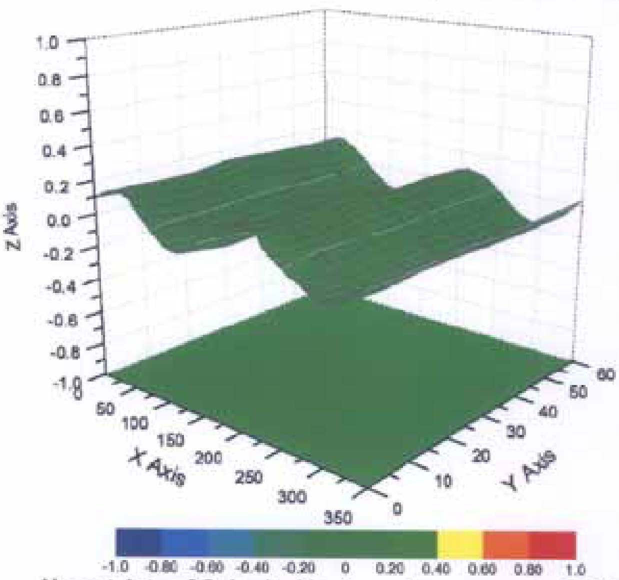
f=900 MHz, WGLS R9(H_convF)



f=1810 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY - Parameters of Probe: EX3DV4 - SN: 3953

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	32
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	2mm

APPENDIX E. DAE CALIBRATION DATA

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **AGC-CERT (Auden)**

Certificate No: **DAE4-1398_Mar15**

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1398
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	March 11, 2015

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-14 (No:15573)	Oct-15
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	06-Jan-15 (in house check)	In house check: Jan-16
Calibrator Box V2.1	SE UMS 006 AA 1002	06-Jan-15 (in house check)	In house check: Jan-16

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	[signature]
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V. [signature]

Issued: March 11, 2015

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
C Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1µV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.177 ± 0.02% (k=2)	404.159 ± 0.02% (k=2)	403.623 ± 0.02% (k=2)
Low Range	3.97359 ± 1.50% (k=2)	3.99241 ± 1.50% (k=2)	3.96904 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	195.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199993.58	-1.10	-0.00
Channel X	+ Input	20001.61	1.19	0.01
Channel X	- Input	-19998.75	2.61	-0.01
Channel Y	+ Input	199994.17	-0.06	-0.00
Channel Y	+ Input	19999.73	-0.66	-0.00
Channel Y	- Input	-20002.27	-0.74	0.00
Channel Z	+ Input	199994.39	-0.01	-0.00
Channel Z	+ Input	19999.60	-0.65	-0.00
Channel Z	- Input	-20002.37	-0.85	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.37	-0.22	-0.01
Channel X	+ Input	201.03	-0.14	-0.07
Channel X	- Input	-198.68	0.01	-0.00
Channel Y	+ Input	2000.16	-0.39	-0.02
Channel Y	+ Input	199.64	-1.42	-0.71
Channel Y	- Input	-200.57	-1.84	0.93
Channel Z	+ Input	2000.33	-0.14	-0.01
Channel Z	+ Input	199.88	-1.17	-0.58
Channel Z	- Input	-200.01	-1.12	0.56

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-13.00	-14.85
	- 200	16.87	14.74
Channel Y	200	8.65	8.14
	- 200	-11.30	-11.41
Channel Z	200	7.15	7.52
	- 200	-9.35	-9.51

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-3.68	-0.69
Channel Y	200	5.01	-	-0.86
Channel Z	200	8.26	0.74	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15958	16128
Channel Y	15964	17962
Channel Z	15846	14478

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.22	-1.08	0.72	0.33
Channel Y	-1.19	-1.94	-0.30	0.32
Channel Z	-1.46	-2.11	0.01	0.32

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

APPENDIX F. DIPOLE CALIBRATION DATA

SATIMO
The microwave vision company

SAR Reference Dipole Calibration Report

Ref : ACR.318.9.13.SATU.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.
1&2F, NO.2 BUILDING, HUAFENG NO.1 INDUSTRIAL PARK, GUSHU COMMUNITY XIXIANG STREET BAOAN DISTRICT, SHENZHEN, P.R. CHINA
SATIMO COMOSAR REFERENCE DIPOLE
FREQUENCY: 2450 MHZ
SERIAL NO.: SN 46/11 DIP 2G450-189

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

ACCREDITED
Calibration CERT #2246.02

11/14/13

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	11/14/2013	
Checked by :	Jérôme LUC	Product Manager	11/14/2013	
Approved by :	Kim RUTKOWSKI	Quality Manager	11/14/2013	

	Customer Name
Distribution :	ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

Issue	*Date*	*Modifications*
A	11/14/2013	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 46/11 DIP 2G450-189
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*

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

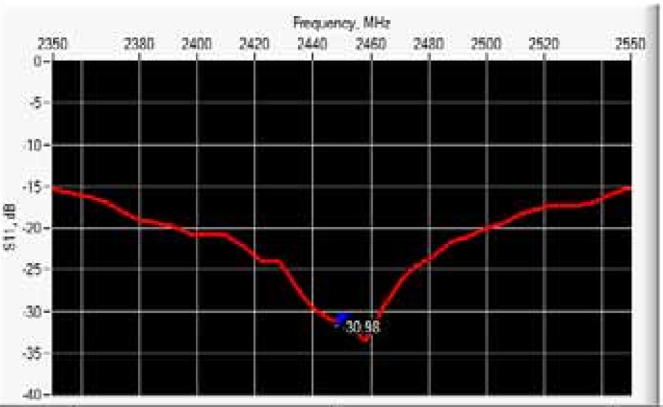
5.3 VALIDATION MEASUREMENT

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	-30.98	-20	47.3 Ω + 0.1 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 MEASUREMENT CONDITION

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 38.6 sigma : 1.82
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 %

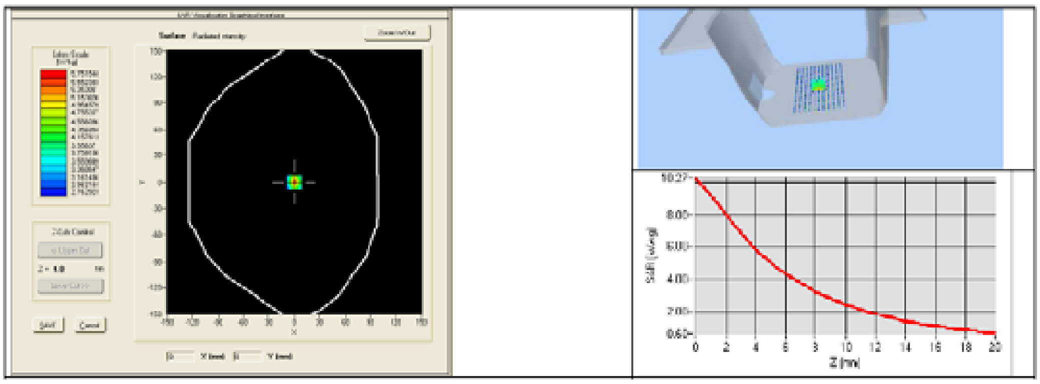
7.2 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative 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 %	

7.3 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.

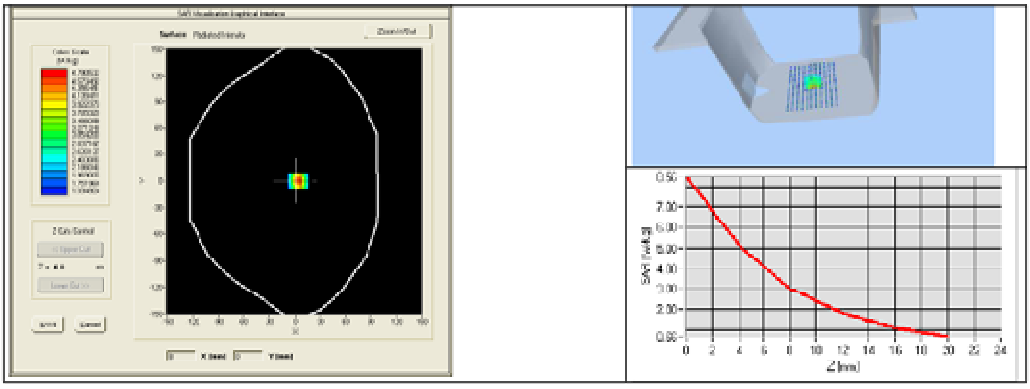
Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4	54.40 (5.44)	24	23.75 (2.38)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.4 BODY MEASUREMENT RESULT

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.0 sigma : 1.94
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	54.19 (5.42)	24.96 (2.50)



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	12/2010	12/2013
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	11/2010	11/2013
Signal Generator	Agilent E4438C	MY49070581	12/2010	12/2013
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	11/2010	11/2013
Power Sensor	HP ECP-E26A	US37181460	11/2010	11/2013
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	3/2012	3/2014