



# TEST REPORT

Report Reference No.....	<b>TRE15120069</b>	R/C.....	54959
Applicant's name.....	<b>KanhaTech Solutions Pvt Ltd</b>		
Address.....	No 74, Prestige Feroze Building, 4th Floor, Cunningham road, Bangalore, India		
Manufacturer.....	KanhaTech Solutions Pvt Ltd		
Address.....	No 74, Prestige Feroze Building, 4th Floor, Cunningham road, Bangalore, India		
Test item description .....	<b>POS</b>		
Trade Mark .....	JioPay		
Model/Type reference.....	JioPay 3850		
Listed Model(s) .....	-		
Standard .....	<b>FCC 47 CFR Part2.1093</b> <b>ANSI/IEEE C95.1: 1999</b> <b>IEEE 1528: 2013</b>		
Date of receipt of test sample.....	Dec 09, 2015		
Date of testing.....	Dec 10, 2015- Dec 10, 2015		
Date of issue.....	Dec 15, 2015		
Result.....	<b>PASS</b>		

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

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## 1 . Test Standards and Test Description

### 1.1. Test Standards

The tests were performed according to following standards:

[FCC 47 Part 2.1093](#) Radiofrequency Radiation Exposure Evaluation:Portable Devices

[IEEE Std C95.1, 1999](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz.

[IEEE Std 1528™-2013](#): IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB 865664 D02 RF Exposure Reporting v01r02](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB 447498 D01 General RF Exposure Guidance v06](#): Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[KDB 248227 D01 802.11 Wi-Fi SAR v02r02](#): SAR Measurement Procedures for 802.11 a/b/g Transmitters

[KDB 941225 D06 Hotspot Mode v02r01](#): SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

### 1.2. Test Description

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

## 2. Summary

### 2.1. Client Information

Applicant:	KanhaTech Solutions Pvt Ltd
Address:	No 74, Prestige Feroze Building, 4th Floor, Cunningham road, Bangalore, India
Manufacturer:	KanhaTech Solutions Pvt Ltd
Address:	No 74, Prestige Feroze Building, 4th Floor, Cunningham road, Bangalore, India

### 2.2. Product Description

Name of EUT:	POS
Trade Mark:	JioPay
Model/Type reference:	JioPay 3850
List Model:	-
Device Category:	Portable
RF Exposure Environment:	General Population / Uncontrolled
Power supply:	DC 3.7V From internal battery
Adapter information:	Model No.:KSA29B0500200HE Input: AC 100-240 50/60Hz 0.5A Output: DC 5.0V 2.0A
Hardware version:	-
Software version:	-

#### Maximum SAR Value

Separation Distance:	Body: 0mm
Maximun SAR Value (1g):	Body: <b>0.641 W/Kg</b>

#### WIFI

Supported type:	802.11b/802.11g/802.11n(H20)/802.11n(H40)
Modulation:	802.11b: DSSS 802.11g/n(HT20)/n(HT40):OFDM
Operation frequency:	2412MHz~2462MHz for 802.11b/g/n(HT20) 2422MHz~2452MHz for 802.11n(HT40)
Channel number:	11 for 802.11b/g/n(HT20) 9 for 802.11n(HT40)
Channel separation:	5MHz

#### Bluetooth

Version:	Bluetooth 3.0+HS
Modulation:	GFSK, π/4DQPSK, 8DPSK
Operation frequency:	2402MHz~2480MHz
Channel number:	79
Channel separation:	1MHz

#### Bluetooth- BLE

Version:	Supported BT4.0
Modulation:	GFSK
Operation frequency:	2402MHz~2480MHz
Channel number:	40

Channel separation:	2MHz
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### **3. Test Environment**

#### **3.1. Address of the test laboratory**

Laboratory: Shenzhen Huatongwei International Inspection Co., Ltd.

Address: 1/F, Bldg 3, Hongfa Hi-tech Industrial Park, Genyu Road, Tianliao, Gongming, Shenzhen, China

Phone: 86-755-26748019 Fax: 86-755-26748089

#### **3.2. Test Facility**

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

##### **CNAS-Lab Code: L1225**

Shenzhen Huatongwei International Inspection Co., Ltd. has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: February 28, 2015. Valid time is until February 27, 2018.

##### **A2LA-Lab Cert. No. 3902.01**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing. Valid time is until December 31, 2016.

##### **FCC-Registration No.: 317478**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 317478, Renewal date Jul. 18, 2014, valid time is until Jul. 18, 2017.

##### **IC-Registration No.: 5377A&5377B**

The 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377A on Dec. 31, 2013, valid time is until Dec. 31, 2016.

Two 3m Alternate Test Site of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 5377B on Dec. 03, 2014, valid time is until Dec. 03, 2017.

##### **ACA**

Shenzhen Huatongwei International Inspection Co., Ltd. EMC Laboratory can also perform testing for the Australian C-Tick mark as a result of our A2LA accreditation.

##### **VCCI**

The 3m Semi-

anechoic chamber (12.2m×7.95m×6.7m) of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-2484. Date of Registration: Dec. 20, 2012. Valid time is until Dec. 29, 2015.

Radiated disturbance above 1GHz measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-292. Date of Registration: Dec. 24, 2013. Valid time is until Dec. 23, 2016.

Main Ports Conducted Interference Measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: C-2726. Date of Registration: Dec. 20, 2012. Valid time is until Dec. 19, 2015.

Telecommunication Ports Conducted Interference Measurement of Shenzhen Huatongwei International Inspection Co., Ltd. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: T-1837. Date of Registration: May 07, 2013. Valid time is until May 06, 2016.

##### **DNV**

Shenzhen Huatongwei International Inspection Co., Ltd. has been found to comply with the requirements of DNV towards subcontractor of EMC and safety testing services in conjunction with the EMC and Low voltage Directives and in the voluntary field. The acceptance is based on a formal quality Audit and follow-ups according to relevant parts of ISO/IEC Guide 17025 (2005), in accordance with the requirements of the DNV Laboratory Quality Manual towards subcontractors. Valid time is until Aug. 24, 2016.

#### 4. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	1315	2015/07/22	1
E-field Probe	SPEAG	ES3DV3	3292	2015/08/15	1
System Validation Dipole 2450V2	SPEAG	D2450V2	884	2015/09/01	1
Dielectric Probe Kit	Agilent	85070E	US44020288	/	/
Power meter	Agilent	E4417A	GB41292254	2015/10/26	1
Power sensor	Agilent	8481H	MY41095360	2015/10/26	1
Network analyzer	Agilent	8753E	US37390562	2015/10/25	1
Universal Radio Communication Tester	ROHDE & SCHWARZ	CMU200	112012	2015/10/23	1

*Note:*

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

## 5. Measurement Uncertainty

No.	Error Description	Type	Uncertainty Value	Probably Distribution	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	Degree of freedom
Measurement System										
1	Probe calibration	B	5.50%	N	1	1	1	5.50%	5.50%	$\infty$
2	Axial isotropy	B	4.70%	R	$\sqrt{3}$	0.7	0.7	1.90%	1.90%	$\infty$
3	Hemispherical isotropy	B	9.60%	R	$\sqrt{3}$	0.7	0.7	3.90%	3.90%	$\infty$
4	Boundary Effects	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	$\infty$
5	Probe Linearity	B	4.70%	R	$\sqrt{3}$	1	1	2.70%	2.70%	$\infty$
6	Detection limit	B	1.00%	R	$\sqrt{3}$	1	1	0.60%	0.60%	$\infty$
7	RF ambient conditions-noise	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	$\infty$
8	RF ambient conditions-reflection	B	0.00%	R	$\sqrt{3}$	1	1	0.00%	0.00%	$\infty$
9	Response time	B	0.80%	R	$\sqrt{3}$	1	1	0.50%	0.50%	$\infty$
10	Integration time	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	$\infty$
11	RF ambient	B	3.00%	R	$\sqrt{3}$	1	1	1.70%	1.70%	$\infty$
12	Probe positioned mech. restrictions	B	0.40%	R	$\sqrt{3}$	1	1	0.20%	0.20%	$\infty$
13	Probe positioning with respect to phantom shell	B	2.90%	R	$\sqrt{3}$	1	1	1.70%	1.70%	$\infty$
14	Max.SAR evalation	B	3.90%	R	$\sqrt{3}$	1	1	2.30%	2.30%	$\infty$
Test Sample Related										
15	Test sample positioning	A	1.86%	N	1	1	1	1.86%	1.86%	$\infty$
16	Device holder uncertainty	A	1.70%	N	1	1	1	1.70%	1.70%	$\infty$
17	Drift of output power	B	5.00%	R	$\sqrt{3}$	1	1	2.90%	2.90%	$\infty$
Phantom and Set-up										
18	Phantom uncertainty	B	4.00%	R	$\sqrt{3}$	1	1	2.30%	2.30%	$\infty$
19	Liquid conductivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	$\infty$
20	Liquid conductivity (meas.)	A	0.50%	N	1	0.64	0.43	0.32%	0.26%	$\infty$
21	Liquid permittivity (target)	B	5.00%	R	$\sqrt{3}$	0.64	0.43	1.80%	1.20%	$\infty$
22	Liquid cpermittivity (meas.)	A	0.16%	N	1	0.64	0.43	0.10%	0.07%	$\infty$
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$		/	/	/	/	10.20%	10.00%	$\infty$
Expanded uncertainty (confidence interval of 95 %)		$u_e = 2u_c$		R	K=2	/	/	20.40%	20.00%	$\infty$

## 6. SAR Measurements System Configuration

## 6.1. SAR Measurement Set-up

The DASY5 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

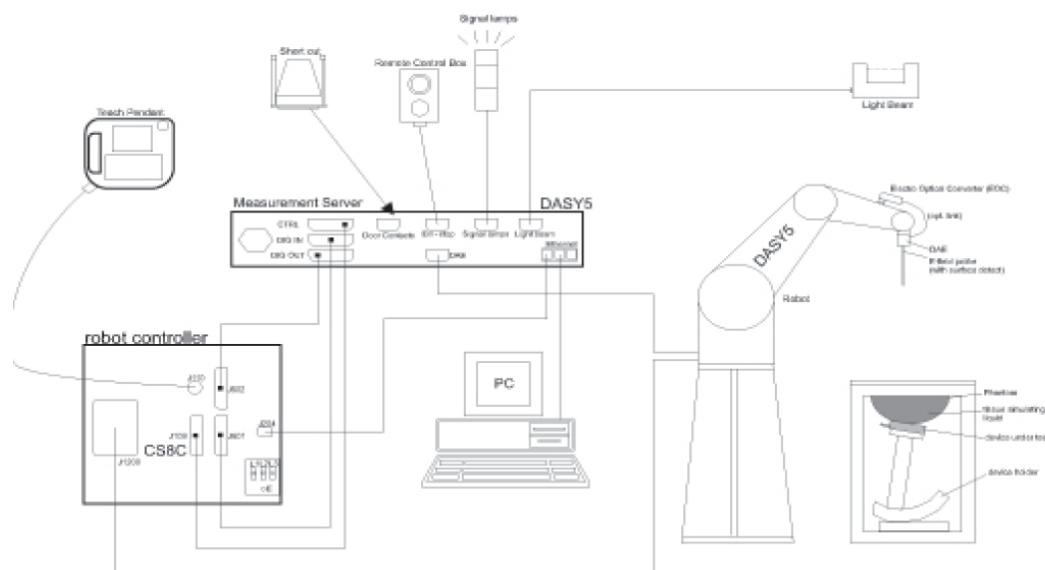
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld Mobile Phones.

Tissue simulating liquid mixed according to the given recipes.

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



## 6.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

### ● Probe Specification

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

Calibration  
ISO/IEC 17025 calibration service available.

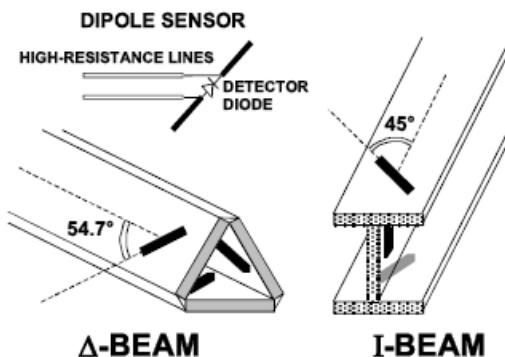
Frequency	10 MHz to 4 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 4 GHz)
Directivity	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.3$ dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of Mobile Phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI



### ● Isotropic E-Field Probe

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

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



### 6.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.



SAM Twin Phantom

### 6.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

## 7. SAR Test Procedure

### 7.1. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The "reference" and "drift" measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT's output power and should vary max.  $\pm 5\%$ .

The "surface check" measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1\text{mm}$ ). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within  $\pm 30^\circ$ .)

#### **Area Scan**

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

#### **Zoom Scan**

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x5 points within a cube whose base is centered around the maxima found in the preceding area scan.

#### **Spatial Peak Detection**

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR. During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x5 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x5 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## 7.2. Data Storage and Evaluation

### Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm<sup>2</sup>], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### Data Evaluation

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

Probe parameters:	Sensitivity:	Normi, ai0, ai1, ai2
	Conversion factor:	ConvFi
	Diode compression point:	Dcp <i>i</i>
Device parameters:	Frequency:	f
	Crest factor:	cf
Media parameters:	Conductivity:	σ
	Density:	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

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

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

Ui: input signal of channel ( i = x, y, z )

cf: crest factor of exciting field (DASY parameter)

dcp*i*: diode compression point (DASY parameter)

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

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

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

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

Norm*i*: sensor sensitivity of channel ( i = x, y, z ),  
[mV/(V/m)<sup>2</sup>] for E-field Probes

ConvF: sensitivity enhancement in solution

aij: sensor sensitivity factors for H-field probes

f: carrier frequency [GHz]

Ei: electric field strength of channel i in V/m

Hi: magnetic field strength of channel i in A/m

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

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

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

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

SAR: local specific absorption rate in mW/g

Etot: total field strength in V/m

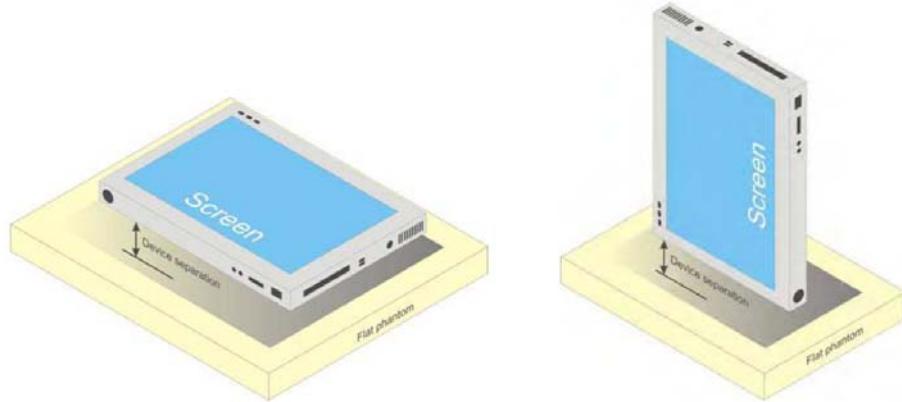
$\sigma$ : conductivity in [mho/m] or [Siemens/m]

$\rho$ : equivalent tissue density in g/cm<sup>3</sup>

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

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

A typical example of a body supported device is a wireless enabled laptop device that among other orientations may be supported on the thighs of a sitting user. To represent this orientation, the device shall be positioned with its base against the flat phantom. Other orientations may be specified by the manufacturer in the user instructions. If the intended use is not specified, the device shall be tested directly against the flat phantom in all usable orientations.



**b) Tablet form factor portable computer**

a tablet form factor portable computer for which SAR should be separately assessed with

d) each surface and

e) the separation distances

positioned against the flat phantom that correspond to the intended use as specified by the manufacturer. If the intended use is not specified in the user instructions, the device shall be tested directly against the flat phantom in all usable orientations

## 9. System Check

### 9.1. Tissue Dielectric Parameters

The liquid is consisted of water, salt, Glycol, Sugar, Preventol and Cellulose. The liquid has previously been proven to be suited for worst-case. The table 3 and table 4 show the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

Tissue dielectric parameters for head and body phantoms				
Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma$ (s/m)	$\epsilon_r$	$\sigma$ (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

#### Check Result:

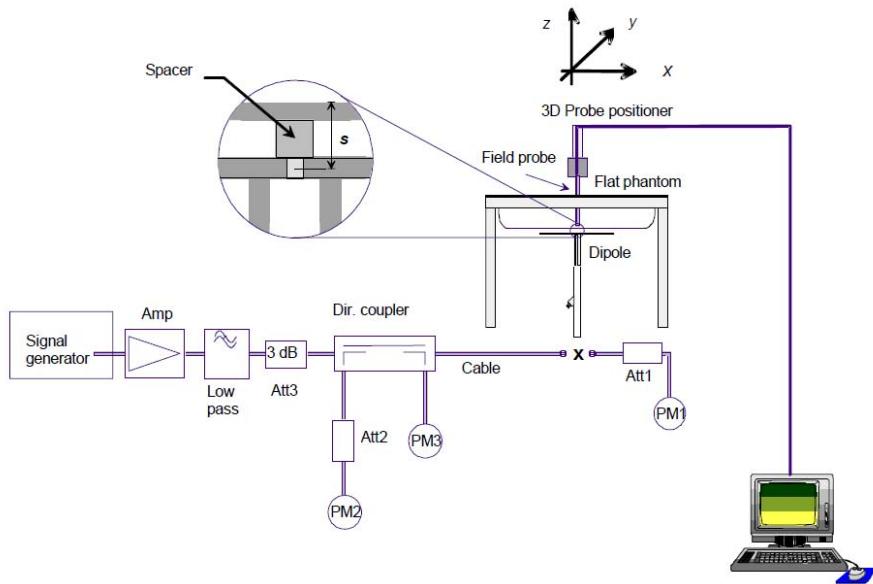
Dielectric performance of Body tissue simulating liquid				
Frequency (MHz)	Description	DielectricParameters		Temp °C
		$\epsilon_r$	$\sigma$ (s/m)	
2450	Recommended result ±5% window	52.7 50.07 to 55.34	1.95 1.85 to 2.05	/
	Measurement value 2015-12-04	52.65	1.93	21

## 9.2. SAR System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ( $\pm 10\%$ ).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



The output power on dipole port must be calibrated to 24 dBm (250mW) before dipole is connected.



Photo of Dipole Setup

**Check Result:**

Body				
Frequency (MHz)	Description	SAR(W/kg)		Temp °C
		1g	10g	
2450	Recommended result ±5% window	13.1 11.79 -14.41	6.11 5.50 -6.72	/
	Measurement value 2015-12-04	12.53	6.09	

Note:

1. the graph results see follow.
2. Recommended Values used derive from the calibration certificate and 250 mW is used as feeding power to the calibrated dipole.

**System Performance Check at 2450 MHz Body**

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 884

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated):  $f = 2450$  MHz;  $\sigma = 1.93$  S/m;  $\epsilon_r = 52.65$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

**DASY5 Configuration:**

Probe: ES3DV3 - SN3292; ConvF(4.23, 4.23, 4.23); Calibrated: 15/08/2015;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 22/07/2015

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (1); SEMCAD X Version 14.6.5 (6469)

**Area Scan (61x91x1):** Measurement grid: dx=10.00 mm, dy=10.00 mm

Maximum value of SAR (interpolated) = 15.15 mW/g

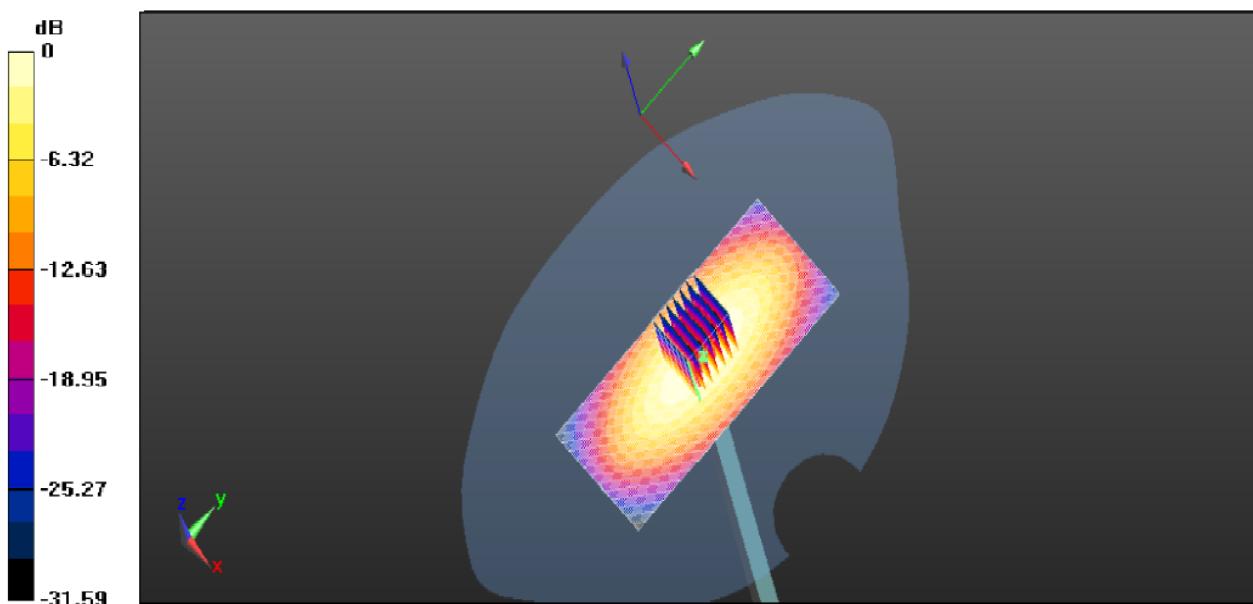
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.986 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 18.08 mW/g

**SAR(1 g) = 12.53 mW/g; SAR(10 g) = 6.09 mW/g**

Maximum value of SAR (measured) = 18.18 mW/g



System Performance Check 2450MHz Body250mW

## **10. SAR Exposure Limits**

SAR assessments have been made in line with the requirements of ANSI/IEEE C95.1-1992

Type Exposure	Limit (W/kg)	
	General Population / Uncontrolled Exposure Environment	Occupational / Controlled Exposure Environment
Spatial Average SAR (whole body)	0.08	0.4
Spatial Peak SAR (1g cube tissue for head and trunk)	1.60	8.0
Spatial Peak SAR (10g for limb)	4.0	20.0

Population/Uncontrolled Environments: are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments: are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

## 11. Conducted Power Measurement Results

For 2.4GHz WLAN SAR testing, highest average RF output power channel for the lowest data rate for 802.11b were for SAR evaluation. 802.11g/n were not investigated since the average output powers over all channels and data rates were not more than 0.25dB higher than the tested channel in the lowest data rate of 802.11b mode.

WIFI					
Mode	Channel	Frequency (MHz)	Conducted Peak Power (dBm)	Conducted Average Power (dBm)	Data rate
802.11b	01	2412	16.04	13.17	1 Mbps
	06	2437	17.28	14.19	1 Mbps
	11	2462	17.33	14.23	1 Mbps
802.11g	01	2412	14.56	10.45	6 Mbps
	06	2437	12.25	8.79	6 Mbps
	11	2462	15.15	10.87	6 Mbps
802.11n(H20)	01	2412	16.91	11.86	6.5 Mbps
	06	2437	17.60	12.34	6.5 Mbps
	11	2462	17.65	12.38	6.5 Mbps
802.11n(H40)	03	2422	10.79	7.11	13.5 Mbps
	06	2437	11.23	7.40	13.5 Mbps
	09	2452	11.25	7.41	13.5 Mbps

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

## Bluetooth Conducted Power

### General note:

Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances  $\leq$  50mm are determined by:

$[(\text{max. Power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})}] \leq 3.0 \text{ for 1-g SAR and } \leq 7.5 \text{ for 10-g extremity SAR}$

Bluetooth			
Mode	Channel	Frequency (MHz)	Conducted power (dBm)
GFSK	00	2402	4.38
	39	2441	4.64
	78	2480	4.61
$\pi/4$ QPSK	00	2402	4.53
	39	2441	4.56
	78	2480	4.59
8DPSK	00	2402	4.73
	39	2441	4.99
	78	2480	4.94
GFSK(BLE)	00	2402	1.97
	19	2440	2.06
	39	2480	2.07

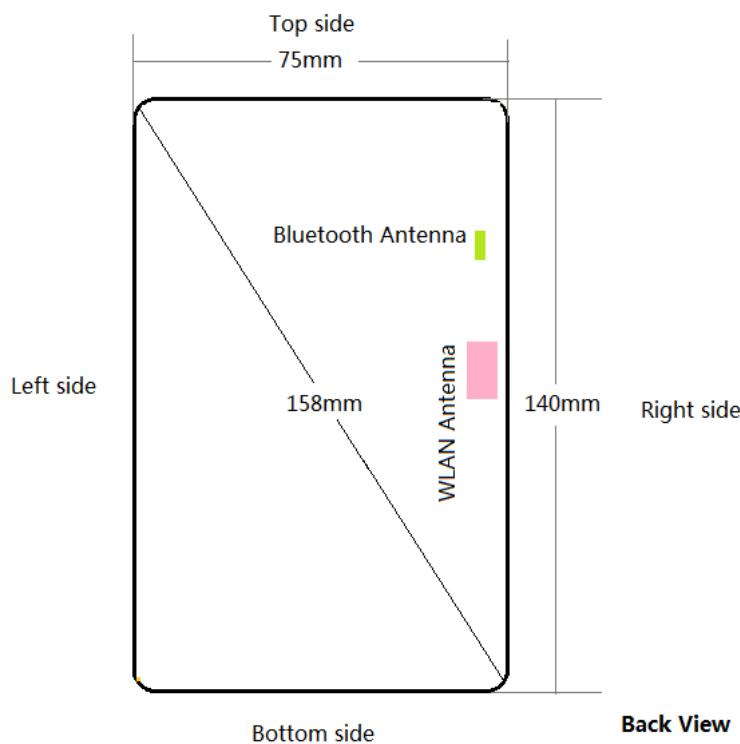
Per KDB 447498 D01v06, when the minimum test separation distance is  $< 5\text{mm}$ , a distance of 5mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.6 which is  $\leq 3$ , SAR testing is not required.

## **12. Maximum Tune-up Limit**

<b>WLAN</b>	
Mode	Average conducted Power (dBm)
802.11b	14.50
802.11g	11.00
802.11n(HT20)	13.00
802.11n(HT40)	8.00

Mode	Conducted Power (dBm)
Bluetooth V3.0+HS	5.00
Bluetooth V4.0 BLE	2.50

### 13. Antenna Location



Distance of the Antenna to the EUT surface/edge						
Antenna	Back	Front	Top side	Bottom side	Right side	Left side
WIFI	≤25mm	≤25mm	60mm	70mm	≤25mm	65mm

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

General note:

Referring to KDB941225 D06 v02r01, when the overall device length and width are >9cm\*5cm, the test distance is 10mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.

## 14. SAR Measurement Results

802.11b mode									
Test Position	Frequency		Conducted Power (dBm)	Tune up limit (dBm)	Tune up scaling factor	Power Drift(dB)	Measured SAR(1g) (W/kg)	Report SAR(1g) (W/kg)	Plot
	CH	MHz							
Back	1	2412	13.17	14.5	1.36	-	-	-	-
	6	2437	14.19	14.5	1.07	-0.03	0.128	0.137	#1
	11	2462	14.23	14.5	1.06	-	-	-	-
Front	1	2412	13.17	14.5	1.36	-	-	-	-
	6	2437	14.19	14.5	1.07	0.04	0.124	0.133	#2
	11	2462	14.23	14.5	1.06	-	-	-	-
Left	6	2437	14.19	14.5	1.07	-0.12	0.597	0.641	#3
Right	6	2437	14.19	14.5	1.07	-	-	-	
Top	6	2437	14.19	14.5	1.07	-0.08	0.103	0.111	#4
Bottom	6	2437	14.19	14.5	1.07	-	-	-	-

*Note:*

1. *The value with blue color is the maximum SAR Value of each test band.*
2. *The distance of the Body test is 0mm;*
3. Per KDB865664 D01v01r04, Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg

SAR Test Data Plots

**#1: Body- worn Rear side ( WLAN 802.11b Middle Channel)**

Communication System: Customer System; Frequency: 2442.0 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f=2442.0$  MHz;  $\sigma=1.93$  S/m;  $\epsilon_r=52.65$ ;  $\rho=1000$  kg/m<sup>3</sup>  
Phantom section : Body- worn

**DASY5 Configuration:**

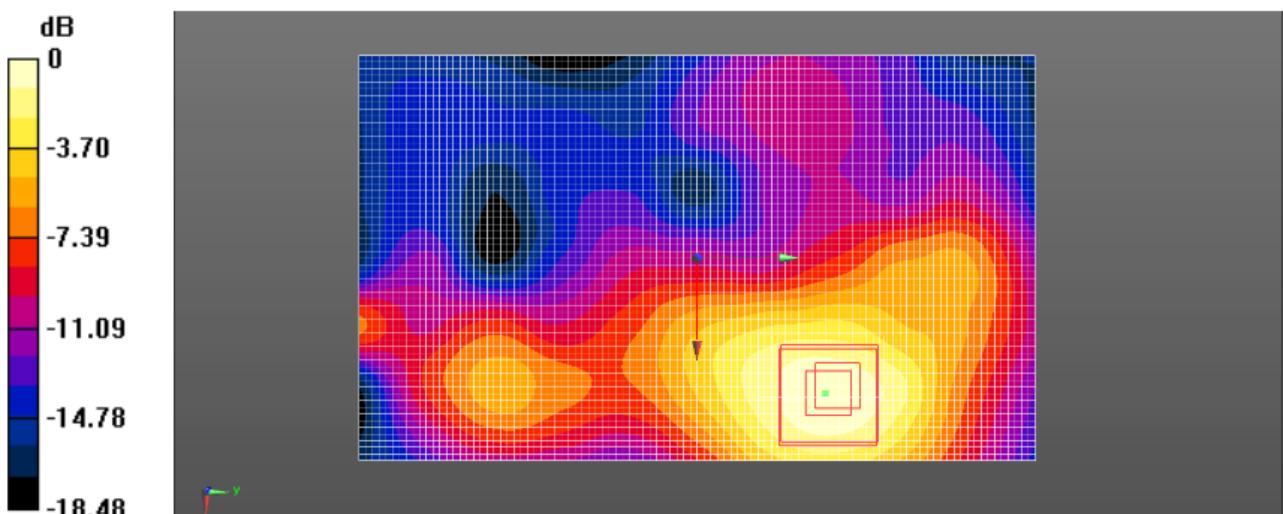
- Probe: ES3DV3 - SN3292; ConvF(4.43, 4.43, 4.43); Calibrated: 15/08/2015;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1315; Calibrated: 22/07/2015
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x101x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Maximum value of SAR (interpolated) = 0.144 W/kg

**Zoom Scan (5x5x6)/Cube 0:** Measurement grid: dx=7mm, dy=7mm, dz=5mm  
Reference Value = 3.735 V/m; Power Drift = -0.03 dB  
Peak SAR (extrapolated) = 0.259 mW/g

**SAR(1 g) = 0.128 mW/g; SAR(10 g) = 0.065 mW/g**

Maximum value of SAR (measured) = 0.143 W/kg



**#2:Body- worn Front side ( WLAN 802.11b Middle Channel)**

Communication System: Customer System; Frequency: 2442.0 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f=2442.0$  MHz;  $\sigma=1.93$  S/m;  $\epsilon_r=52.65$ ;  $\rho=1000$  kg/m<sup>3</sup>  
Phantom section : Body- worn

**DASY5 Configuration:**

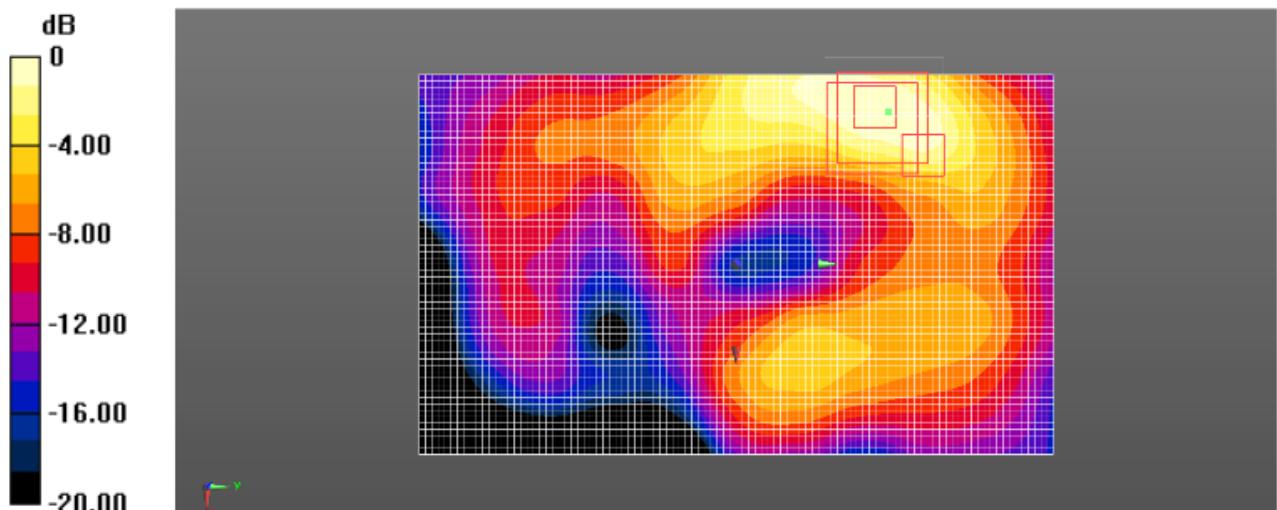
- Probe: ES3DV3 - SN3292; ConvF(4.43, 4.43, 4.43); Calibrated: 15/08/2015;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1315; Calibrated: 22/07/2015
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x101x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Maximum value of SAR (interpolated) = 0.142W/kg

**Zoom Scan (5x5x6)/Cube 0:** Measurement grid: dx=7mm, dy=7mm, dz=5mm  
Reference Value = 1.947 V/m; Power Drift = 0.04 dB  
Peak SAR (extrapolated) = 0.599 mW/g

**SAR(1 g) = 0.124 mW/g; SAR(10 g) = 0.036 mW/g**

Maximum value of SAR (measured) = 0.141W/kg



Body- worn Front side (WLAN802.11bMiddle Channel)

**#3:Body- worn Left side ( WLAN 802.11b Middle Channel)**

Communication System: Customer System; Frequency: 2442.0 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f=2442.0$  MHz;  $\sigma=1.93$  S/m;  $\epsilon_r=52.65$ ;  $\rho=1000$  kg/m<sup>3</sup>  
Phantom section : Body- worn

**DASY5 Configuration:**

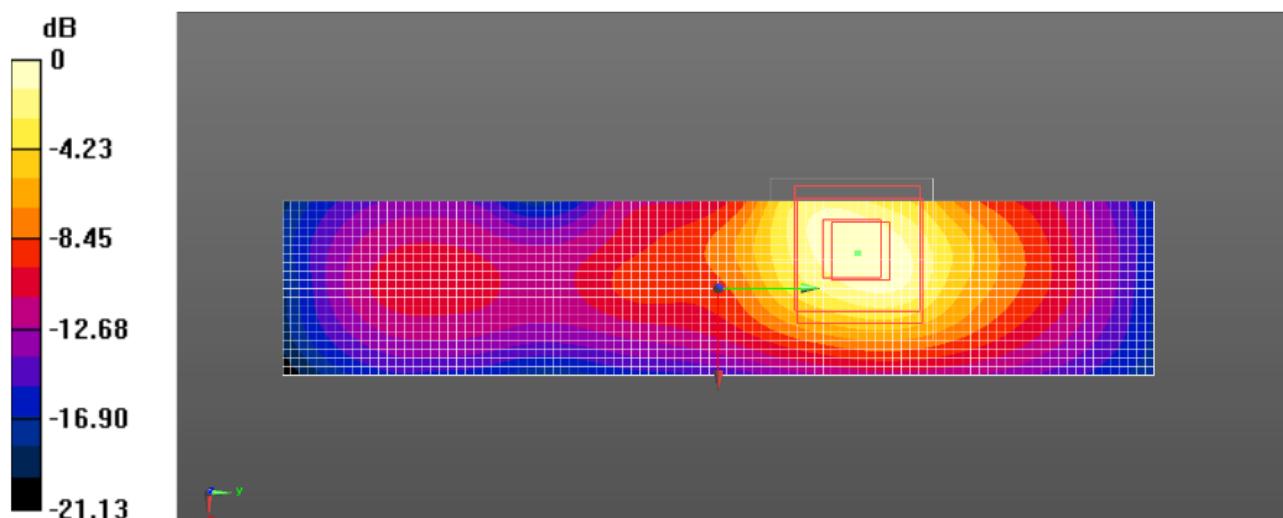
- Probe: ES3DV3 - SN3292; ConvF(4.43, 4.43, 4.43); Calibrated: 15/08/2015;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1315; Calibrated: 22/07/2015
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (21x101x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm  
Maximum value of SAR (interpolated) = 0.577W/kg

**Zoom Scan (5x5x6)/Cube 0:** Measurement grid: dx=7mm, dy=7mm, dz=5mm  
Reference Value = 6.474 V/m; Power Drift = -0.12 dB  
Peak SAR (extrapolated) = 1.689 mW/g

**SAR(1 g) = 0.597 mW/g; SAR(10 g) = 0.247 mW/g**

Maximum value of SAR (measured) = 0.576 W/kg



**#4: Body- worn Top side ( WLAN 802.11b Middle Channel)**

Communication System: Customer System; Frequency: 2442.0 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f=2442.0$  MHz;  $\sigma=1.93$  S/m;  $\epsilon_r=52.65$ ;  $\rho=1000$  kg/m<sup>3</sup>  
Phantom section : Body- worn

**DASY5 Configuration:**

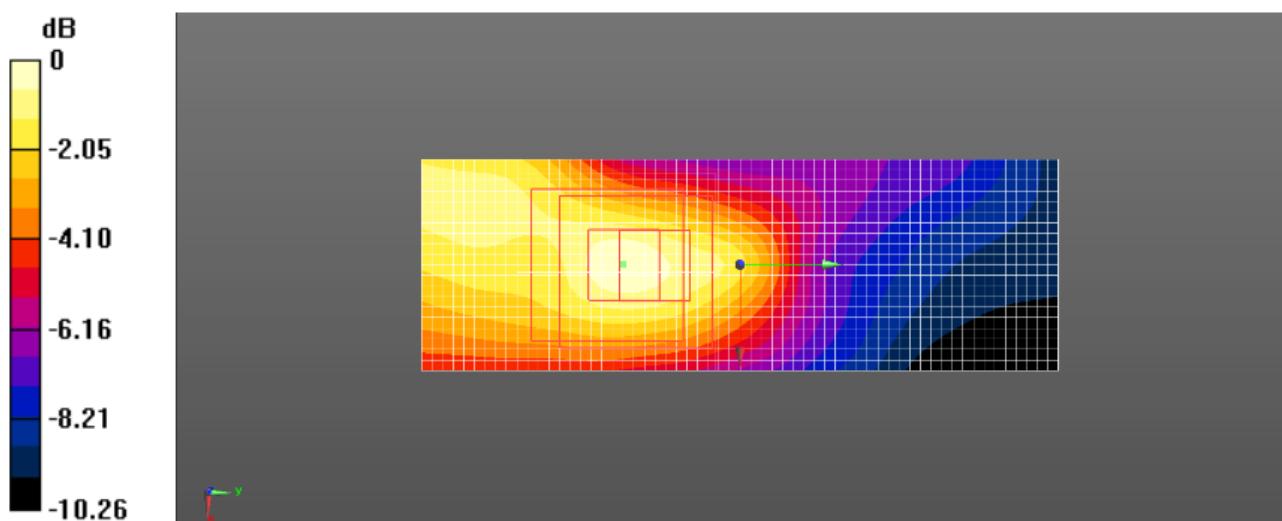
- Probe: ES3DV3 - SN3292; ConvF(4.43, 4.43, 4.43); Calibrated: 15/08/2015;
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1315; Calibrated: 22/07/2015
- Phantom: SAM 1; Type: SAM;
- Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (21x61x1):** Interpolated grid:  $dx=1.500$  mm,  $dy=1.500$  mm  
Maximum value of SAR (interpolated) = 0.075 W/kg

**Zoom Scan (5x5x6)/Cube 0:** Measurement grid:  $dx=7$  mm,  $dy=7$  mm,  $dz=5$  mm  
Reference Value = 4.913 V/m; Power Drift = -0.08 dB  
Peak SAR (extrapolated) = 0.150 mW/g

**SAR(1 g) = 0.103 mW/g; SAR(10 g) = 0.059 mW/g**

Maximum value of SAR (measured) = 0.074 W/kg



Body- worn Top side (WLAN802.11bMiddle Channel)

## 15. Simultaneous Transmission analysis

No.	Simultaneous Transmission Configurations	Body-worn	Note
1	WIFI(data) + Bluetooth (data)	Yes	

General note:

1. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01 based on the formula below
  - a)  $[(\text{max. Power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] * [\sqrt{f(\text{GHz})/x}] \text{W/kg}$  for test separation distances  $\leq 50\text{mm}$ ; when  $x=7.5$  for 1-g SAR, and  $x=18.75$  for 10-g SAR.
  - b) When the minimum separation distance is  $< 5\text{mm}$ , the distance is used 5mm to determine SAR test exclusion
  - c) 0.4 W/kg for 1-g SAR and 1.0W/kg for 10-g SAR, when the test separation distances is  $> 50\text{mm}$ .

Bluetooth Max power	Exposure position	Body worn
	Test separation	0mm
5.00dBm	Estimated SAR (W/kg)	0.132 W/kg

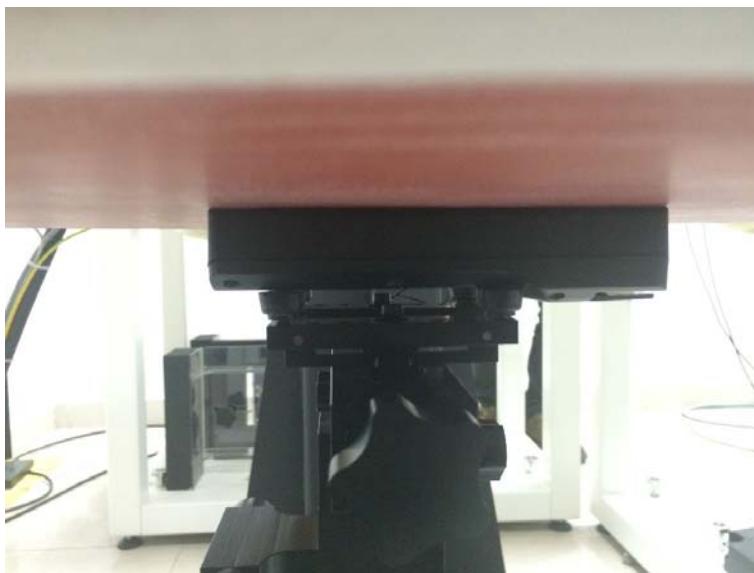
Simultaneous Transmission data:

Exposure Position	Max SAR (W/kg)		Summed SAR (W/kg)
	WIFI	Bluetooth	
Back	0.137	0.132	0.269
Front	0.133	0.132	0.265
Left	0.641	0.132	0.773
Right	-	0.132	0.132
Top	0.111	0.132	0.243
Bottom	-	0.132	0.132

## 16. TestSetup Photos



2450MHz



Front side (0mm)



Rear side (0mm)



Left side (0mm)



Right side (0mm)



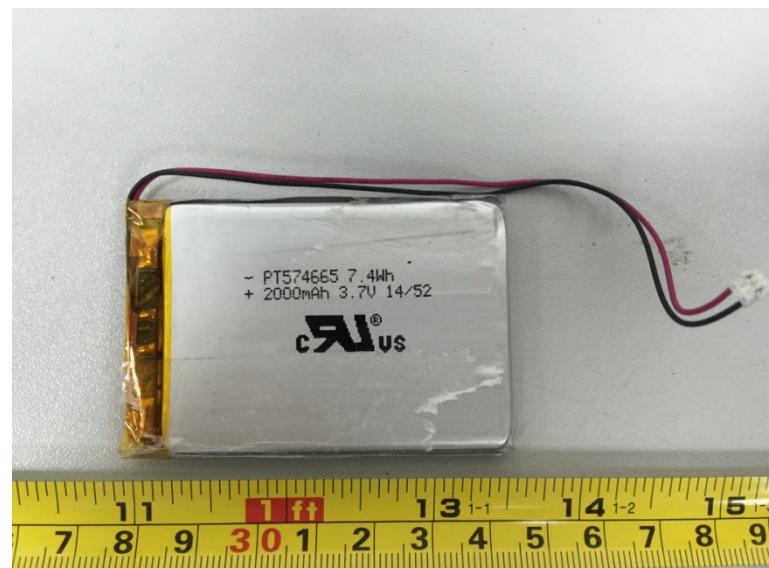
Top side (0mm)



Bottom side (0mm)

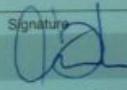
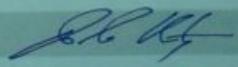
## 17. External and Internal Photos of the EUT

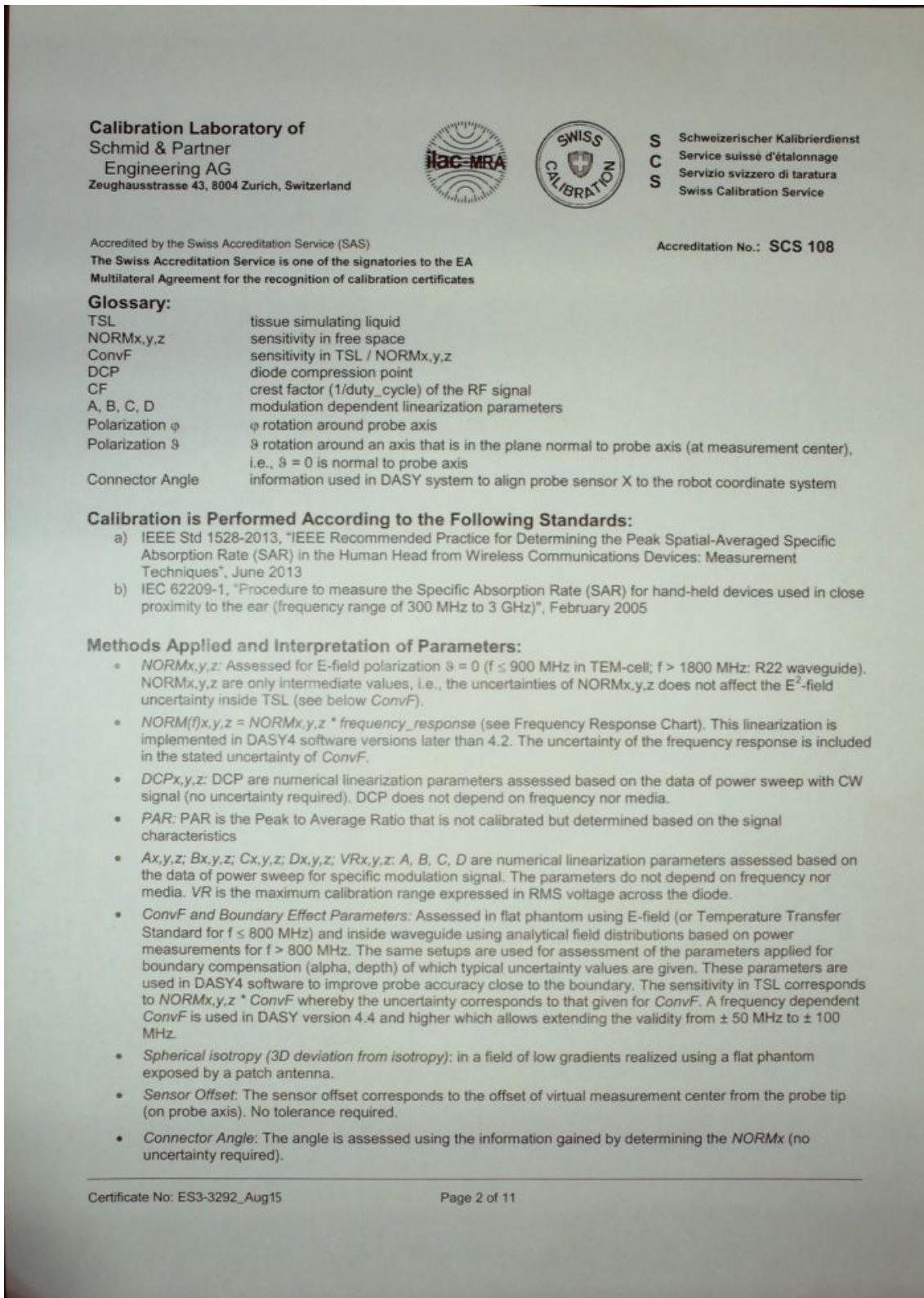




-----End of Report-----

## 1.1. Probe Calibration Certificate

<b>Calibration Laboratory of</b> <b>Schmid &amp; Partner</b> <b>Engineering AG</b> <b>Zeughausstrasse 43, 8004 Zurich, Switzerland</b>		 	<b>S</b> Schweizerischer Kalibrierdienst <b>C</b> Service suisse d'étalonnage <b>S</b> Servizio svizzero di taratura <b>S</b> Swiss Calibration Service																																												
<small>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</small>		<small>Accreditation No.: SCS 108</small>																																													
Client	CIQ (Auden)	Certificate No: ES3-3292_Aug15																																													
<b>CALIBRATION CERTIFICATE</b>																																															
Object	ES3DV3 - SN:3292																																														
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes																																														
Calibration date:	August 15, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$ .																																															
Calibration Equipment used (M&TE critical for calibration)																																															
<table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter E4419B</td> <td>GB41293874</td> <td>03-Apr-15 (No. 217-01911)</td> <td>Apr-16</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY41498087</td> <td>03-Apr-15 (No. 217-01911)</td> <td>Apr-16</td> </tr> <tr> <td>Reference 3 dB Attenuator</td> <td>SN: S5054 (3c)</td> <td>03-Apr-15 (No. 217-01915)</td> <td>Apr-16</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: S5277 (20x)</td> <td>03-Apr-15 (No. 217-01919)</td> <td>Apr-16</td> </tr> <tr> <td>Reference 30 dB Attenuator</td> <td>SN: S5129 (30b)</td> <td>03-Apr-15 (No. 217-01920)</td> <td>Apr-16</td> </tr> <tr> <td>Reference Probe ES3DV2</td> <td>SN: 3013</td> <td>30-Dec-14 (No. ES3-3013, Dec13)</td> <td>Dec-15</td> </tr> <tr> <td>DAE4</td> <td>SN: 660</td> <td>13-Dec-14 (No. DAE4-660, Dec13)</td> <td>Dec-15</td> </tr> <tr> <td>Secondary Standards</td> <td>ID</td> <td>Check Date (in house)</td> <td>Scheduled Check</td> </tr> <tr> <td>RF generator HP 8648C</td> <td>US3642U01700</td> <td>4-Aug-99 (in house check Apr-13)</td> <td>In house check: Apr-16</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (in house check Oct-13)</td> <td>In house check: Oct-14</td> </tr> </tbody> </table>				Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration	Power meter E4419B	GB41293874	03-Apr-15 (No. 217-01911)	Apr-16	Power sensor E4412A	MY41498087	03-Apr-15 (No. 217-01911)	Apr-16	Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-15 (No. 217-01915)	Apr-16	Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-15 (No. 217-01919)	Apr-16	Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-15 (No. 217-01920)	Apr-16	Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013, Dec13)	Dec-15	DAE4	SN: 660	13-Dec-14 (No. DAE4-660, Dec13)	Dec-15	Secondary Standards	ID	Check Date (in house)	Scheduled Check	RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16	Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14
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Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013, Dec13)	Dec-15																																												
DAE4	SN: 660	13-Dec-14 (No. DAE4-660, Dec13)	Dec-15																																												
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Calibrated by:	Name Claudio Leubler	Function Laboratory Technician																																													
Approved by:	Katja Pokovic	Technical Manager																																													
<small>Issued: August 15, 2015</small>																																															
<small>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</small>																																															



ES3DV3 – SN:3292

August 15, 2015

# Probe ES3DV3

SN:3292

Manufactured: July 6, 2010  
Repaired: July 28, 2015  
Calibrated: August 15, 2015

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

ES3DV3- SN:3292

August 15, 2015

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.89	0.95	1.46	$\pm 10.1\%$
DCP (mV) <sup>B</sup>	107.1	106.1	103.9	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	209.7	$\pm 3.8\%$
		Y	0.0	0.0	1.0		218.8	
		Z	0.0	0.0	1.0		198.5	

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%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>C</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

Certificate No: ES3-3292\_Aug15

Page 4 of 11

ES3DV3— SN:3292

August 15, 2015

**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292**

**Calibration Parameter Determined in Head Tissue Simulating Media**

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unct. (k=2)
450	43.5	0.87	6.71	6.71	6.71	0.18	1.80	± 13.3 %
835	41.5	0.90	6.23	6.23	6.23	0.80	1.11	± 12.0 %
900	41.5	0.97	6.71	6.71	6.10	6.71	1.17	± 12.0 %
1810	40.0	1.40	5.07	5.07	5.07	0.61	1.36	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.45	1.55	± 12.0 %
2100	39.8	1.49	5.04	5.04	5.04	0.77	1.17	± 12.0 %
2450	39.2	1.80	4.43	4.43	4.43	0.73	1.23	± 12.0 %

<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> 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 frequencies between 3-8 GHz at any distance larger than half the probe tip diameter from the boundary.

ES3DV3- SN:3292

August 15, 2015

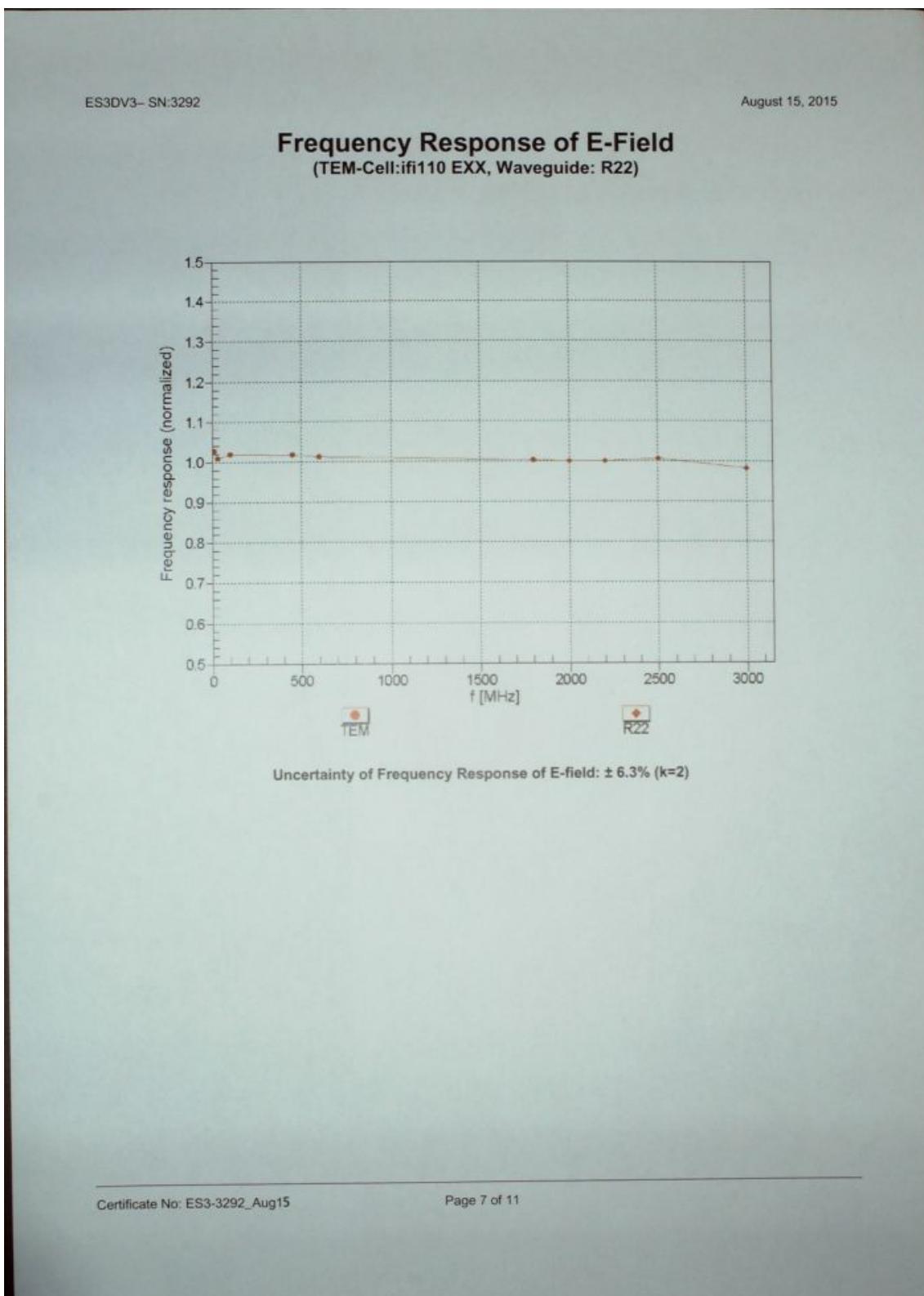
**DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292****Calibration Parameter Determined in Body Tissue Simulating Media**

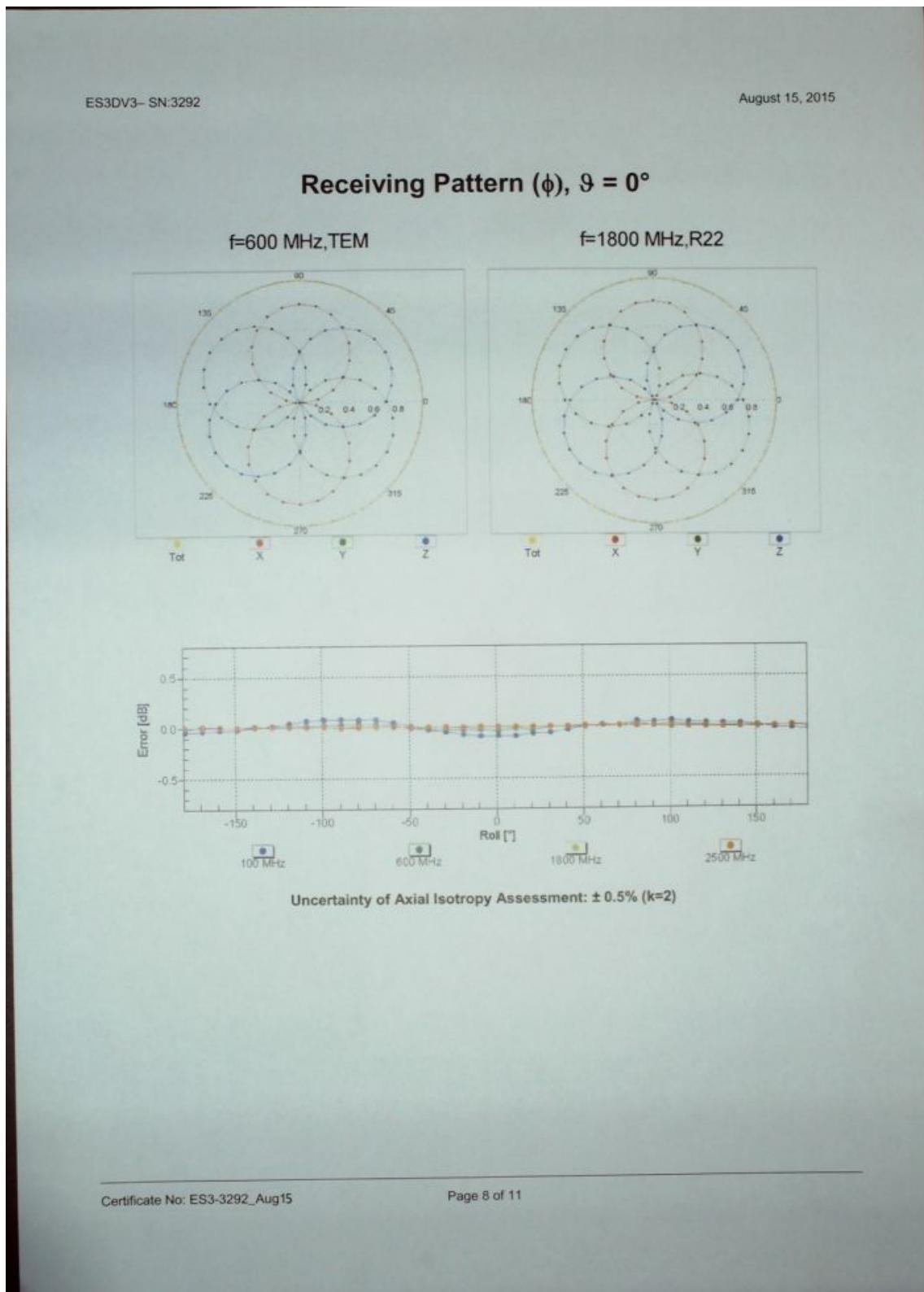
f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>H</sup> (mm)	Unct. (k=2)
450	56.7	0.94	7.10	7.10	7.10	0.13	1.00	± 13.3 %
835	55.2	0.97	6.11	6.11	6.11	0.36	1.78	± 12.0 %
900	55.0	1.05	5.97	5.97	5.97	0.73	1.22	± 12.0 %
1810	53.3	1.52	4.79	4.79	4.79	0.59	1.45	± 12.0 %
1900	53.3	1.52	4.66	4.66	4.66	0.41	1.79	± 12.0 %
2100	53.2	1.62	4.77	4.77	4.77	0.63	1.42	± 12.0 %
2450	52.7	1.95	4.23	4.23	4.23	0.66	0.98	± 12.0 %

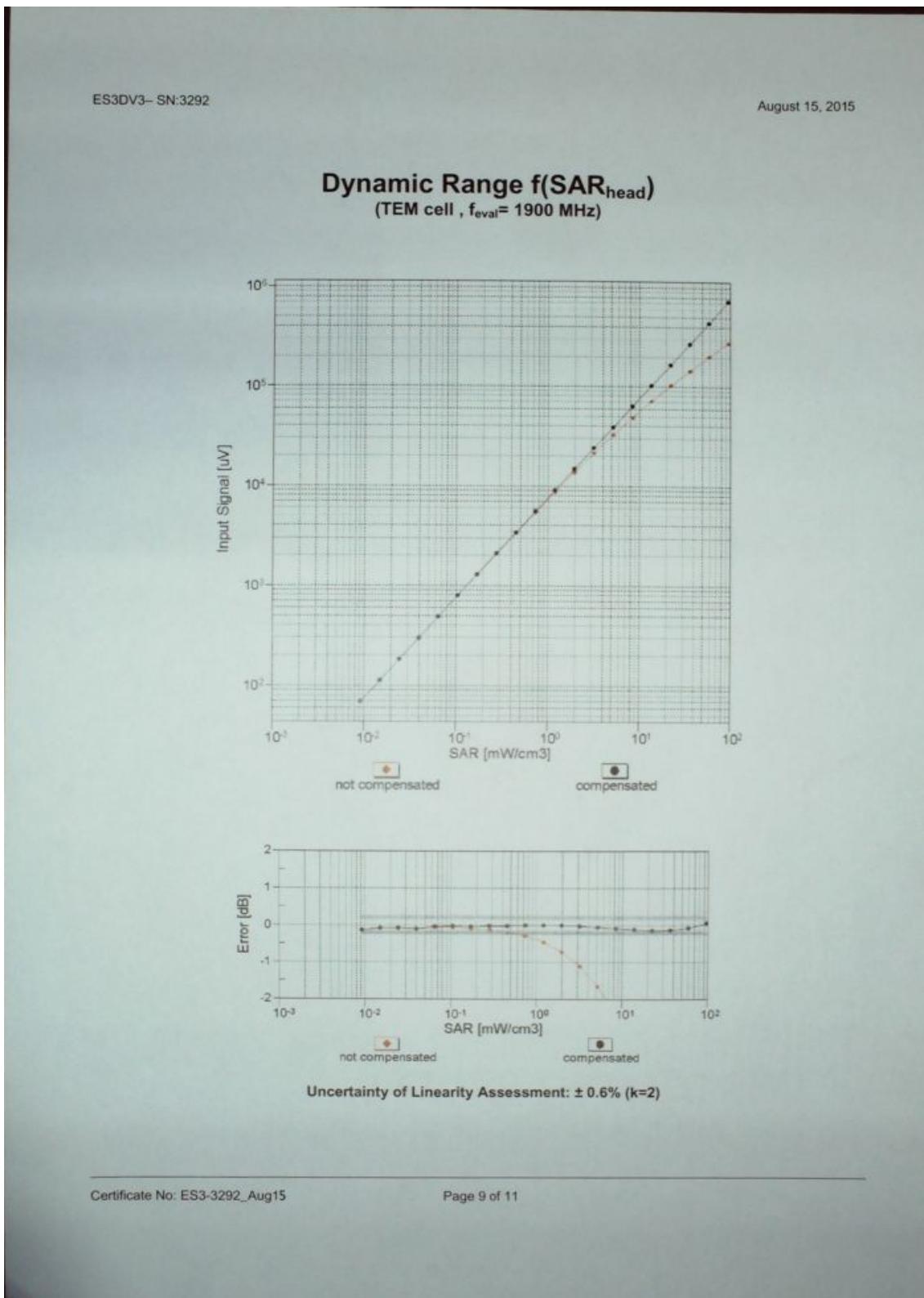
<sup>C</sup> Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

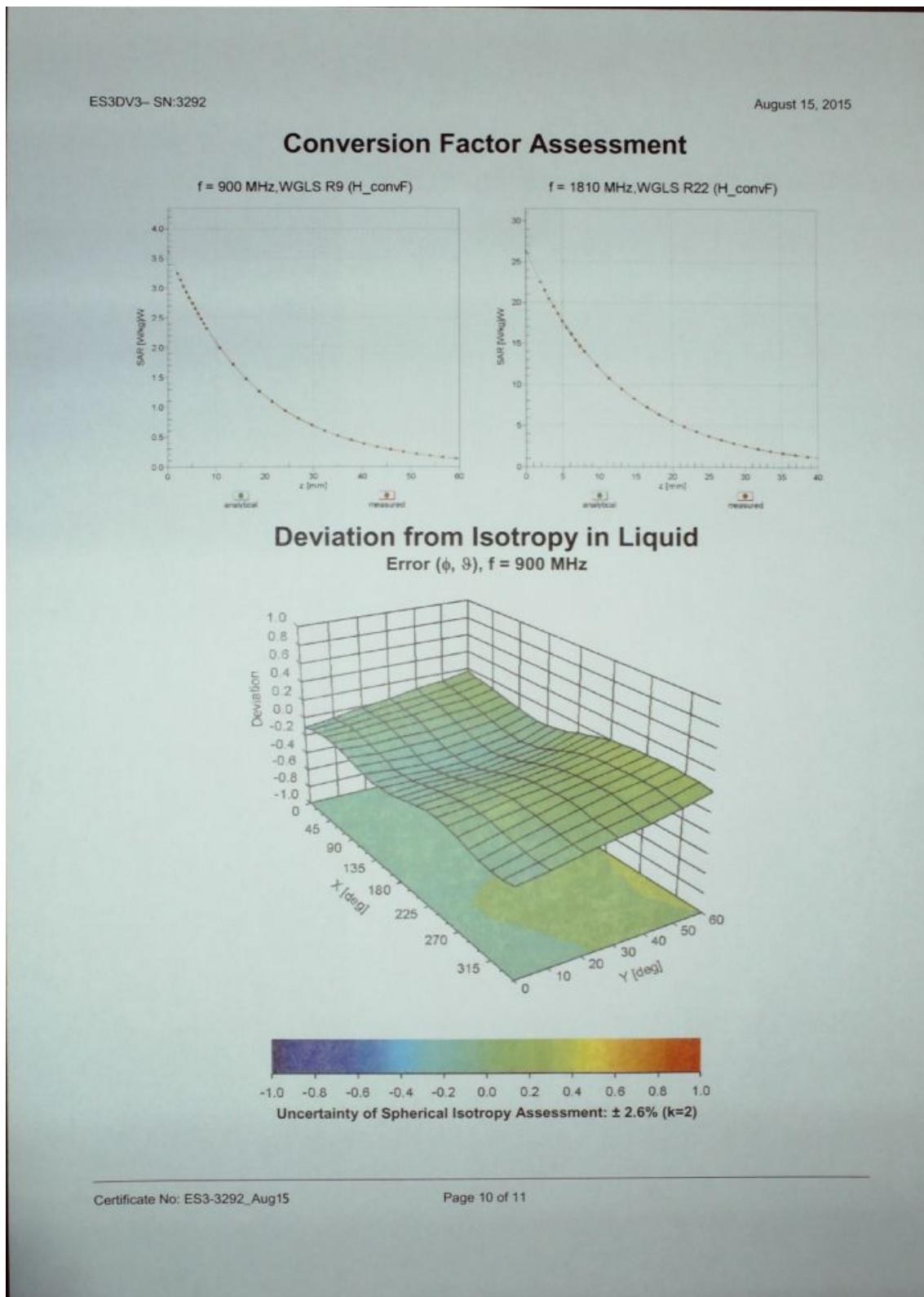
<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> 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 frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.









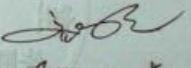
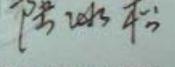
ES3DV3- SN:3292	August 15, 2015
<b>DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292</b>	
<b>Other Probe Parameters</b>	
Sensor Arrangement	Triangular
Connector Angle (°)	-8.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

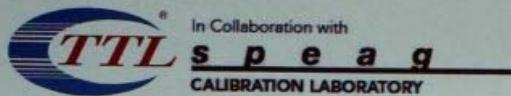
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Certificate No: ES3-3292\_Aug15

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## 1.2. D2450V2 Dipole Calibration Certificate

 <b>In Collaboration with</b> <b>s p e a g</b> <b>CALIBRATION LABORATORY</b>		 <b>ILAC-MRA</b> <b>CNAS</b> <b>CALIBRATION</b> <b>No. L0570</b>	
Client	CIQ-SZ(Auden)		
Certificate No: Z15-97070			
<b>CALIBRATION CERTIFICATE</b>			
Object	D2450V2 - SN: 884		
Calibration Procedure(s)	TMC-OS-E-02-194 Calibration procedure for dipole validation kits		
Calibration date:	September 1, 2015		
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(<math>22\pm3</math>)°C and humidity&lt;70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p>			
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	11-Sep-14 (TMC, No.JZ13-443)	Sep-15
Power sensor NRV-Z5	100595	11-Sep-14 (TMC, No. JZ13-443)	Sep-15
Reference Probe ES3DV3	SN 3149	5- Sep-14 (SPEAG, No.ES3-3149_Sep13)	Sep-15
DAE3	SN 536	23-Jan-15 (SPEAG, DAE3-536_Jan14)	Jan-16
Signal Generator E4438C	MY49070393	13-Nov-14 (TMC, No.JZ13-394)	Nov-15
Network Analyzer E8362B	MY43021135	19-Oct-14 (TMC, No.JZ13-278)	Oct-15
Calibrated by:	Name	Function	Signature
	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	
Issued: September 4, 2015			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Certificate No: Z15-97070		Page 1 of 8	



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](mailto:cttl@chinattl.com) [Http://www.chinattl.com](http://www.chinattl.com)



**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

**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
- c) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

- d) DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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%.

 <p>In Collaboration with <b>s p e a g</b> CALIBRATION LABORATORY</p>	<p>Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504 E-mail: <a href="mailto:ctl@chinattl.com">ctl@chinattl.com</a> <a href="http://www.chinattl.cn">Http://www.chinattl.cn</a></p>	 <p>ILAC-MRA CNAS CALIBRATION No. L0570</p>																		
<p><b>Measurement Conditions</b> DASY system configuration, as far as not given on page 1.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">DASY Version</td> <td style="width: 33%;">DASY52</td> <td style="width: 33%;">52.8.8.1222</td> </tr> <tr> <td>Extrapolation</td> <td colspan="2">Advanced Extrapolation</td> </tr> <tr> <td>Phantom</td> <td colspan="2">Triple Flat Phantom 5.1C</td> </tr> <tr> <td>Distance Dipole Center - TSL</td> <td>10 mm</td> <td>with Spacer</td> </tr> <tr> <td>Zoom Scan Resolution</td> <td colspan="2">dx, dy, dz = 5 mm</td> </tr> <tr> <td>Frequency</td> <td colspan="2">2450 MHz ± 1 MHz</td> </tr> </table>			DASY Version	DASY52	52.8.8.1222	Extrapolation	Advanced Extrapolation		Phantom	Triple Flat Phantom 5.1C		Distance Dipole Center - TSL	10 mm	with Spacer	Zoom Scan Resolution	dx, dy, dz = 5 mm		Frequency	2450 MHz ± 1 MHz	
DASY Version	DASY52	52.8.8.1222																		
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<p><b>Head TSL parameters</b> The following parameters and calculations were applied.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td>Nominal Head TSL parameters</td> <td>22.0 °C</td> <td>39.2</td> <td>1.80 mho/m</td> </tr> <tr> <td>Measured Head TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>40.2 ± 6 %</td> <td>1.84 mho/m ± 6 %</td> </tr> <tr> <td>Head TSL temperature change during test</td> <td>&lt;1.0 °C</td> <td>---</td> <td>---</td> </tr> </tbody> </table>				Temperature	Permittivity	Conductivity	Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m	Measured Head TSL parameters	(22.0 ± 0.2) °C	40.2 ± 6 %	1.84 mho/m ± 6 %	Head TSL temperature change during test	<1.0 °C	---	---		
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<p><b>SAR result with Head TSL</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</td> <td style="width: 33%;">Condition</td> <td style="width: 33%;"></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>13.1 mW / g</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>52.1 mW /g ± 20.8 % (k=2)</td> </tr> <tr> <td>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</td> <td>Condition</td> <td></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>6.17 mW / g</td> </tr> <tr> <td>SAR for nominal Head TSL parameters</td> <td>normalized to 1W</td> <td>24.6 mW /g ± 20.4 % (k=2)</td> </tr> </table>			SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition		SAR measured	250 mW input power	13.1 mW / g	SAR for nominal Head TSL parameters	normalized to 1W	52.1 mW /g ± 20.8 % (k=2)	SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition		SAR measured	250 mW input power	6.17 mW / g	SAR for nominal Head TSL parameters	normalized to 1W	24.6 mW /g ± 20.4 % (k=2)
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SAR for nominal Head TSL parameters	normalized to 1W	24.6 mW /g ± 20.4 % (k=2)																		
<p><b>Body TSL parameters</b> The following parameters and calculations were applied.</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th>Temperature</th> <th>Permittivity</th> <th>Conductivity</th> </tr> </thead> <tbody> <tr> <td>Nominal Body TSL parameters</td> <td>22.0 °C</td> <td>52.7</td> <td>1.95 mho/m</td> </tr> <tr> <td>Measured Body TSL parameters</td> <td>(22.0 ± 0.2) °C</td> <td>51.3 ± 6 %</td> <td>2.00 mho/m ± 6 %</td> </tr> <tr> <td>Body TSL temperature change during test</td> <td>&lt;1.0 °C</td> <td>---</td> <td>---</td> </tr> </tbody> </table>				Temperature	Permittivity	Conductivity	Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m	Measured Body TSL parameters	(22.0 ± 0.2) °C	51.3 ± 6 %	2.00 mho/m ± 6 %	Body TSL temperature change during test	<1.0 °C	---	---		
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Body TSL temperature change during test	<1.0 °C	---	---																	
<p><b>SAR result with Body TSL</b></p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</td> <td style="width: 33%;">Condition</td> <td style="width: 33%;"></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>13.1 mW / g</td> </tr> <tr> <td>SAR for nominal Body TSL parameters</td> <td>normalized to 1W</td> <td>51.6 mW /g ± 20.8 % (k=2)</td> </tr> <tr> <td>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</td> <td>Condition</td> <td></td> </tr> <tr> <td>SAR measured</td> <td>250 mW input power</td> <td>6.11 mW / g</td> </tr> <tr> <td>SAR for nominal Body TSL parameters</td> <td>normalized to 1W</td> <td>24.2 mW /g ± 20.4 % (k=2)</td> </tr> </table>			SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition		SAR measured	250 mW input power	13.1 mW / g	SAR for nominal Body TSL parameters	normalized to 1W	51.6 mW /g ± 20.8 % (k=2)	SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition		SAR measured	250 mW input power	6.11 mW / g	SAR for nominal Body TSL parameters	normalized to 1W	24.2 mW /g ± 20.4 % (k=2)
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SAR measured	250 mW input power	6.11 mW / g																		
SAR for nominal Body TSL parameters	normalized to 1W	24.2 mW /g ± 20.4 % (k=2)																		



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CALIBRATION  
No. L0570

### Appendix

#### Antenna Parameters with Head TSL

Impedance, transformed to feed point	58.3Ω- 0.76jΩ
Return Loss	- 22.3dB

#### Antenna Parameters with Body TSL

Impedance, transformed to feed point	58.1Ω+ 2.61jΩ
Return Loss	- 22.1dB

#### General Antenna Parameters and Design

Electrical Delay (one direction)	1.224 ns
----------------------------------	----------

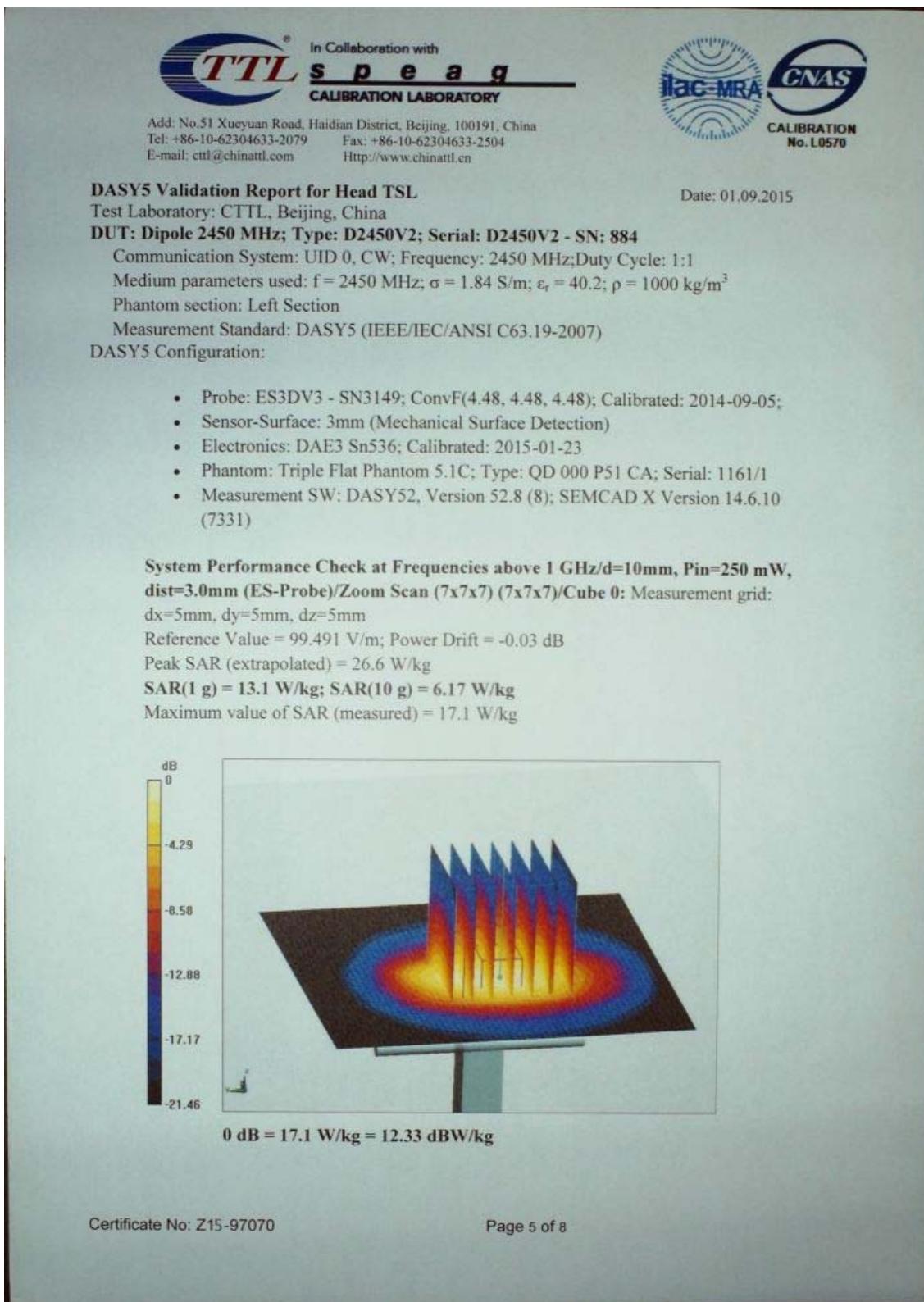
After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

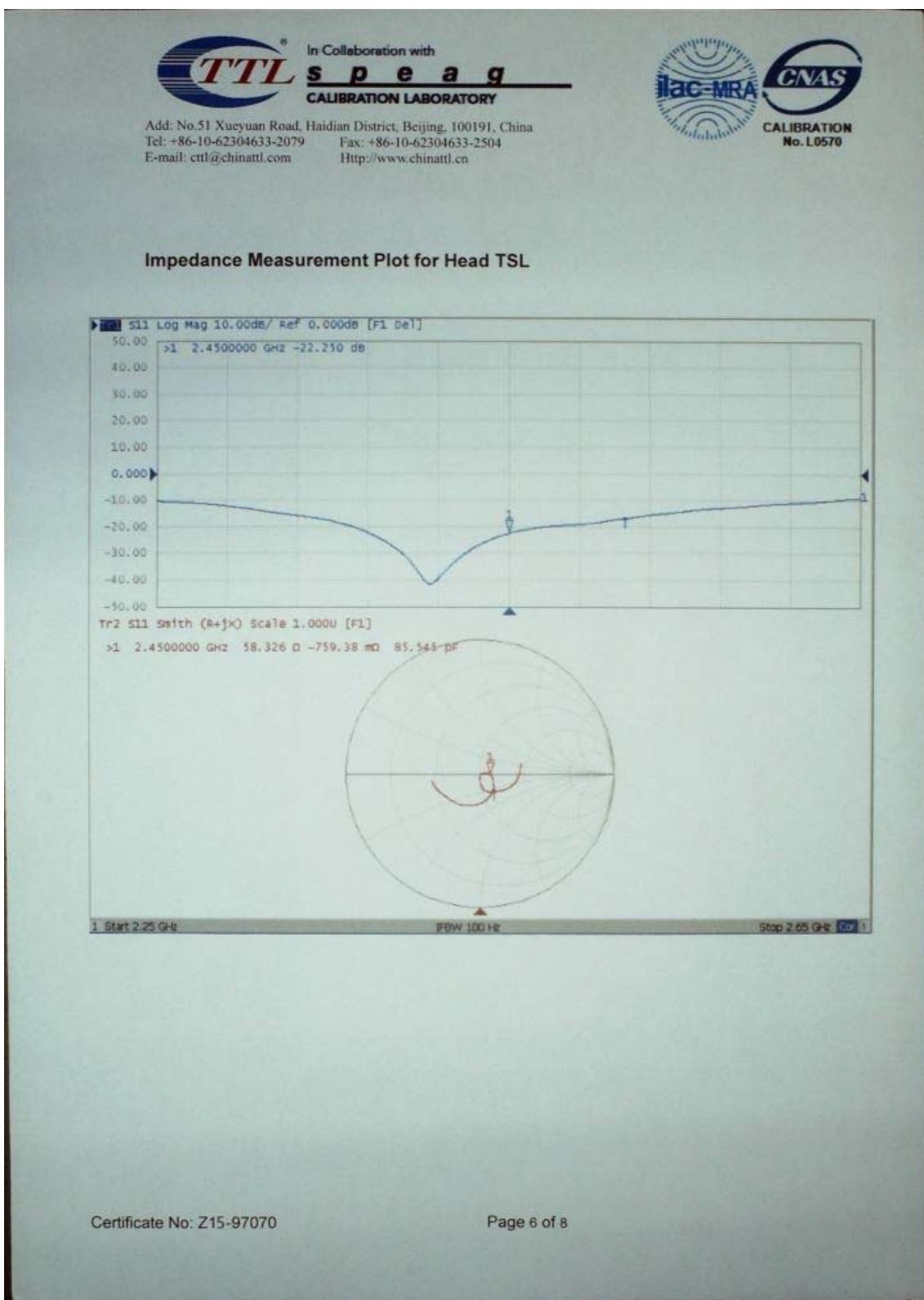
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

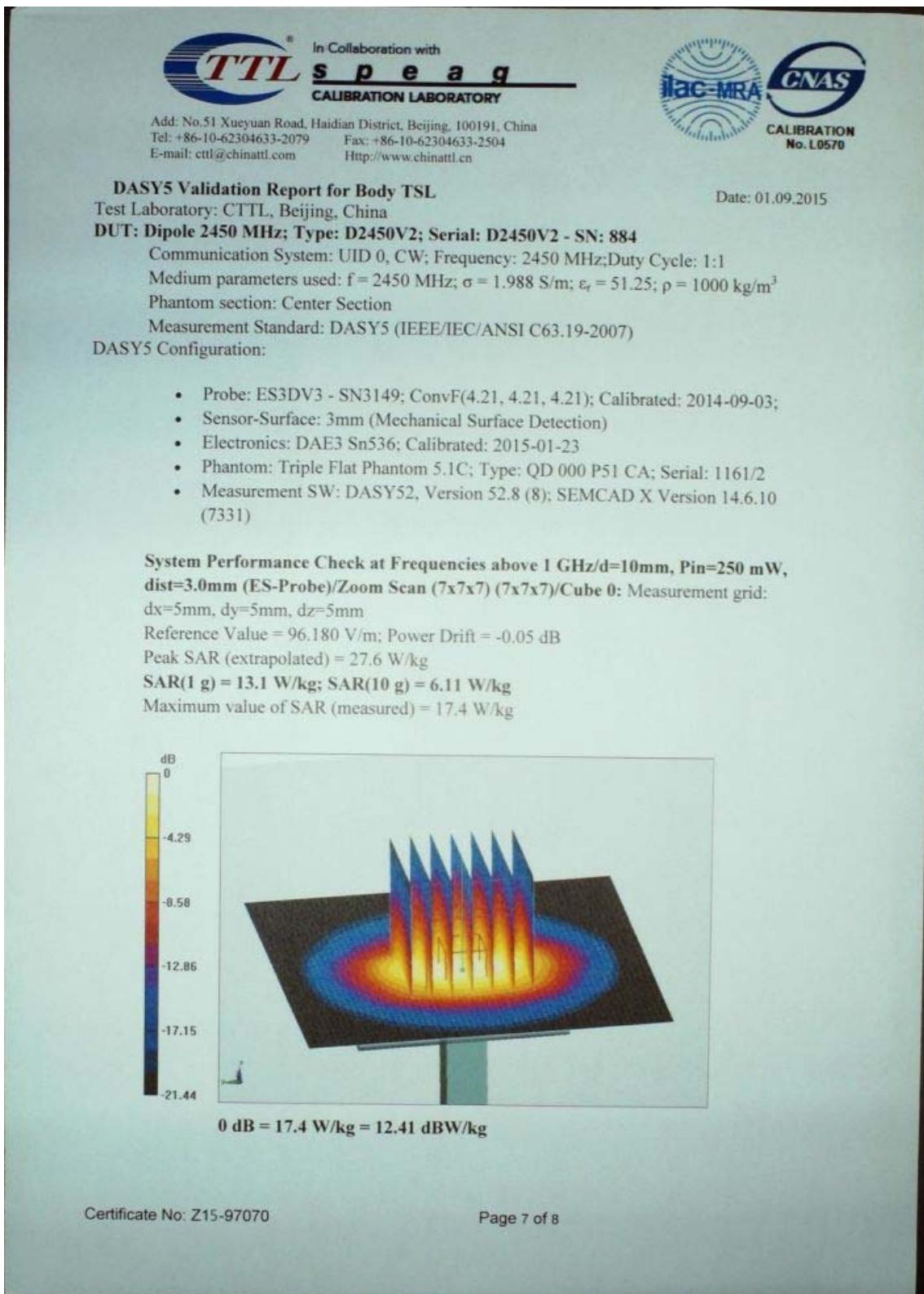
#### Additional EUT Data

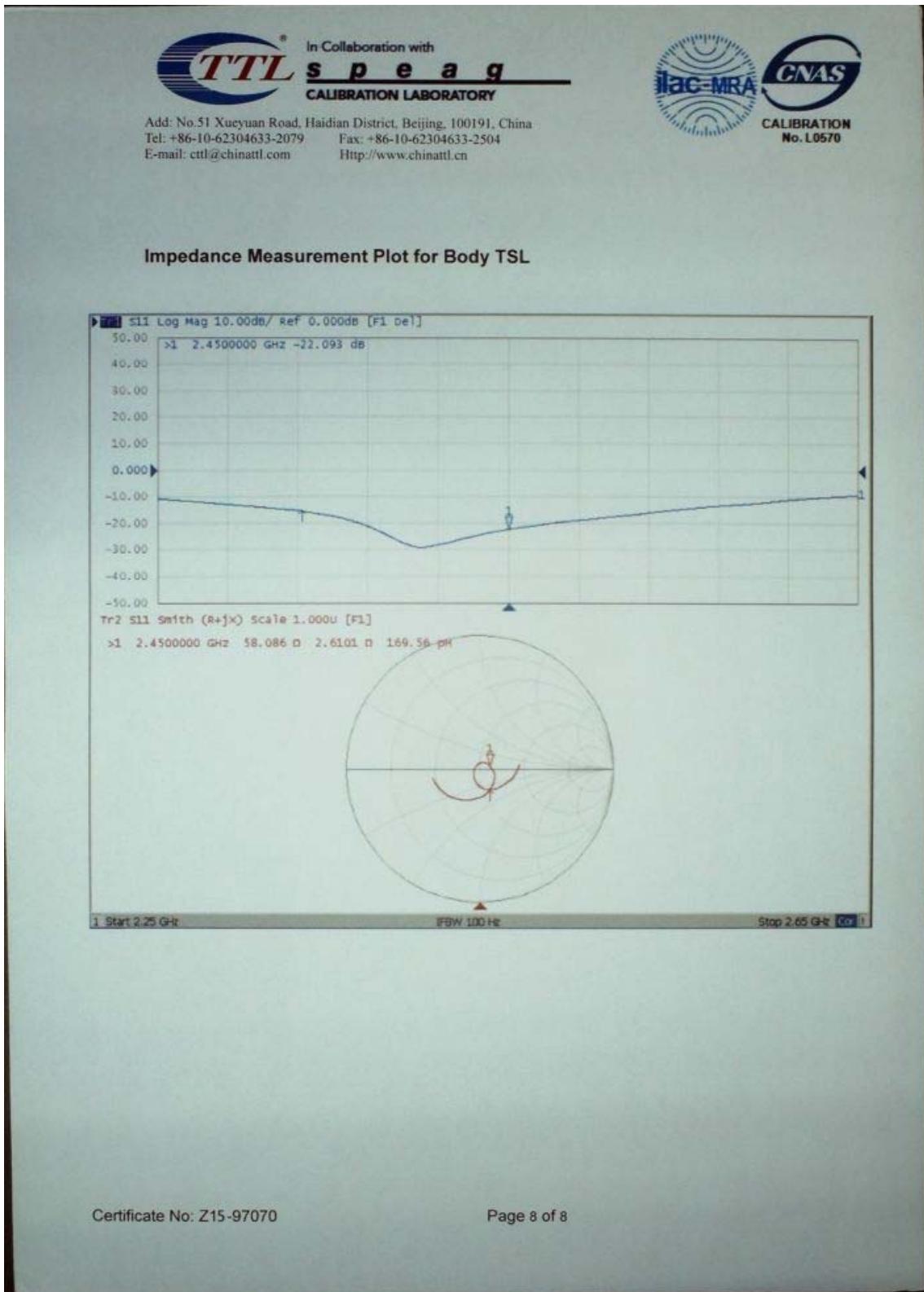
Manufactured by	SPEAG
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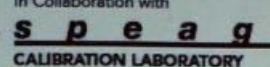
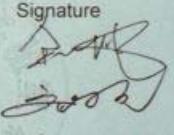
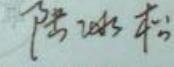
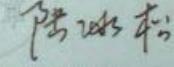
## Appendix A: Calibration Certificate







### 1.3. DAE4 Calibration Certificate

 <b>In Collaboration with</b> 		  <b>CALIBRATION</b> <b>No. L0570</b>	
Client : <b>CIQ-SZ(Auden)</b>		<b>Certificate No: Z15-97066</b>	
<b>CALIBRATION CERTIFICATE</b>			
Object <b>DAE4 - SN: 1315</b>			
Calibration Procedure(s) <b>TMC-OS-E-01-198</b> Calibration Procedure for the Data Acquisition Electronics (DAEEx)			
Calibration date: <b>July 22, 2015</b>			
<p>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.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature(<math>22\pm3</math>)°C and humidity&lt;70%.</p>			
Calibration Equipment used (M&TE critical for calibration)			
Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Documenting Process Calibrator 753	1971018	01-July-15 (CTTL, No:J14X02147)	July-16
Calibrated by: <b>Yu Zongying</b> Function: <b>SAR Test Engineer</b> Reviewed by: <b>Qi Dianyuan</b> Function: <b>SAR Project Leader</b> Approved by: <b>Lu Bingsong</b> Function: <b>Deputy Director of the laboratory</b>			  
Issued: July 23, 2015			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			
Certificate No: Z15-97066		Page 1 of 3	



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CALIBRATION  
No. L0570

**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 report provide only calibration results for DAE, it does not contain other performance test results.

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In Collaboration with  
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CALIBRATION  
No. L0570

#### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB =  $6.1\mu V$ , 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	$405.162 \pm 0.15\% (k=2)$	$405.006 \pm 0.15\% (k=2)$	$404.963 \pm 0.15\% (k=2)$
Low Range	$3.99072 \pm 0.7\% (k=2)$	$3.98481 \pm 0.7\% (k=2)$	$3.98836 \pm 0.7\% (k=2)$

#### Connector Angle

Connector Angle to be used in DASY system	$22^\circ \pm 1^\circ$
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