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CNAS L4963

# SAR TEST REPORT

Report No. 2015SAR318

FCC ID: XYOPCDQ880FBASIC  
Applicant: AsiaTelco Technologies Co.  
Product: GSM dual band fixed wireless phone  
Model: Q880 FBASIC  
HW Version: FB001  
SW Version: TELCEL\_PCD\_FBASIC01\_MX\_V01  
Issue Date: 2015-07-14

Prepared by:

  
Chen Qiang

Reviewed by:

  
Yin Xiaoming

Approved by:



**Remark:** This report details the results of the testing carried out on the samples specified in this report, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. The report shall not be reproduced except in full, without written approval of the Company.

## Standards

Applicable Limit Regulations	<b>ANSI/IEEE C95.1-2005</b> Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields. 3 kHz to 300 GHz
	<b>ANSI/IEEE C95.3-2002</b> Recommended Practice For Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to such Fields. 100 kHz-300 GHz
Applicable Standards	<b>IEEE Std 1528™-2013:</b> IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
	<b>KDB865664 D01v01r03:</b> SAR Measurement Requirements for 100 MHz to 6 GHz
	<b>KDB447498 D01v05r02:</b> Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

## Conclusion

Localized Specific Absorption Rate (SAR) of this equipment has been measured in all cases requested by the relevant standards above. Maximum localized SAR is below exposure limits as well.

**Change History**

Version	Change Contents	Author	Date
V1.0	First edition	Chen Qiang	2015-07-14

Note: The last version will be invalid automatically while the new version is issued.

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## 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **AsiaTelco Technologies Co. GSM dual band fixed wireless phone Q880 FBASIC** are as follows.

### Highest standalone SAR Summary of three versions:

Exposure Position	Frequency Band	Reported 1g SAR (W/kg)	Highest reported 1g SAR (W/kg)
Body-worn (15mm)	GSM850	1.391	1.391
	GSM1900	0.383	

This device is in 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 C95.1-2005,and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

## **2. Administrative Information**

### **2.1 Project Information**

Date of start test	2015-06-29
Date of end test:	2015-07-03

### **2.2 Test Laboratory Information**

Company:	Shanghai Tejet Communications Technology Co., Ltd Testing Center
Address:	Room 6205-6208, Building 6, No.399 Cailun Rd. Zhangjiang Hi-Tech Park, Shanghai, China
Post Code:	210203
Tel:	+86-21-61650880
Fax:	+86-21-61650881
Website:	<a href="http://www.tejet.cn">www.tejet.cn</a>

### **2.3 Test Environment**

Temperature:	20℃～25℃
Relative Humidity:	20%～70%

### **3. Client Information**

#### **3.1 Applicant information**

Company Name: AsiaTelco Technologies Co.  
Address: #289 Bisheng Road, Building-8, 3F, Zhangjiang Hi-Tech Park,  
Pudong, Shanghai 201204, China  
City: Shanghai  
Postal Code: /  
Country: China  
Telephone: +86 21 51688806 x 226  
Fax: +86 21 33932400

#### **3.2 Manufacturer Information**

Company Name: AsiaTelco Technologies Co.  
Address: #289 Bisheng Road, Building-8, 3F, Zhangjiang Hi-Tech Park,  
Pudong, Shanghai 201204, China  
City: Shanghai  
Postal Code: /  
Country: China  
Telephone: +86 21 51688806 x 226  
Fax: +86 21 33932400



## 4. Equipment Under Test (EUT) and Accessory Equipment (AE)

### 4.1 Information of EUT

Device Type	Portable device	
Product	GSM dual band fixed wireless phone	
Model	Q880 FBASIC	
Type	Identical Prototype	
Exposure Category	Uncontrolled environment / general population	
Device operation configuration:		
Operating Mode(s):	GSM850	
	PCS1900	
Test Modulation	(GSM)GMSK	
Rated Output Power	GSM 850:33dBm	
	PCS1900: 30dBm	
Antenna Type:	Internal antenna	
Operating Frequency Range(s):	Band	Tx(MHz)
	GSM850	824.2~848.8
	PCS1900	1850.2~1909.8
Power Class	GSM850: 4,test with power level 5	
	PCS1900: 1,test with power level 0	

## 4.2 Identification of EUT

EUT ID	SN or IMEI	HW Version	SW Version	Received Date
TN01	86621402XXXXXXX	FB001	TELCEL_PCD_FBA SIC01_MX_V01	2015-06-29

\*EUT ID: identify the test sample in the lab internally.

## 4.3 Identification of AE

AE ID*	Description
AE1	Battery
AE2	Travel Adaptor

### AE1

Model	Q880 FBASIC
Manufacturer	Shenzhen Chihang Technology Co.,Ltd.
Capacitance	700mAh
Nominal Voltage	3.7V

### AE2

Model	DY-050757D1
Manufacturer	DAYEAR ELECTRONIC CO.,LTD
Length of DC line	140cm

\*AE ID: identify the test sample in the lab internally.

## **5. Operational Conditions during Test**

### **5.1 General description of test procedures**

A communication link is set up with a system simulator by air link, and a call is established. The absolute radio frequency channel is allocated to low, middle and high respectively in the case of each band. The EUT is commanded to operate at maximum transmitting power.

Connection to the EUT is established via air interface with CMU200, and the EUT is set to maximum output power by CMU200. The antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30dB.

### **5.2 GSM Test Configuration**

SAR test for GSM 850/1900, a communication link is set up with a system simulator by air link. Using CMU200 the power level is set to "5" in SAR of GSM850, set to "0" in SAR of GSM 1900, The tests in the band of GSM850/1900 are performed in the mode of voice and data transfer function.

## **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 (Staubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic \_field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (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.
- 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.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as 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.

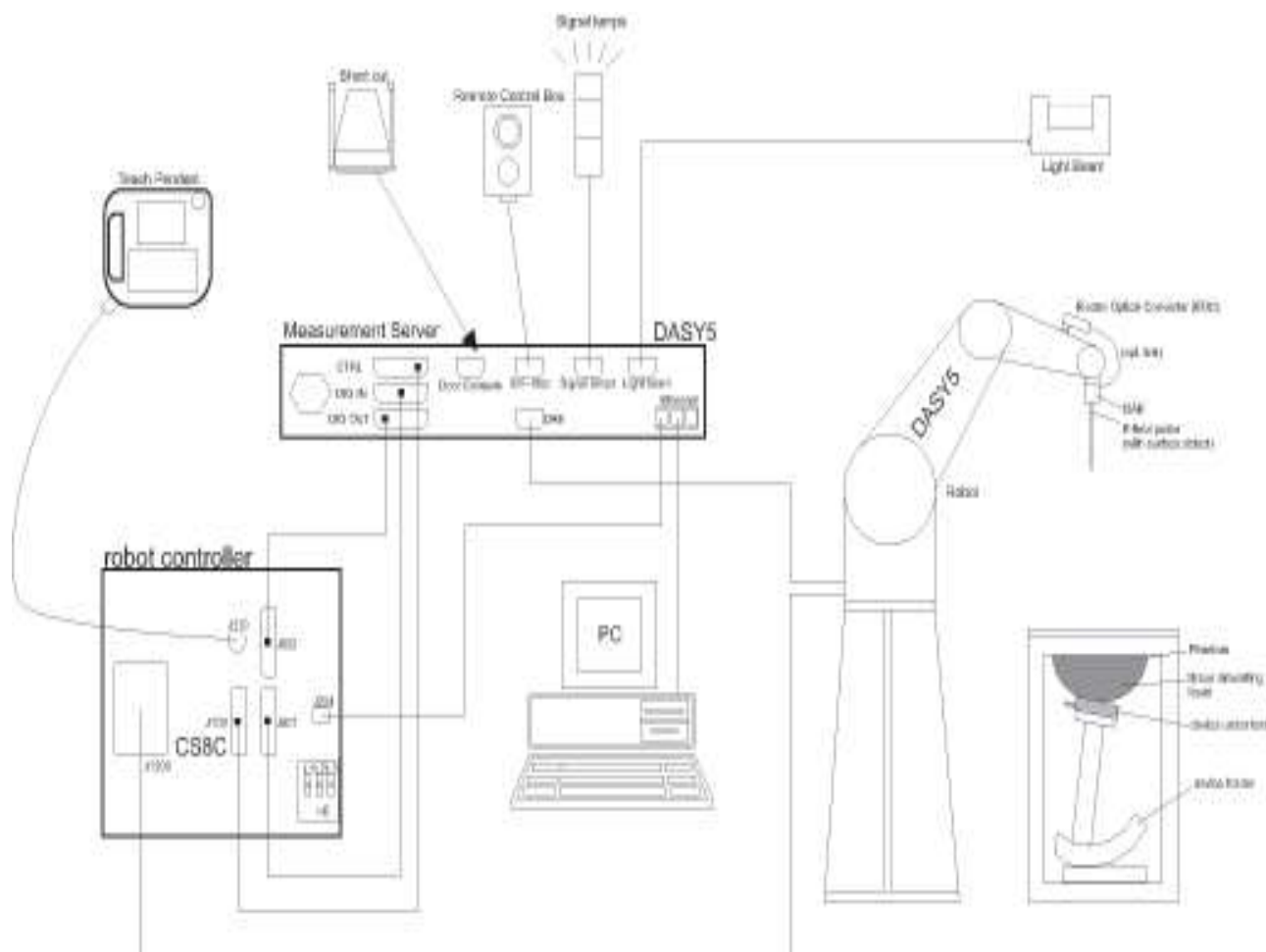


Figure 5-1 SAR Lab Test Measurement Set-up

## 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.

### 6.2.1 Es3DV3 Probe Specification

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 850 and HSL 1750 Additional CF for other liquids and frequencies upon request
Frequency	10 MHz to > 6 GHz Linearity: $\pm 0.2$ dB (30 MHz to 6 GHz)
Directivity	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 $\mu$ W/g to > 100 mW/g Linearity: $\pm 0.2$ dB (noise: typically < 1 $\mu$ W/g)

Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	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%.



Figure 5-2.ES3DV3 E-field Probe



Figure 5-3. ES3DV3 E-field probe

### 6.2.2 E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

$$\text{SAR} = C \frac{\Delta T}{\Delta t}$$

Where:  $\Delta t$  = Exposure time (30 seconds),  
 $C$  = Heat capacity of tissue (brain or muscle),  
 $\Delta T$  = Temperature increase due to RF exposure.  
 Or

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

Where:

$\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density (kg/m<sup>3</sup>).

## 6.3 Other Test Equipment

### 6.3.1 Device Holder for Transmitters

The DASY5 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 are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. 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.



Figure 5-4. Device Holder

### 6.3.2 Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden frame. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness	2±0.1 mm
Filling Volume	Approx. 20 liters
Dimensions	810 x 1000 x 500 mm (H x L x W)



**Figure 5-5. Generic Twin Phantom**

## **6.4 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 7x7x7 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 7x7x7 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 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## **6.5 Data Storage and Evaluation**

### **6.5.1 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/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### 6.5.2 Data Evaluation by SEMCAD

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	Norm <sub>i</sub> , a <sub>i0</sub> , a <sub>i1</sub> , a <sub>i2</sub>
	- Conversion factor	ConvF <sub>i</sub>
	- Diode compression point	Dcp <sub>i</sub>
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	
	- Density	

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:

$$V_i = U_i + U_i^2 \cdot c f / d c p_i$$

With  $V_i$  = compensated signal of channel i (i = x, y, z)

$U_i$  = input signal of channel i (i = x, y, z)

**cf** = crest factor of exciting field (DASY parameter)

**dcp** = diode compression point (DASY parameter)

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

E-field probes:  $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes:  $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1} f + a_{i2} f^2) / f$

With  $V_i$  = compensated signal of channel i (i = x, y, z)

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

**ConvF** = sensitivity enhancement in solution

**a<sub>ij</sub>** = sensor sensitivity factors for H-field probes

**f** = carrier frequency [GHz]

**E<sub>i</sub>** = electric field strength of channel i in V/m

**H<sub>i</sub>** = magnetic field strength of channel i in A/m

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

$$E_{tot} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$$

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

$$SAR = (E_{tot}^2 \cdot \square) / (\rho \cdot 1000)$$

with **SAR** = local specific absorption rate in mW/g

**E<sub>tot</sub>** = total field strength in V/m

$\square$  = 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. The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = E_{tot}^2 / 3770 \quad \text{or} \quad P_{pwe} = H_{tot}^2 \cdot 37.7$$

with  $P_{pwe}$  = equivalent power density of a plane wave in mW/cm<sup>2</sup>

$E_{tot}$  = total electric field strength in V/m

$H_{tot}$  = total magnetic field strength in A/m

## 6.6 System check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the 6.2.1 and 6.2.2

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 DASY 5 system.

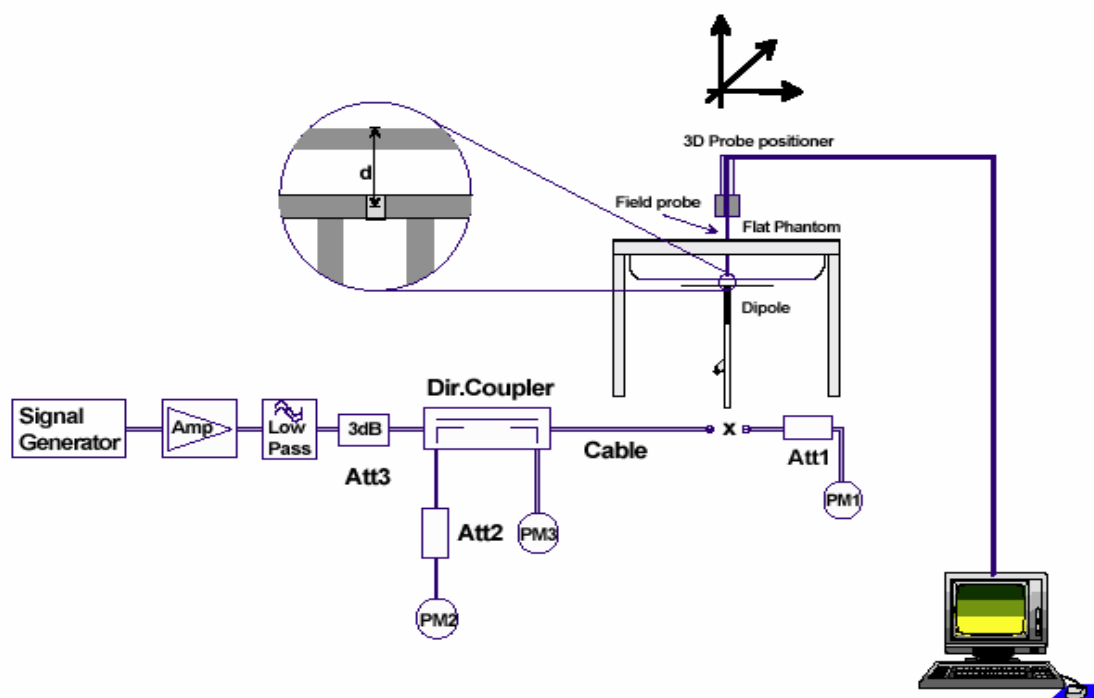


Figure 5-6. System Check Set-up

## 6.7 Equivalent Tissues

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 show the detail solution. It's

satisfying the latest tissue dielectric parameters requirements proposed by the OET 65.

MIXTURE%	FREQUENCY(body) 835MHz
Water	52.5
Sugar	45
Salt	1.4
Preventol	0.1
Cellulose	1.0
Dielectric Parameters Target Value	f=835MHz $\epsilon=55.2$ $\sigma=0.97$
MIXTURE%	FREQUENCY(body)1900MHz
Water	69.91
Glycol monobutyl	29.96
Salt	0.13
Dielectric Parameters Target Value	f=1900MHz $\epsilon=53.3$ $\sigma=1.52$

## 7. Summary of Test Results

### 7.1 Conducted Output Power Measurement

#### 7.1.1 Summary

The DUT is tested using a CMU200 communications tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted power.

Conducted output power was measured using an integrated RF connector and attached RF cable.

This result contains conducted output power for the EUT.

#### 7.1.2 Conducted Power Results

GSM850	Conducted output power(dBm)		
	low	middle	high
	CH128	CH189	CH251
	824.2MHz	836.6MHz	848.8MHz
GSM	31.5	31.5	31.5

GSM1900	Conducted output power(dBm)		
	low	middle	high
	CH512	CH661	CH810
	1850.2MHz	1880MHz	1909.8MHz
GSM	29.5	29.3	29.1

Body-worn of GSM850/1900 are tested for voice.

## 7.2 Test Results

### 7.2.1. Dielectric Performance

#### Dielectric Performance of Tissue Simulating Liquid

Frequency	Description	Dielectric Parameters $\epsilon_r$	$\sigma$ (s/m)	temp °C
<b>835MHz (body)</b>	Target value 5% window	55.2 52.44-57.96	0.97 0.92-1.02	/
	Measurement value 2015-07-01	54.53	0.95	21.8
<b>1900MHz (body)</b>	Target value 5% window	53.3 50.63-55.96	1.52 1.44 -1.60	/
	Measurement value 2015-07-03	52.54	1.50	21.9

### 7.2.2. System Check Results

#### System Check for tissue simulation liquid

Frequency	Description	SAR(W/kg)		Targeted SAR1g (W/kg)	Normalized SAR1g (W/kg)	Deviation (%)
		10g	1g			
<b>835MHz (body)</b>	Recommended result ±10% window	1.6 1.44-1.76	2.41 2.17-2.65	/	/	/
	Measurement value 2015-07-01	1.55	2.35	9.52	9.4	-1.26
<b>1900MHz (body)</b>	Recommended result ±10% window	5.28 4.75-5.81	10.1 9.09-11.11	/	/	/
	Measurement value 2015-07-03	5.11	9.75	39.6	39.0	-1.52

Note: 1. the graph results see ANNEX B.1.

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

### 7.2.3 Test Results

#### 7.2.3.1 Summary of Measurement Results (GSM850)

##### SAR Values (GSM850)

Test Case			Measurement Result(W/kg)	Power Drift(dB)	Note
Different Test Position	Channel	1 g			
		Average			
Test position of Body (Distance 15mm)					
Antenna_Horizontal	Towards Ground	middle	0.202	0.02	
	front	middle	0.018	-0.12	
	back	middle	0.00418	0.01	
	right side	middle	0.985	-0.06	max
Antenna_vertical	towards phantom	middle	0.013	0.17	
	towards ground	middle	0.012	-0.17	
	back	middle	0.319	-0.14	
	right side	middle	0.916	0.04	
Antenna_vertical	right side	low	0.878	0.04	
		high	0.749	0.03	
Antenna_Horizontal	right side	low	0.885	0.02	
		high	0.890	-0.09	
Antenna_Horizontal	right side	middle	0.944	0.06	repeat

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

- Upper and lower frequencies were measured at the worst position.
- The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is lower than the SAR limit ( $< 0.4\text{W/kg}$ ), testing at the high and low channels is optional.
- Per KDB 865664 d01v01, for each frequency band ,repeated SAR measurement is required only when the measured SAR is  $\geq 0.8(\text{W/kg})$ .



### 7.2.3.2 Summary of Measurement Results (PCS1900)

#### SAR Values (PCS1900)

Test Case			Measurement Result(W/kg)	Power Drift(dB)	Note
Different Test Position	Channel	1 g			
		Average			
Test position of Body (Distance 15mm)					
Antenna_ Horizontal	towards ground	middle	0.061	0.07	
	front	middle	0.023	0.05	
	back	middle	0.045	0.03	
	right side	middle	0.224	0.1	
Antenna_ vertical	towards phantom	middle	0.023	0.14	
	towards ground	middle	0.041	0.17	
	back	middle	0.091	0.16	
	right side	middle	0.250	-0.02	
Antenna_ vertical	right side	low	0.239	-0.12	
		high	0.311	-0.14	max

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

- Upper and lower frequencies were measured at the worst position.
- The SAR test shall be performed at the high, middle and low frequency channels of each operating mode. If the SAR measured at mid-band channel for each test configuration is lower than the SAR limit ( $< 0.4\text{W/kg}$ ), testing at the high and low channels is optional.
- Per KDB 865664 d01v01, for each frequency band ,repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{(W/kg)}$ .

### 7.2.6 Maximum SAR

Test Case				Measurement Result (W/kg)	conducted power (dBm)	maximum power (dBm)	Maximum reported 1g SAR (W/kg)	Limit 1g SAR (W/kg)
band	Different Test Position		Ch	1g Average				
GSM 850	body	Antenna_vertical right side	middle	0.985	31.5	33	1.391	1.6
GSM 1900	body	Antenna_vertical right side	high	0.311	29.1	30	0.383	1.6

General Judgment: PASS

## 8. Test Equipments Utilized

No.	Name	Type	S/N	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071E	MY46109425	Oct 30 <sup>th</sup> , 2014	One year
02	Dielectric Probe Kit	Agilent 85070E	MY44300524	No Calibration Requested	
03	Power meter	Agilent E4418B	MY50000852	Oct 30 <sup>th</sup> , 2014	One year
04	Power sensor	Agilent E9200B	MY50300011	Oct 30 <sup>th</sup> , 2014	One year
05	Signal Generator	Agilent N5182A	MY49071248	Oct 30 <sup>th</sup> , 2014	One year
06	Amplifier	ZHL-42W	QA1020005	No Calibration Requested	
07	BTS	CMU200	121464	Oct 30 <sup>th</sup> , 2014	One year
08	E-field Probe	ES3DV3	3241	Sep 29 <sup>th</sup> , 2014	One year
09	DAE	DAE4	1226	Sep 15 <sup>th</sup> , 2014	One year
10	Validation Kit 835MHz	D835V2	4d100	Sep 23 <sup>th</sup> , 2014	One year
11	Validation Kit 1900MHz	D1900V2	5d155	Apr 21 <sup>th</sup> , 2015	One year

## 9. Measurement Uncertainty

No	Source of Uncertainty	Type	Uncertainty value ± %	Probability Distribution	Div.	$c_i$ (1 g)	$c_i$ (10 g)	Standard Unc ± %, (1 g)	Standard Unc ± %, (10 g)	$\nu_i$ or $\nu_{\text{eff}}$
1	System repetivity	A	2.7	N	1	1	1	2.7	2.7	9
<i>Measurement System</i>										
2	Probe Calibration	B	5.9	N	1	1	1	5.9	5.9	$\infty$
3	Isotropy	B	4.7	R	$\sqrt{3}$	0.7	0.7	1.9	1.9	$\infty$
4	Boundary Effect	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
5	Linearity	B	4.7	R	$\sqrt{3}$	1	1	2.7	2.7	$\infty$
6	Detection Limits	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
7	Readout Electronics	B	0.3	N	1	1	1	0.3	0.3	$\infty$
8	Response Time	B	0.8	R	$\sqrt{3}$	1	1	0.5	0.5	$\infty$
9	Integration Time	B	2.6	R	$\sqrt{3}$	1	1	1.5	1.5	$\infty$
10	RF ambient conditions – noise	B	0	R	$\sqrt{3}$	1	1	0	0	$\infty$
11	RF ambient conditions – reflections	B	0	R	$\sqrt{3}$	1	1	0	0	$\infty$
12	Probe Positioner Mech. Restrictions	B	0.4	R	$\sqrt{3}$	1	1	0.2	0.2	$\infty$
13	Probe Positioning with respect to Phantom Shell	B	2.9	R	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
14	Post-Processing	B	1.0	R	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
<i>Test Sample Related</i>										

15	Test Sample Positioning	A	3.3	N	1	1	1	3.3	3.3	71
16	Device Holder Uncertainty	A	4.1	N	1	1	1	4.1	4.1	5
17	Drift of Output Power	B	5.0	R	$\sqrt{3}$	1	1	2.9	2.9	$\infty$
<i>Phantom and Set-up</i>										
18	Phantom Uncertainty	B	4.0	R	$\sqrt{3}$	1	1	2.3	2.3	$\infty$
19	Liquid Conductivity (target.)	B	5.0	R	$\sqrt{3}$	0.64	0.43	1.8	1.2	$\infty$
20	Liquid Conductivity (meas.)	A	2.06	N	1	0,64	0,43	1.7	1.4	43
21	Liquid Permittivity (target.)	B	5.0	R	$\sqrt{3}$	0,6	0,49	1.7	1.4	$\infty$
22	Liquid Permittivity (meas.)	A	1.6	N	1	0,6	0,49	1.0	0.8	521
Combined standard uncertainty		$u_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$						10.54	10.34	
Expanded uncertainty (95 % confidence interval)		k=2						21.08	20.68	

## ANNEX A: Detailed Test Results

### Annex A.1 System Check Results

#### System check 835body

Date/Time: 01/07/2015 08:45:00

Communication System: UID 10000, CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.948$  S/m;  $\epsilon_r = 54.525$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS (IEEE1528)

DASY5 Configuration:

- Probe: ES3DV3 - SN3241; ConvF(6.37, 6.37, 6.37); Calibrated: 29/09/2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 15/09/2014
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASYS2, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**835body/d=15mm, Pin=250 mW/Area Scan (61x121x1):** Interpolated grid:  
dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.39 W/kg

**835body/d=15mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**

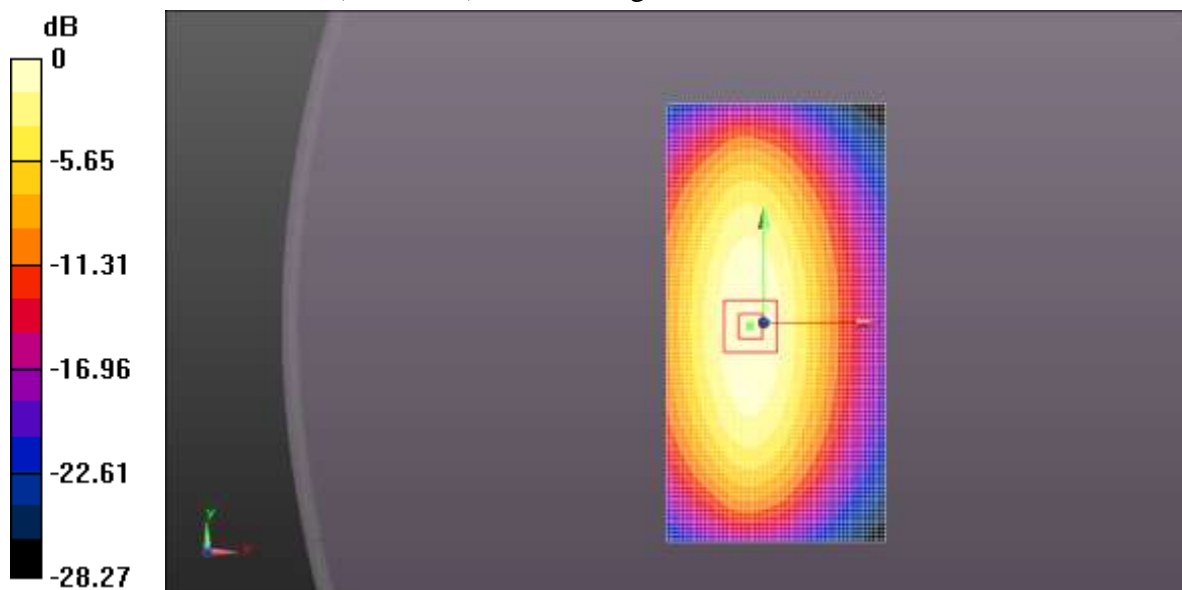
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 51.344 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

**SAR(1 g) = 2.35W/kg; SAR(10 g) = 1.55 W/kg**

Maximum value of SAR (measured) = 2.38 W/kg



0 dB = 2.39 W/kg = 3.78 dBW/kg

# System check 1900body

Date/Time: 03/07/2015 08:38:41

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz; Communication System PAR: 0 dB

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.503$  S/m;  $\epsilon_r = 52.544$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528)

DASY5 Configuration:

- Probe: ES3DV3 - SN3241; ConvF(4.85, 4.85, 4.85); Calibrated: 29/09/2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 15/09/2014
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**1900body/d=10mm, Pin=250 mW/Area Scan (61x71x1):** Interpolated grid:  
dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 12.8 W/kg

**1900body/d=10mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**

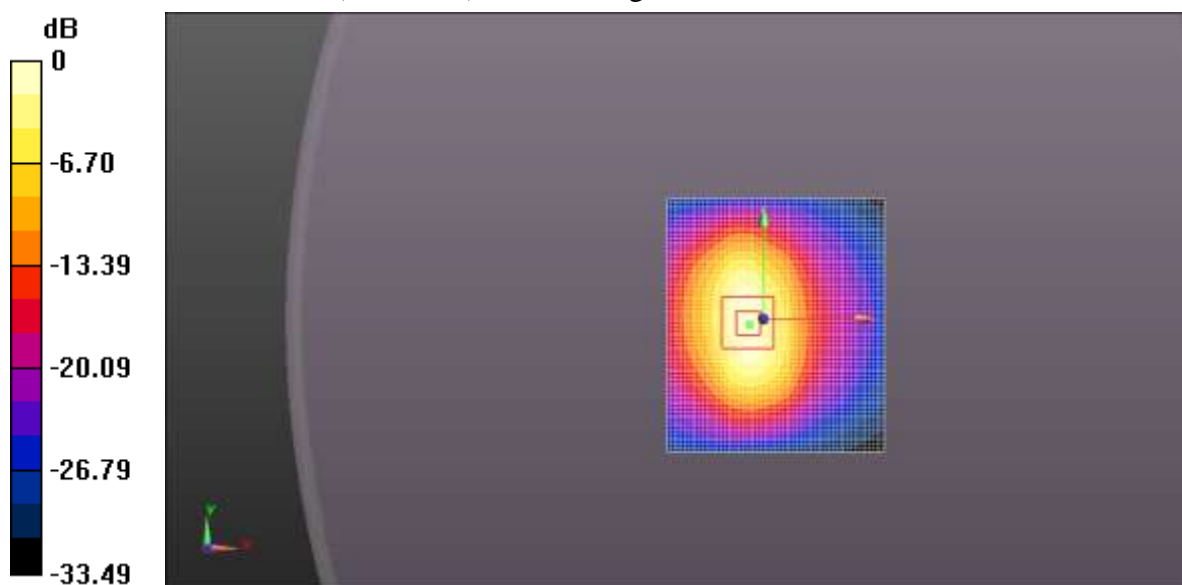
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 80.747 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 16.3 W/kg

**SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.11 W/kg**

Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 12.8 W/kg = 11.06 dBW/kg

## Annex A.2 Graph Result

### GSM850 Horizontal right mid

Date/Time: 01/07/2015 16:22:19

Communication System: UID 0, GSM (0); Communication System Band: GSM850(824.0-849.0MHz); Frequency: 836.6 MHz; Communication System PAR: 9.191 dB

Medium parameters used:  $f = 837$  MHz;  $\sigma = 0.951$  S/m;  $\epsilon_r = 54.241$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528)

DASY5 Configuration:

- Probe: ES3DV3 - SN3241; ConvF(6.37, 6.37, 6.37); Calibrated: 29/09/2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 15/09/2014
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

### body-horizontal 2/towards right mid 15mm 31.5dBm/Area Scan (221x71x1):

Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 1.11 W/kg

### body-horizontal 2/towards right mid 15mm 31.5dBm/Zoom Scan (7x7x7)/Cube 0:

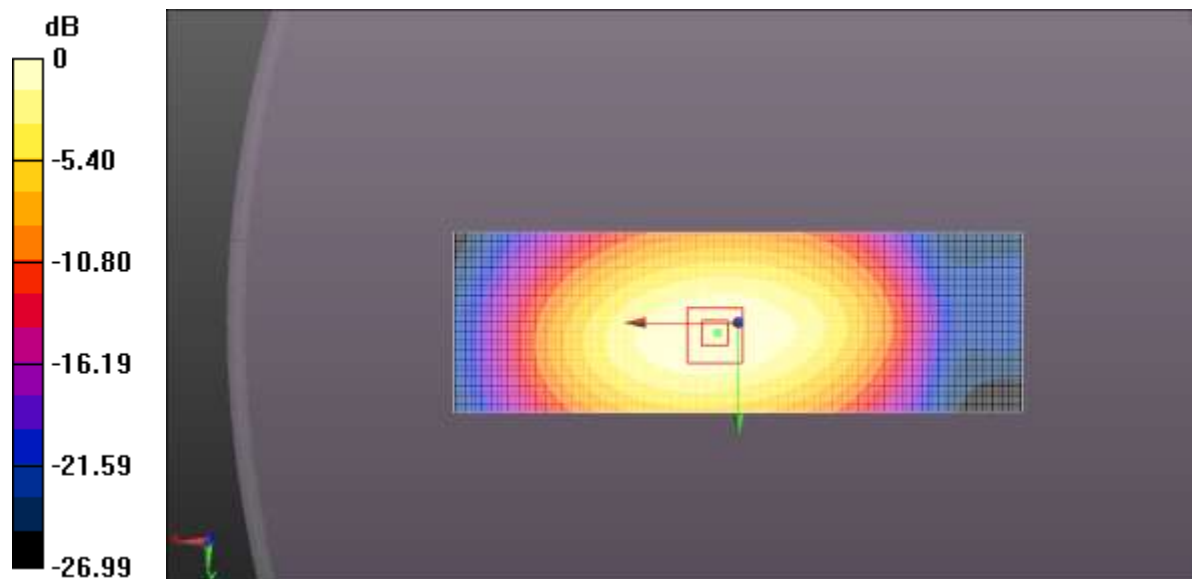
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 34.462 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 1.37 W/kg

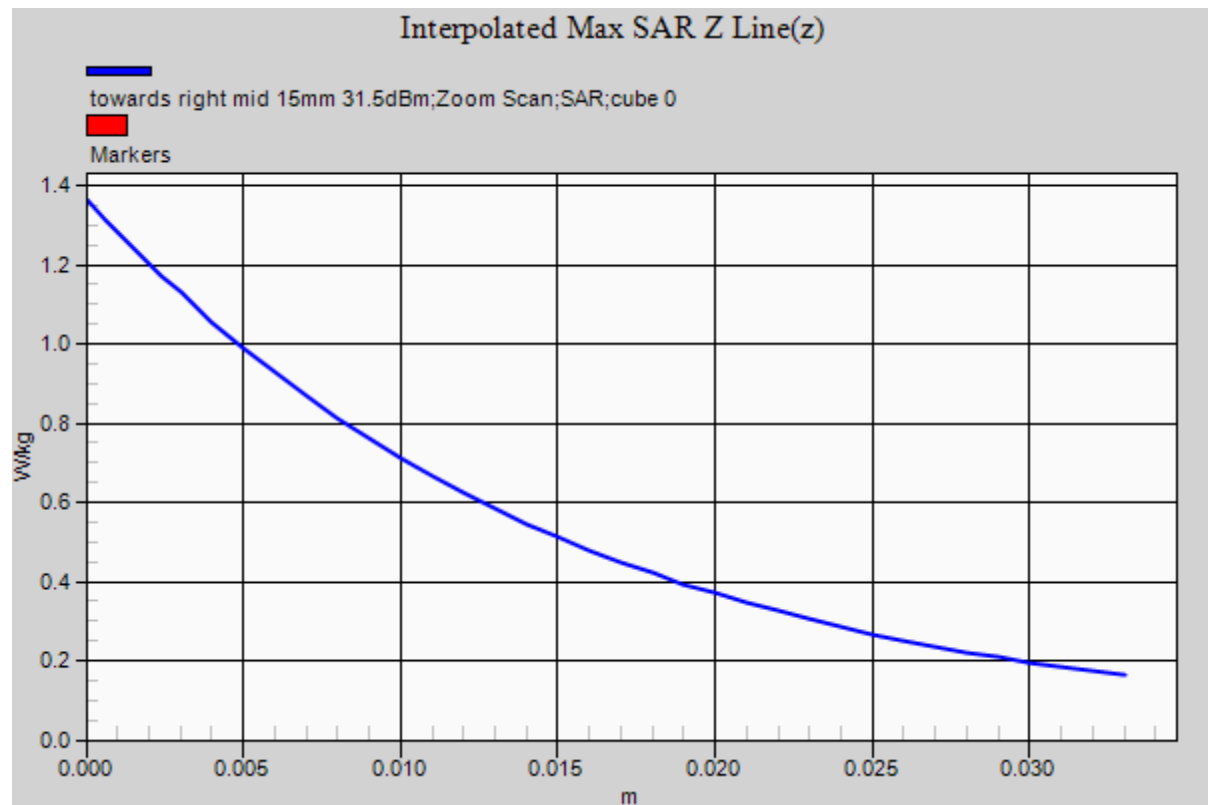
**SAR(1 g) = 0.985 W/kg; SAR(10 g) = 0.677 W/kg**

Maximum value of SAR (measured) = 1.13 W/kg



0 dB = 1.11 W/kg = 0.47 dBW/kg





**GSM1900 vertical right high**

Date/Time: 03/07/2015 11:16:13

Communication System: UID 0, GSM (0); Communication System Band: PCS1900(1850.0-1910.0MHz); Frequency: 1909.8 MHz; Communication System PAR: 9.191 dB

Medium parameters used:  $f = 1910$  MHz;  $\sigma = 1.503$  S/m;  $\epsilon_r = 52.325$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528)

DASY5 Configuration:

- Probe: ES3DV3 - SN3241; ConvF(4.85, 4.85, 4.85); Calibrated: 29/09/2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 15/09/2014
- Phantom: ELI v4.0; Type: ELI4; Serial: TP:1086
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**body-vertical2/towards right high/Area Scan (71x221x1):** Interpolated grid:

$dx=1.000$  mm,  $dy=1.000$  mm

Maximum value of SAR (interpolated) = 0.374 W/kg

**body-vertical2/towards right high/Zoom Scan (7x7x7)/Cube 0:** Measurement

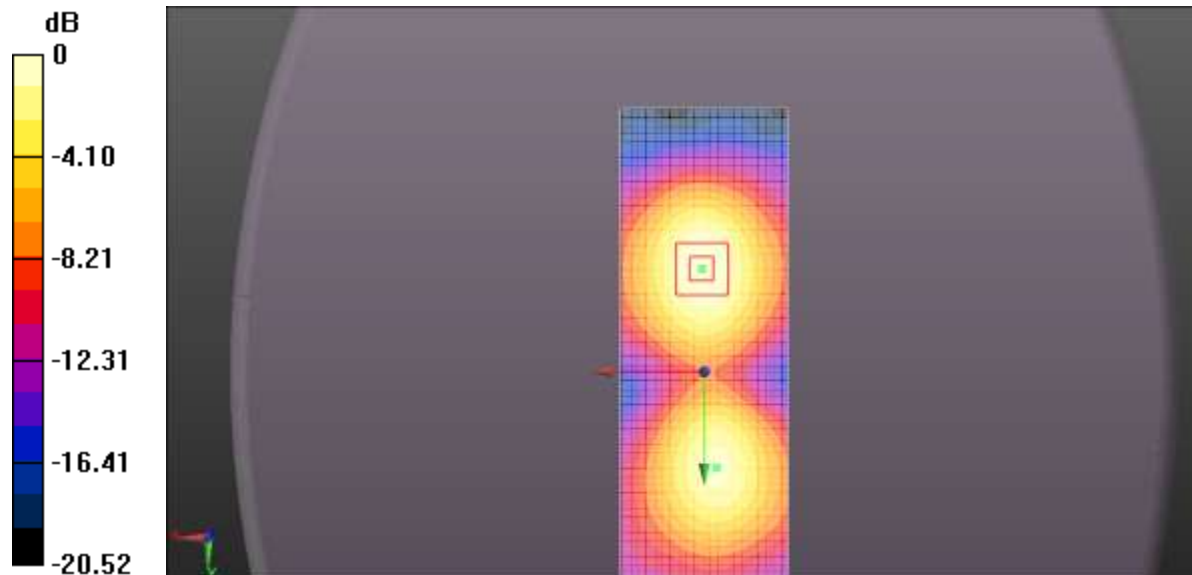
grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 6.558 V/m; Power Drift = -0.14 dB

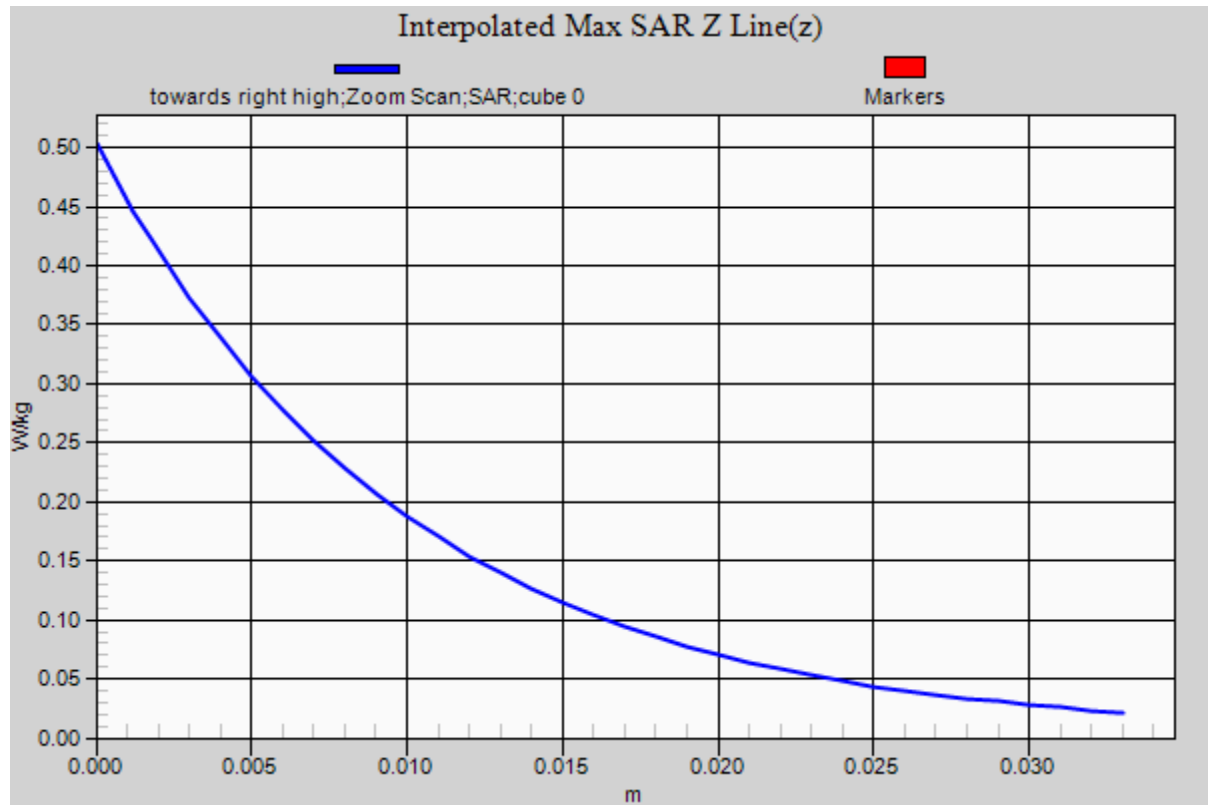
Peak SAR (extrapolated) = 0.503 W/kg

**SAR(1 g) = 0.311 W/kg; SAR(10 g) = 0.183 W/kg**

Maximum value of SAR (measured) = 0.374 W/kg




0 dB = 0.374 W/kg = -4.27 dBW/kg




## ANNEX B: Calibration Certificate

### Annex B.1 Probe Calibration Certificate



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](http://www.chinattl.cn)



CALIBRATION  
No. L0570

Client **Tejet**
Certificate No: **Z14-97105**

### CALIBRATION CERTIFICATE

Object: **ES3DV3 - SN:3241**

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



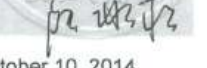
Calibration date: **September 29, 2014**

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)°C 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: October 10, 2014

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



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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization $\Phi$	$\Phi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\theta=0$ 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:

- 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
- 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:

- NORM<sub>x,y,z</sub>: Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM( $f$ )<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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.
- DCP<sub>x,y,z</sub>: 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.
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; 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  $f \leq 800\text{MHz}$ ) and inside waveguide using analytical field distributions based on power measurements for  $f > 800\text{MHz}$ . 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 NORM<sub>x,y,z</sub> \* 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  $\pm 50\text{MHz}$  to  $\pm 100\text{MHz}$ .
- 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 NORM<sub>x</sub> (no uncertainty required).



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ettl@chinattl.com](mailto:ettl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

# Probe ES3DV3

## SN: 3241

Calibrated: September 29, 2014

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)





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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY – Parameters of Probe: ES3DV3 - SN: 3241

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	1.12	0.83	1.00	±10.8%
DCP(mV) <sup>B</sup>	105.8	106.3	106.4	

### 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	294.1	±2.3%
		Y	0.0	0.0	1.0		250.2	
		Z	0.0	0.0	1.0		276.2	

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 Norm X, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 5 and Page 6).

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

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



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 Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504  
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## DASY – Parameters of Probe: ES3DV3 - SN: 3241

### 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)
750	41.9	0.89	6.90	6.90	6.90	0.59	1.23	± 12%
835	41.5	0.90	6.41	6.41	6.41	0.43	1.46	± 12%
900	41.5	0.97	6.35	6.35	6.35	0.46	1.44	± 12%
1750	40.1	1.37	5.48	5.48	5.48	0.47	1.50	± 12%
1900	40.0	1.40	5.12	5.12	5.12	0.73	1.24	± 12%
2000	40.0	1.40	5.10	5.10	5.10	0.52	1.48	± 12%
2450	39.2	1.80	4.64	4.64	4.64	0.89	1.13	± 12%

<sup>C</sup> 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.

<sup>F</sup> At frequency 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 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: ES3DV3 - SN: 3241

### 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>G</sup> (mm)	Unct. (k=2)
750	55.2	0.97	6.44	6.44	6.44	0.38	1.64	± 12%
835	55.2	0.99	6.37	6.37	6.37	0.48	1.48	± 12%
900	55.0	1.05	6.24	6.24	6.24	0.40	1.62	± 12%
1750	53.4	1.49	5.01	5.01	5.01	0.52	1.53	± 12%
1900	53.3	1.52	4.85	4.85	4.85	0.48	1.64	± 12%
2000	53.3	1.52	4.92	4.92	4.92	0.52	1.58	± 12%
2450	52.7	1.95	4.46	4.46	4.46	0.86	1.18	± 12%

<sup>C</sup> 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.

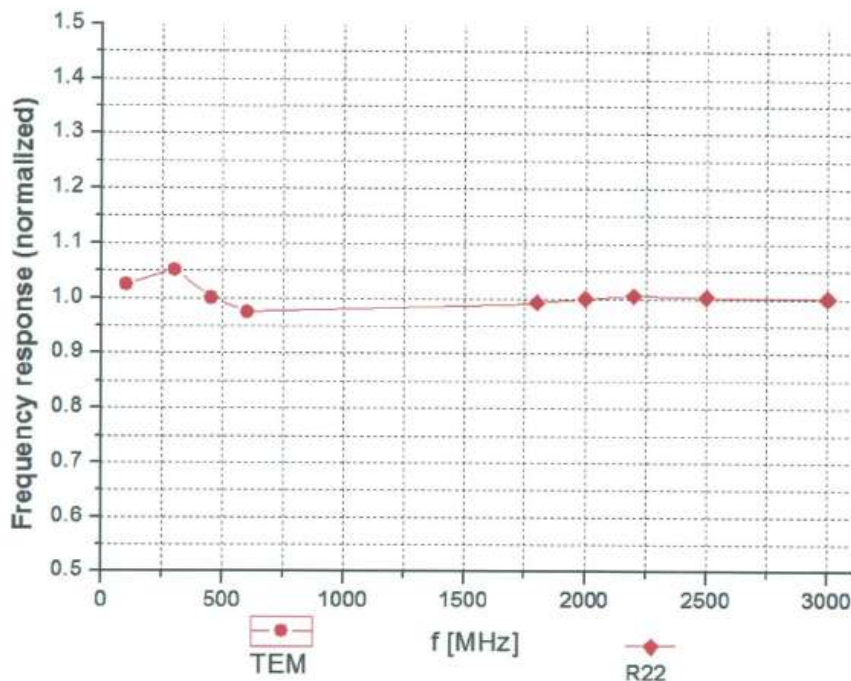
<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ±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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.



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



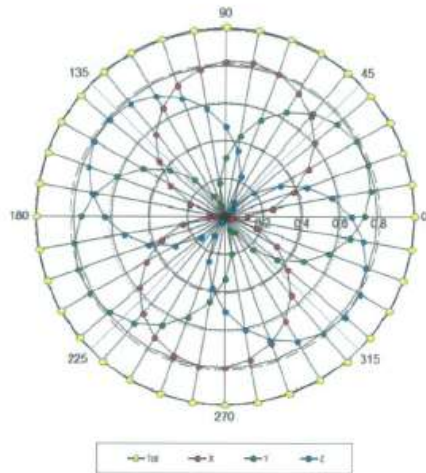
Uncertainty of Frequency Response of E-field:  $\pm 7.5\%$  ( $k=2$ )



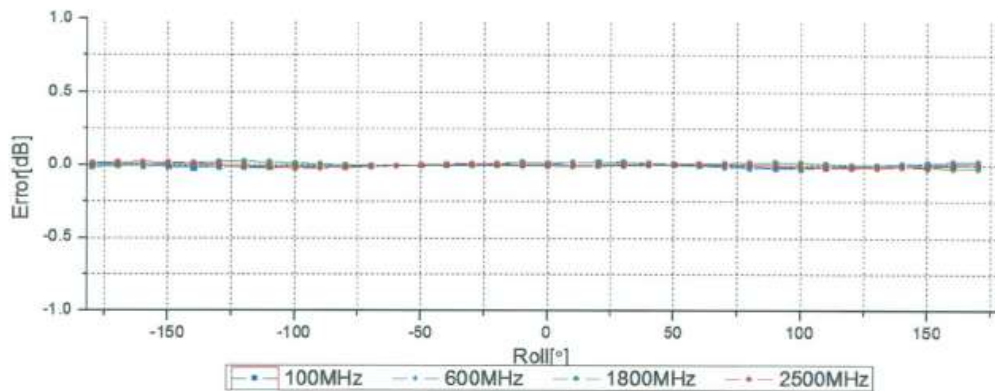
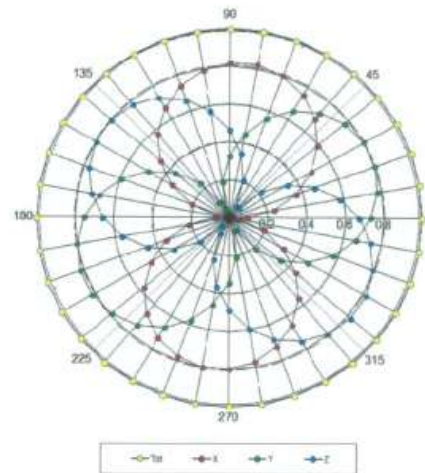
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## Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

**f=600 MHz, TEM**



**f=1800 MHz, R22**

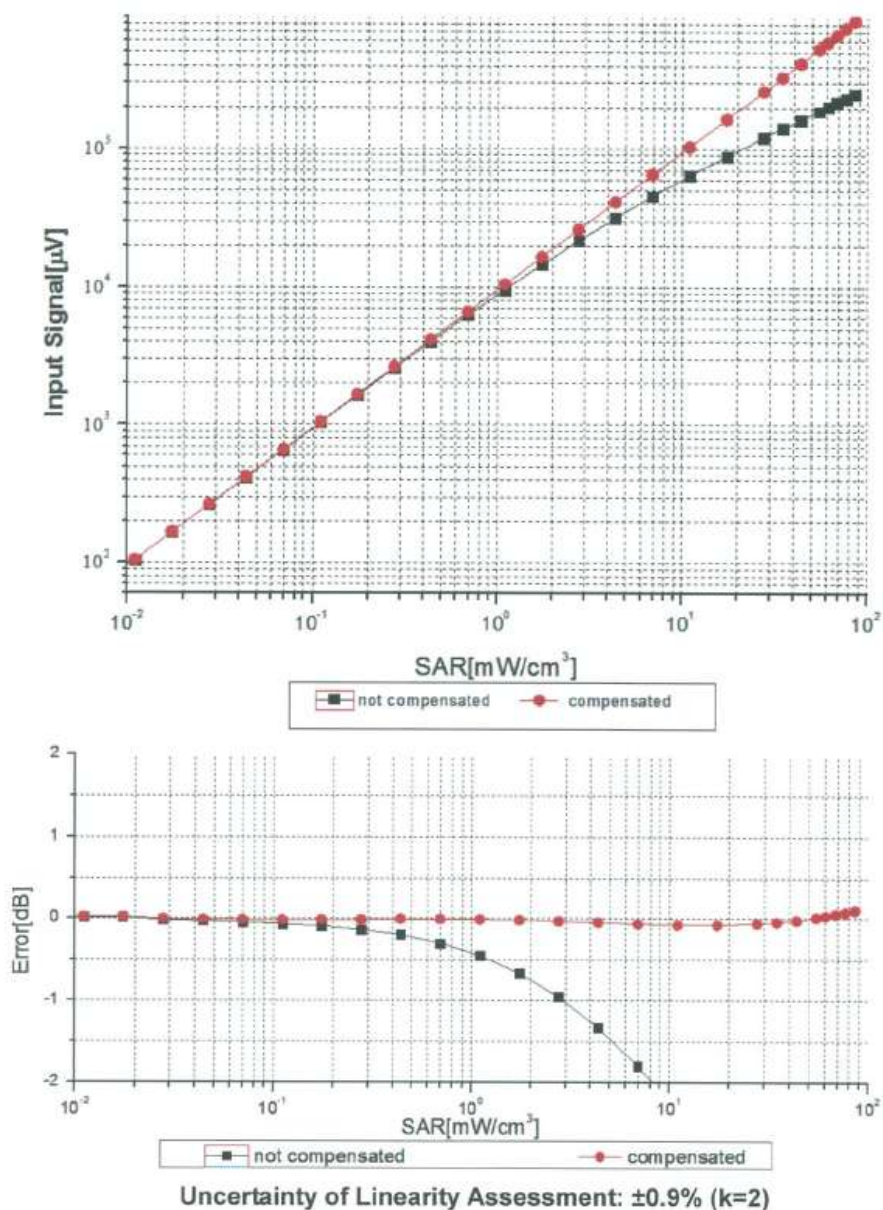


Uncertainty of Axial Isotropy Assessment:  $\pm 0.9\%$  ( $k=2$ )



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## Dynamic Range f(SAR<sub>head</sub>) (TEM cell, f = 900 MHz)





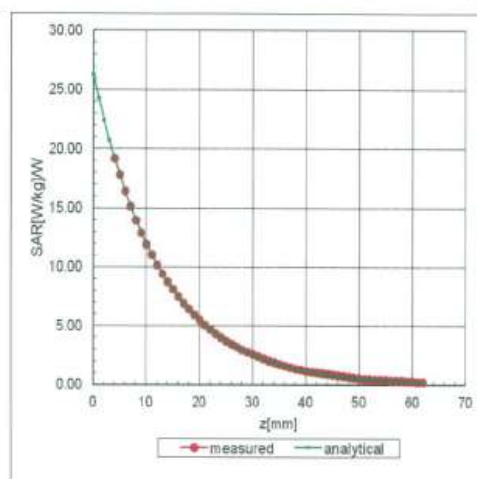
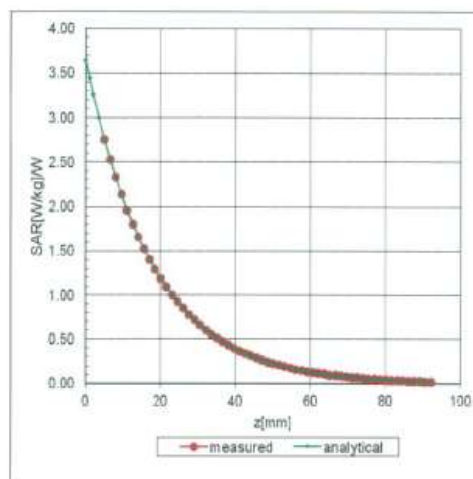


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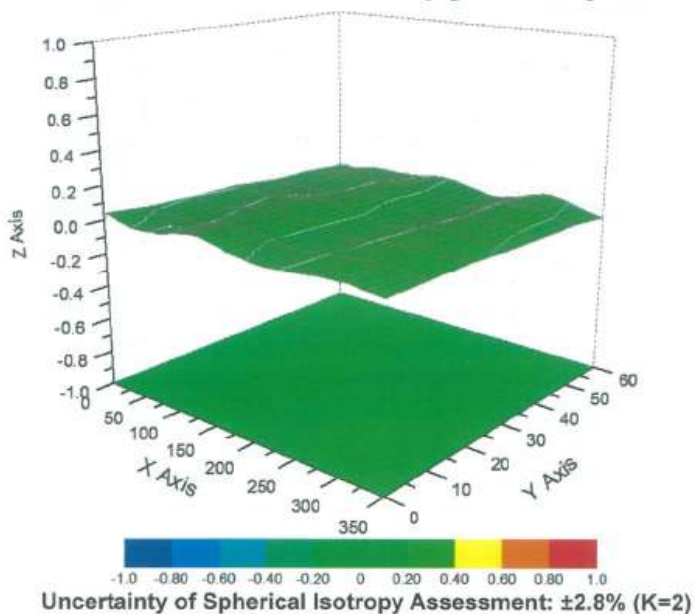
## Conversion Factor Assessment

f=900 MHz, WGLS R9(H\_convF)

f=1750 MHz, WGLS R22(H\_convF)



## Deviation from Isotropy in Liquid



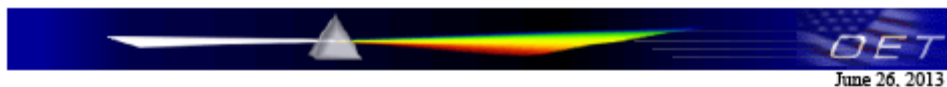


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## DASY - Parameters of Probe: ES3DV3 - SN: 3241

### Other Probe Parameters

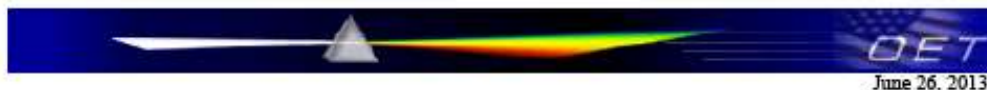
Sensor Arrangement	Triangular
Connector Angle (°)	150.2
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	10mm
Tip Diameter	4mm
Probe Tip to Sensor X Calibration Point	2mm
Probe Tip to Sensor Y Calibration Point	2mm
Probe Tip to Sensor Z Calibration Point	2mm
Recommended Measurement Distance from Surface	3mm



### Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

- 1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.



June 26, 2013

- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
  - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
  - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
  - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
  - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.



## Annex B.2 DAE4 Calibration Certificate



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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Client : **Tejet**

Certificate No: **Z14-97086**

### CALIBRATION CERTIFICATE

Object **DAE4 - SN: 1226**

Calibration Procedure(s) **TMC-OS-E-01-198  
Calibration Procedure for the Data Acquisition Electronics (DAEx)**


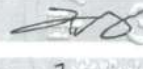
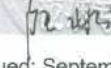
Calibration date: **September 15, 2014**

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
Process Calibrator 753	1971018	01-July-14 (CTTL, No:J14X02147)	July-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: September 17, 2014

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



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**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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### DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

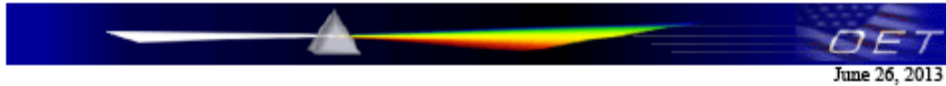
Low Range: 1LSB = 61nV, full range = -1.....+3mV

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

Calibration Factors	X	Y	Z
High Range	404.607 $\pm$ 0.15% (k=2)	404.376 $\pm$ 0.15% (k=2)	404.104 $\pm$ 0.15% (k=2)
Low Range	3.97906 $\pm$ 0.7% (k=2)	4.00337 $\pm$ 0.7% (k=2)	3.98461 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	114.5° $\pm$ 1 °
---	------------------

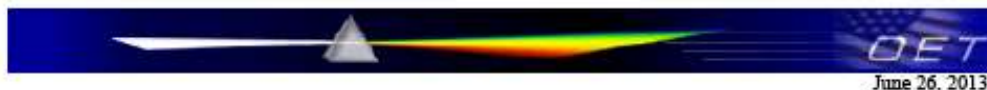


**Acceptable Conditions for SAR Measurements Using Probes and Dipoles  
Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to  
Support FCC Equipment Certification**

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

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    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.





June 26, 2013

- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
  - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
  - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
  - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
  - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.




Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.

# Annex B.3 D835V2 Calibration Certificate



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Client	Tejet			Certificate No: Z14-97088
<b>CALIBRATION CERTIFICATE</b>				
Object	D835V2 - SN: 4d100			
Calibration Procedure(s)	TMC-OS-E-02-194 Calibration procedure for dipole validation kits			
Calibration date:	September 23, 2014			
<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(22±3)℃ 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	102196	14-Mar-14 (CTTL, No.JZ14-896)	Mar-15	
Power sensor NRV-Z5	100596	14-Mar-14 (CTTL, No. JZ14-896)	Mar -15	
Reference Probe ES3DV3	SN 3142	1- Sep-14 (CTTL-SPEAG, No.JZ14-97079)	Aug-15	
DAE3	SN 536	23-Jan-14 (SPEAG, DAE3-536_Jan14)	Jan -15	
Signal Generator E4438C	MY49070393	13-Nov-13 (TMC, No.JZ13-394)	Nov-14	
Network Analyzer E8362B	MY43021135	19-Oct-13 (TMC, No.JZ13-278)	Oct-14	
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		
<p>Issued: September 30, 2014</p> <p>This calibration certificate shall not be reproduced except in full without written approval of the laboratory.</p>				



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#### Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
N/A	not applicable or not measured

#### Calibration is Performed According to the Following Standards:

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

#### Additional Documentation:

- 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%.





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### Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.8.8.1222
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.4 $\pm$ 6 %	0.93 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	----	----

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.44 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.51 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.60 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.27 mW / g $\pm$ 20.4 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	54.4 $\pm$ 6 %	0.98 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	----	----

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.41 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.52 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.60 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.34 mW / g $\pm$ 20.4 % (k=2)





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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.7Ω + 0.73jΩ
Return Loss	- 31.3dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2Ω - 1.47jΩ
Return Loss	- 32.4dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.327 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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# **DASY5 Validation Report for Head TSL**

Date: 22.09.2014

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d100**

Communication System: UID 0, CW (0); Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.925 \text{ S/m}$ ;  $\epsilon_r = 40.43$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3142; ConvF(5.89, 5.89, 5.89); Calibrated: 2014-09-01;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2014-01-23
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

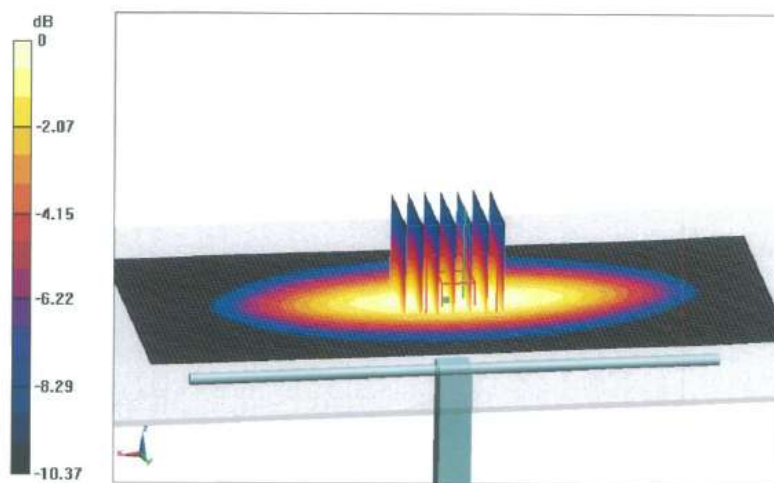
$dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 55.51 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.63 W/kg

**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.6 W/kg**

Maximum value of SAR (measured) = 2.85 W/kg



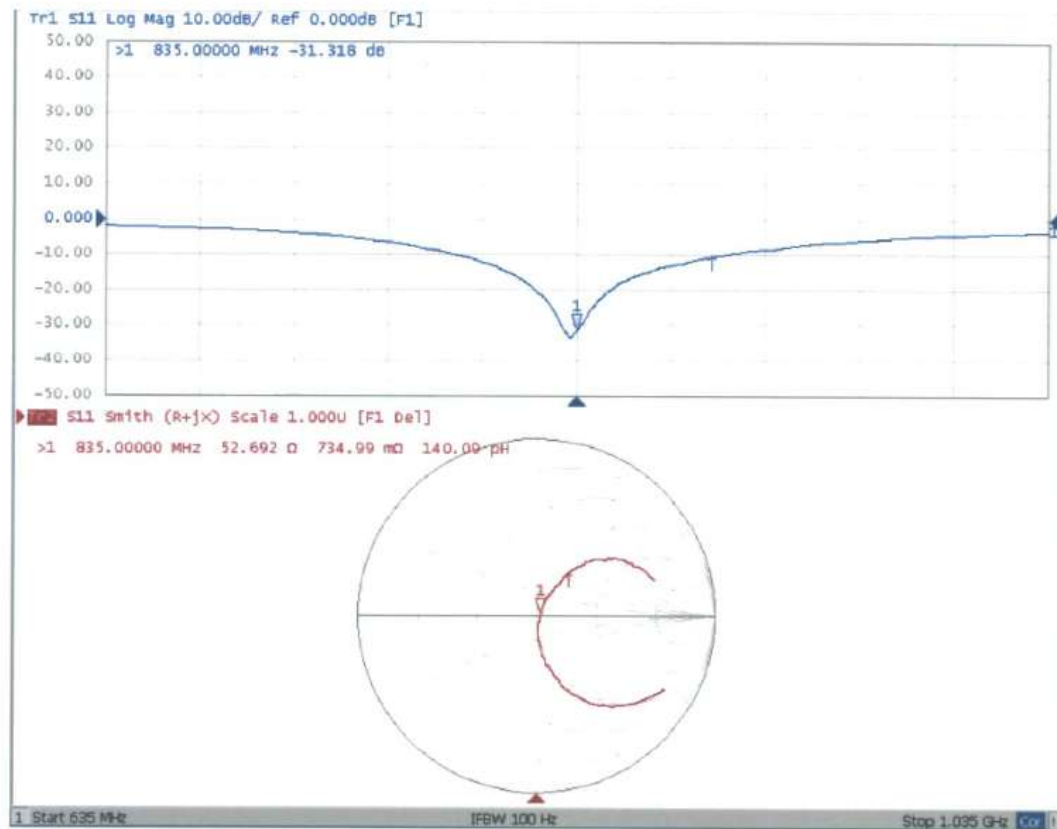
0 dB = 2.85 W/kg = 4.55 dBW/kg



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### Impedance Measurement Plot for Head TSL





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# **DASY5 Validation Report for Body TSL**

Date: 23.09.2014

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d100**

Communication System: UID 0, CW (0); Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.982 \text{ S/m}$ ;  $\epsilon_r = 54.36$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3142; ConvF(6.01, 6.01, 6.01); Calibrated: 2014-09-01;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 2014-01-23
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/2
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**System Performance Check at Frequencies below 1 GHz/d=15mm, Pin=250**

**mW, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement**

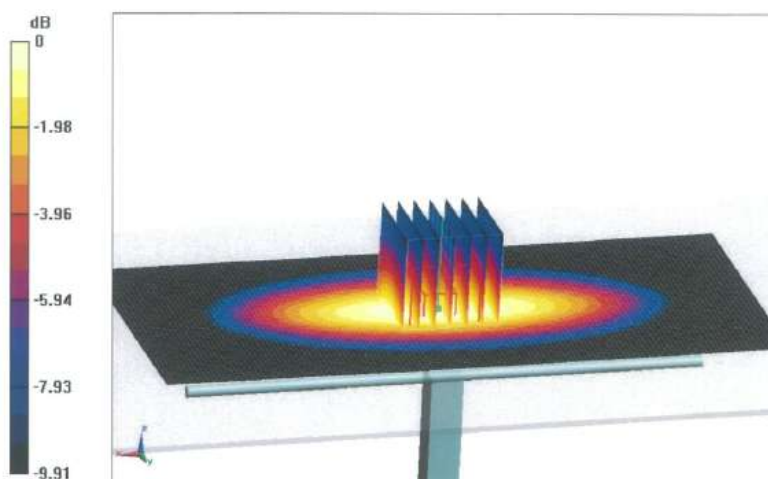
**grid: dx=5mm, dy=5mm, dz=5mm**

Reference Value = 53.51 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 3.52 W/kg

**SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.6 W/kg**

Maximum value of SAR (measured) = 2.79 W/kg



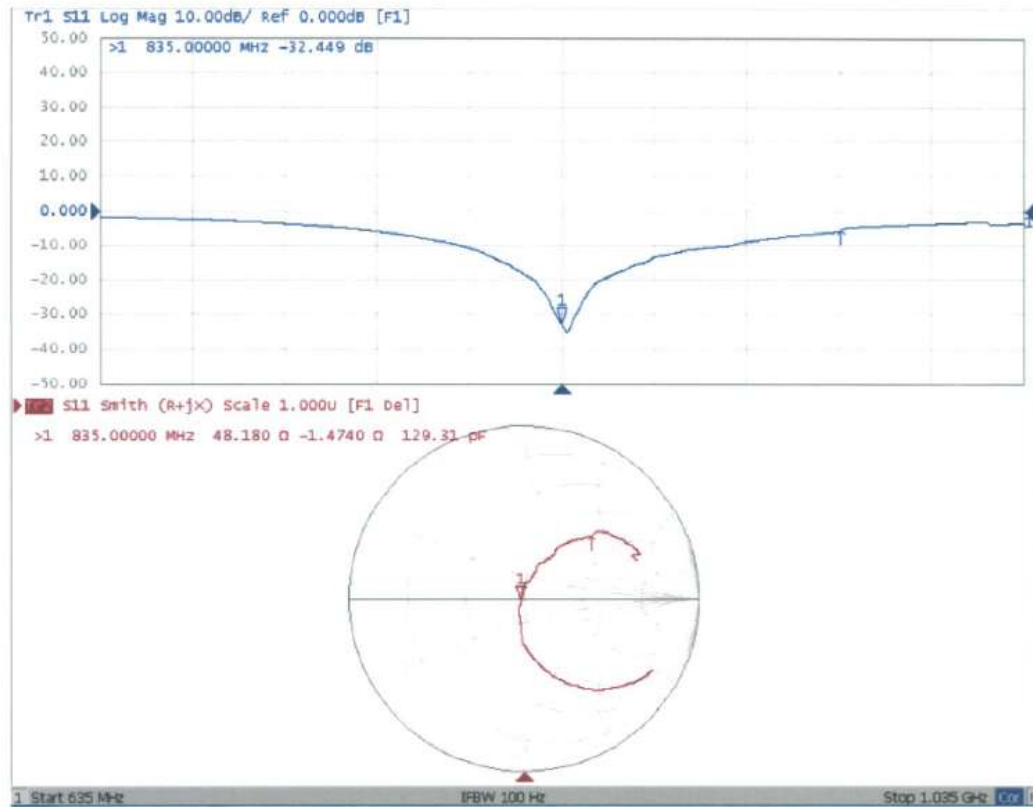
0 dB = 2.79 W/kg = 4.46 dBW/kg



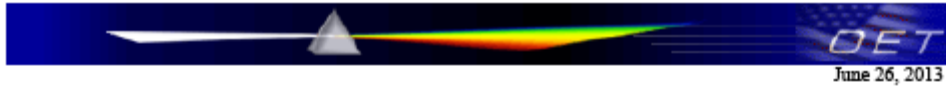
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Impedance Measurement Plot for Body TSL



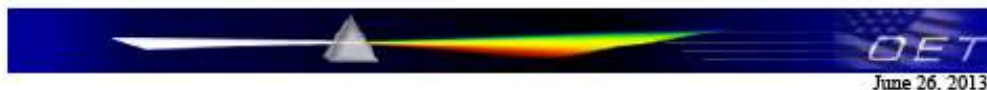




### Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to Support FCC Equipment Certification

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

- 1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.




June 26, 2013

- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
  - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
  - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
  - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
  - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.



Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.

# Annex B.4 D1900V2 Calibration Certificate



In Collaboration with  
**s p e a g**  
CALIBRATION LABORATORY

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CALIBRATION  
No. L0570

Client **Tejet**
Certificate No: **Z15-97069**

## CALIBRATION CERTIFICATE

Object: **D1900V2 - SN: 5d155**

Calibration Procedure(s): **FD-Z11-2-003-01**  
**Calibration Procedures for dipole validation kits**

Calibration date: **April 21, 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)℃ 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
Reference Probe EX3DV4	SN 3846	24-Sep-14(SPEAG, No.EX3-3846_Sep14)	Sep-15
DAE4	SN 1331	20-Jan-15(CTTL-SPEAG, No. Z15-97011)	Jan-16
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	02-Feb-15 (CTTL, No.J15X00729)	Feb-16
Network Analyzer E5071C	MY46110673	03-Feb-15 (CTTL, No.J15X00728)	Feb-16

Calibrated by: **Zhao Jing** SAR Test Engineer

Reviewed by: **Qi Danyuan** SAR Project Leader

Approved by: **Lu Bingsong** Deputy Director of the laboratory

Signature

*[Signatures]*

Issued: April 24, 2015

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

Certificate No: Z15-97069

Page 1 of 8





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**Glossary:**

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
N/A	not applicable or not measured

**Calibration is Performed According to the Following Standards:**

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

**Additional Documentation:**

- 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%.



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### Measurement Conditions

DASY system configuration, as far as not given on page 1.

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	1900 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	40.2 $\pm$ 6 %	1.37 mho/m $\pm$ 6 %
Head TSL temperature change during test	<1.0 °C	—	—

### SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.70 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	39.4 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.04 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	20.3 mW / g $\pm$ 20.4 % (k=2)

### Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	51.8 $\pm$ 6 %	1.55 mho/m $\pm$ 6 %
Body TSL temperature change during test	<1.0 °C	—	—

### SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	39.6 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.28 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.9 mW / g $\pm$ 20.4 % (k=2)



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## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$53.3\Omega + 5.48j\Omega$
Return Loss	- 24.2dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.2\Omega + 7.20j\Omega$
Return Loss	- 22.7dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.126 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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**DASY5 Validation Report for Head TSL**

Date: 04.21.2015

Test Laboratory: CCTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d155**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.37$  S/m;  $\epsilon_r = 40.22$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3846; ConvF(7.26, 7.26, 7.26); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2015-01-20
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

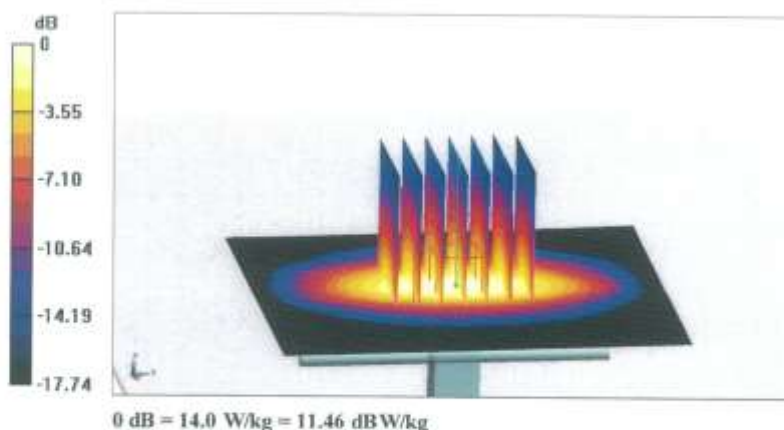
$dx=5$  mm,  $dy=5$  mm,  $dz=5$  mm

Reference Value = 103.8 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.7 W/kg

SAR(1 g) = 9.7 W/kg; SAR(10 g) = 5.04 W/kg

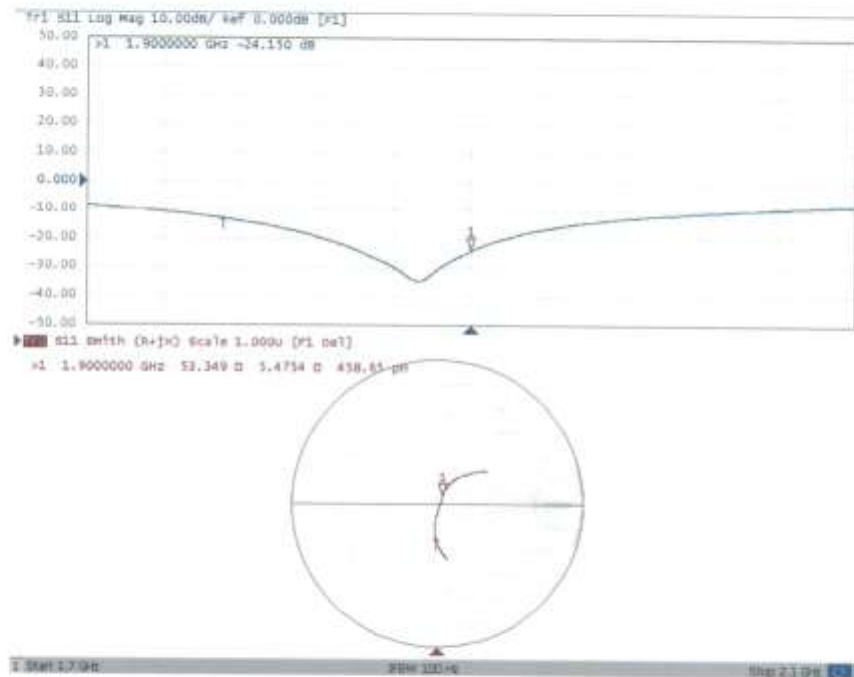
Maximum value of SAR (measured) = 14.0 W/kg





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### Impedance Measurement Plot for Head TSL







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**DASY5 Validation Report for Body TSL**

Date: 04.21.2015

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d155**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.553$  S/m;  $\epsilon_r = 51.76$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

**DASY5 Configuration:**

- Probe: EX3DV4 - SN3846; ConvF(7.15, 7.15, 7.15); Calibrated: 9/24/2014;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1331; Calibrated: 2015-01-20
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid:**

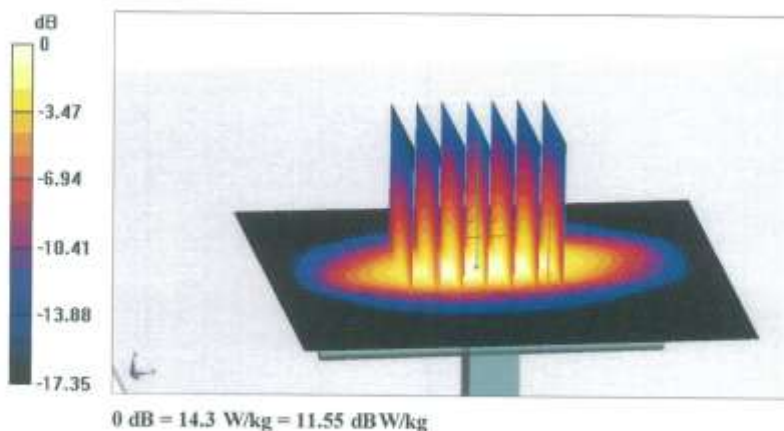
$dx=5$  mm,  $dy=5$  mm,  $dz=5$  mm

Reference Value = 98.03 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 18.1 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.28 W/kg

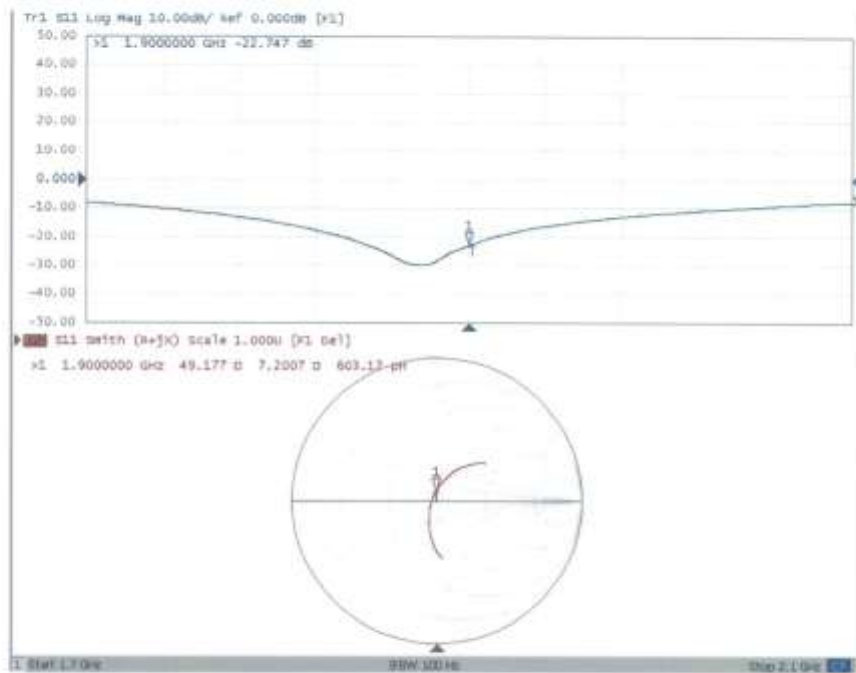
Maximum value of SAR (measured) = 14.3 W/kg

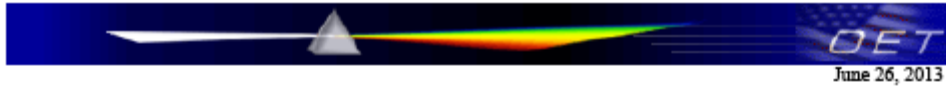




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Impedance Measurement Plot for Body TSL



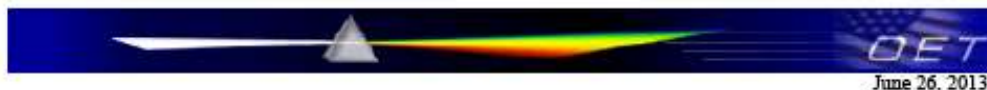


**Acceptable Conditions for SAR Measurements Using Probes and Dipoles  
Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to  
Support FCC Equipment Certification**

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- 1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
  - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
    - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
    - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
  - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
  - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
  - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
  - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
  - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.





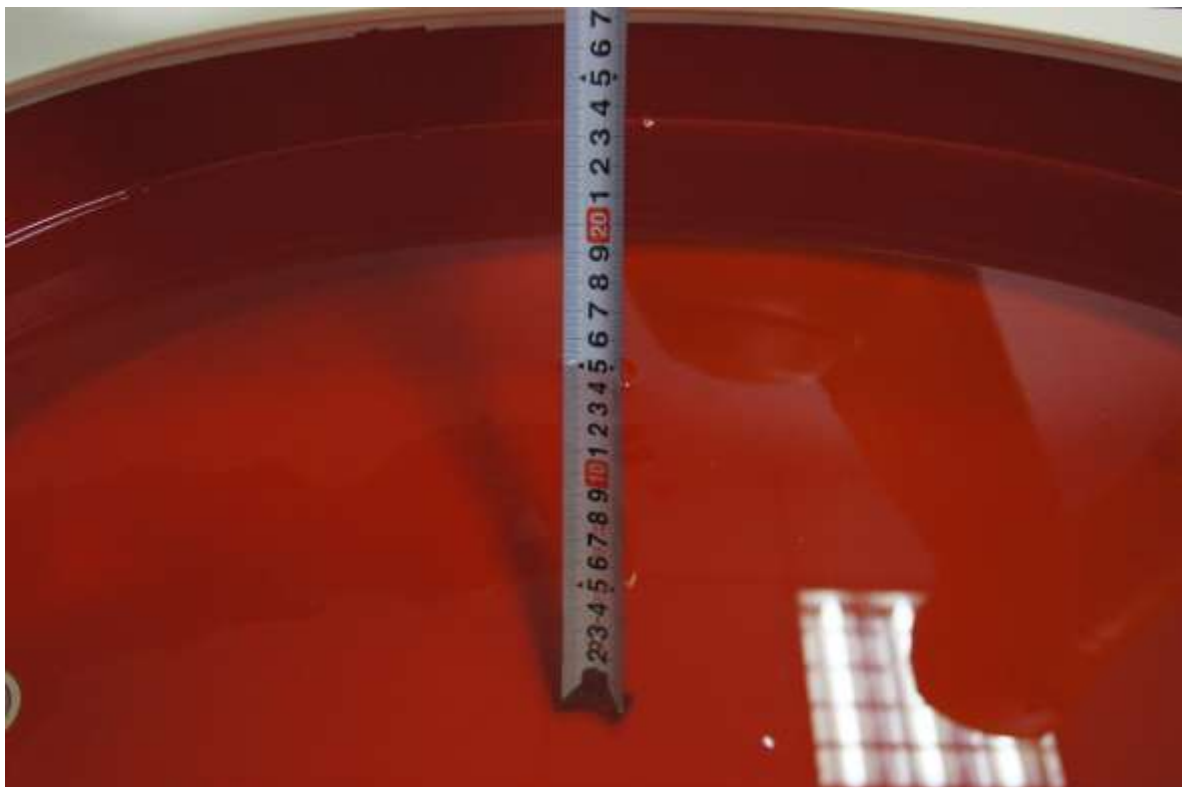
- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
  - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
  - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
  - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
  - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.

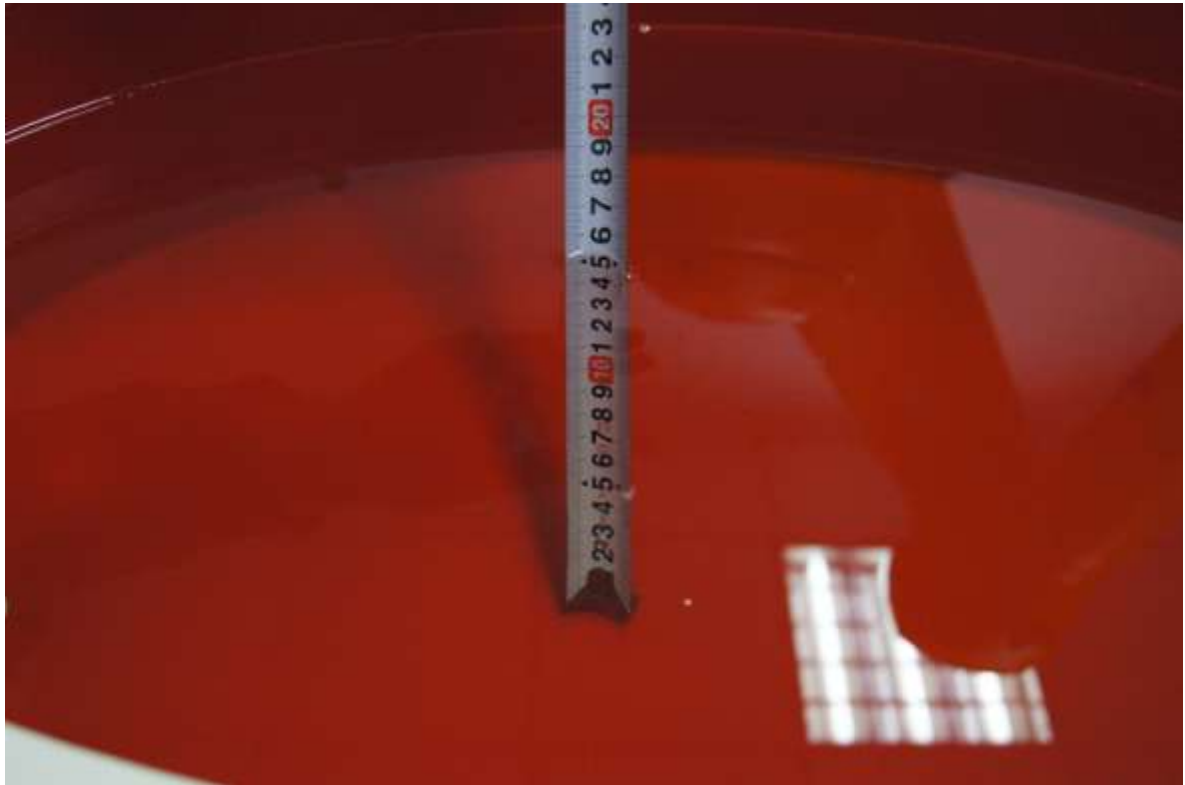
## ANNEX C: Test Layout



Picture C.1: Specific Absorption Rate Test Layout



Picture C.2: Liquid depth in the flat Phantom (835MHz) (15.1cm deep)



Picture C.3: Liquid depth in the flat Phantom (1900 MHz) (15.3cm deep)

-----END OF REPORT-----