



## ANSI/IEEE Std. C95.1-1992

In accordance with the requirements of FCC Report and Order:  
ET Docket 93-62 ; FCC 47 CFR Part 2 ( 2.1093)

## FCC SAR TEST REPORT

For

Product Name: Nuqleo Cell phone

Brand Name:N/A

Model No.: SPARQ

Series Model: N/A

Test Report Number:

C140102S03-SF

Issued for

Accvent LLC

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Issued by

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TESTING CERT #2541.01

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## Revision History

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## 1. CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

<b>Product Name:</b>	Nucleo Cell phone
<b>Brand Name:</b>	N/A
<b>Model Name.:</b>	SPARQ
<b>Series Model:</b>	N/A
<b>Devices supporting GPRS:</b>	No
<b>Description Test Modes(worst case ):</b>	SIM 1 and SIM2 is a chipset unit and tested as single chipset
<b>Device Category:</b>	PORTABLE DEVICES
<b>Exposure Category:</b>	GENERAL POPULATION/UNCONTROLLED EXPOSURE
<b>Date of Test:</b>	January 11,2014 & January 12,2014
<b>Applicant:</b>	<b>Accvent LLC</b> 3505 N.W. 107th Ave., Doral., Florida
<b>Manufacturer:</b>	<b>UNITED TIME TECHNOLOGY CO.,LTD</b> Room 1001 Microprofit Building,6 Gaoxin south Road, High-Tech Park Nanshan district, ShenZhen,P.R.China.
<b>Application Type:</b>	Certification
<b>APPLICABLE STANDARDS AND TEST PROCEDURES</b>	
<b>STANDARDS AND TEST PROCEDURES</b>	<b>TEST RESULT</b>
KDB 865664	No non-compliance noted
<b>Deviation from Applicable Standard</b>	
None	
The device was tested by Compliance Certification Services Inc. in accordance with the measurement methods and procedures specified in KDB 865664 The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.	

**Approved by:**

Jeff Fang  
RF Manager  
Compliance Certification Services Inc.

**Tested by:**

Jason Qiao  
Test Engineer  
Compliance Certification Services Inc.



## 2. EUT DESCRIPTION

<b>Product Name:</b>	Nuqleo Cell phone	
<b>Brand Name:</b>	N/A	
<b>Model Name.:</b>	SPARQ	
<b>Series Model:</b>	N/A	
<b>Model Discrepancy:</b>	N/A	
<b>FCC ID:</b>	JJMSPARQ	
<b>Power reduction:</b>	NO	
<b>Device Category:</b>	Production unit	
<b>Frequency Range:</b>	GSM 850: 824.2 ~ 848.8 MHz GSM1900: 1850.2 ~ 1909.8MHz Bluetooth: 2402 ~ 2480 MHz	
<b>Transmit Power(Max):</b>	GSM 850: 32.04 dBm GSM 1900: 28.51 dBm Bluetooth: 1.68 dBm	
<b>Max. Reported 1g SAR:</b>	Head: GSM850:0.776 W/kg GSM1900:0.557 W/kg	Body: GSM850:0.584 W/kg GSM1900:0.408 W/kg
<b>Modulation Technique:</b>	GSM : GMSK Bluetooth: FHSS (GFSK + $\pi/4$ DQPSK+8DPSK)	
<b>Accessories:</b>	Power supply and ADP(rating): Model No.: SparQ-AC Input: AC 100-240V 50-60Hz 0.2A Output: 5V 500mA	Battery(rating): Model No.: SparQ-Bat Capacitance: 600mA Rated Voltage: 3.7V Charging limited voltage :4.2V
<b>Antenna Specification:</b>	GSM: PIFA antenna Bluetooth : Dipole antenna	
<b>Operating Mode:</b>	Maximum continuous output	



### 3. REQUIREMENTS FOR COMPLIANCE TESTING DEFINED BY THE FCC

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996. The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g for an uncontrolled environment and 8.0 mW/g for an occupational/controlled environment as recommended by the ANSI/IEEE standard C95.1-1992.

### 4. TEST METHODOLOGY

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

☒ FCC 47 CFR Part 2 ( 2.1093)

☒ ANSI/IEEE C95.1-1992

☒ KDB 447498 D01v05r01

Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

☒ KDB 648474 D04v01r01

SAR Evaluation Considerations for Wireless Handsets

☒ KDB 865664 D01v01r01

SAR Measurement Requirements for 100 MHz to 6 GHz

☒ KDB 941225 D03v01

SAR Test Reduction Procedures GSM/GPRS/EDGE



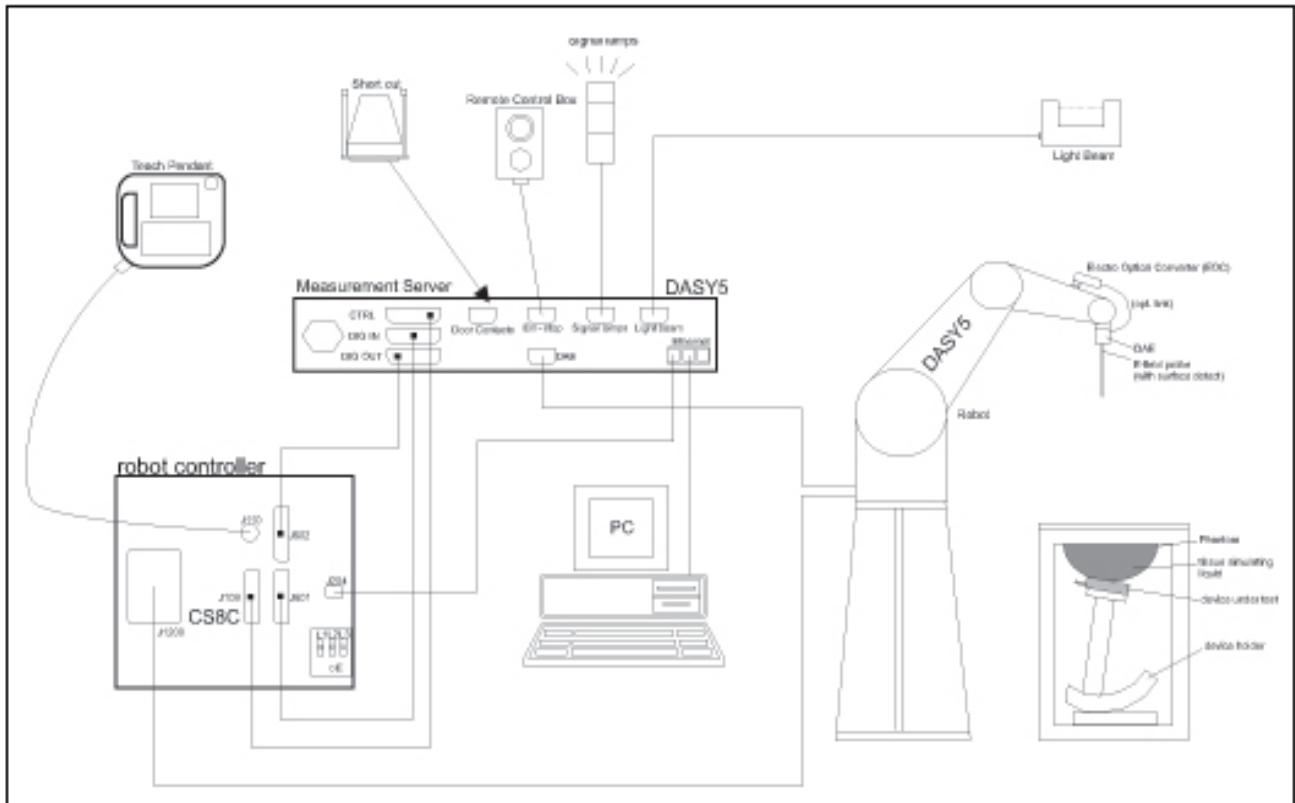
## 5. DOSIMETRIC ASSESSMENT SETUP

These measurements were performed with the automated near-field scanning system DASY 5 from ATENNESSA. The system is based on a high precision robot (working range greater than 0.9 m), which positions the probes with a positional repeatability of better than  $\pm 0.02$  mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines to the data acquisition unit. The SAR measurements were conducted with the E-field PROBE EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than  $\pm 10\%$ . The spherical isotropy was evaluated with the procedure described in [8] and found to be better than  $\pm 0.25$  dB. The phantom used was the SAM Twin Phantom as described in FCC supplement C, IEE P1528 and CENELEC EN 62209.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78



## 5.1 MEASUREMENT SYSTEM DIAGRAM



### The DASYS5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition 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 between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected 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.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 7.
- DASYS5 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing validating the proper functioning of the system.





## 5.2 SYSTEM COMPONENTS



The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV celeron, 128MB chip-disk and 128 MB RAM. The necessary circuits for communication with either the DAE4(or DAE3) electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY5 I/O-board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation.



The PC-operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with two expansion slots which are reserved for future applications. Please note that the expansion slots do not have a standardized pinout and therefore only the expansion cards provided by SPEAG can be inserted. Expansion cards from any other supplier could seriously damage the measurement server. Calibration: No calibration required.

### Data Acquisition Electronics (DAE)



The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE4 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

### EX3DV4 Isotropic E-Field Probe for Dosimetric Measurements



**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: 10-3000 MHz.

Conversion Factors (CF) for HSL 900 and HSL 1800  
CF-Calibration for other liquids and frequencies upon request.

**Frequency:** 10 MHz to > 6 GHz; Linearity:  $\pm 0.2$  dB (30 MHz to 3 GHz)

**Directivity:**  $\pm 0.3$  dB in HSL (rotation around probe axis)  
 $\pm 0.5$  dB in HSL (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: 337 mm (Tip: 9 mm)  
Tip diameter: 2.5 mm (Body: 10 mm)  
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%.



Interior of probe

## SAM Twin Phantom

### Construction:

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50360 and IEC 62209. 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 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 with the robot.



**Shell Thickness:**  $2 \pm 0.2$  mm

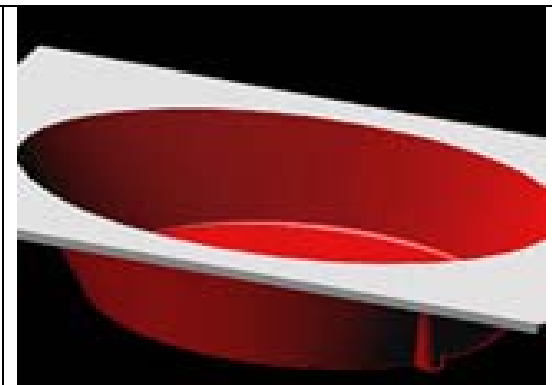
**Filling Volume:** Approx. 25 liters

**Dimensions:** Height: 850mm; Length: 1000mm; Width: 750mm

## SAM Phantom (ELI4 v4.0)

### Description Construction:

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY4/DASY5.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles



**Shell Thickness:**  $2.0 \pm 0.2$  mm (sagging: <1%)

**Filling Volume:** Approx. 25 liters

**Dimensions:** Major ellipse axis: 600 mm

**Minor axis:** 400 mm 500mm



## Device Holder for SAM Twin Phantom

**Construction:** In combination with the Twin SAM Phantom, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).



## System Validation Kits for SAM Twin Phantom

**Construction:** Symmetrical dipole with 1/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

**Frequency:** 900,1800,2450,5800 MHz

**Return loss:** > 20 dB at specified validation position

**Power capability:** > 100 W (f < 1GHz); > 40 W (f > 1GHz)

**Dimensions:**

D835V2: dipole length: 161 mm; overall height: 340 mm

D1800V2: dipole length: 72.5 mm; overall height: 300 mm

D1900V2: dipole length: 67.7 mm; overall height: 300 mm

D2450V2: dipole length: 51.5 mm; overall height: 290 mm

D5GHzV2: dipole length: 20.6 mm; overall height: 300mm



## System Validation Kits for ELI4 phantom

**Construction:** Symmetrical dipole with 1/4 balun Enables measurement of feedpoint impedance with NWA Matched for use near flat phantoms filled with brain simulating solutions Includes distance holder and tripod adaptor.

**Frequency:** 900, 1800, 2450, 5800 MHz

**Return loss:** > 20 dB at specified validation position

**Power capability:** > 100 W (f < 1GHz); > 40 W (f > 1GHz)

**Dimensions:**

D835V2: dipole length: 161 mm; overall height: 340 mm

D1800V2: dipole length: 72.5 mm; overall height: 300 mm

D1900V2: dipole length: 67.7 mm; overall height: 300 mm

D2450V2: dipole length: 51.5 mm; overall height: 290 mm

D5GHzV2: dipole length: 20.6 mm; overall height: 300 mm





## 6. EVALUATION PROCEDURES

### DATA EVALUATION

The DASY 5 post processing 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	$Norm_i, a_{i0}, a_{i1}, a_{i2}$
	- Conversion factor	$ConvF_i$
	- Diode compression point	$dcp_i$
Device parameters:	- Frequency	$f$
	- Crest factor	$cf$
Media parameters:	- Conductivity	$\sigma$
	- Density	$\rho$

These parameters must be set correctly in the software. They can be found in the component documents or be imported into the software from the configuration files issued for the DASY 5 components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

with	$V_i$	= 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 5 parameter)
	$dcp_i$	= Diode compression point (DASY 5 parameter)

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

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

H-field probes:

$$H_i = \sqrt{V_i} \cdot \frac{a_{i10} + a_{i11}f + a_{i12}f^2}{f}$$

with	$V_i$	= Compensated signal of channel i (i = x, y, z)
	$Norm_i$	= Sensor sensitivity of channel i (i = x, y, z) $\mu V/(V/m)^2$ for E0field Probes
	$ConvF$	= Sensitivity enhancement in solution
	$a_{ij}$	= Sensor sensitivity factors for H-field probes
	$f$	= Carrier frequency (GHz)
	$E_i$	= Electric field strength of channel i in V/m
	$H_i$	= Magnetic field strength of channel i in A/m

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

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



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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with  $SAR$  = local specific absorption rate in mW/g  
 $E_{tot}$  = total field strength in V/m  
 $\sigma$  = conductivity in [mho/m] or [Siemens/m]  
 $\rho$  = equivalent tissue density in g/cm<sup>3</sup>

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

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

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

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





## **SAR EVALUATION PROCEDURES**

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

- **Power Reference Measurement**

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

- **Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY 5 software can find the maximum locations even in relatively coarse grids. The scan area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the area scan's property sheet is brought-up, grid was at to 15 mm by 15 mm and can be edited by a user.

- **Zoom Scan**

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default zoom scan measures 5 x 5 x 7 points within a cube whose base faces are centered around the maximum found in a preceding area scan job within the same procedure. If the preceding Area Scan job indicates more than one maximum, the number of Zoom Scans has to be enlarged accordingly (The default number inserted is 1).

- **Power Drift measurement**

The drift job measures the field at the same location as the most recent reference job within the same procedure, and with the same settings. The drift measurement gives the field difference in dB from the reading conducted within the last reference measurement. Several drift measurements are possible for one reference measurement. This allows a user to monitor the power drift of the device under test within a batch process. In the properties of the Drift job, the user can specify a limit for the drift and have DASY 5 software stop the measurements if this limit is exceeded.

- **Z-Scan**

The Z Scan job measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. A user can anchor the grid to the current probe location. As with any other grids, the local Z-axis of the anchor location establishes the Z-axis of the grid.



## SPATIAL PEAK SAR EVALUATION

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

The DASY 5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maximum searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

### Extrapolation

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

Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Cube Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 5x5x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1 g and 10 g cubes.

### Boundary effect

For measurements in the immediate vicinity of a phantom surface, the field coupling effects between the probe and the boundary influence the probe characteristics. Boundary effect errors of different dosimetric probe types have been analyzed by measurements and using a numerical probe model. As expected, both methods showed an enhanced sensitivity in the immediate vicinity of the boundary. The effect strongly depends on the probe dimensions and disappears with increasing distance from the boundary. The sensitivity can be approximately given as:

$$S \approx S_o + S_b \exp\left(-\frac{z}{a}\right) \cos\left(\pi \frac{z}{\lambda}\right)$$

Since the decay of the boundary effect dominates for small probes ( $a \ll \lambda$ ), the cos-term can be omitted. Factors  $S_b$  (parameter Alpha in the DASY 5 software) and  $a$  (parameter Delta in the DASY 5 software) are assessed during probe calibration and used for numerical compensation of the boundary effect. Several simulations and measurements have confirmed that the compensation is valid for different field and boundary configurations.

This simple compensation procedure can largely reduce the probe uncertainty near boundaries. It works well as long as:

- the boundary curvature is small
- the probe axis is angled less than 30° to the boundary normal
- the distance between probe and boundary is larger than 25% of the probe diameter
- the probe is symmetric (all sensors have the same offset from the probe tip)

Since all of these requirements are fulfilled in a DASY 5 system, the correction of the probe boundary effect in the vicinity of the phantom surface is performed in a fully automated manner via the measurement data extraction during post processing.



## 7. MEASUREMENT UNCERTAINTY

UNCERTAINTY BUDGE ACCORDING TO IEEE 1528-2003						
Error Description	Uncertainty Value $\pm\%$	Probability distribution	Divisor	C <sub>1</sub> 1g	Standard unc.(1g) $\pm\%$	V <sub>1</sub> or V <sub>eff</sub>
<b>Measurement System</b>						
Probe calibration	$\pm 5.5$	normal	1	1	$\pm 5.5$	$\infty$
Axial isotropy of probe	$\pm 4.7$	rectangular	$\sqrt{3}$	0.7	$\pm 1.9$	$\infty$
Hemispherical Isotropy of probe	$\pm 9.6$	rectangular	$\sqrt{3}$	0.7	$\pm 3.9$	$\infty$
Probe linearity	$\pm 4.7$	rectangular	$\sqrt{3}$	1	$\pm 2.7$	$\infty$
Detection Limit	$\pm 1.0$	rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Boundary effects	$\pm 1.0$	rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
Readout electronics	$\pm 0.3$	normal	1	1	$\pm 0.3$	$\infty$
Response time	$\pm 0.8$	rectangular	$\sqrt{3}$	1	$\pm 0.5$	$\infty$
Integration time	$\pm 2.6$	rectangular	$\sqrt{3}$	1	$\pm 1.5$	$\infty$
Probe positioning	$\pm 2.9$	rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Probe positioner	$\pm 0.4$	rectangular	$\sqrt{3}$	1	$\pm 0.2$	$\infty$
RF ambient Noise	$\pm 3.0$	rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
RF ambient Reflections	$\pm 3.0$	rectangular	$\sqrt{3}$	1	$\pm 1.7$	$\infty$
Max.SAR Eval	$\pm 1.0$	rectangular	$\sqrt{3}$	1	$\pm 0.6$	$\infty$
<b>Test Sample Related</b>						
Device positioning	$\pm 2.9$	normal	1	1	$\pm 2.9$	145
Device holder uncertainty	$\pm 3.6$	normal	1	1	$\pm 3.6$	5
Power drift	$\pm 5.0$	rectangular	$\sqrt{3}$	1	$\pm 2.9$	$\infty$
<b>Phantom and Set up</b>						
Phantom uncertainty	$\pm 4.0$	rectangular	$\sqrt{3}$	1	$\pm 2.3$	$\infty$
Liquid conductivity(target)	$\pm 5.0$	rectangular	$\sqrt{3}$	0.64	$\pm 1.8$	$\infty$
Liquid conductivity(meas.)	$\pm 2.5$	rectangular	1	0.64	$\pm 1.6$	$\infty$
Liquid permittivity(target)	$\pm 5.0$	rectangular	$\sqrt{3}$	0.6	$\pm 1.7$	$\infty$
Liquid permittivity(meas.)	$\pm 2.5$	rectangular	1	0.6	$\pm 1.5$	$\infty$
<b>Combined Standard Uncertainty</b>					$\pm 10.7$	387
<b>Coverage Factor for 95%</b>		kp=2				
<b>Expanded Standard Uncertainty</b>					$\pm 21.4$	

Table: Worst-case uncertainty for DASY5 assessed according to IEEE1528-2003.

The budge is valid for the frequency range 300 MHz to 6G Hz and represents a worst-case analysis.





## 8. EXPOSURE LIMIT

(A). Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

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

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

**Note:** **Whole-Body SAR** is averaged over the entire body, **partial-body SAR** is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube. **SAR for hands, wrists, feet and ankles** is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

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

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

**NOTE**  
**GENERAL POPULATION/UNCONTROLLED EXPOSURE**  
**PARTIAL BODY LIMIT**  
**1.6 W/kg**



## 9. EUT ARRANGEMENT

Please refer to IEEE1528-2003 illustration below.

### 9.1 ANTHROPOMORPHIC HEAD PHANTOM

Figure 7-1a shows the front, back and side views of SAM. The point “M” is the reference point for the center of mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERPs are 15 mm posterior to the entrance to ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 7-1b. The plane passing through the two ear reference points and M is defined as the Reference Plane. The line N-F (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 7-1c). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines should be marked on the external phantom shell to facilitate handset positioning. Posterior to the N-F line, the thickness of the phantom shell with the shape of an ear is a flat surface 6 mm thick at the ERPs. Anterior to the N-F line, the ear is truncated as illustrated in Figure 7-1b. The ear truncation is introduced to avoid the handset from touching the ear lobe, which can cause unstable handset positioning at the cheek.

Figure 7-1a  
Front, back and side view of SAM (model for the phantom shell)



Figure 7-1b

Close up side view of phantom showing the ear region



Figure 7-1c

Close up side view of phantom showing the ear region

Figure 7-1c

Side view of the phantom showing relevant markings and the 7 cross sectional plane locations

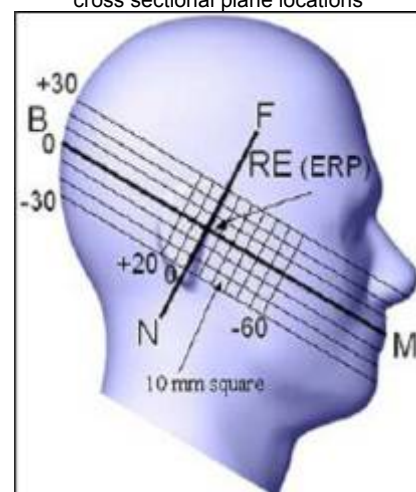


Figure 7-1c

Side view of the phantom showing relevant markings and the 7 cross sectional plane locations



## 9.2 DEFINITION OF THE “CHEEK/TOUCH” POSITION

The “cheek” or “touch” position is defined as follows:

- a. Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover. (If the handset can also be used with the cover closed both configurations must be tested.)
- b. Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width  $w_t$  of the handset at the level of the acoustic output (point A on Figures 7-2a and 7-2b), and the midpoint of the width  $w_b$  of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 7-2a). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 7-2b), especially for clamshell handsets, handsets with flip pieces, and other irregularly-shaped handsets.
- c. Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 7-2c), such that the plane defined by the vertical center line and the horizontal line of the handset is approximately parallel to the sagittal plane of the phantom.
- d. Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the pinna.
- e. e) While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
- f. Rotate the handset around the vertical centerline until the handset (horizontal line) is symmetrical with respect to the line NF.
- g. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the handset contact with the pinna, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the pinna (cheek). See Figure 7-2c. The physical angles of rotation should be noted.



Figure 7.2c

Phone “cheek” or “touch” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for handset positioning, are indicated.

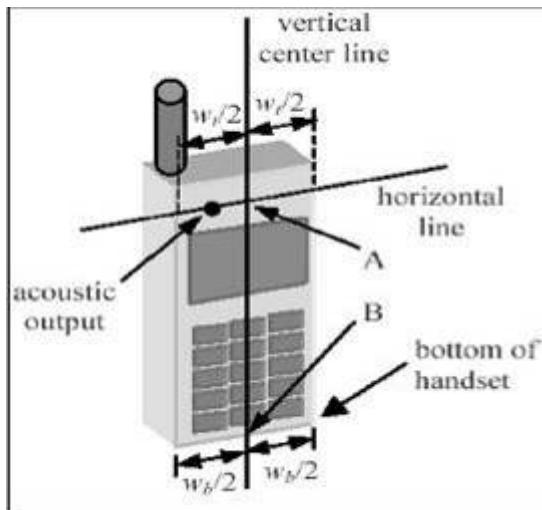


Figure 7.2a

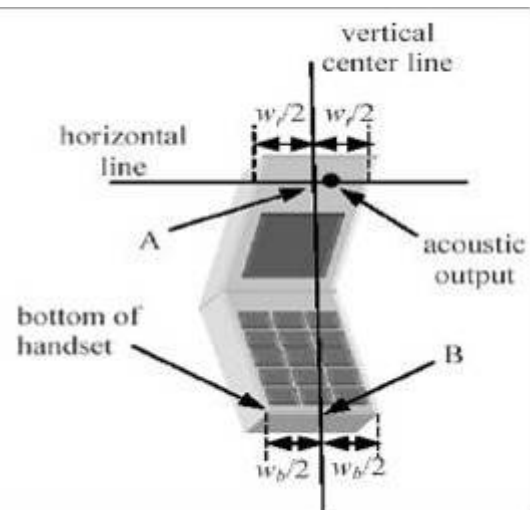


Figure 7.2b

## 9.3 DEFINITION OF THE “TILTED” POSITION

The “tilted” position is defined as follows:

- Repeat steps (a) – (g) of 7.2 to place the device in the “cheek position.”
- While maintaining the orientation of the handset move the handset away from the pinna along the line passing through RE and LE in order to enable a rotation of the handset by 15 degrees.
- Rotate the handset around the horizontal line by 15 degrees.
- While maintaining the orientation of the handset, move the handset towards the phantom on a line passing through RE and LE until any part of the handset touches the ear. The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna (e.g., the antenna with the back of the phantom head), the angle of the handset should be reduced. In this case, the tilted position is obtained if any part of the handset is in contact with the pinna as well as a second part of the handset is contact with the phantom (e.g., the antenna with the back of the head).

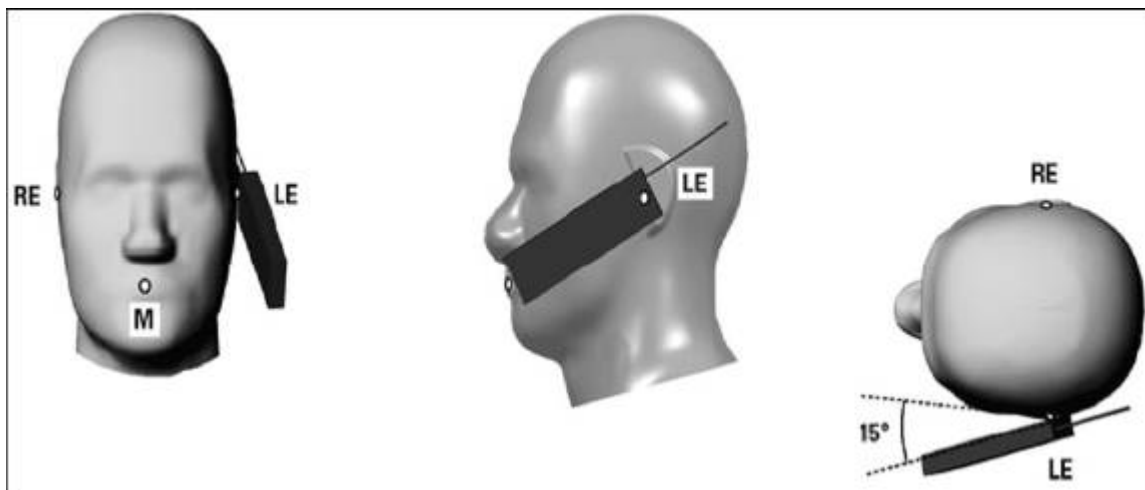


Figure 7-3

Phone “tilted” position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for handset positioning, are indicated.



## 10. MEASUREMENT RESULTS

### 10.1 TEST LIQUIDS CONFIRMATION

#### SIMULATED TISSUE LIQUID PARAMETER CONFIRMATION

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

#### KDB865664 RECOMMENDED TISSUE DIELECTRIC PARAMETERS

The tissue dielectric parameters recommended by the KDB865664 have been incorporated in the following table.

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

( $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho$  = 1000 kg/m<sup>3</sup>)



## 10.2 LIQUID MEASUREMENT RESULTS

The following table show the measuring results for simulating liquid:

Liquid Type	Liquid Temp. (°C)	Parameters	Target	Measured	Deviation (%)	Limited (%)	Measured Date
Head835	21.5	Permittivity( $\epsilon$ )	41.50	41.81	0.75	$\pm 5$	2014-1-11
		Conductivity( $\sigma$ )	0.90	0.92	2.22	$\pm 5$	
Body835	21.5	Permittivity( $\epsilon$ )	55.20	55.54	0.62	$\pm 5$	2014-1-11
		Conductivity( $\sigma$ )	0.97	0.97	0.00	$\pm 5$	
Head1900	21.5	Permittivity( $\epsilon$ )	40.00	40.89	2.23	$\pm 5$	2014-1-12
		Conductivity( $\sigma$ )	1.40	1.4	0.00	$\pm 5$	
Body1900	21.5	Permittivity( $\epsilon$ )	53.30	53.9	1.13	$\pm 5$	2014-1-12
		Conductivity( $\sigma$ )	1.52	1.53	0.66	$\pm 5$	



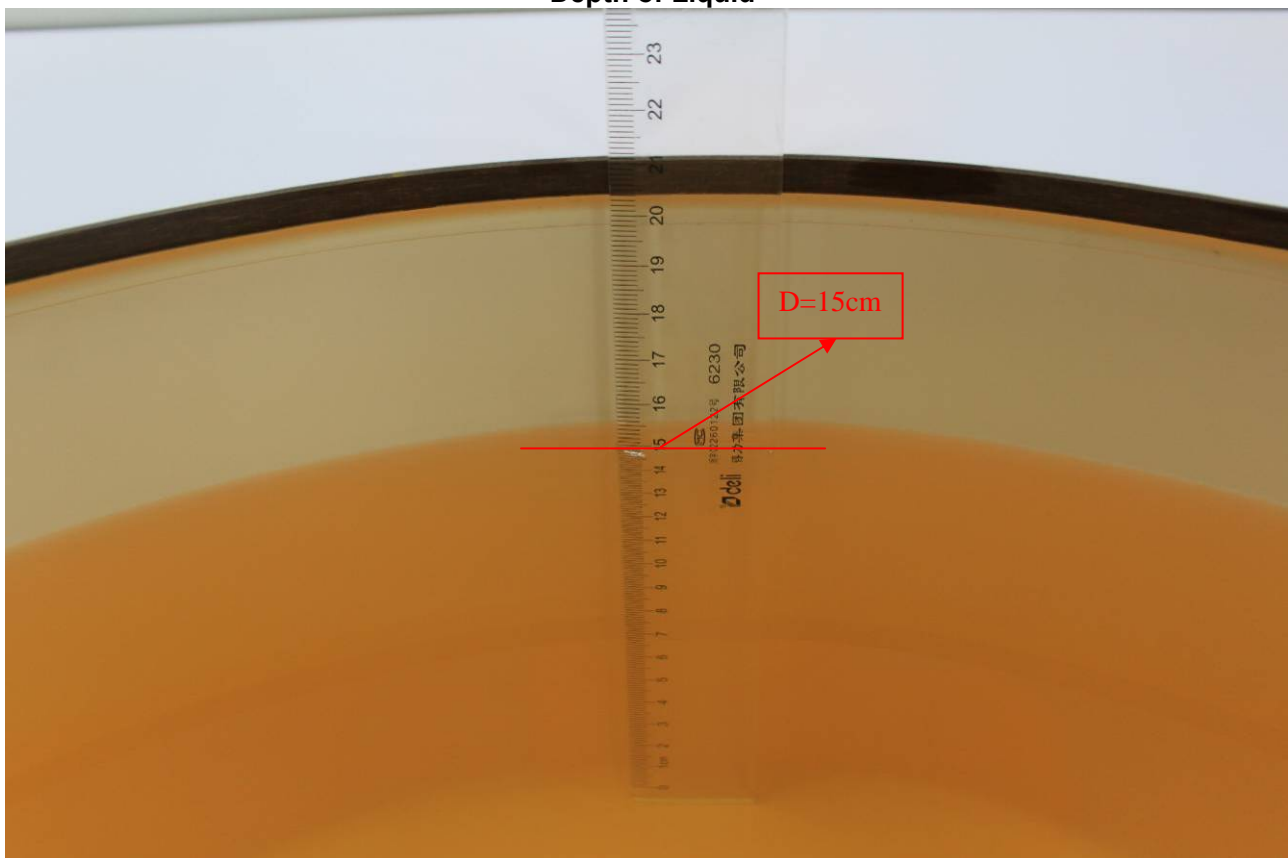
## 10.3 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of  $\pm 10\%$ . The system performance check results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

### SYSTEM PERFORMANCE CHECK MEASUREMENT CONDITIONS

- The measurements were performed in the flat section of the SAM twin phantom filled with head and body simulating liquid of the following parameters.
- The DASY5 system withan E-fileld probe EX3DV4 SN: 3798 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15 mm (below 1 GHz) and 10 mm (above 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 10mm was aligned with the dipole.
- Special 7x7x7 fine cube was chosen for cube integration (dx= 5 mm, dy= 5 mm, dz= 5 mm).
- Distance between probe sensors and phantom surface was set to 2 mm.
- The dipole input power was 250mW $\pm 3\%$ .
- The results are normalized to 1 W input power.

Depth of Liquid



- Note: For SAR testing, the depth is 15cm shown above





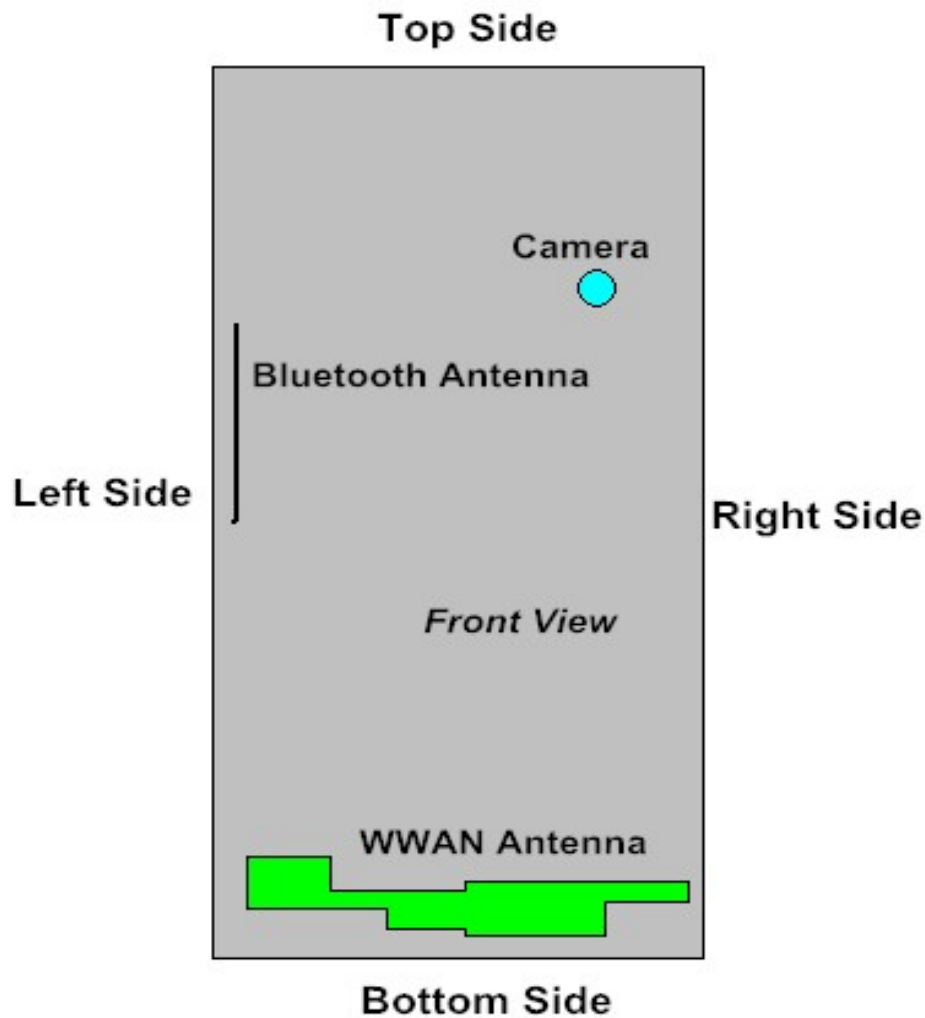
## SYSTEM PERFORMANCE CHECK RESULTS

Liquid Type	Ambient Temp. (°C)	Liquid Temp. (°C)	Input Power (W)	Measured SAR <sub>1g</sub> (W/Kg)	1W Target SAR <sub>1g</sub> (W/Kg)	1W Normalized SAR <sub>1g</sub> (W/Kg)	Deviation (%)	Limited (%)	Date
Head835	22.9	21.5	0.25	2.38	9.50	9.52	0.21	± 10	2014-1-11
Body835	22.9	21.5	0.25	2.34	9.53	9.36	-1.78	± 10	2014-1-11
Head1900	23	21.5	0.25	9.96	40.40	39.84	-1.39	± 10	2014-1-12
Body1900	23	21.5	0.25	9.81	40.50	39.24	-3.11	± 10	2014-1-12





## 10.4 SAR TEST CONFIGURATIONS



Device dimensions (H x W x D): 110 x 45 x 15 mm

Antennas	Wireless Interface
WWAN antenna	GSM850 GSM1900
Bluetooth antenna	Bluetooth

**Test Mode**

GSM 850/PCS1900	Voice mode(GSM)
-----------------	-----------------

**Head Exposure Condition for WWAN**

Test Configurations	SAR required	Note
Right Cheek	Yes	N/A
Right Tilted	Yes	N/A
Left Cheek	Yes	N/A
Left Tilted	Yes	N/A

**Body Exposure Condition for WWAN**

Test Configurations	Antenna-to-edge	SAR required	Note
Front	10mm	Yes	N/A
Rear	5mm	Yes	N/A



## 10.5 EUT TUNE-UP PROCEDURES AND TEST MODE

The following procedure had been used to prepare the EUT for the SAR test.

To setup the desire channel frequency and the maximum output power. A Radio Communication Tester "CMU200 " was used to program the EUT.

### GSM 850

Network Support: GSM only

Main Service: Circuit Switched/Packet data

Power Setting: 33dBm/33dBm

### GSM 1900

Network Support: GSM only

Main Service: Circuit Switched/Packet data

Power Setting: 30dBm/30dBm

### GSM Conducted output power(dBm):

Band	GSM 850			GSM 1900		
Channel	128	190	251	512	661	810
Frequency(MHz)	824.2	836.6	848.8	1850.2	1880	1909.8
Maximum Burst-Averaged Output Power						
GSM(GMSK,1Uplink)	31.52	<b>31.86</b>	31.21	28.33	<b>28.62</b>	28.45
Maximum Frame-Averaged Output Power						
GSM(GMSK,1Uplink)	22.49	22.83	22.18	19.30	19.59	19.42

**Remark:** The frame-averaged power is linearly scaled the maximum burst-averaged power based on time slots. The calculated methods are shown as below:

Frame-averaged power = Burst-averaged power (1 Uplink) – 9.03 dBm

Frame-averaged power = Burst averaged power (2 Uplink) – 6.02 dBm

Frame-averaged power = Burst-averaged power (3 Uplink) – 4.26 dBm

Frame-averaged power = Burst averaged power (4 Uplink) – 3.01 dBm

**Note:** Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.



## Bluetooth Conducted output power(dBm)

CH	Frequency	Average power(dBm)		
		Data Rate		
		1Mbps	2Mbps	3Mbps
CH00	2402MHZ	1.68	0.95	1.22
CH39	2441MHZ	1.52	0.82	1.08
CH78	2480MHZ	1.55	0.85	1.12

According to KDB447498 D01:The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f_{\text{(GHz)}}}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR,<sup>24</sup> where

- $f_{\text{(GHz)}}$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation<sup>25</sup>
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below
- If the test separation distance (antenna-user) is < 5mm, 5mm is used for excluded SAR calculation

	Wireless Interface	Bluetooth
	Tune-up Maximum power (dBm)	2
	Tune-up Maximum rated power (mW)	1.585
Head	Antenna to user (mm)	5
	Frequency(GHz)	2.402
	Test result	0.491
	SAR exclusion threshold	3
Body	Antenna to user (mm)	15
	Frequency(GHz)	2.402
	Test result	0.164
	SAR exclusion threshold	3

Per KDB 447498 D01v05r01 exclusion thresholds is  $0.491 < 3$ , RF exposure evaluation is not required.  
**So Bluetooth SAR test is not required.**



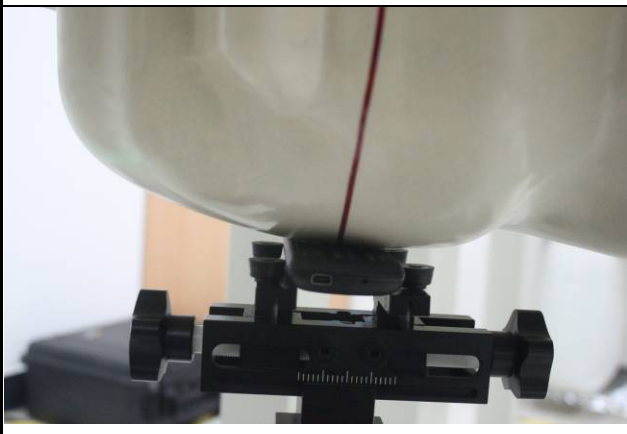
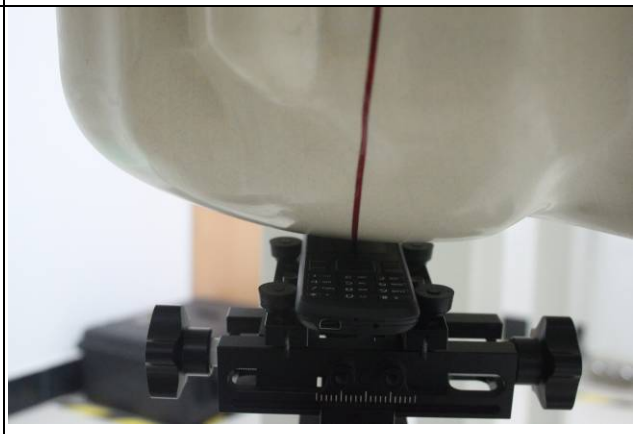
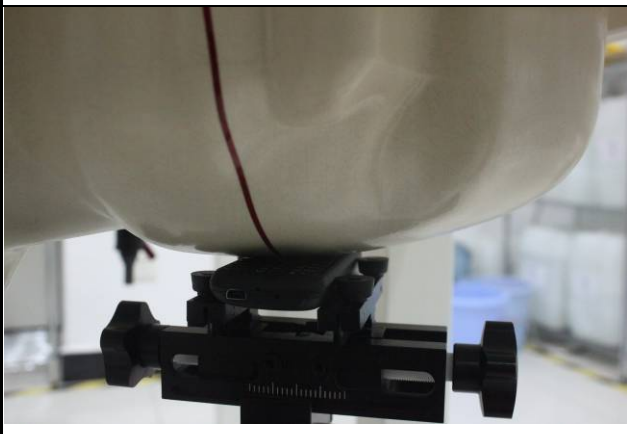
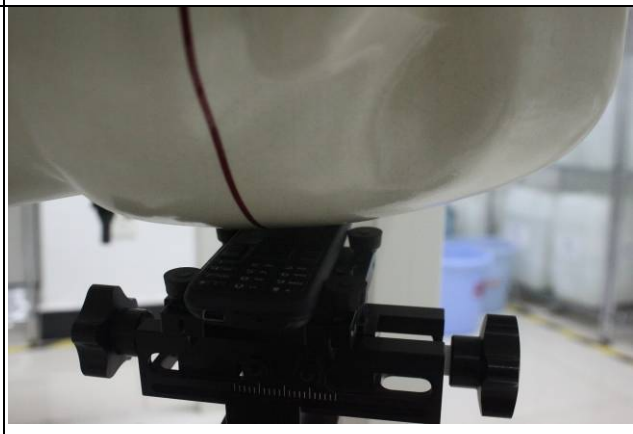
## EUT Tune-up Procedures

Mode	The Tune-up Maximum Power(Customer Declared)(dBm)	Range	Measured Conduct Maximum Power(dBm)
GSM 850	32 +/-1	31~33	31.86
GSM 1900	28+/-1	27~29	28.62
Bluetooth 1 Mbps	1+/-1	0~2	1.68
Bluetooth 2 Mbps	1+/-1	0~2	0.95
Bluetooth 3 Mbps	1+/-1	0~2	1.22

So, they are in tune-up range and complied.



## 10.6 EUT SETUP PHOTOS

Cheek device with right head phantom.	Tilt device with right head phantom
	
<u><b>EUT Setup Configuration 1</b></u>	<u><b>EUT Setup Configuration 2</b></u>
Cheek device with left head phantom.	Tilt device with left head phantom
	
<u><b>EUT Setup Configuration 3</b></u>	<u><b>EUT Setup Configuration 4</b></u>



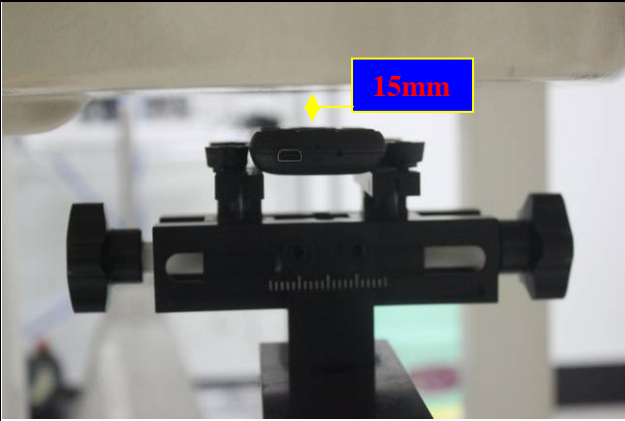
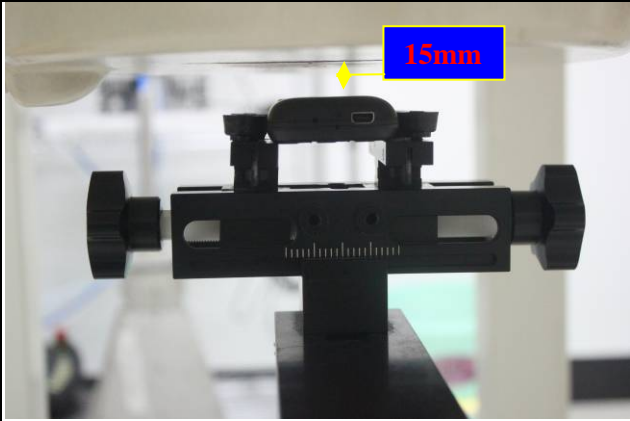
## 10.7 SAR MEASUREMENT RESULTS

### Head SAR Test Records

#### GSM SAR

Band	Mode	Test Position	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Report SAR1g (mW/g)
<b>GSM850</b>	<b>GSM</b>	<b>Right Cheek</b>	<b>190</b>	<b>836.6</b>	<b>31.86</b>	<b>33</b>	<b>1.300</b>	<b>-0.04</b>	<b>0.597</b>	<b>0.776</b>
GSM850	GSM	Right Tilted	190	836.6	31.86	33	1.300	-0.10	0.318	0.413
GSM850	GSM	Left Cheek	190	836.6	31.86	33	1.300	0.16	0.575	0.748
GSM850	GSM	Left Tilted	190	836.6	31.86	33	1.300	0.00	0.307	0.399
<b>GSM1900</b>	<b>GSM</b>	<b>Right Cheek</b>	<b>661</b>	<b>1880</b>	<b>28.62</b>	<b>29</b>	<b>1.091</b>	<b>0.11</b>	<b>0.510</b>	<b>0.557</b>
GSM1900	GSM	Right Tilted	661	1880	28.62	29	1.091	0.01	0.321	0.350
GSM1900	GSM	Left Cheek	661	1880	28.62	29	1.091	0.05	0.492	0.537
GSM1900	GSM	Left Tilted	661	1880	28.62	29	1.091	0.04	0.272	0.297



Front view body position	Rear View in body position
	
<b><u>EUT Setup Configuration 5</u></b>	<b><u>EUT Setup Configuration 6</u></b>





## Body Worn SAR Test Records

### GSM SAR

Band	Mode	Test Position	Dist. (mm)	Ch.	Freq. (MHZ)	max Power (dBm)	Turn-Up Limit (dBm)	Scaling Factor	Power Drift (dB)	SAR1g (mW/g)	Scaled SAR1g (mW/g)
GSM850	GSM	Front	15	190	836.6	31.86	33	1.300	-0.08	0.407	0.529
<b>GSM850</b>	<b>GSM</b>	<b>Rear</b>	<b>15</b>	<b>190</b>	<b>836.6</b>	<b>31.86</b>	<b>33</b>	<b>1.300</b>	<b>0.01</b>	<b>0.449</b>	<b>0.584</b>
GSM1900	GSM	Front	15	661	1880	28.62	29	1.091	0.06	0.224	0.244
<b>GSM1900</b>	<b>GSM</b>	<b>Rear</b>	<b>15</b>	<b>661</b>	<b>1880</b>	<b>28.62</b>	<b>29</b>	<b>1.091</b>	<b>0.13</b>	<b>0.374</b>	<b>0.408</b>

### SAR Measurement Variability

According to KDB 865664 D01 v01r01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are  $\leq 1.45$  W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is  $\leq 1.10$ , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR repeated measurement procedure:

1. When the highest measured SAR is  $< 0.80$  W/kg, repeated measurement is not required.
2. When the highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
3. If the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$ , or when the original or repeated measurement is  $\geq 1.45$  W/kg, perform a second repeated measurement.
4. If the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ , and the original, first or second repeated measurement is  $\geq 1.5$  W/kg, perform a third repeated measurement.



## 10.8 SAR HANDSETS MULTI XMITER ASSESSMENT

	Position	Applicable Combination
Simultaneous Transmission	Head	WWAN (voice) + BT
	Body-worn	WWAN + BT

**Note:**

- 2.4GHz WLAN and BT share the same antenna, and cannot transmit simultaneously.
- The reported SAR summation is calculated based on the same configuration and test position.
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05 based on the formula below.  
$$(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})/x}] \text{ W/kg}$$
for test separation distances  $\leq 50$  mm; where  $x = 7.5$  for 1-g SAR, and  $x = 18.75$  for 10-g SAR.  
0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is  $> 50$  mm.

	Max power	Head (5mm distance)	Body (15mm distance)
Estimated SAR (W/kg)	2dBm	0.066W/kg	0.022 W/kg

- Per KDB 447498 D01v05, simultaneous transmission SAR is compliant if,
  - Scalar SAR summation  $< 1.6\text{W/kg}$ .
  - $\text{SPLSR} = (\text{SAR1} + \text{SAR2})^{1.5} / (\text{min. separation distance, mm})$ , and the peak separation distance is determined from the square root of  $[(x1-x2)^2 + (y1-y2)^2 + (z1-z2)^2]$ , where  $(x1, y1, z1)$  and  $(x2, y2, z2)$  are the coordinates of the extrapolated peak SAR locations in the zoom scan  
If  $\text{SPLSR} \leq 0.04$ , simultaneously transmission SAR is compliant
  - Simultaneously transmission SAR measurement, and the reported multi-band SAR  $< 1.6\text{W/kg}$

**Result of SUM  $\Sigma$ SAR<sub>1g</sub> of Head**

SUM $\Sigma$ SAR <sub>1g</sub> (GSM850+ Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	GSM850	Bluetooth	WWAN + Bluetooth
Right Cheek	0	0.776	0.066	0.842
Right Tilted	0	0.413	0.066	0.479
Left Cheek	0	0.748	0.066	0.814
Left Tilted	0	0.399	0.066	0.465

SUM $\Sigma$ SAR <sub>1g</sub> (PCS1900+ Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	PCS1900	Bluetooth	WWAN + Bluetooth
Right Cheek	0	0.557	0.066	0.623
Right Tilted	0	0.350	0.066	0.416
Left Cheek	0	0.537	0.066	0.603
Left Tilted	0	0.297	0.066	0.363

**Result of SUM  $\Sigma$ SAR<sub>1g</sub> of Body-worn**

SUM $\Sigma$ SAR <sub>1g</sub> (GSM850+ Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	GSM850	Bluetooth	WWAN + Bluetooth
Front	15	0.529	0.022	0.551
Rear	15	0.584	0.022	0.606

SUM $\Sigma$ SAR <sub>1g</sub> (PCS1900+ Bluetooth)				
Position	Distance	Stand alone SAR(1g) [W/kg]		SUM SAR(1g)[W/kg]
	[mm]	PCS1900	Bluetooth	WWAN + Bluetooth
Front	15	0.244	0.022	0.266
Rear	15	0.408	0.022	0.430



## 11. EUT PHOTO













**12. EQUIPMENT LIST & CALIBRATION STATUS**

Name of Equipment	Manufacturer	Type/Model	Serial Number	Last Calibration	Calibration Due
P C	HP	Core(rm)3.16G	CZCO48171H	N/A	N/A
Signal Generator	Agilent	E8257C	MY43321570	05/12/2013	05/11/2014
S-Parameter Network Analyzer	Agilent	E5071B	MY42301382	03/11/2013	03/10/2014
Wireless Communication Test Set	R&S	CMU200	SN:109525	01/23/2013	01/22/2014
Power Meter	Agilent	E4416A	GB41292714	03/16/2013	03/15/2014
Peak & Average sensor	Agilent	E9327A	CF0001	03/16/2013	03/15/2014
E-field PROBE	SPEAG	EX3DV4	3798	07/26/2013	07/25/2014
DAE	SPEAG	DEA4	1245	07/25/2013	07/24/2014
DIPOLE 835MHZ ANTENNA	SPEAG	D835V2	4d114	07/30/2013	07/29/2014
DIPOLE 1900MHZ ANTENNA	SPEAG	D1900V2	5d136	07/22/2013	07/21/2014
DUMMY PROBE	SPEAG	DP_2	SPDP2001AA	N/A	N/A
SAM PHANTOM (ELI4 v4.0)	SPEAG	QDOVA001BB	1102	N/A	N/A
Twin SAM Phantom	SPEAG	QD000P40CD	1609	N/A	N/A
ROBOT	SPEAG	TX60	F10/5E6AA1/A101	N/A	N/A
ROBOT KRC	SPEAG	CS8C	F10/5E6AA1/C101	N/A	N/A
LIQUID CALIBRATION KIT	ANTENNESSA	41/05 OCP9	00425167	N/A	N/A





## 13. FACILITIES

All measurement facilities used to collect the measurement data are located at

☒ No.10, Weiye Rd., Innovation Park, Eco & Tec. Development Part, Kunshan City, Jiangsu Province, China.

## 14. REFERENCES

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## 15. ATTACHMENTS

Exhibit	Content
1	System Performance Check Plots
2	Dipole calibration report D835V2 SN:4d114
3	Dipole calibration report D1900V2-SN:5d136
4	Probe calibration report EX3DV4 SN3798
5	DAE calibration report DEA4 SD000D04BJ SN:1245
6	SAR Test Plots



## **APPENDIX A: PLOTS OF PERFORMANCE CHECK**

The plots are showing as followings.



Test Laboratory: Compliance Certification Services Inc.

Date: 1/11/2014

**System Performance Check-Head D835****DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial:4d114**

Communication System: CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.918$  S/m;  $\epsilon_r = 41.811$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22.9°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

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

**DASY Configuration:**

- Probe: EX3DV4 - SN3798; ConvF(9.16, 9.16, 9.16); Calibrated: 7/26/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/25/2013
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- DASY52 52.8.5(1059);
- SEMCAD X Version 14.6.8 (7028)

**System Performance Check at Frequencies Low 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.48 W/kg

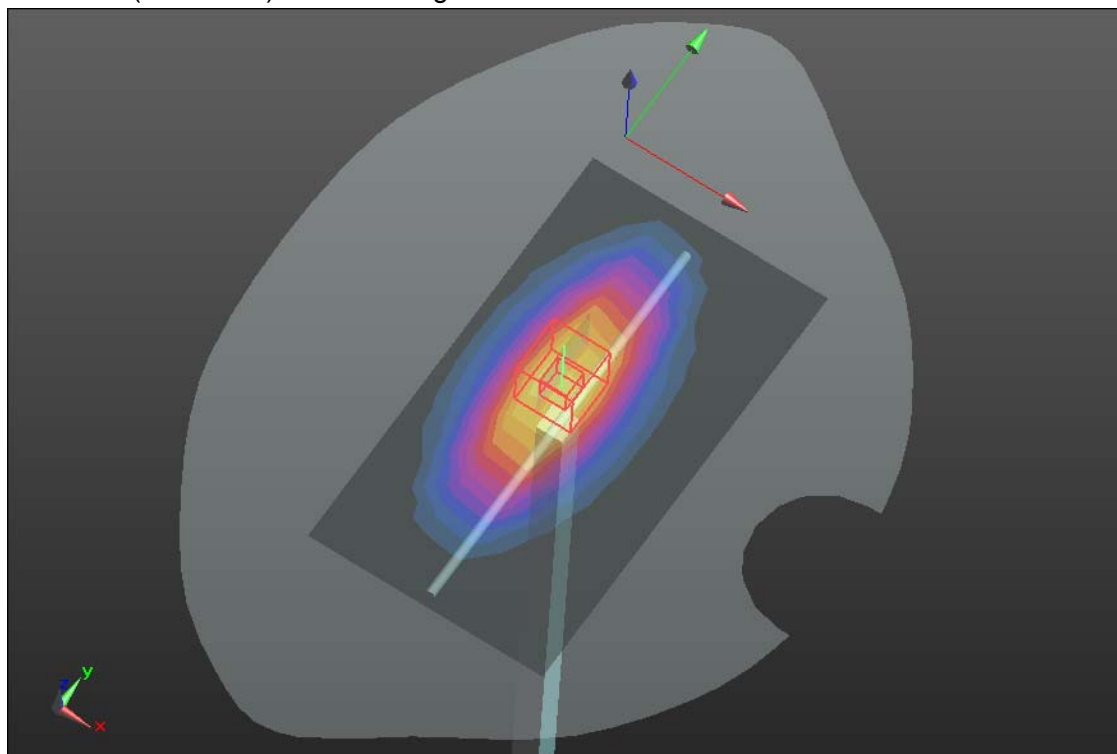
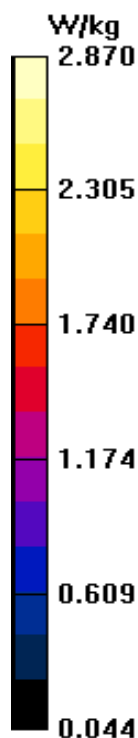
**System Performance Check at Frequencies Low 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.997 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.39 W/kg

**SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 2.870 W/kg





Test Laboratory: Compliance Certification Services Inc.

Date: 1/11/2014

**System Performance Check-Body D835****DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial:4d092**

Communication System: CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 835$  MHz;  $\sigma = 0.971$  S/m;  $\epsilon_r = 55.536$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 22.9°C; Liquid Temperature: 21.5°C

Phantom section: Flat Section

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

**DASY Configuration:**

- Probe: EX3DV4 - SN3798; ConvF(9.27, 9.27, 9.27); Calibrated: 7/26/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/25/2013
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- DASYS52 52.8.5(1059);
- SEMCAD X Version 14.6.8 (7028)

**System Performance Check at Frequencies Low 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Area Scan (7x12x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 2.97 W/kg

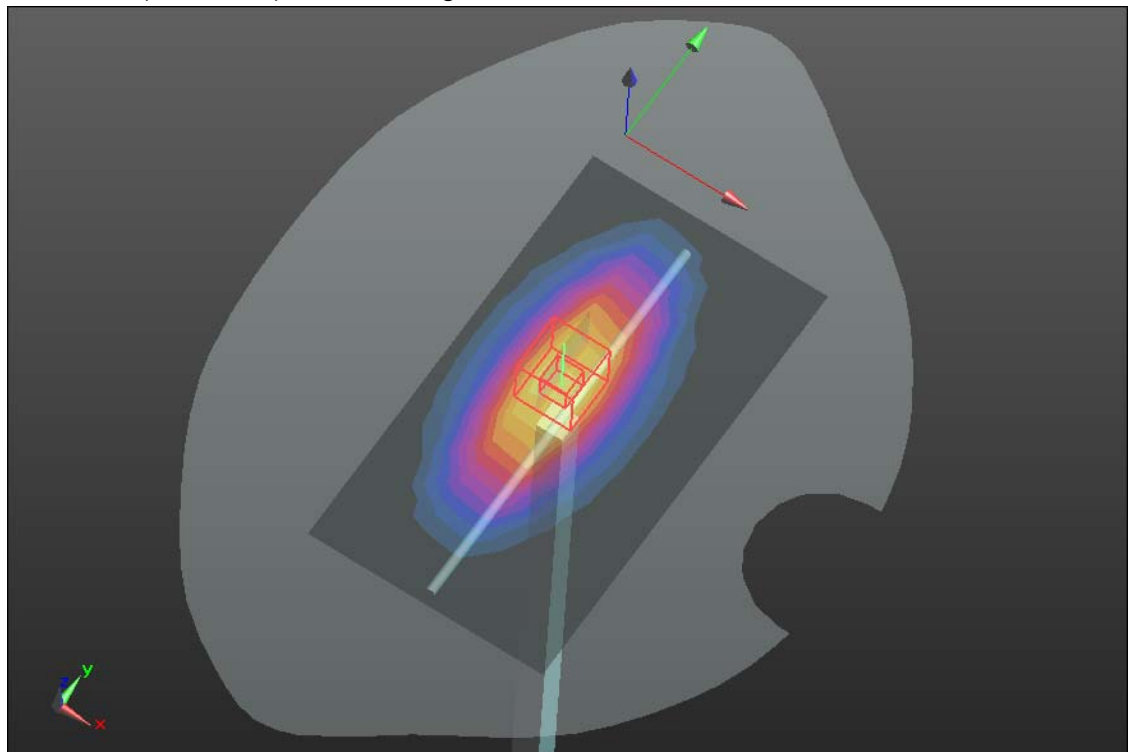
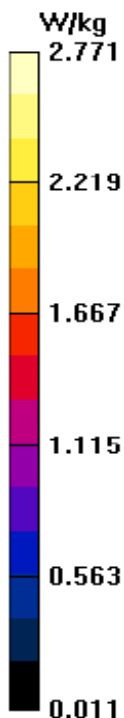
**System Performance Check at Frequencies Low 1 GHz/d=15mm, Pin=250 mW, dist=3.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 45.917 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 2.33 W/kg

**SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.56 W/kg**

Maximum value of SAR (measured) = 2.771 W/kg





Test Laboratory: Compliance Certification Services Inc.

Date: 1/12/2014

**System Performance Check-Head D1900****DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial:5d136**

Communication System: CW; Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.402$  S/m;  $\epsilon_r = 40.881$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 23°C; Liquid Temperature: 22°C

Phantom section: Flat Section

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

DASY Configuration:

- Probe: EX3DV4 - SN3798; ConvF(7.73, 7.73, 7.73); Calibrated: 7/26/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/25/2013
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- DASYS 52.8.5(1059);
- SEMCAD X Version 14.6.8 (7028)

**System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm****(EX-Probe)/Area Scan (7x7x1):** Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 13.9 W/kg

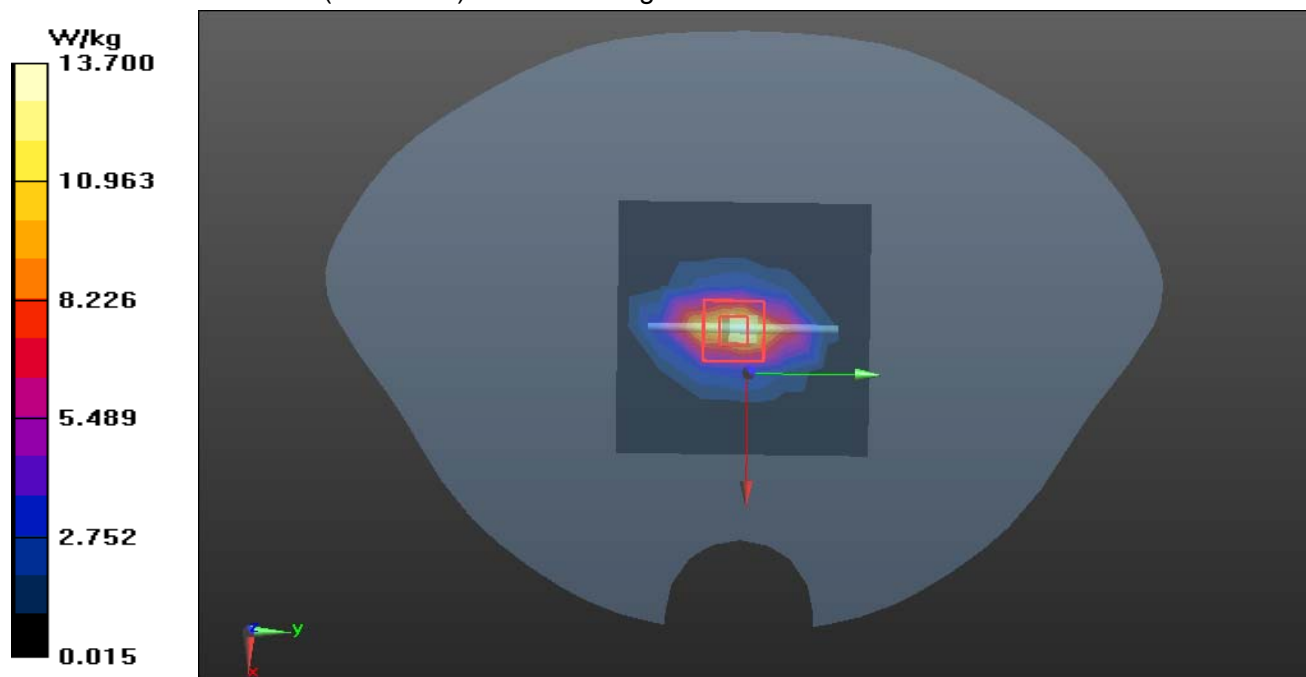
**System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm****(EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.6 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 18.3 W/kg

**SAR(1 g) = 9.96 W/kg; SAR(10 g) = 5.10 W/kg**

Maximum value of SAR (measured) = 13.700 W/kg





Test Laboratory: Compliance Certification Services Inc.

Date:1/12/2014

**System Performance Check-Body D1900****DUT: Dipole 1900 MHz ; Type: D1900V2; Serial:5d142**

Communication System: CW; Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.525$  S/m;  $\epsilon_r = 53.891$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Room Ambient Temperature: 23°C; Liquid Temperature: 22°C

Phantom section: Flat Section

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

**DASY Configuration:**

- Probe: EX3DV4 - SN3798; ConvF(7.32, 7.32, 7.32); Calibrated: 7/26/2013;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1245; Calibrated: 7/25/2013
- Phantom: Twin SAM Phantom; Type: QD 000 P40 CD; Serial: 1609
- DASY52 52.8.5(1059);
- SEMCAD X Version 14.6.8 (7028)

**System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Area Scan (7x7x1):**

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 10.9 W/kg

**System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**

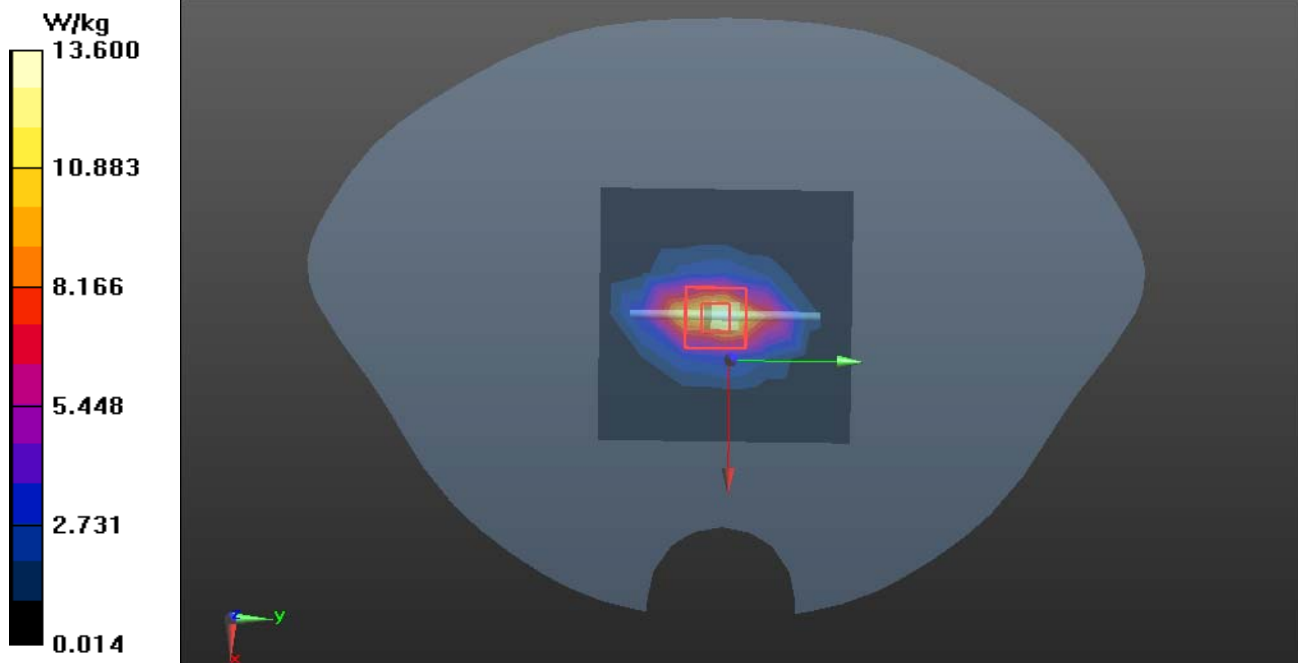
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 83.104 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 14.2 W/kg

**SAR(1 g) = 9.81 W/kg; SAR(10 g) = 4.40 W/kg**

Maximum value of SAR (measured) = 13.600 W/kg





## **APPENDIX B: DASY CALIBRATION CERTIFICATE**

The DASY Calibration Certificates are showing as followings .





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



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

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

Accreditation No.: **SCS 108**Client **CCS-CN (Auden)**Certificate No: **D835V2-4d114\_Jul13**

## CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d114**Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**Calibration date: **July 30, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

Calibrated by: **Name** Claudio Leubler **Function** Laboratory Technician

Approved by: **Name** Katja Pokovic **Technical Manager**

Signature

Issued: July 30, 2013

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



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



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

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

Accreditation No.: **SCS 108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## 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%.





## Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	41.8 $\pm$ 6 %	0.92 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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	2.41 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	9.50 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.58 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	6.24 W/kg $\pm$ 16.5 % (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	54.9 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °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	2.44 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	9.53 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.61 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	6.32 W/kg $\pm$ 16.5 % (k=2)



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.1 $\Omega$ - 1.3 j $\Omega$
Return Loss	- 32.1 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.2 $\Omega$ - 3.0 j $\Omega$
Return Loss	- 29.1 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.399 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
Manufactured on	June 29, 2010



## DASY5 Validation Report for Head TSL

Date: 30.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114**

Communication System: UID 0 - CW ; Frequency: 835 MHz

Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.92 \text{ S/m}$ ;  $\epsilon_r = 41.8$ ;  $\rho = 1000 \text{ kg/m}^3$ 

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

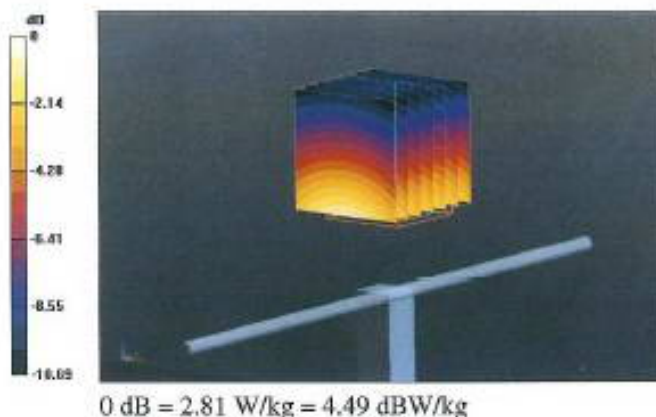
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 56.702 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 3.60 W/kg

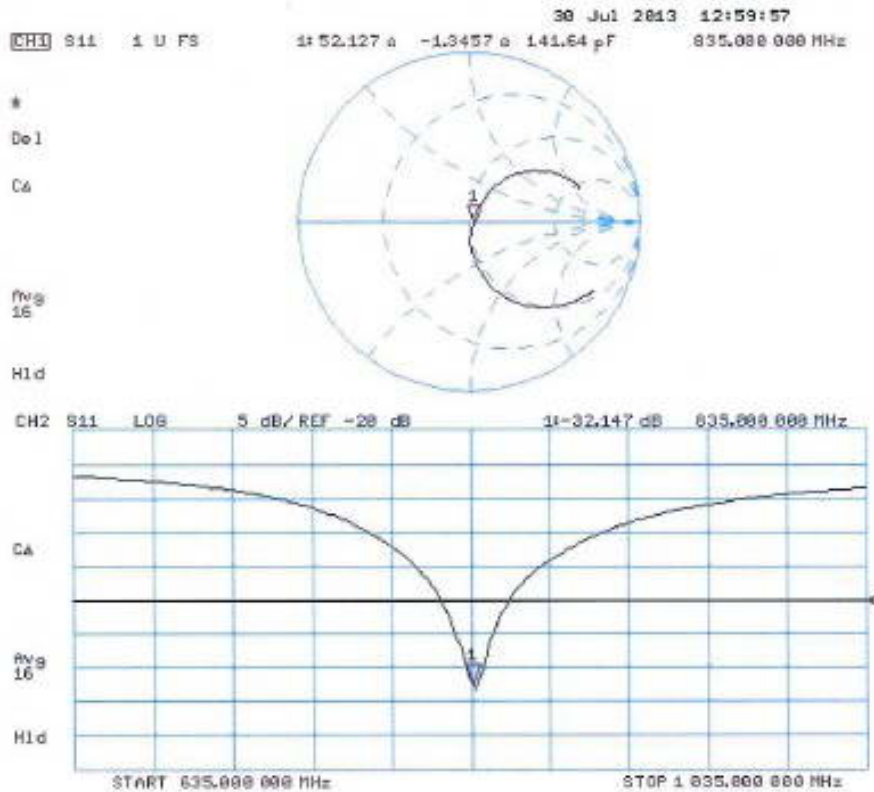
**SAR(1 g) = 2.41 W/kg; SAR(10 g) = 1.58 W/kg**

Maximum value of SAR (measured) = 2.81 W/kg





## Impedance Measurement Plot for Head TSL







## DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d114**

Communication System: UID 0 - CW ; Frequency: 835 MHz

Medium parameters used:  $f = 835$  MHz;  $\sigma = 1$  S/m;  $\epsilon_r = 54.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

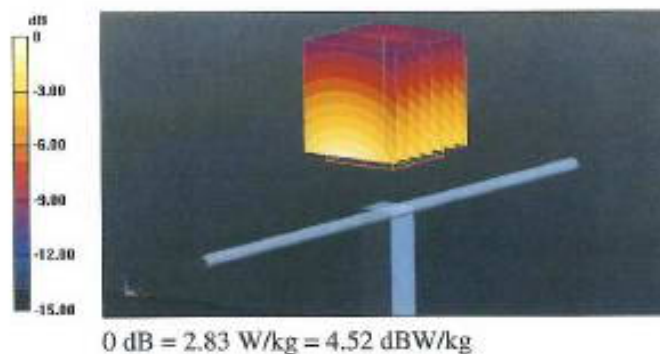
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.853 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 3.56 W/kg

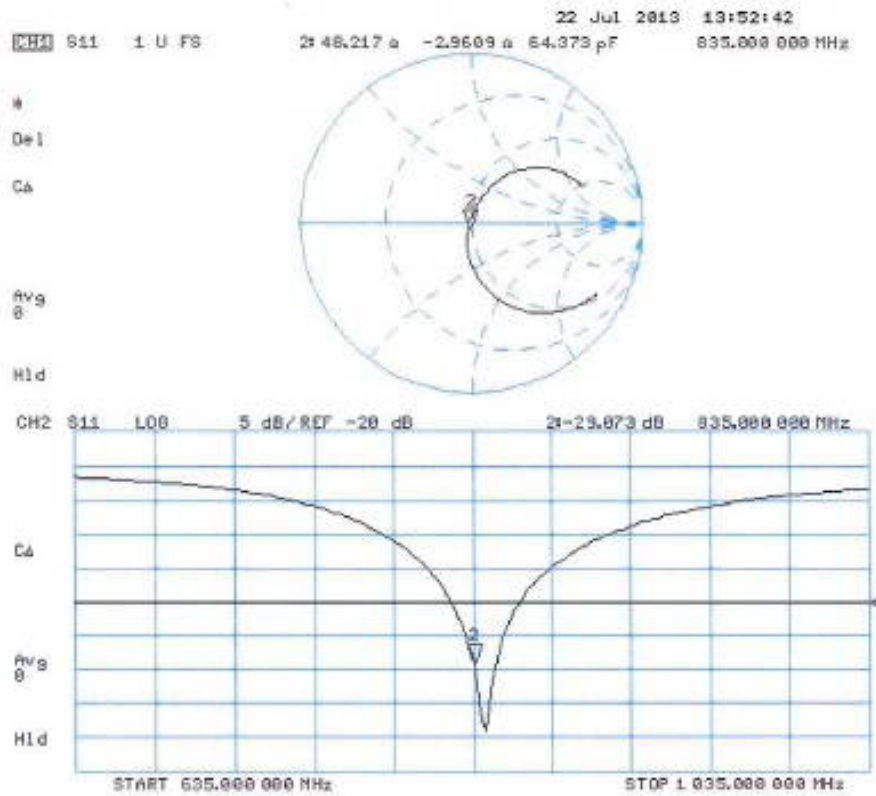
**SAR(1 g) = 2.44 W/kg; SAR(10 g) = 1.61 W/kg**

Maximum value of SAR (measured) = 2.83 W/kg





## Impedance Measurement Plot for Body TSL







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Client **CCS-CN (Auden)**Certificate No: **D1900V2-5d136\_Jul13**

## CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d136**

Calibration procedure(s) **QA CAL-05.v9**  
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **July 22, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3^\circ\text{C}$ ) and humidity < 70%.

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	QB37480704	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
Reference 20 dB Attenuator	SN: 5058 (20k)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 22, 2013

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Accreditation No.: **SCS 108**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## 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%.





## Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
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	38.9 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °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	10.0 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 W/kg $\pm$ 16.5 % (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	53.4 $\pm$ 6 %	1.49 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °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	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)



## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.9 $\Omega$ + 7.2 j $\Omega$
Return Loss	- 22.5 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.7 $\Omega$ + 7.3 j $\Omega$
Return Loss	- 22.1 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 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
Manufactured on	April 14, 2010



## DASY5 Validation Report for Head TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d136**

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.36$  S/m;  $\epsilon_r = 38.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

### Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

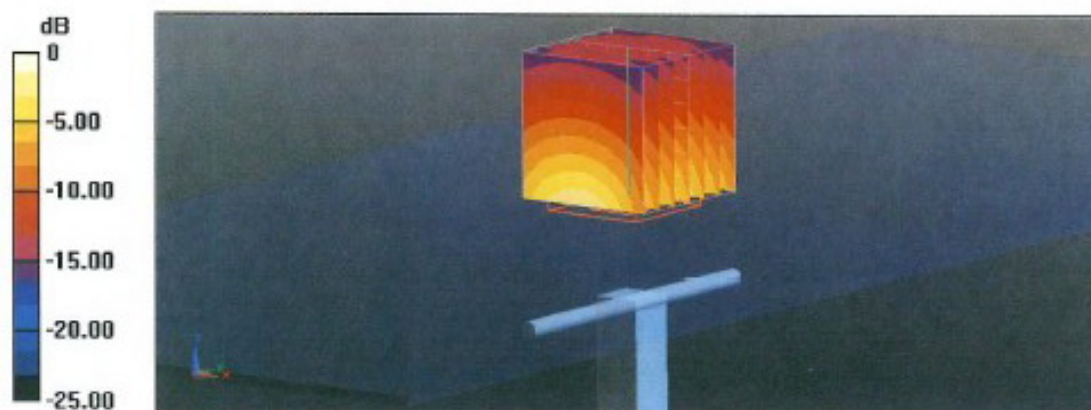
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.803 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 18.1 W/kg

**SAR(1 g) = 10 W/kg; SAR(10 g) = 5.29 W/kg**

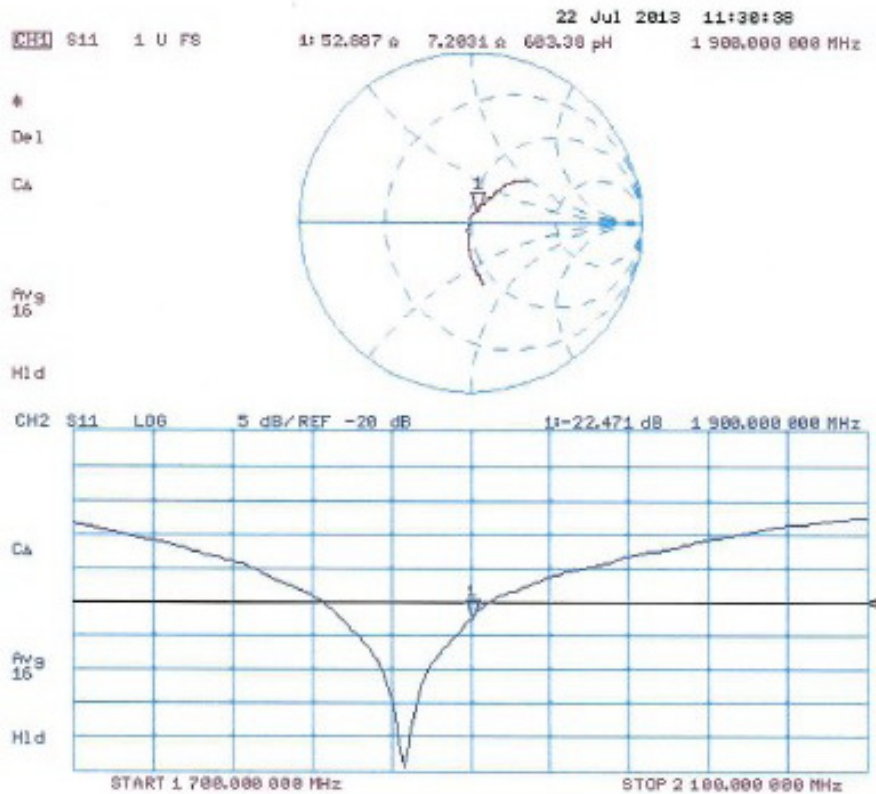
Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg



## Impedance Measurement Plot for Head TSL







## DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d136**

Communication System: UID 0 - CW ; Frequency: 1900 MHz

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.49$  S/m;  $\epsilon_r = 53.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

### DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAB4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

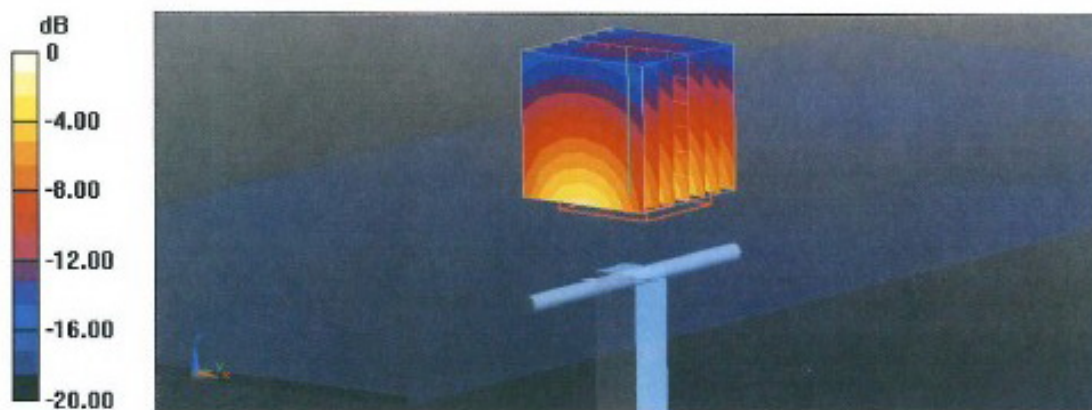
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.803 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.37 W/kg

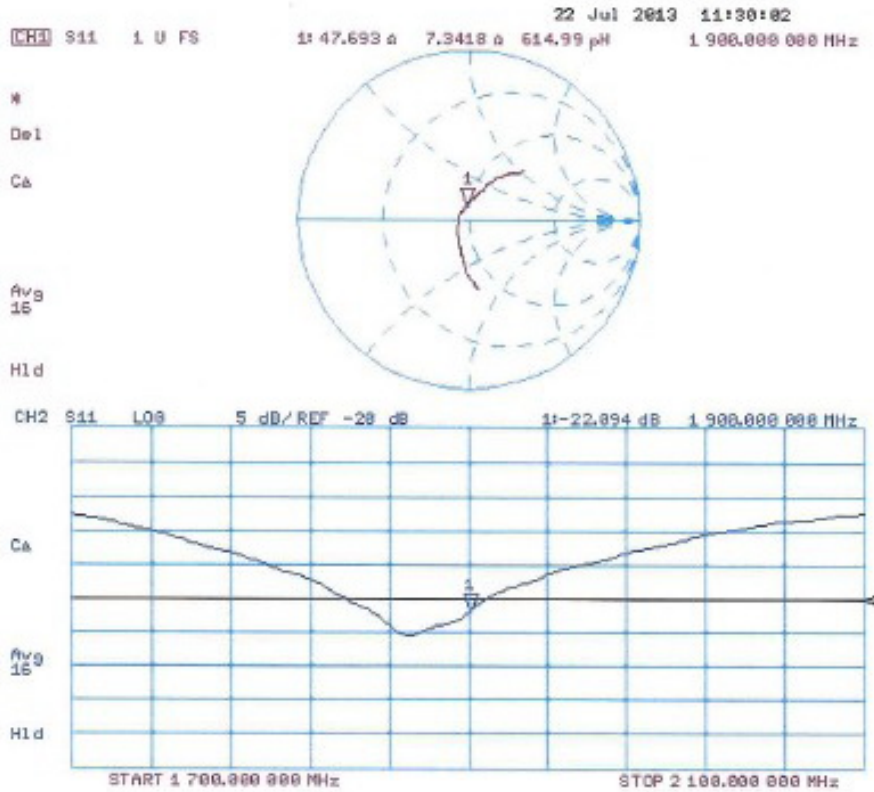
Maximum value of SAR (measured) = 12.5 W/kg



0 dB = 12.5 W/kg = 10.97 dBW/kg



## Impedance Measurement Plot for Body TSL







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**s p e a g**

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1245

## IMPORTANT NOTICE

### USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange:** The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

**Shipping of the DAE:** Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures:** Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair:** Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

#### Important Note:

**Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.**

#### Important Note:

**Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.**

#### Important Note:

**To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.**

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TN\_BR040315AD DAE4.doc

11.12.2009



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Accreditation No.: **SCS 108**Client **CCS-CN (Auden)**Certificate No: **DAE4-1245\_Jul13**

## CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1245**

Calibration procedure(s) **QA CAL-06.v26**  
**Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **July 25, 2013**

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

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

Calibration Equipment used (M&amp;TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0610278	02-Oct-12 (No:12728)	Oct-13
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Auto DAE Calibration Unit	SE UWS 053 AA 1001	07-Jan-13 (in house check)	In house check: Jan-14
Calibrator Box V2.1	SE UMS 006 AA 1002	07-Jan-13 (in house check)	In house check: Jan-14

Calibrated by:	Name Dominique Steffen	Function Technician	Signature 
Approved by:	Fin Bornhoft	Deputy Technical Manager	

Issued: July 25, 2013

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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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - **DC Voltage Measurement Linearity:** Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - **Common mode sensitivity:** Influence of a positive or negative common mode voltage on the differential measurement.
  - **Channel separation:** Influence of a voltage on the neighbor channels not subject to an input voltage.
  - **AD Converter Values with Inputs shorted:** Values on the internal AD converter corresponding to zero input voltage
  - **Input Offset Measurement:** Output voltage and statistical results over a large number of zero voltage measurements.
  - **Input Offset Current:** Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - **Input resistance:** Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - **Low Battery Alarm Voltage:** Typical value for information. Below this voltage, a battery alarm signal is generated.
  - **Power consumption:** Typical value for information. Supply currents in various operating modes.



## DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	405.940 $\pm$ 0.02% (k=2)	404.664 $\pm$ 0.02% (k=2)	405.801 $\pm$ 0.02% (k=2)
Low Range	4.00386 $\pm$ 1.50% (k=2)	3.96278 $\pm$ 1.50% (k=2)	4.02487 $\pm$ 1.50% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	30.5 $^{\circ}$ $\pm$ 1 $^{\circ}$
---	------------------------------------



## Appendix

### 1. DC Voltage Linearity

High Range	Reading ( $\mu$ V)	Difference ( $\mu$ V)	Error (%)
Channel X + Input	199992.97	-4.47	-0.00
Channel X + Input	20001.91	0.89	0.00
Channel X - Input	-19999.11	1.66	-0.01
Channel Y + Input	199994.30	-3.32	-0.00
Channel Y + Input	20001.64	0.75	0.00
Channel Y - Input	-20000.51	0.28	-0.00
Channel Z + Input	199995.90	-1.30	-0.00
Channel Z + Input	20000.30	-0.60	-0.00
Channel Z - Input	-19999.90	0.89	-0.00

Low Range	Reading ( $\mu$ V)	Difference ( $\mu$ V)	Error (%)
Channel X + Input	2001.51	0.38	0.02
Channel X + Input	201.72	0.21	0.11
Channel X - Input	-198.76	-0.28	0.14
Channel Y + Input	2000.72	-0.41	-0.02
Channel Y + Input	199.98	-1.50	-0.74
Channel Y - Input	-198.85	-0.28	0.14
Channel Z + Input	2000.21	-0.84	-0.04
Channel Z + Input	200.77	-0.56	-0.28
Channel Z - Input	-199.95	-1.29	0.65

### 2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu$ V)	Low Range Average Reading ( $\mu$ V)
Channel X	200	-8.24	-10.01
	- 200	10.27	8.63
Channel Y	200	-7.32	-7.74
	- 200	6.53	6.34
Channel Z	200	-5.94	-6.42
	- 200	5.13	4.65

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu$ V)	Channel Y ( $\mu$ V)	Channel Z ( $\mu$ V)
Channel X	200	-	4.16	-2.61
Channel Y	200	8.79	-	3.99
Channel Z	200	9.96	7.22	-



#### 4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15874	16183
Channel Y	16451	15694
Channel Z	15932	15717

#### 5. Input Offset Measurement

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

Input 10M $\Omega$ 

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	0.94	-0.24	2.04	0.48
Channel Y	-0.42	-1.91	0.54	0.47
Channel Z	-0.83	-2.62	0.57	0.60

#### 6. Input Offset Current

Nominal input circuitry offset current on all channels: &lt;25fA

#### 7. Input Resistance (Typical values for information)

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

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

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

#### 9. Power Consumption (Typical values for information)

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





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Accreditation No.: SCS 108

Client CCS-CN (Auden)

Certificate No: EX3-3798\_Jul13

## CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3798

Calibration procedure(s) QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4  
Calibration procedure for dosimetric E-field probes

Calibration date: July 26, 2013

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^{\circ}\text{C}$  and humidity  $< 70\%$ .

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	31-Jan-13 (No. DAE4-660_Jan13)	Jan-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: July 26, 2013

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Certificate No: EX3-3798\_Jul13

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## 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 $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

## Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-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 with CW signal (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>; D<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C, D 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  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values 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  $\pm 50$  MHz to  $\pm 100$  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.



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## Probe EX3DV4

### SN:3798

Manufactured: April 5, 2011  
Calibrated: July 26, 2013

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



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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup>	0.54	0.51	0.59	$\pm 10.1 \%$
DCP (mV) <sup>B</sup>	95.9	98.8	98.6	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc <sup>C</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	164.4	$\pm 3.0 \%$
		Y	0.0	0.0	1.0		168.1	
		Z	0.0	0.0	1.0		130.9	

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

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

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

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





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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>□</sup>	Relative Permittivity <sup>△</sup>	Conductivity (S/m) <sup>△</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	9.16	9.16	9.16	0.35	0.94	± 12.0 %
900	41.5	0.97	9.01	9.01	9.01	0.35	0.93	± 12.0 %
1810	40.0	1.40	7.79	7.79	7.79	0.73	0.59	± 12.0 %
1900	40.0	1.40	7.73	7.73	7.73	0.68	0.62	± 12.0 %
2000	40.0	1.40	7.73	7.73	7.73	0.80	0.58	± 12.0 %
2450	39.2	1.80	7.08	7.08	7.08	0.66	0.62	± 12.0 %
5200	36.0	4.66	4.85	4.85	4.85	0.37	1.80	± 13.1 %
5300	35.9	4.76	4.71	4.71	4.71	0.38	1.80	± 13.1 %
5500	35.6	4.96	4.76	4.76	4.76	0.36	1.80	± 13.1 %
5600	35.5	5.07	4.51	4.51	4.51	0.42	1.80	± 13.1 %
5800	35.3	5.27	4.48	4.48	4.48	0.40	1.80	± 13.1 %

<sup>□</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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



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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

### 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	Depth (mm)	Unct. (k=2)
835	55.2	0.97	9.27	9.27	9.27	0.49	0.84	± 12.0 %
900	55.0	1.05	9.11	9.11	9.11	0.80	0.62	± 12.0 %
1810	53.3	1.52	7.45	7.45	7.45	0.37	0.88	± 12.0 %
1900	53.3	1.52	7.32	7.32	7.32	0.37	0.86	± 12.0 %
2000	53.3	1.52	7.54	7.54	7.54	0.29	1.01	± 12.0 %
2450	52.7	1.95	7.08	7.08	7.08	0.80	0.57	± 12.0 %
5200	49.0	5.30	4.38	4.38	4.38	0.41	1.90	± 13.1 %
5300	48.9	5.42	4.22	4.22	4.22	0.41	1.90	± 13.1 %
5500	48.6	5.65	3.93	3.93	3.93	0.46	1.90	± 13.1 %
5600	48.5	5.77	3.92	3.92	3.92	0.38	1.90	± 13.1 %
5800	48.2	6.00	4.24	4.24	4.24	0.46	1.90	± 13.1 %

<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

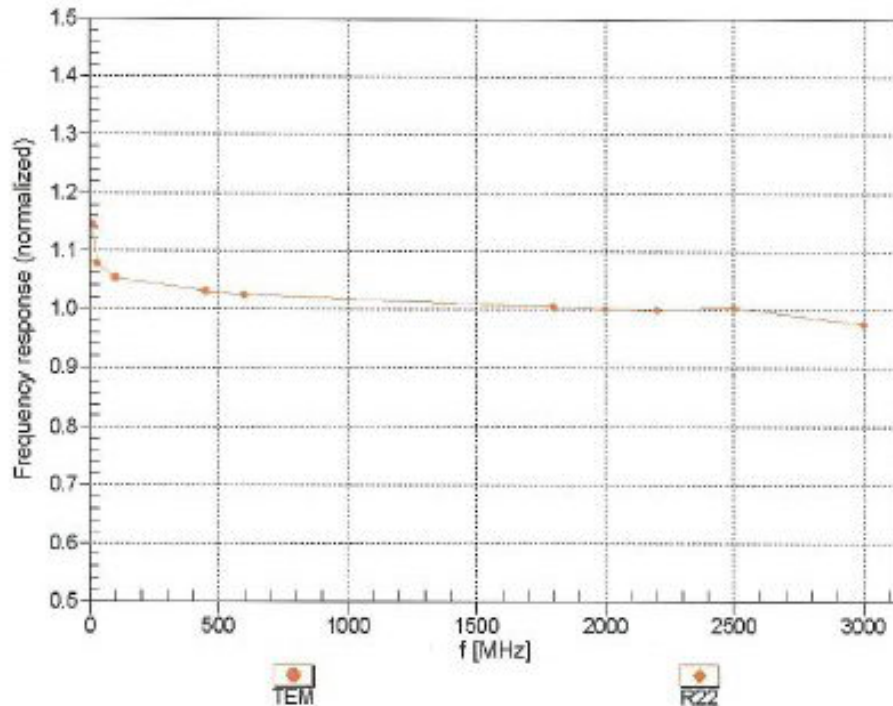




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## Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

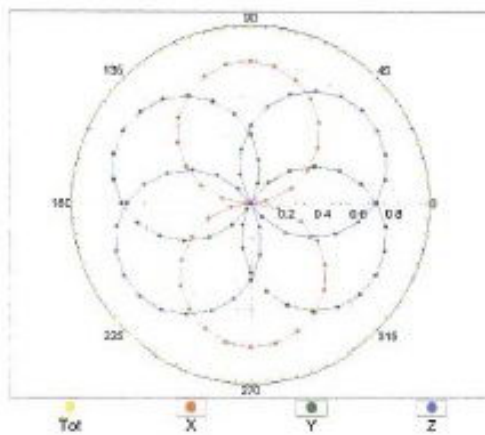


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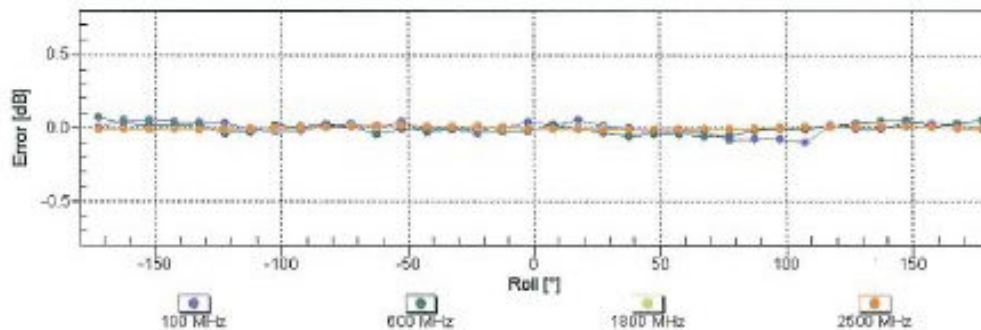
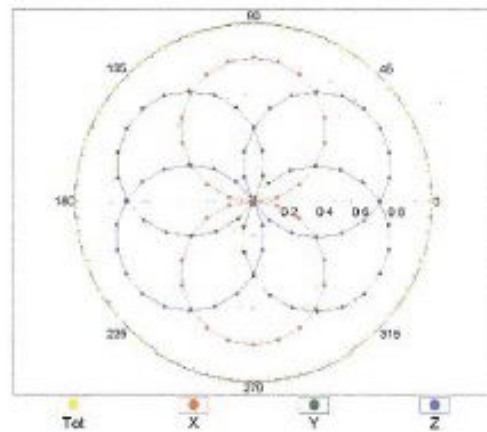
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## Receiving Pattern ( $\phi$ ), $\theta = 0^\circ$

f=600 MHz,TEM



f=1800 MHz,R22



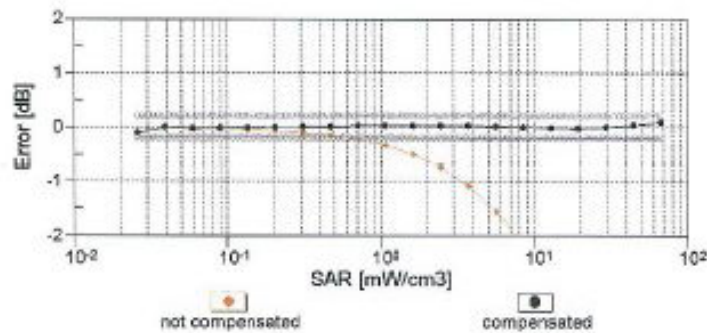
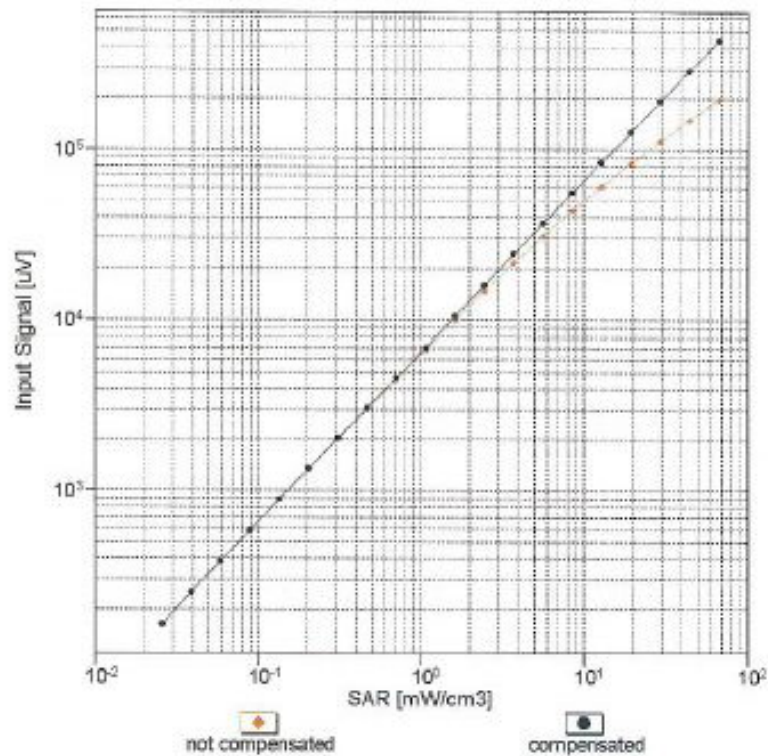
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)



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## Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell , $f = 900 \text{ MHz}$ )



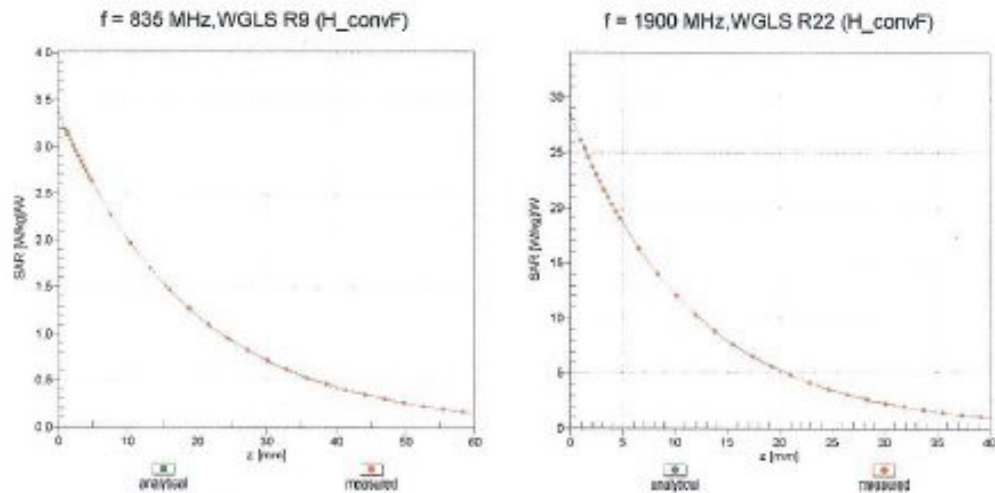
Uncertainty of Linearity Assessment:  $\pm 0.6\%$  ( $k=2$ )



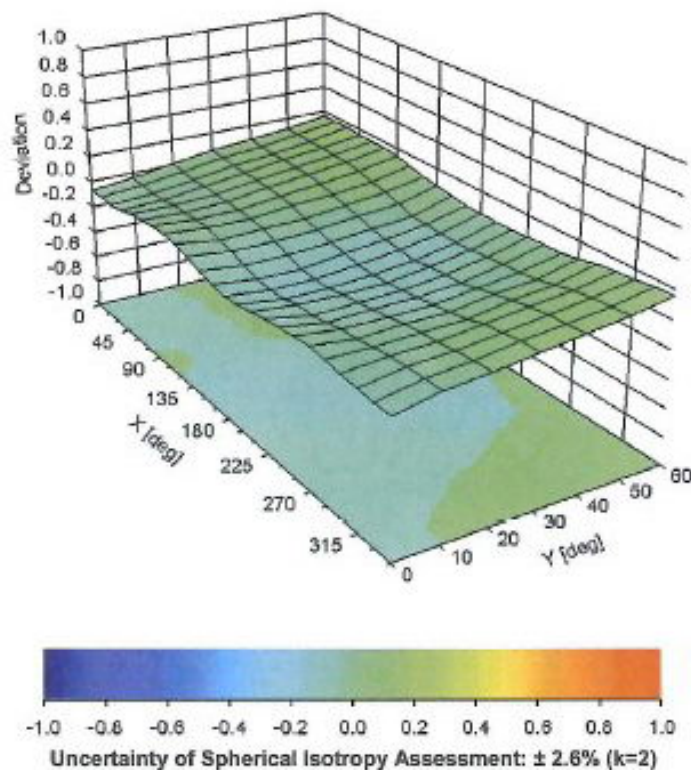
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## Conversion Factor Assessment



## Deviation from Isotropy in Liquid Error ( $\phi$ , $\theta$ ), f = 900 MHz





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## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3798

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-42.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm





## **APPENDIX C: PLOTS OF SAR TEST RESULT**

The plots are showing in the file named Appendix C Plots of SAR Test Result

**END REPORT**