

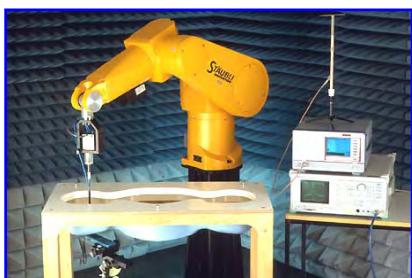
# A Test Lab Techno Corp.

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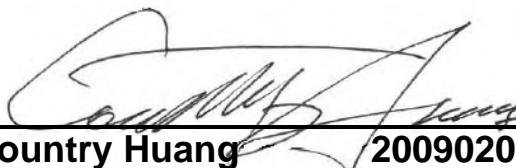


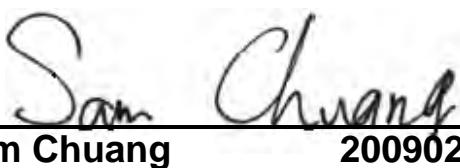
## SAR EVALUATION REPORT

<b>Test Report No.</b>	: 0812FS11-03
<b>Applicant</b>	: Binatone Electronics International Limited.
<b>EUT Type</b>	: 1.9GHz DECT 6.0 Handset
<b>FCC ID</b>	: VLJ80-6997-01
<b>Trade Name</b>	: Motorola
<b>Model Name</b>	: L401(Model list see Section 1)
<b>Battery Type</b>	: Ni-MH Battery (2.4V , 550mAh)
<b>Dates of Test</b>	: Dec. 01 ~ 02, 2008
<b>Test Environment</b>	: Ambient Temperature : 22 ± 2 °C Relative Humidity : 40 - 70 %
<b>Test Specification</b>	: Standard C95.1-1999 IEEE Std. 1528-2003 2.1093;FCC/OET Bulletin 65 Supplement C [July 2001]
<b>Max. SAR</b>	: 0.029 W/kg UPCS Head SAR 0.026 W/kg UPCS Body SAR
<b>Test Lab</b>	: Changan Lab



1. The test operations have to be performed with cautious behavior, the test results are as attached.
2. The test results are under chamber environment of A Test Lab Techno Corp. A Test Lab Techno Corp. does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples.
3. The measurement report has to be written approval of A Test Lab Techno Corp. It may only be reproduced or published in full.

  
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## 1. **Description of Equipment Under Test (EUT)**

**Applicant :**

**Binatone Electronics International Limited.**

**Floor 23A, 9 Des Voeux Road West, Sheung Wan, Hong Kong**

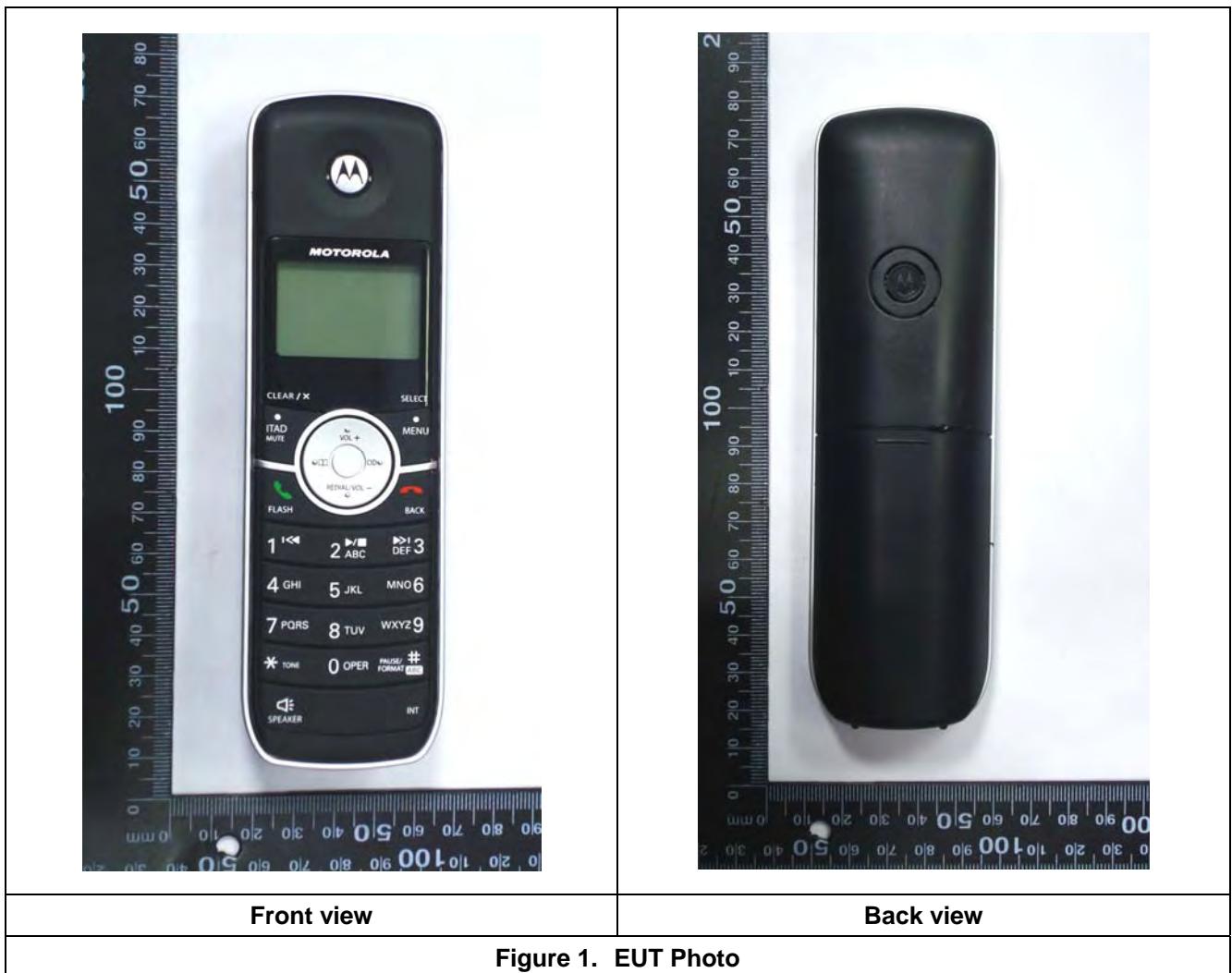
<b>Manufacturer</b>	: Dongguan VTech Electronics Telecommunication Industries
<b>Manufacturer Address</b>	: VTech Science Park, Xia Ling Bei Management Zone, Liaobu, Dongguan, Guangdong, China.
<b>EUT Type</b>	: 1.9GHz DECT 6.0 Handset
<b>FCC ID</b>	: VLJ80-6997-01
<b>Trade Name</b>	: Motorola
<b>Model Name</b>	: L401(Model list see Section 1)
<b>Battery Type</b>	: Ni-MH Battery (2.4V , 550mAh )
<b>Test Device</b>	: Production Unit
<b>Tx Frequency</b>	: 1921.536 -1928.448 MHz ( UPSCS )
<b>Max. RF Conducted Power</b>	: 0.091 W (19.59dBm ) UPSCS
<b>Max. SAR Measurement</b>	: 0.029 W/kg UPSCS Head SAR 0.026 W/kg UPSCS Body SAR
<b>HW Version</b>	: NA
<b>SW Version</b>	: NA
<b>Antenna Type</b>	: Fixed Type
<b>Antenna Gain</b>	: 0dBi
<b>Device Category</b>	: Portable
<b>RF Exposure Environment</b>	: General Population / Uncontrolled
<b>Battery Option</b>	: Standard
<b>Application Type</b>	: Certification

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general population exposure limits specified in Standard C95.1-1999 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.



### Model Name List

Trade Name	Model Name
	L301
	L302
	L303
	L304
	L305
	L30x
	L3
	L401
	L402
Motorola	L403
	L404
	L405
	L40x
	L4
	L402C
	L403C
	L404C
	L405C
	L40xC



## 2. Other Accessories



Figure 2. Battery (Ni-MH 2.4V , 550mAh)



Figure 3. Base



Figure 4. AC Adapter for Base



### **3. Introduction**

The A Test Lab Techno Corp. has performed measurements of the maximum potential exposure to the user of **Binatone Electronics International Limited. Trade Name : Motorola Model(s) : L401(Model list see Section 1)**. The test procedures, as described in American National Standards, Institute C95.1 - 1999 [ 1 ] , FCC/OET Bulletin 65 Supplement C [July 2001] were employed and they specify the maximum exposure limit of 1.6mW/g as averaged over any 1 gram of tissue for portable devices being used within 20cm between user and EUT in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

#### 4. SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dw) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density ( $\rho$ ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Table 1).

$$\text{SAR} = \frac{d}{dt} \left( \frac{dw}{dm} \right) = \frac{d}{dt} \left( \frac{dw}{\rho dv} \right)$$

**Table 1. SAR Mathematical Equation**

**SAR is expressed in units of Watts per kilogram (W/kg)**

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

Where :

$\sigma$  = conductivity of the tissue (S/m)

$\rho$  = mass density of the tissue (kg/m<sup>3</sup>)

$E$  = RMS electric field strength (V/m)

\*Note :

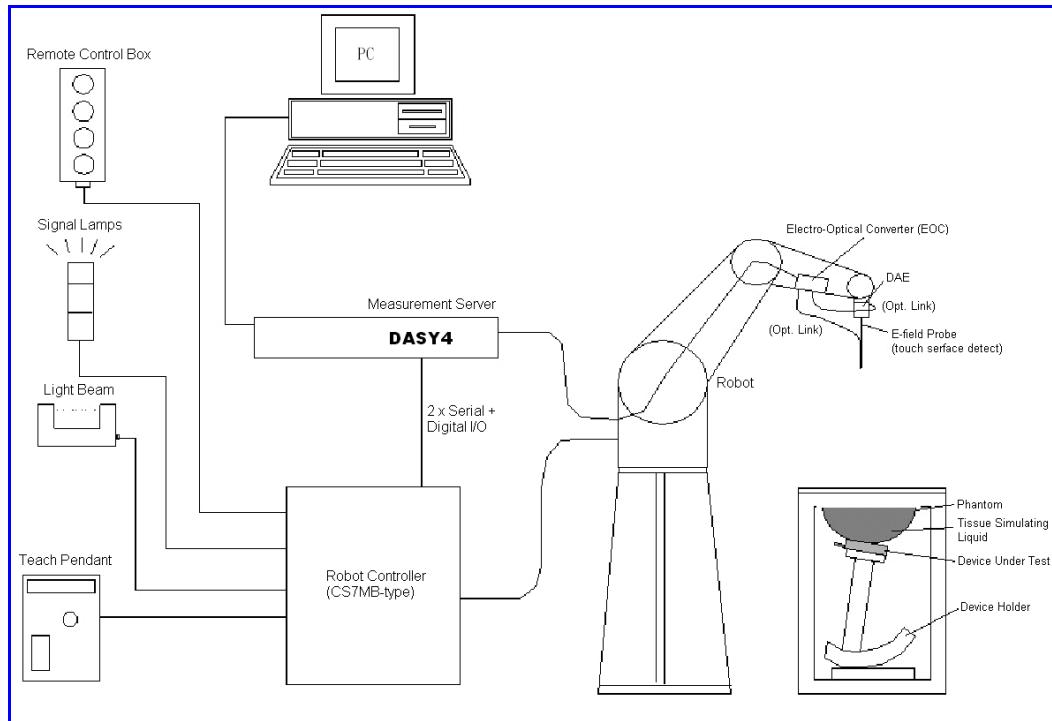
The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane [ 2 ]



## 5. **SAR Measurement Setup**

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than  $\pm 0.025\text{mm}$ . 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 (length = 300mm) to the data acquisition unit.

A cell controller system contains the power supply, robot controller, teaches pendant (Joystick) and remote control, and is used to drive the robot motors. The Measurement Server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chipdisk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board. The PC consists of the Intel Pentium 4 2.4GHz computer with Windows XP system and SAR Measurement Software DASY4, Post Processor SEMCAD, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection...etc. is connected to the Electro-optical converter (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the Measurement Server.



**Figure 5. SAR Lab Test Measurement Setup**

The DAE4 (or DAE3) 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 PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [ 3 ] .



## **6. System Components**

### **6.1 DASY4 E-Field Probe System**

The SAR measurements were conducted with the dosimetric probe ES3DV3 or ET3DV6 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

### 6.1.1 E-Field Probe Specification

<b>Construction</b>	Symmetrical design with triangular core Built-in optical fiber for surface detection System Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.q., glycol)
<b>Calibration</b>	In air from 10 MHz to 6 GHz In brain and muscle simulating tissue at frequencies of 450MHz, 900MHz, 1800MHz, 1950MHz, 2000MHz and 2450MHz (accuracy $\pm 8\%$ ) Calibration for other liquids and frequencies upon request
<b>Frequency</b>	10 MHz to $> 6$ GHz; Linearity: $\pm 0.2$ dB (30 MHz to 3 GHz)
<b>Directivity</b>	$\pm 0.3$ dB in brain tissue (rotation around probe axis) $\pm 0.5$ dB in brain tissue (rotation normal probe axis)
<b>Dynamic Range</b>	10 $\mu$ W/g to $> 100$ mW/g; Linearity: $\pm 0.2$ dB
<b>Surface Detection</b>	$\pm 0.2$ mm repeatability in air and clear liquids over diffuse reflecting surface(ET3DV6 only)
<b>Dimensions</b>	Overall length: 330mm Tip length: 20mm Body diameter: 12mm Tip diameter: 2.5mm Distance from probe tip to dipole centers: 1.0mm
<b>Application</b>	General dosimetry up to 6GHz Compliance tests of mobile phones Fast automatic scanning in arbitrary phantoms



**Figure 6.**  
**E-field Probe**



**Figure 7.**  
**Probe setup on robot**



### 6.1.2 E-Field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure described in [ 4 ] with accuracy better than  $\pm 10\%$ . The spherical isotropy was evaluated with the procedure described in [ 5 ] and found to be better than  $\pm 0.25\text{dB}$ . The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

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

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

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

Where :

$\Delta t$  = Exposure time (30 seconds),

$C$  = Heat capacity of tissue (head or body),

$\Delta T$  = Temperature increase due to RF exposure.

Or

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

Where :

$\sigma$  = Simulated tissue conductivity,

$\rho$  = Tissue density ( $\text{kg}/\text{m}^3$ ).



## 6.2 Data Acquisition Electronic (DAE) System

### Cell Controller

Processor : Intel Pentium 4  
Clock Speed : 2.4GHz  
Operating System : Windows XP Professional

### Data Converter

Features : Signal Amplifier, multiplexer, A/D converter, and control logic  
Software : DASY4 v4.7 (Build 71) & SEMCAD X Version 1.8 Build 184  
Connecting Lines : Optical downlink for data and status info  
Optical uplink for commands and clock

## 6.3 Robot

Positioner : Stäubli Unimation Corp. Robot Model: RX90L  
Repeatability :  $\pm 0.025$  mm  
No. of Axis : 6

## 6.4 Measurement Server

Processor : PC/104 with a 166MHz low-power Pentium  
I/O-board : Link to DAE4 (or DAE3)  
16-bit A/D converter for surface detection system  
Digital I/O interface  
Serial link to robot  
Direct emergency stop output for robot

## 6.5 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeat ably positioned according to the IEEE SCC34-SC2 and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

**\*Note :** A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations [ 6 ] . To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Larger DUT cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values. Therefore those devices are normally only tested at the flat part of the SAM.

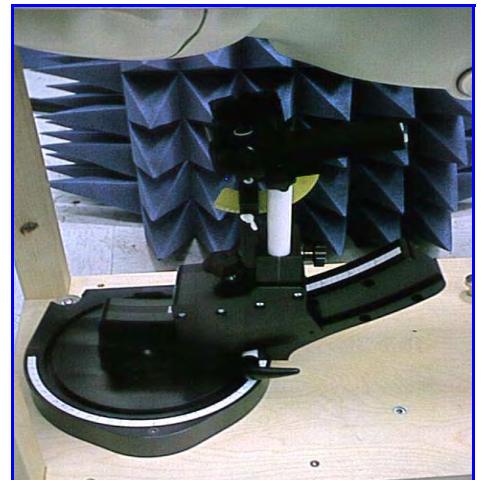


Figure 8. Device Holder

## 6.6 Phantom - SAM v4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, CENELEC 50361 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.

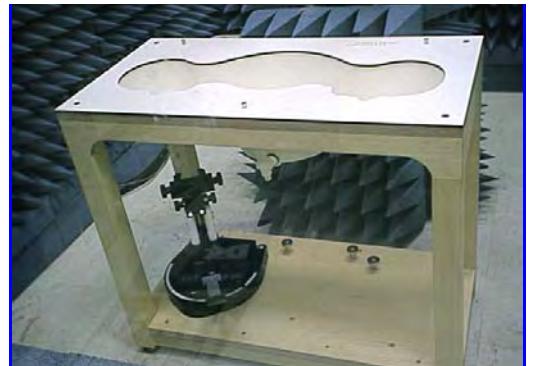


Figure 9. SAM Twin Phantom

<b>Shell Thickness</b>	2 ±0.2 mm
<b>Filling Volume</b>	Approx. 25 liters
<b>Dimensions</b>	810x1000x500 mm (HxLxW)

Table 2. Specification of SAM v4.0

## 6.7 Data Storage and Evaluation

### 6.7.1 Data Storage

The DASY4 software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension .DA4. The postprocessing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

## 6.7.2 Data Evaluation

The DASY4 post processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software :

**Probe parameters :** - Sensitivity Normi, ai0, ai1, ai2

- Conversion factor ConvFi

- Diode compression point dcpi

**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 they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

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

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

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

$dcpi$  = diode compression point (DASY parameter)

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

**E-field probes :**

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

**H-field probes :** 
$$H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

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 E-field 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

$Hi$  = magnetic field strength of channel  $i$  in A/m

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

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

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

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

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

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

$\sigma$  = conductivity in [mho/m] or [AT&T/m]

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

**\*Note :** that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

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

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

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



## 7. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Field Probe	ES3DV3	3150	Jan. 09, 2008	Jan. 09, 2009
SPEAG	1950MHz System Validation Kit	D1950V3	1117	Dec. 20, 2007	Dec. 20, 2008
SPEAG	Data Acquisition Electronics	DAE4	541	Feb. 21, 2008	Feb. 21, 2009
SPEAG	Device Holder	N/A	N/A	NCR	
SPEAG	Phantom	SAM V4.0	1009	NCR	
SPEAG	Robot	Staubli RX90L	F00/589B1/A/01	NCR	
SPEAG	Software	DASY4 V4.7 Build 71	N/A	NCR	
SPEAG	Software	SEMCAD X V1.8 Build 184	N/A	NCR	
SPEAG	Measurement Server	SE UMS 001 BA	1021	NCR	
R & S	Wireless Communication Test Set	CMU200	112387	Oct. 31, 2008	Oct. 31, 2009
Agilent	Wireless Communication Test Set	E5515C(8960)	GB47020167	Apr. 17, 2008	Apr. 17, 2009
Agilent	ENA Series Network Analyzer	E5071B	MY42402996	Nov. 04, 2008	Nov. 04, 2009
Agilent	Dielectric Probe Kit	85070C	US99360094	NCR	
R & S	Power Sensor	NRP-Z22	100179	Apr. 23, 2008	Apr. 23, 2009
Agilent	Signal Generator	E8257D	MY44320425	Jul. 03, 2008	Jul. 03, 2009
Agilent	Dual Directional Coupler	778D	50334	NCR	
Mini-Circuits	Power Amplifier	ZHL-42W-SMA	D111103#5	NCR	
Mini-Circuits	Power Amplifier	ZVE-8G-SMA	D042005 671800514	NCR	

Table 3. Test Equipment List



## 8. **Tissue Simulating Liquids**

The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8720ES Network Analyzer.

### **IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters**

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

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

(  $\epsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho = 1000 \text{ kg/m}^3$  )

**Table 4. Tissue dielectric parameters for head and body phantoms**

## 8.1 Ingredients

The following ingredients are used:

- Water: deionized water (pure H<sub>2</sub>O), resistivity  $\geq 16 \text{ M } \Omega$  -as basis for the liquid
- Sugar: refined white sugar (typically 99.7 % sucrose, available as crystal sugar in food shops)
  - to reduce relative permittivity
- Salt: pure NaCl -to increase conductivity
- Cellulose: Hydroxyethyl-cellulose, medium viscosity (75-125 mPa.s, 2% in water, 20°C), CAS # 54290 -to increase viscosity and to keep sugar in solution.
- Preservative: Preventol D-7 Bayer AG, D-51368 Leverkusen, CAS # 55965-84-9 -to prevent the spread of bacteria and molds
- DGBE: Diethylenglycol-monobutyl ether (DGBE), Fluka Chemie GmbH, CAS # 112-34-5 -to reduce relative permittivity



## 8.2 Recipes

The following tables give the recipes for tissue simulating liquids to be used in different frequency bands.

Note: The goal dielectric parameters (at 22 °C) must be achieved within a tolerance of  $\pm 5\%$  for  $\epsilon$  and  $\pm 5\%$  for  $\sigma$ .

Liquid type	HSL 1950-B	
Ingredient	Weight (g)	Weight (%)
Water	554.12	55.41
DGBE	445.08	44.51
Salt	0.80	0.08
Total amount	1,000.00	100.00
Goal dielectric parameters		
Frequency [MHz]	1950	2000
Relative Permittivity	40.0	40.0
Conductivity [S/m]	1.40	1.40

Liquid type	MSL 1950-B	
Ingredient	Weight (g)	Weight (%)
Water	697.94	69.79
DGBE	300.03	30.00
Salt	2.03	0.20
Total amount	1,000.00	100.00
Goal dielectric parameters		
Frequency [MHz]	1950	2000
Relative Permittivity	53.3	53.3
Conductivity [S/m]	1.52	1.52

## 8.3 Liquid Confirmation

### 8.3.1 Parameters

Liquid Verify								
Ambient Temperature : 22 ± 2 °C ; Relative Humidity : 40 -70%								
Liquid Type	Frequency	Temp (°C)	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)	Measured Date
1950MHz Head	1950MHz	22.0	$\epsilon_r$	40.0	39.7	-0.75%	± 5 %	Dec. 01, 2008
			$\sigma$	1.40	1.43	2.14%	± 5 %	
1950MHz Body	1950MHz	22.0	$\epsilon_r$	53.3	51.8	-2.81%	± 5 %	Dec. 02, 2008
			$\sigma$	1.52	1.55	1.97%	± 5 %	

Table 5. Measured Tissue dielectric parameters for head and body phantoms

### 8.3.2 Liquid Depth

The liquid level was during measurement 15cm ±0.5cm.

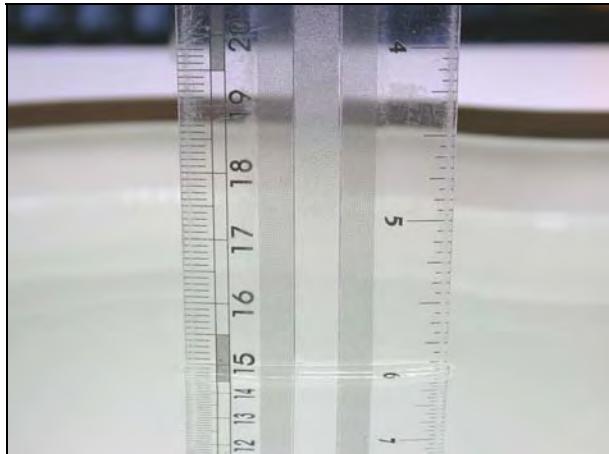


Figure 10. Head-Tissue-Simulating-Liquid

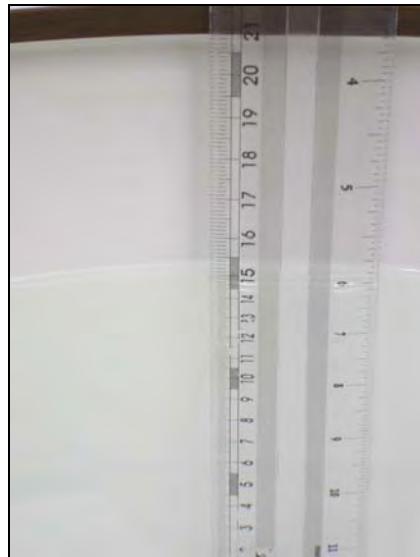


Figure 11. Body-Tissue-Simulating-Liquid



## 9. Measurement Process

### 9.1 Device and Test Conditions

The Test Device was provided by **Binatone Electronics International Limited**. for this evaluation. The spatial peak SAR values were assessed for the lowest, middle and highest channels defined by UPCS (Ch0 = 1928.448MHz, Ch2 = 1924.992MHz, Ch4 = 1921.536MHz) systems. The antenna(s), battery and accessories shall be those specified by the manufacturer. The battery shall be fully charged before each measurement and there shall be no external connections.

<b>Usage</b>	Operates with normal mode by client			
<b>Distance between antenna axis at the joint and the liquid surface:</b>	For head, EUT left head, right head, to phantom 2mm separation. For Body, EUT back to phantom 2mm separation.			
<b>Simulating human Head/Body</b>	Head and Body			
<b>EUT Battery</b>	Fully-charged with Ni-MH batteries.			
<b>Conducted power</b>	<b>Channel</b>	<b>Frequency MHz</b>	<b>Before SAR Test (dBm)</b>	<b>After SAR Test (dBm)</b>
	Highest Channel - 0	1928.448	19.56	19.51
	Middle Channel - 2	1924.992	19.50	19.48
	Lowest Channel - 4	1921.536	19.59	19.58

## 9.2 System Performance Check

### 9.2.1 Symmetric Dipoles for System Validation

<b>Construction</b>	Symmetrical dipole with 1/4 balun enables measurement of feed point impedance with NWA matched for use near flat phantoms filled with head simulating solutions. Includes distance holder and tripod adaptor Calibration Calibrated SAR value for specified position and input power at the flat phantom in head simulating solutions.
<b>Frequency</b>	450, 900, 1800, 1950, 2000, 2450, 5200, 5600, 5800MHz
<b>Return Loss</b>	> 20 dB at specified validation position
<b>Power Capability</b>	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
<b>Options</b>	Dipoles for other frequencies or solutions and other calibration conditions are available upon request
<b>Dimensions</b>	<p>D450V2 : dipole length 270 mm; overall height 330 mm</p> <p>D900V2 : dipole length 149 mm; overall height 330 mm</p> <p>D1800V2 : dipole length 72 mm; overall height 300 mm</p> <p>D1950V2 : dipole length 62 mm; overall height 300 mm</p> <p>D2000V2 : dipole length 65 mm; overall height 300 mm</p> <p>D2450V2 : dipole length 51.5 mm; overall height 300 mm</p> <p>D5GHzV2 : dipole length 20.6 mm; overall height 450 mm</p>



Figure 12. Validation Kit

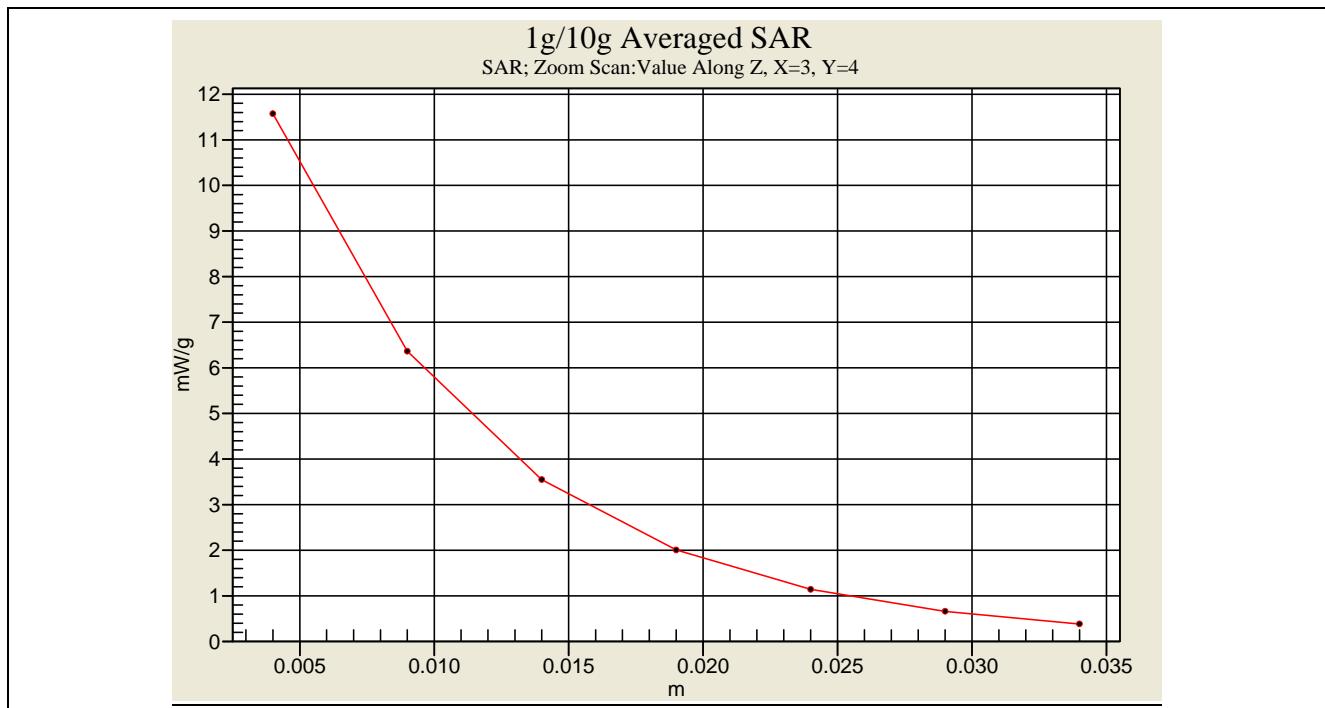
### 9.2.2 Validation

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of  $\pm 7\%$ . The validation was performed at 1950MHz.

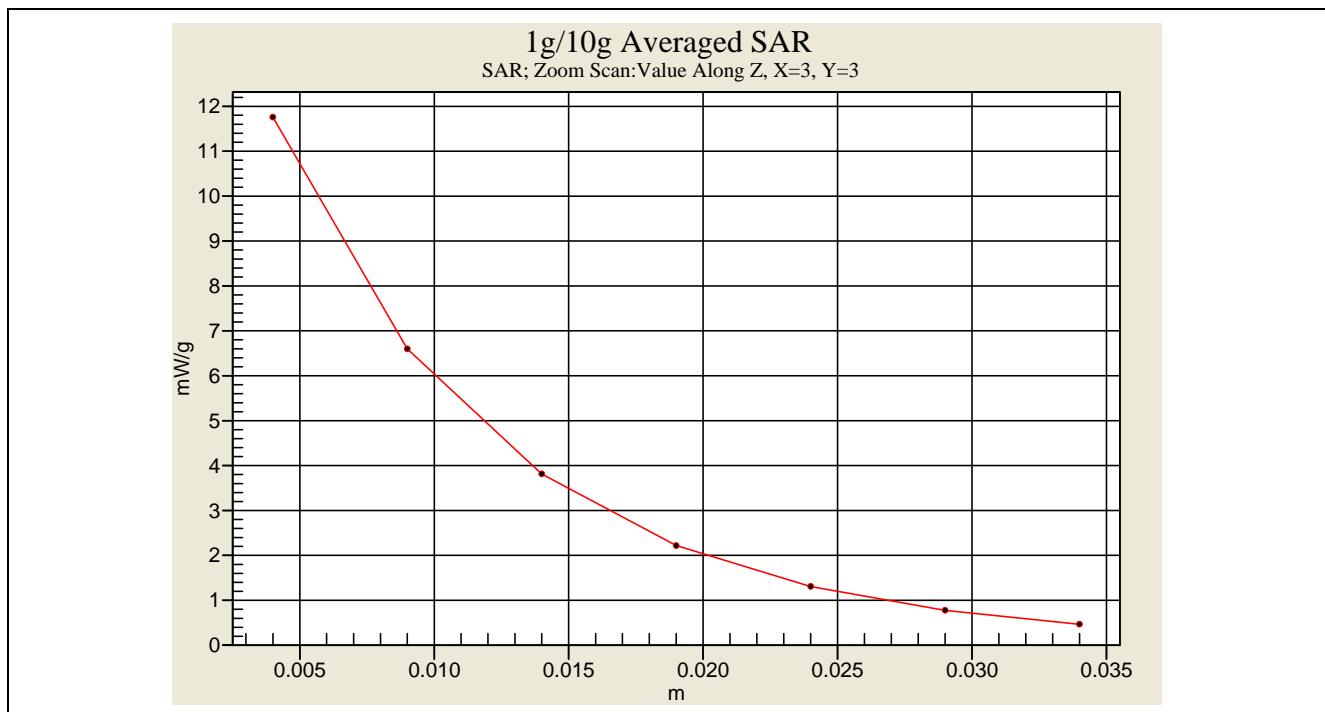
Validation kit		Mixture Type	$SAR_{1g}$ [mW/g]		$SAR_{10g}$ [mW/g]		Date of Calibration
D1950V3 - SN1117		Head	40.0		20.96		Dec. 20, 2007
		Body	41.2		21.76		
Frequency (MHz)	Power	$SAR_{1g}$ (mW/g)	$SAR_{10g}$ (mW/g)	Drift (dB)	Difference percentage		Date
		250mW	10.1		1g	10g	
1950 (Head)	Normalize to 1 Watt	40.4	20.56	0.015	1.0%	-1.9%	Dec. 01, 2009
1950 (Body)	250mW	10.3	5.28	0.004	0.0%	-2.9%	Dec. 02, 2009
	Normalize to 1 Watt	41.2	21.12				

Detail results see Appendix A.

### Z-axis Plot of System Performance Check



**Head-Tissue-Simulating-Liquid 1950MHz**



**Body-Tissue-Simulating-Liquid 1950MHz**



## 9.3 Dosimetric Assessment Setup

### 9.3.1 Body-Worn Test Position

#### Body-Worn Configuration

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device.

Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances.

For this test :

- The EUT is placed into the holster/belt clip and the holster is positioned against the surface of the phantom in a normal operating position.
- Since this EUT doesn't supply any body-worn accessory to the end user, a distance of 2 mm was tested to confirm the necessary "minimum SAR separation distance".

(\*Note : This distance includes the 2 mm phantom shell thickness.)

### 9.3.2 Measurement Procedures

**The evaluation was performed with the following procedures :**

**Surface Check :** A surface check job gathers data used with optical surface detection. It determines the distance from the phantom surface where the reflection from the optical detector has its peak. Any following measurement jobs using optical surface detection will then rely on this value. The surface check performs its search a specified number of times, so that the repeatability can be verified. The probe tip distance is 1.3mm to phantom inner surface during scans.

**Reference :** The reference job measures the field at a specified reference position, at 4 mm from the selected section's grid reference point.

**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 can find the maximum locations even in relatively coarse grids. When an area scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. Any following zoom scan within the same procedure will then perform fine scans around these maxima. The area covered the entire dimension of the EUT and the horizontal grid spacing was 15 mm x 15 mm.

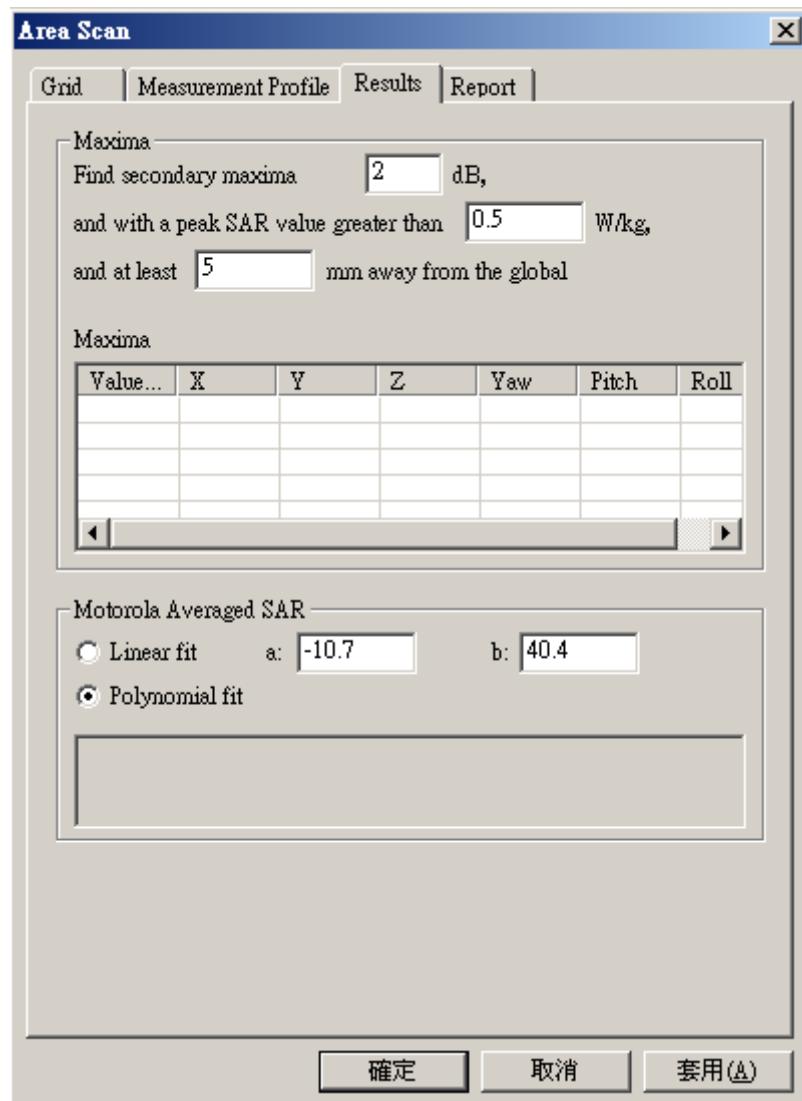
**Zoom Scan :** Zoom scans are used to assess the highest averaged SAR for cubic averaging volumes with 1 g and 10 g of simulated tissue. The zoom scan measures 5 x 5 x 7 points in a 32 x 32 x 30 mm cube whose base faces are centered around the maxima returned from a preceding area scan within the same procedure.

**Drift :** The drift job measures the field at the same location as the most recent reference job within the same procedure, with the same settings. The drift measurement gives the field difference in dB from the last reference measurement. Several drift measurements are possible for each reference measurement. This allows monitoring of the power drift of the device in the batch process. If the value changed by more than 5%, the evaluation was repeated.

## 2 Hot spots

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. The test use 2dB range is required in IEEE 1528-2003, EN50361 and IEC 62209 standards.

If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scan has to be increased accordingly. After measurement is completed, all maxima and their coordinates are listed in the Results property page. The maximum selected in the list is highlighted in the 3-D view. For the secondary maxima returned from an Area Scan, the user can specify a lower limit (peak SAR value), in addition to the Find secondary maxima within xdB condition. Only the primary maximum and any secondary maxima within xdB from the primary maximum and above this limit will be measured.



## 9.4 Spatial Peak SAR Evaluation

The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR values. Based on the Draft: SCC-34, SC-2, WG-2 - Computational Dosimetry, IEEE P1529/D0.0 (Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a "cube" measurement in a volume of  $(32 \times 32 \times 30) \text{ mm}^3$  (5x5x7 points). The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan. If the 10g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the Postprocessing engine (SEMCAD). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location.

The entire evaluation of the spatial peak values is performed within the Postprocessing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into three stages:

### Interpolation and Extrapolation

The probe is calibrated at the center of the dipole sensors which is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated.

In DASY4, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and SAR extrapolation routines. The interpolation, Maxima Search and extrapolation routines are all based on the modified Quadratic Shepard's method [7].



## **10. Measurement Uncertainty**

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, we estimate the measurement uncertainties in SAR to be less than  $\pm 22.4\%$  [8].

According to Std. C95.3 [9], the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of  $\pm 1$  to  $3$  dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least  $\pm 2$  dB can be expected.

According to CENELEC [10], typical worst-case uncertainty of field measurements is  $\pm 5$  dB. For well-defined modulation characteristics the uncertainty can be reduced to  $\pm 3$  dB.

Uncertainty Component	Uncertainty Value	Probability Distribution	Divisor	$c_i$ (1g)	$c_i$ (10g)	Standard Uncertainty $\pm 1\%$ (1-g)	Standard Uncertainty $\pm 1\%$ (10-g)	$v_i$ or $V_{eff}$
<b>Measurement System</b>								
Probe Calibration ( $k=1$ )	4.8	Normal	1	1	1	4.8	4.8	$\infty$
Axial Isotropy	4.7	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	$\sqrt{0.5}$	1.9	1.9	$\infty$
Hemispherical Isotropy	9.6	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	$\sqrt{0.5}$	3.9	3.9	$\infty$
Boundary Effect	0.8	Rectangular	$\sqrt{3}$	1	1	0.5	0.5	$\infty$
Linearity	4.7	Rectangular	$\sqrt{3}$	1	1	2.7	2.7	$\infty$
System Detection Limit	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Readout Electronics	1.0	Normal	1	1	1	1.0	1.0	$\infty$
Response Time	1.0	Rectangular	$\sqrt{3}$	1	1	0.6	0.6	$\infty$
Integration Time	1.9	Rectangular	$\sqrt{3}$	1	1	1.1	1.1	$\infty$
RF Ambient Conditions	3.0	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Probe Positioner Mechanical Tolerance	1.4	Rectangular	$\sqrt{3}$	1	1	0.8	0.8	$\infty$
Probe Positioning with respect to Phantom Shell	2.9	Rectangular	$\sqrt{3}$	1	1	1.7	1.7	$\infty$
Extrapolation, interpolation and integration Algorithms for Max. SAR Evaluation	4.5	Rectangular	$\sqrt{3}$	1	1	2.6	2.6	$\infty$
<b>Test sample Related</b>								
Test sample Positioning	2.9	Normal	1	1	1	2.9	2.9	145
Device Holder Uncertainty	3.6	Normal	1	1	1	3.6	3.6	5
Output Power Variation - SAR drift measurement	5.0	Rectangular	$\sqrt{3}$	1	1	2.9	2.9	$\infty$
<b>Phantom and Tissue Parameters</b>								
Phantom Uncertainty ( shape and thickness tolerances)	4.0	Rectangular	$\sqrt{3}$	1	1	2.3	2.3	$\infty$
Liquid Conductivity - deviation from target values	5.0	Rectangular	$\sqrt{3}$	0.64	0.43	1.8	1.2	$\infty$
Liquid Conductivity - measurement uncertainty	5.0	Normal	1	0.64	0.43	3.2	2.2	$\infty$
Liquid Permittivity - deviation from target values	5.0	Rectangular	$\sqrt{3}$	0.6	0.49	1.7	1.4	$\infty$
Liquid Permittivity - measurement uncertainty	5.0	Normal	1	0.6	0.49	3.0	2.5	$\infty$
<b>Combined standard uncertainty</b>		RSS				11.2	10.7	388
<b>Expanded uncertainty</b> (95% CONFIDENCE LEVEL)		$k=2$				22.4	21.5	

Table 6. Uncertainty Budget of DASY



## 11. SAR Test Results Summary

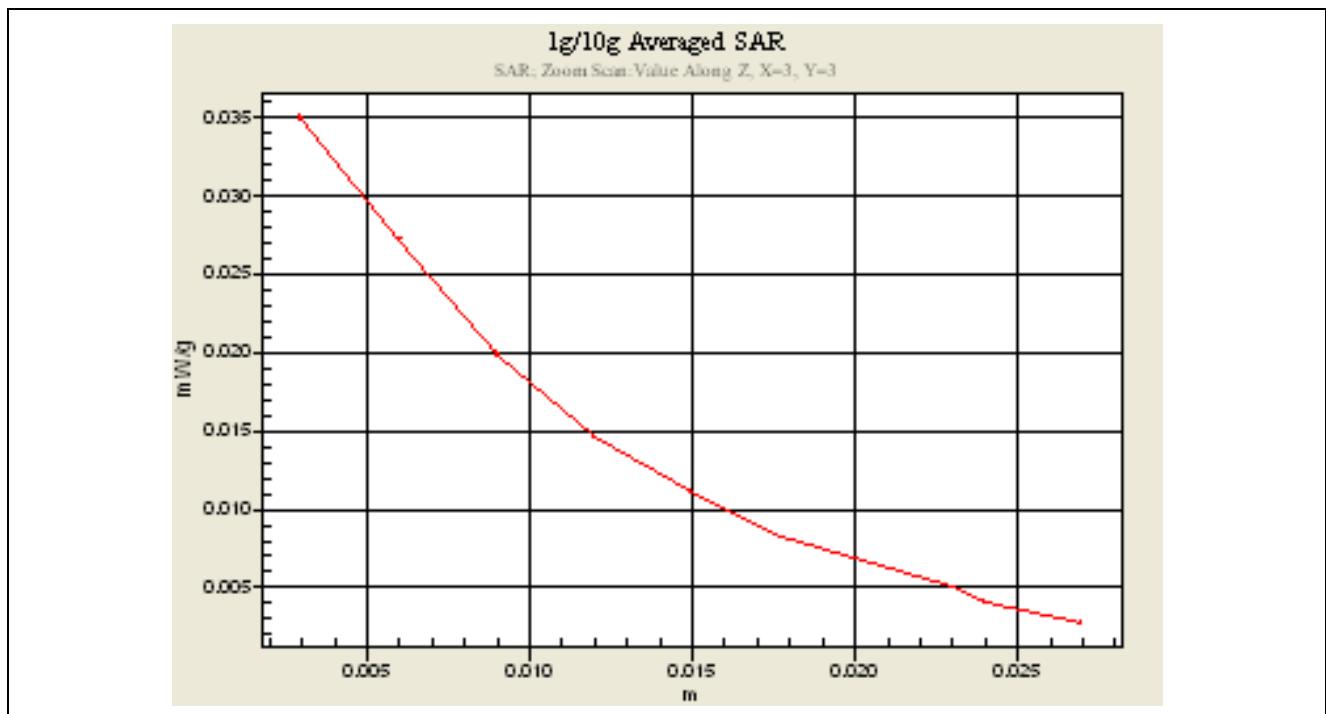
### 11.1 UPCS Head SAR

**Ambient :**Temperature (°C) : 22 ± 2Relative HUMIDITY (%) : 40 - 70**Liquid :**Mixture Type : HSL1950Liquid Temperature (°C) : 22.0Depth of liquid (cm) : 15**Measurement :**Crest Factor : 24Probe S/N : 3150

Frequency		Battery	Phantom Position	Accessory	SAR <sub>1g</sub> [mW/g]	Power Drift (dB)	Amb. Temp.	Remark
MHz	CH							
1928.448	0	Ni-MH	Right-Cheek	N/A	0.025	-0.056	22.0	-
1924.992	2	Ni-MH	Right-Cheek	N/A	0.028	-0.058	22.0	-
1921.536	4	Ni-MH	Right-Cheek	N/A	0.029	-0.163	22.0	-
1928.448	0	Ni-MH	Right-Tilted	N/A	0.017	-0.032	22.0	-
1924.992	2	Ni-MH	Right-Tilted	N/A	0.018	0.023	22.0	-
1921.536	4	Ni-MH	Right-Tilted	N/A	0.017	0.139	22.0	-
1928.448	0	Ni-MH	Left-Cheek	N/A	0.019	-0.080	22.0	-
1924.992	2	Ni-MH	Left-Cheek	N/A	0.022	0.043	22.0	-
1921.536	4	Ni-MH	Left-Cheek	N/A	0.024	-0.069	22.0	-
1928.448	0	Ni-MH	Left-Tilted	N/A	0.015	0.008	22.0	-
1924.992	2	Ni-MH	Left-Tilted	N/A	0.016	0.044	22.0	-
1921.536	4	Ni-MH	Left-Tilted	N/A	0.016	0.012	22.0	-
Std. C95.1-1999 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					1.6 W/kg (mW/g) Averaged over 1 gram			

Detail results see Appendix B.

### Z-axis Plot of SAR Measurement



**Head SAR Measurement \_ Right Cheek CH4**



## 11.2 UPCS Body SAR \_ 2mm

Ambient :

Temperature (°C) : 22 ± 2

Relative HUMIDITY (%) : 40 - 70

Liquid :

Mixture Type : MSL1950

Liquid Temperature (°C) : 22.0

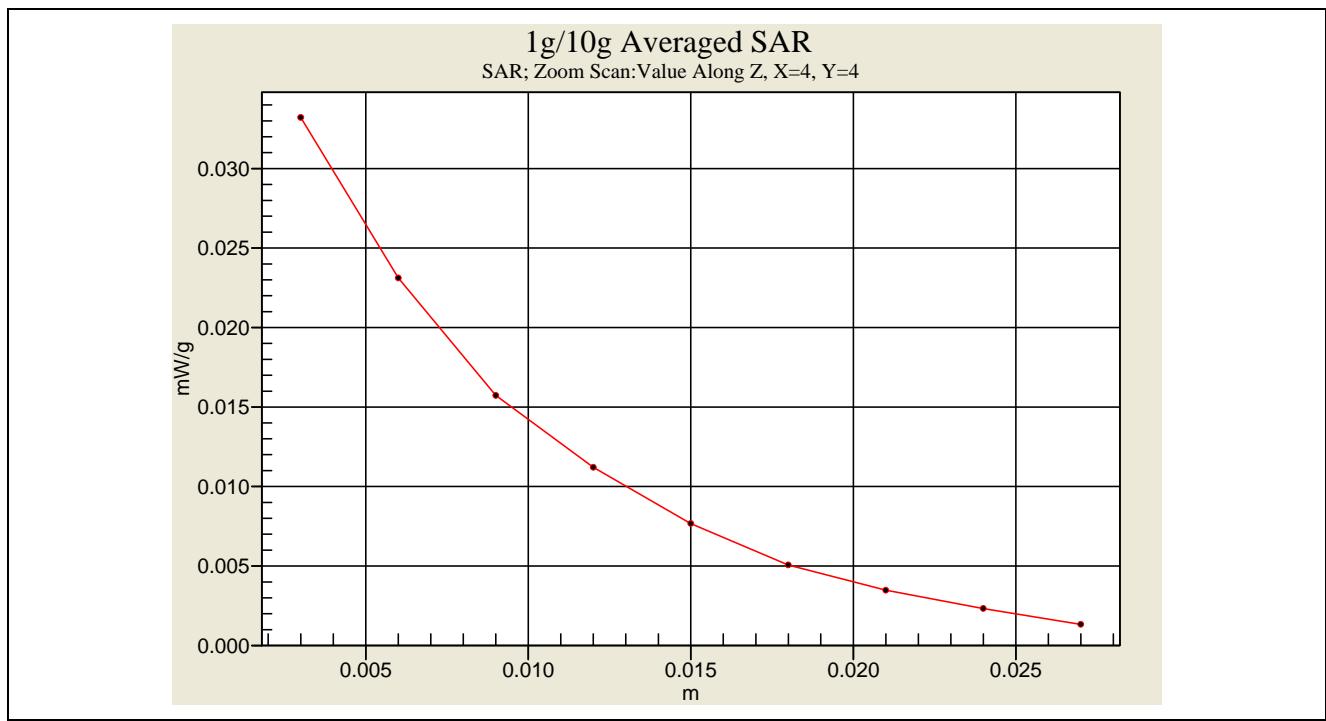
Measurement :

Crest Factor : 24

Probe S/N : 3150

Frequency		Battery	Phantom Position	Accessory	SAR <sub>1g</sub> [mW/g]	Power Drift (dB)	Amb. Temp.	Remark
MHz	CH							
1928.448	0	Ni-MH	Flat	N/A	0.026	0.067	22.0	-
1924.992	2	Ni-MH	Flat	N/A	0.018	-0.067	22.0	-
1921.536	4	Ni-MH	Flat	N/A	0.017	-0.007	22.0	-
Std. C95.1-1999 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					1.6 W/kg (mW/g) Averaged over 1 gram			

Detail results see Appendix B.

**Z-axis Plot of SAR Measurement**

## 11.3 EUT Setup up Photo

### 11.3.1 UPCS Head SAR



Figure 13. Right Head SAR Test Setup (Cheek)



Figure 14. Right Head SAR Test Setup (Tilted)



Figure 15. Left Head SAR Test Setup (Cheek)



Figure 16. Left Head SAR Test Setup (Tilted)

### 11.3.2 UPCS Body SAR



Figure 17. Body SAR Test Setup \_ Back to Phantom 2mm separation

## 11.4 Std. C95.1-1999 RF Exposure Limit

Human Exposure	Population Uncontrolled Exposure ( W/kg ) or (mW/g)	Occupational Controlled Exposure ( W/kg ) or (mW/g)
<b>Spatial Peak SAR*</b> (head)	1.60	8.00
<b>Spatial Peak SAR**</b> (Whole Body)	0.08	0.40
<b>Spatial Peak SAR***</b> (Partial-Body)	1.60	8.00
<b>Spatial Peak SAR****</b> (Hands / Feet / Ankle / Wrist )	4.00	20.00

**Table 7. Safety Limits for Partial Body Exposure**

**Notes :**

- \* The Spatial Peak value of the SAR averaged over any 1 gram of tissue.  
( defined as a tissue volume in the shape of a cube ) and over the appropriate averaging time.
- \*\* The Spatial Average value of the SAR averaged over the whole – body.
- \*\*\* The Spatial Average value of the SAR averaged over the partial – body.
- \*\*\*\* The Spatial Peak value of the SAR averaged over any 10 grams of tissue.  
( defined as a tissue volume in the shape of a cube ) and over the appropriate averaging time.

**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 persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).



## **12. Conclusion**

The SAR test values found for the portable mobile phone **Binatone Electronics International Limited. Trade Name : Motorola Model(s) : L401 (Model list see Section 1)** are below the maximum recommended level of 1.6 W/kg ( mW/g ).

### **13. References**

- [1] Std. C95.1-1999, "American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300KHz to 100GHz", New York.
- [2] NCRP, National Council on Radiation Protection and Measurements, "Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields", NCRP report NO. 86, 1986.
- [3] T. Schmid, O. Egger, and N. Kuster, "Automatic E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105-113, Jan. 1996.
- [4] K. Poković, T. Schmid, and N. Kuster, "Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequency", in ICECOM'97, Dubrovnik, October 15-17, 1997, pp.120-124.
- [5] K. Poković, T. Schmid, and N. Kuster, "E-field probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23-25 June, 1996, pp.172-175.
- [6] N. Kuster, and Q. Balzano, "Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz", IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.
- [7] Robert J. Renka, "Multivariate Interpolation Of Large Sets Of Scattered Data", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988 , pp. 139-148.
- [8] N. Kuster, R. Kastle, T. Schmid, *Dosimetric evaluation of mobile communications equipment with known precision*, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.
- [9] Std. C95.3-1991, "IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave", New York: IEEE, Aug. 1992.
- [10]CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), *Human Exposure to Electromagnetic Fields High-frequency: 10KHz-300GHz*, Jan. 1995.



## **Appendix A - System Performance Check**

See following Attached Pages for System Performance Check.

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 AM 10:13:46

### System Performance Check at 1950MHz\_20081201\_Head

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN:1117**

Communication System: CW; Frequency: 1950 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1950 \text{ MHz}$ ;  $\sigma = 1.43 \text{ mho/m}$ ;  $\epsilon_r = 39.7$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### System Performance Check at 1950MHz/Area Scan (61x81x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 11.6 mW/g

### System Performance Check at 1950MHz/Zoom Scan (7x7x7)/Cube 0:

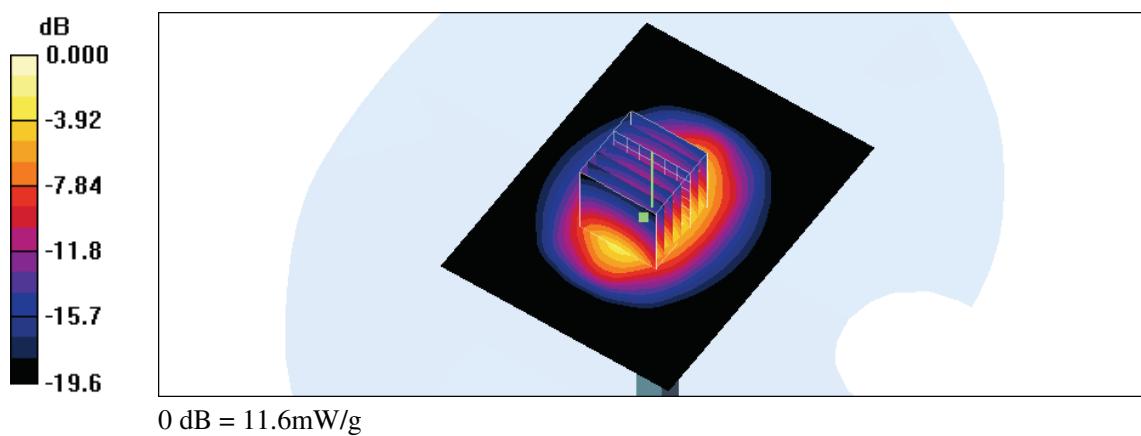
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 91.3 V/m; Power Drift = 0.015 dB

Peak SAR (extrapolated) = 18.9 W/kg

**SAR(1 g) = 10.1 mW/g; SAR(10 g) = 5.14 mW/g**

Maximum value of SAR (measured) = 11.6 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/2 PM 03:20:05

### System Performance Check at 1950MHz\_20081202\_Body

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN:1117**

Communication System: CW; Frequency: 1950 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1950 \text{ MHz}$ ;  $\sigma = 1.55 \text{ mho/m}$ ;  $\epsilon_r = 51.8$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.55, 4.55, 4.55); Calibrated: 2008/1/9
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### System Performance Check at 1950MHz/Area Scan (91x121x1):

Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

Maximum value of SAR (interpolated) = 11.9 mW/g

### System Performance Check at 1950MHz/Zoom Scan (7x7x7)/Cube 0:

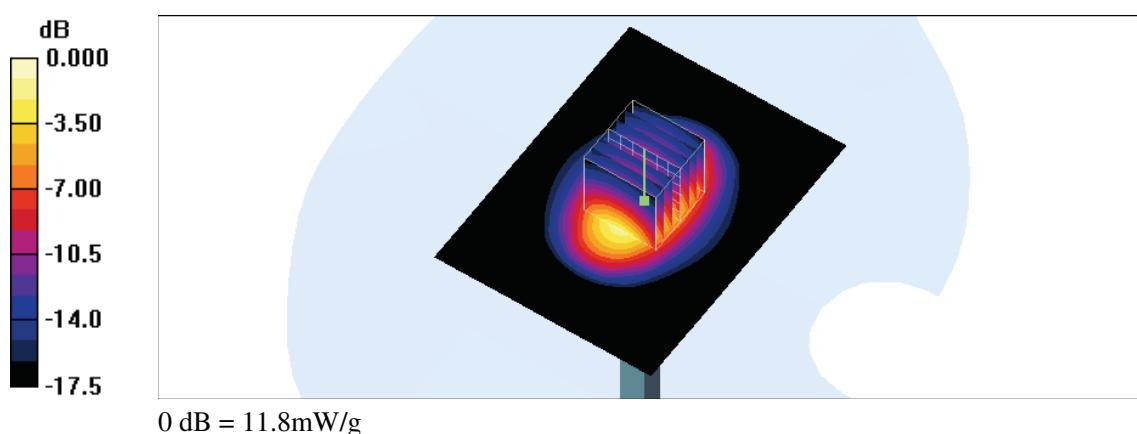
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 88.2 V/m; Power Drift = 0.004 dB

Peak SAR (extrapolated) = 19.2 W/kg

**SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.28 mW/g**

Maximum value of SAR (measured) = 11.8 mW/g





## **Appendix B - SAR Measurement Data**

See following Attached Pages for SAR Measurement Data.

Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 03:18:16

## RC\_DECT CH0

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1928.448 MHz; Duty Cycle: 1:24

Medium parameters used (interpolated):  $f = 1928.448$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Cheek/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.032 mW/g

### Right Cheek/Zoom Scan (7x7x9)/Cube 0:

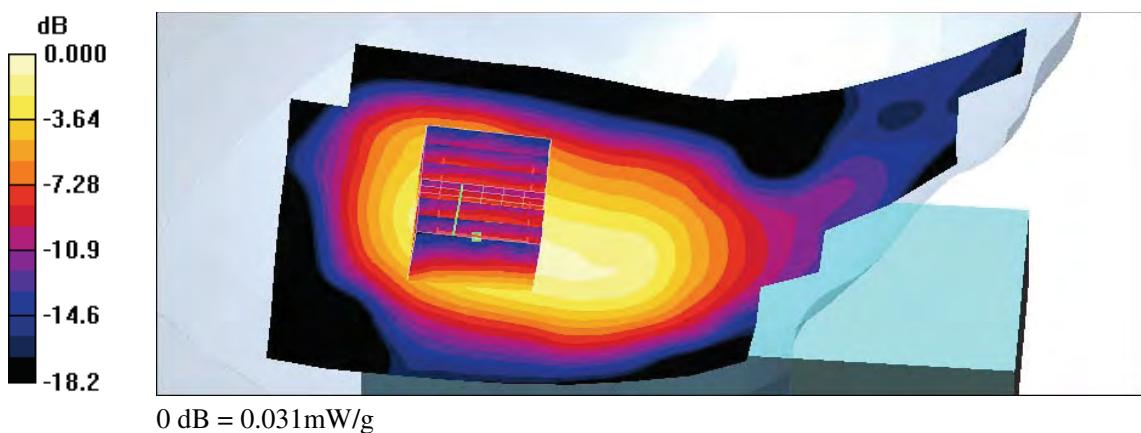
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 4.67 V/m; Power Drift = -0.056 dB

Peak SAR (extrapolated) = 0.038 W/kg

**SAR(1 g) = 0.025 mW/g; SAR(10 g) = 0.014 mW/g**

Maximum value of SAR (measured) = 0.031 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 04:08:33

## RC\_DECT CH2

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1924.992 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1924.992 \text{ MHz}$ ;  $\sigma = 1.42 \text{ mho/m}$ ;  $\epsilon_r = 40.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Cheek/Area Scan (61x131x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.036 mW/g

### Right Cheek/Zoom Scan (7x7x9)/Cube 0:

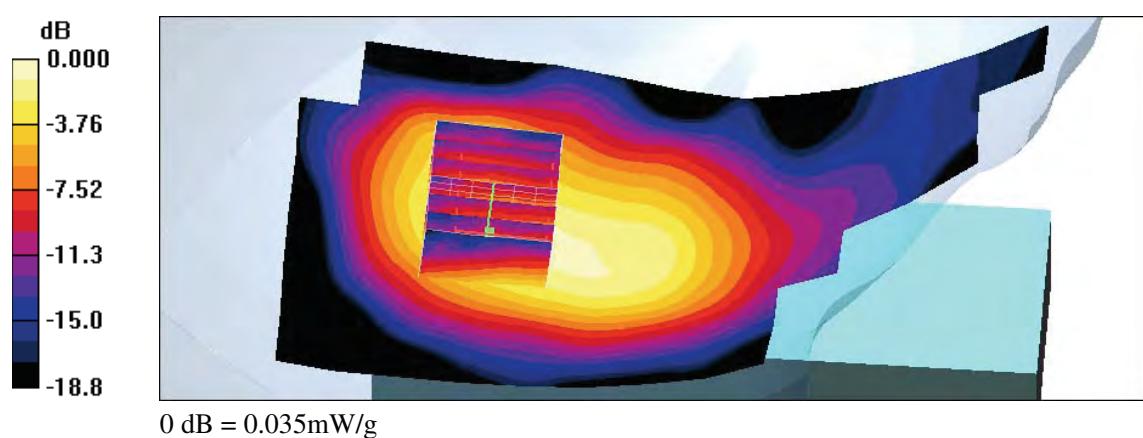
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$

Reference Value = 4.80 V/m; Power Drift = -0.058 dB

Peak SAR (extrapolated) = 0.043 W/kg

**SAR(1 g) = 0.028 mW/g; SAR(10 g) = 0.016 mW/g**

Maximum value of SAR (measured) = 0.035 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 AM 11:09:11

## RC\_DECT CH4

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1921.536 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1921.536$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Cheek/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.037 mW/g

### Right Cheek/Zoom Scan (7x7x9)/Cube 0:

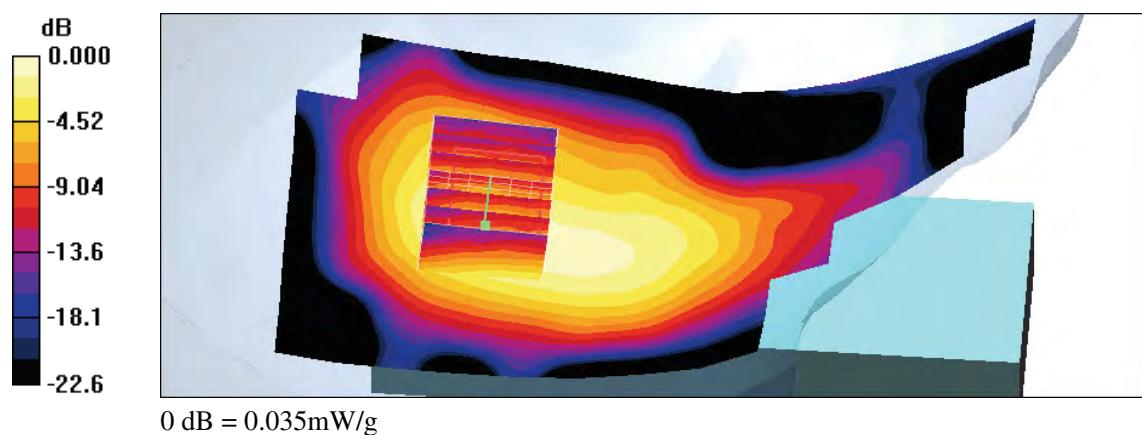
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 4.98 V/m; Power Drift = -0.163 dB

Peak SAR (extrapolated) = 0.043 W/kg

**SAR(1 g) = 0.029 mW/g; SAR(10 g) = 0.016 mW/g**

Maximum value of SAR (measured) = 0.035 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 03:40:06

## RT\_DECT CH0

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1928.448 MHz; Duty Cycle: 1:24

Medium parameters used (interpolated):  $f = 1928.448$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Tilted/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.020 mW/g

### Right Tilted/Zoom Scan (7x7x9)/Cube 0:

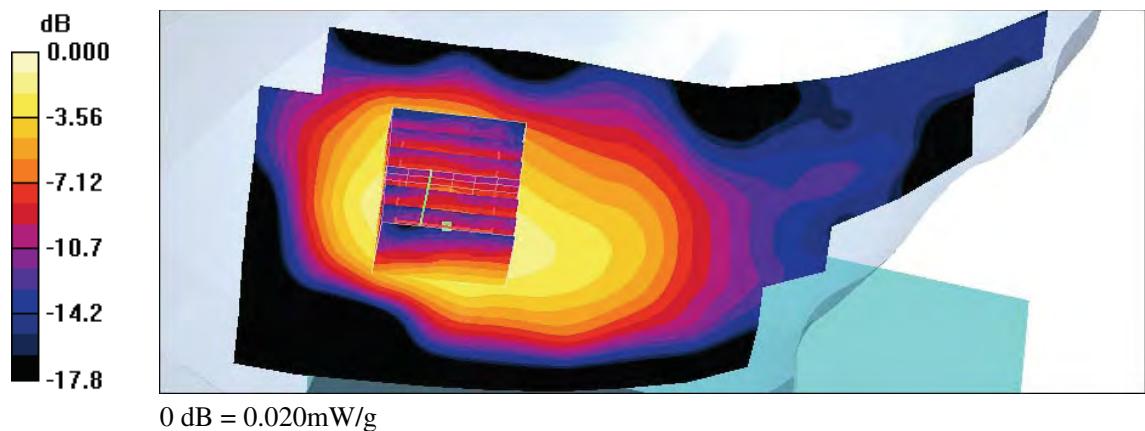
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 3.95 V/m; Power Drift = -0.032 dB

Peak SAR (extrapolated) = 0.024 W/kg

**SAR(1 g) = 0.017 mW/g; SAR(10 g) = 0.00944 mW/g**

Maximum value of SAR (measured) = 0.020 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 04:30:14

## RT\_DECT CH2

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1924.992 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1924.992$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 40.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Tilted/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.021 mW/g

### Right Tilted/Zoom Scan (7x7x9)/Cube 0:

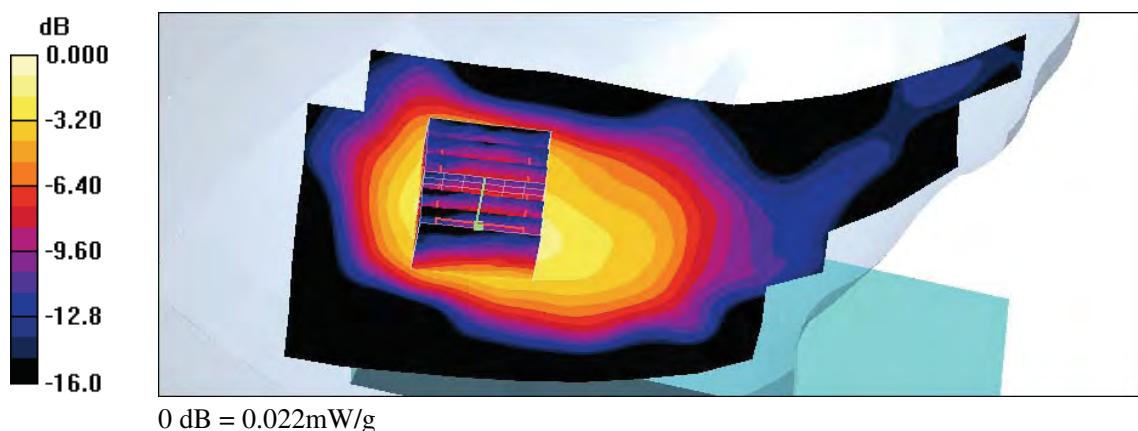
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 3.84 V/m; Power Drift = 0.023 dB

Peak SAR (extrapolated) = 0.029 W/kg

**SAR(1 g) = 0.018 mW/g; SAR(10 g) = 0.00992 mW/g**

Maximum value of SAR (measured) = 0.022 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 AM 11:31:31

## RT\_DECT CH4

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1921.536 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1921.536$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Right Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Right Tilted/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.021 mW/g

### Right Tilted/Zoom Scan (7x7x9)/Cube 0:

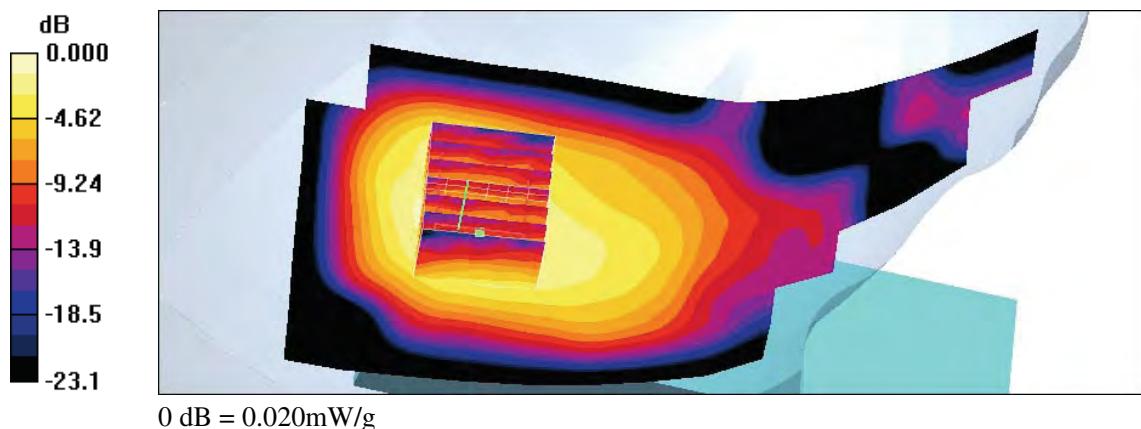
Measurement grid:  $dx=5$  mm,  $dy=5$  mm,  $dz=3$  mm

Reference Value = 3.99 V/m; Power Drift = 0.139 dB

Peak SAR (extrapolated) = 0.031 W/kg

**SAR(1 g) = 0.017 mW/g; SAR(10 g) = 0.00938 mW/g**

Maximum value of SAR (measured) = 0.020 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 02:32:03

## LC\_DECT CH0

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1928.448 MHz; Duty Cycle: 1:24

Medium parameters used (interpolated):  $f = 1928.448$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Cheek/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.024 mW/g

### Left Cheek/Zoom Scan (7x7x9)/Cube 0:

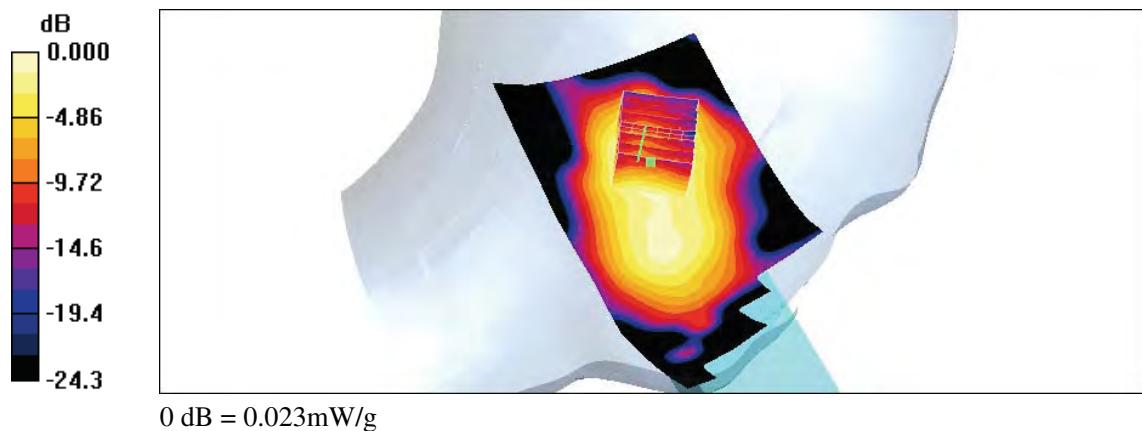
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 4.07 V/m; Power Drift = -0.080 dB

Peak SAR (extrapolated) = 0.028 W/kg

**SAR(1 g) = 0.019 mW/g; SAR(10 g) = 0.010 mW/g**

Maximum value of SAR (measured) = 0.023 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 05:01:17

## LC\_DECT CH2

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1924.992 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1924.992 \text{ MHz}$ ;  $\sigma = 1.42 \text{ mho/m}$ ;  $\epsilon_r = 40.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Cheek/Area Scan (61x121x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.029 mW/g

### Left Cheek/Zoom Scan (7x7x9)/Cube 0:

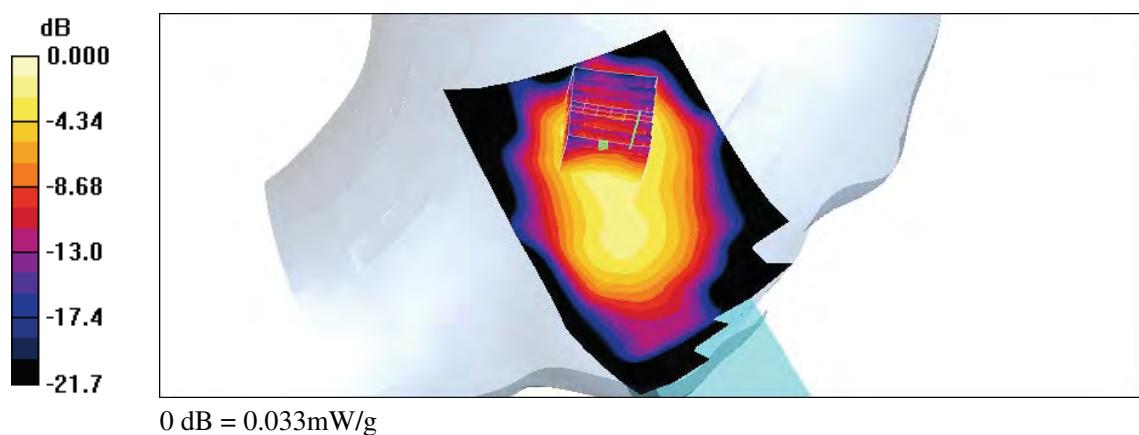
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$

Reference Value = 4.41 V/m; Power Drift = 0.043 dB

Peak SAR (extrapolated) = 0.053 W/kg

**SAR(1 g) = 0.022 mW/g; SAR(10 g) = 0.013 mW/g**

Maximum value of SAR (measured) = 0.033 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 12:06:44

## LC\_DECT CH4

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1921.536 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1921.536 \text{ MHz}$ ;  $\sigma = 1.42 \text{ mho/m}$ ;  $\epsilon_r = 40.2$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Cheek/Area Scan (61x131x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.031 mW/g

### Left Cheek/Zoom Scan (7x7x9)/Cube 0:

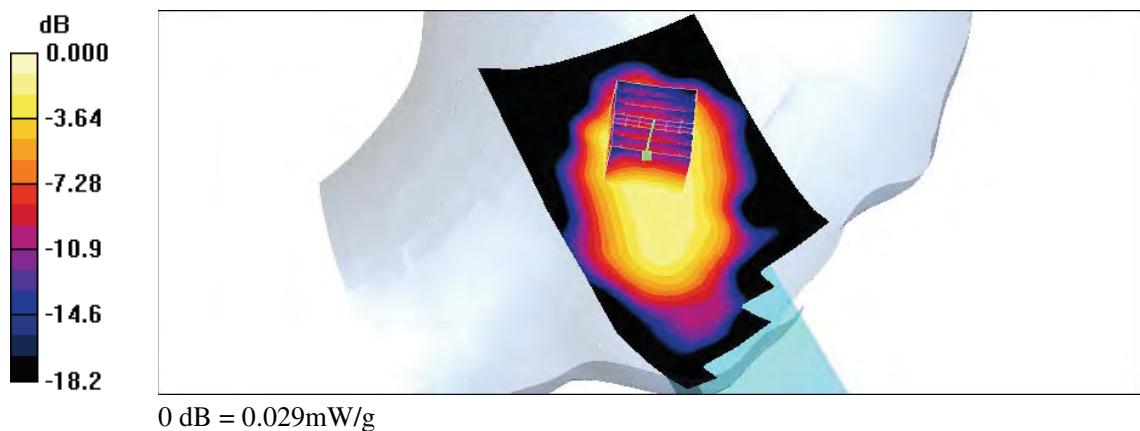
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$

Reference Value = 4.64 V/m; Power Drift = -0.069 dB

Peak SAR (extrapolated) = 0.036 W/kg

**SAR(1 g) = 0.024 mW/g; SAR(10 g) = 0.013 mW/g**

Maximum value of SAR (measured) = 0.029 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 02:54:35

## LT\_DECT CH0

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1928.448 MHz; Duty Cycle: 1:24

Medium parameters used (interpolated):  $f = 1928.448$  MHz;  $\sigma = 1.43$  mho/m;  $\epsilon_r = 40.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Tilted/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.021 mW/g

### Left Tilted/Zoom Scan (7x7x9)/Cube 0:

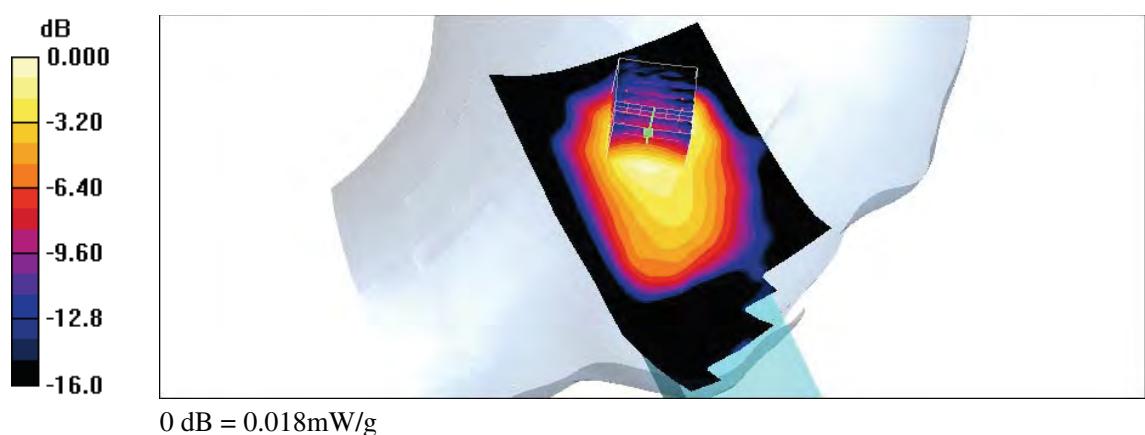
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 3.66 V/m; Power Drift = 0.008 dB

Peak SAR (extrapolated) = 0.022 W/kg

**SAR(1 g) = 0.015 mW/g; SAR(10 g) = 0.0078 mW/g**

Maximum value of SAR (measured) = 0.018 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 05:23:23

## LT\_DECT CH2

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1924.992 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1924.992 \text{ MHz}$ ;  $\sigma = 1.42 \text{ mho/m}$ ;  $\epsilon_r = 40.3$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Tilted/Area Scan (61x131x1):

Measurement grid:  $dx=15\text{mm}$ ,  $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.020 mW/g

### Left Tilted/Zoom Scan (7x7x9)/Cube 0:

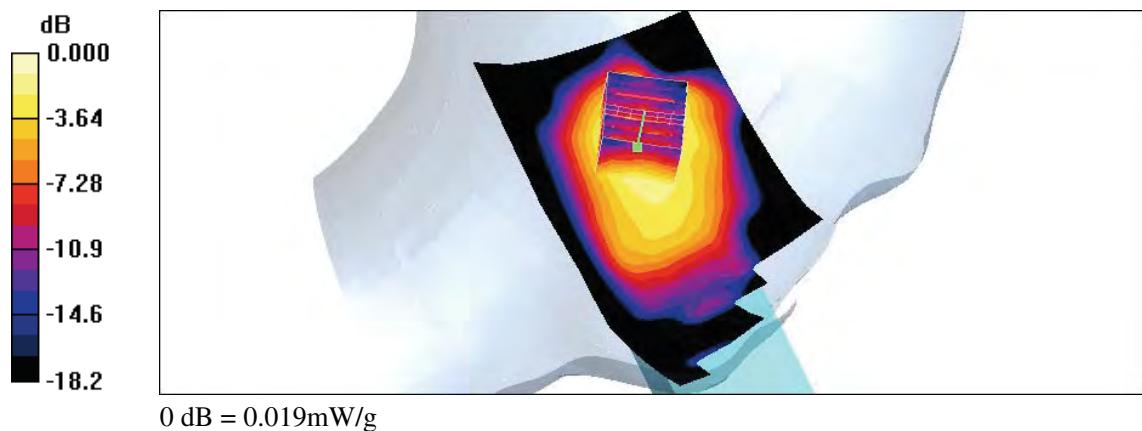
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$

Reference Value = 3.72 V/m; Power Drift = 0.044 dB

Peak SAR (extrapolated) = 0.023 W/kg

**SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00895 mW/g**

Maximum value of SAR (measured) = 0.019 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/1 PM 12:52:13

## LT\_DECT CH4

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1921.536 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1921.536$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 40.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Left Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.84, 4.84, 4.84); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

### Left Tilted/Area Scan (61x131x1):

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

Maximum value of SAR (interpolated) = 0.020 mW/g

### Left Tilted/Zoom Scan (7x7x9)/Cube 0:

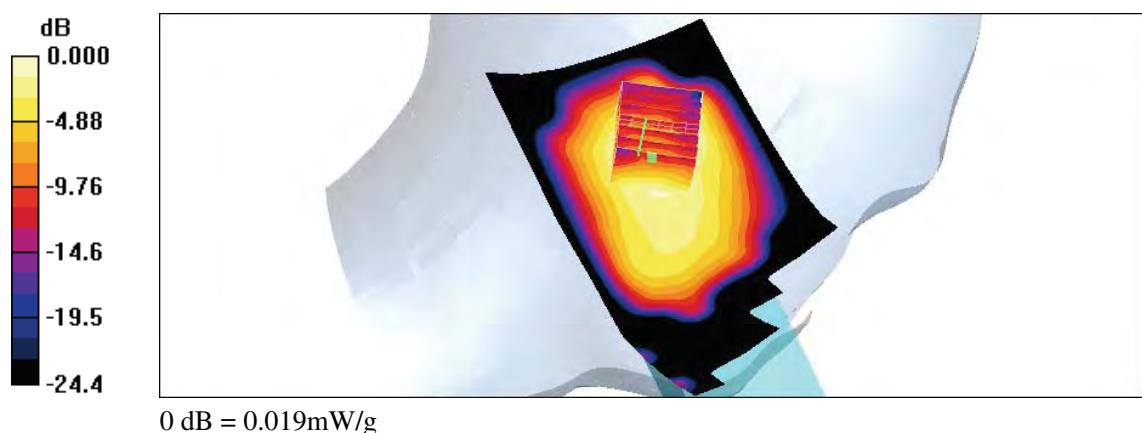
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 3.78 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 0.024 W/kg

**SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00891 mW/g**

Maximum value of SAR (measured) = 0.019 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/2 PM 06:47:30

### Flat\_DECT CH0\_Close Body

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1928.448 MHz; Duty Cycle: 1:24

Medium parameters used (interpolated):  $f = 1928.448$  MHz;  $\sigma = 1.54$  mho/m;  $\epsilon_r = 51.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.55, 4.55, 4.55); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

#### Flat/Area Scan (91x201x1):

Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.034 mW/g

#### Flat/Zoom Scan (7x7x9)/Cube 0:

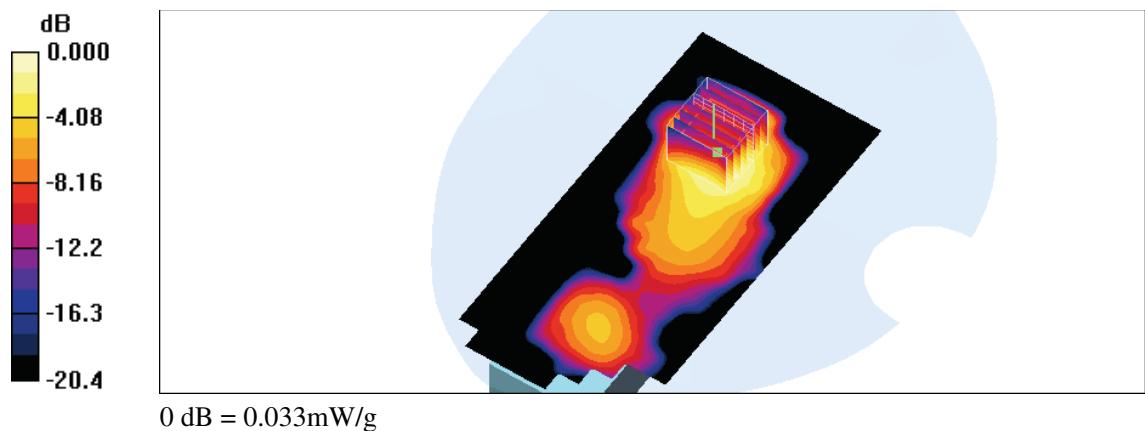
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 4.74 V/m; Power Drift = 0.067 dB

Peak SAR (extrapolated) = 0.046 W/kg

**SAR(1 g) = 0.026 mW/g; SAR(10 g) = 0.015 mW/g**

Maximum value of SAR (measured) = 0.033 mW/g



Test Laboratory: A Test Lab Techno Corp

Date/Time: 2008/12/2 PM 04:55:24

### Flat\_DECT CH2\_Close Body

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1924.992 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1924.992 \text{ MHz}$ ;  $\sigma = 1.54 \text{ mho/m}$ ;  $\epsilon_r = 51.9$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.55, 4.55, 4.55); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

#### Flat/Area Scan (91x201x1):

Measurement grid:  $dx=10\text{mm}$ ,  $dy=10\text{mm}$

Maximum value of SAR (interpolated) = 0.024 mW/g

#### Flat/Zoom Scan (7x7x9)/Cube 0:

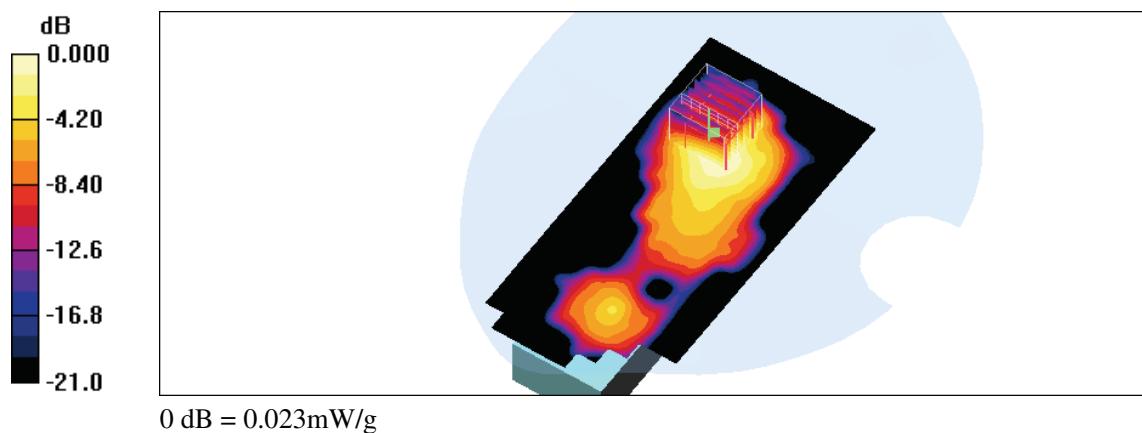
Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=3\text{mm}$

Reference Value = 3.93 V/m; Power Drift = -0.067 dB

Peak SAR (extrapolated) = 0.032 W/kg

**SAR(1 g) = 0.018 mW/g; SAR(10 g) = 0.010 mW/g**

Maximum value of SAR (measured) = 0.023 mW/g



Test Laboratory: A Test Lab Techno Corp.

Date/Time: 2008/12/2 PM 05:27:11

### Flat\_DECT CH4\_Close Body

**DUT: L401; Type: 1.9GHz DECT6.0 Handset; FCC ID: VLJ80-6997-01**

Communication System: DECT; Frequency: 1921.536 MHz; Duty Cycle: 1:24

Medium parameters used:  $f = 1921.536$  MHz;  $\sigma = 1.52$  mho/m;  $\epsilon_r = 51.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY4 Configuration:

- Probe: ES3DV3 - SN3150; ConvF(4.55, 4.55, 4.55); Calibrated: 2008/1/9
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn541; Calibrated: 2008/2/21
- Phantom: SAM12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

#### Flat/Area Scan (91x201x1):

Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 0.021 mW/g

#### Flat/Zoom Scan (7x7x9)/Cube 0:

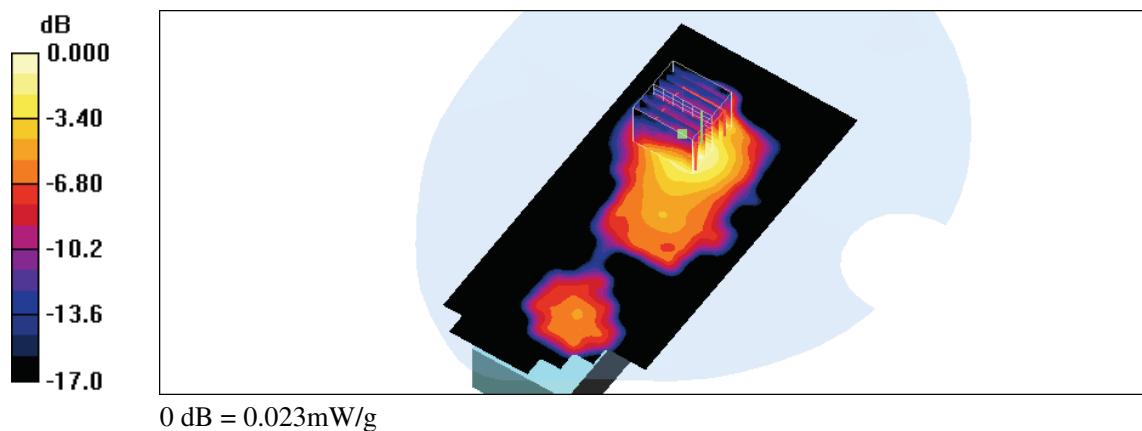
Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 3.65 V/m; Power Drift = -0.007 dB

Peak SAR (extrapolated) = 0.035 W/kg

**SAR(1 g) = 0.017 mW/g; SAR(10 g) = 0.00907 mW/g**

Maximum value of SAR (measured) = 0.023 mW/g





## **Appendix C - Calibration**

All of the instruments Calibration information are listed below.

- Dipole \_ D1950V3 SN:1117 Calibration No.D1950V3-1117\_Dec.07
- Probe \_ ES3DV3SN:3150 Calibration No.ES3-3150\_Jan.08
- DAE \_ DAE4 SN:541Calibration No.DAE4-541\_Feb.21



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Accreditation No.: SCS 108

Client ATL (Auden)

Certificate No: D1950V3-1117\_Dec07

## CALIBRATION CERTIFICATE

Object D1950V3 - SN: 1117

Calibration procedure(s) QA CAL-05.v7  
Calibration procedure for dipole validation kits

Calibration date: December 20, 2007

Condition of the calibrated item In Tolerance

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&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Power sensor HP 8481A	US37292783	04-Oct-07 (METAS, No. 217-00736)	Oct-08
Reference 20 dB Attenuator	SN: 5086 (20g)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference 10 dB Attenuator	SN: 5047.2 (10r)	07-Aug-07 (METAS, No 217-00718)	Aug-08
Reference Probe ET3DV6 (HF)	SN 1507	26-Oct-07 (SPEAG, No. ET3-1507_Oct07)	Oct-08
DAE4	SN 601	30-Jan-07 (SPEAG, No. DAE4-601_Jan07)	Jan-08
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

Calibrated by:	Name	Function	Signature
	Marcel Fehr	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 20, 2007

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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 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.

## Measurement Conditions

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

<b>DASY Version</b>	DASY4	V4.7
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	1950 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	40.0	1.40 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	39.0 $\pm$ 6 %	1.38 mho/m $\pm$ 6 %
<b>Head TSL temperature during test</b>	(21.4 $\pm$ 0.2) °C	---	---

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	10.0 mW / g
SAR normalized	normalized to 1W	40.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	39.8 mW / g $\pm$ 17.0 % (k=2)

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	5.24 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	20.8 mW / g $\pm$ 16.5 % (k=2)

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## 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 ± 0.2) °C	52.9 ± 6 %	1.51 mho/m ± 6 %
Body TSL temperature during test	(21.8 ± 0.2) °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	10.3 mW / g
SAR normalized	normalized to 1W	41.2 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	41.2 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.44 mW / g
SAR normalized	normalized to 1W	21.8 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	21.7 mW / g ± 16.5 % (k=2)

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.7 $\Omega$ - 2.8 $j\Omega$
Return Loss	- 31.0 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.3 $\Omega$ - 2.1 $j\Omega$
Return Loss	- 25.3 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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.

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	October 20, 2006

# DASY4 Validation Report for Head TSL

Date/Time: 17.12.2007 12:12:25

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN1117**

Communication System: CW-1950; Frequency: 1950 MHz; Duty Cycle: 1:1

Medium: HSL1950;

Medium parameters used:  $f = 1950$  MHz;  $\sigma = 1.39$  mho/m;  $\epsilon_r = 39$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.78, 4.78, 4.78); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

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

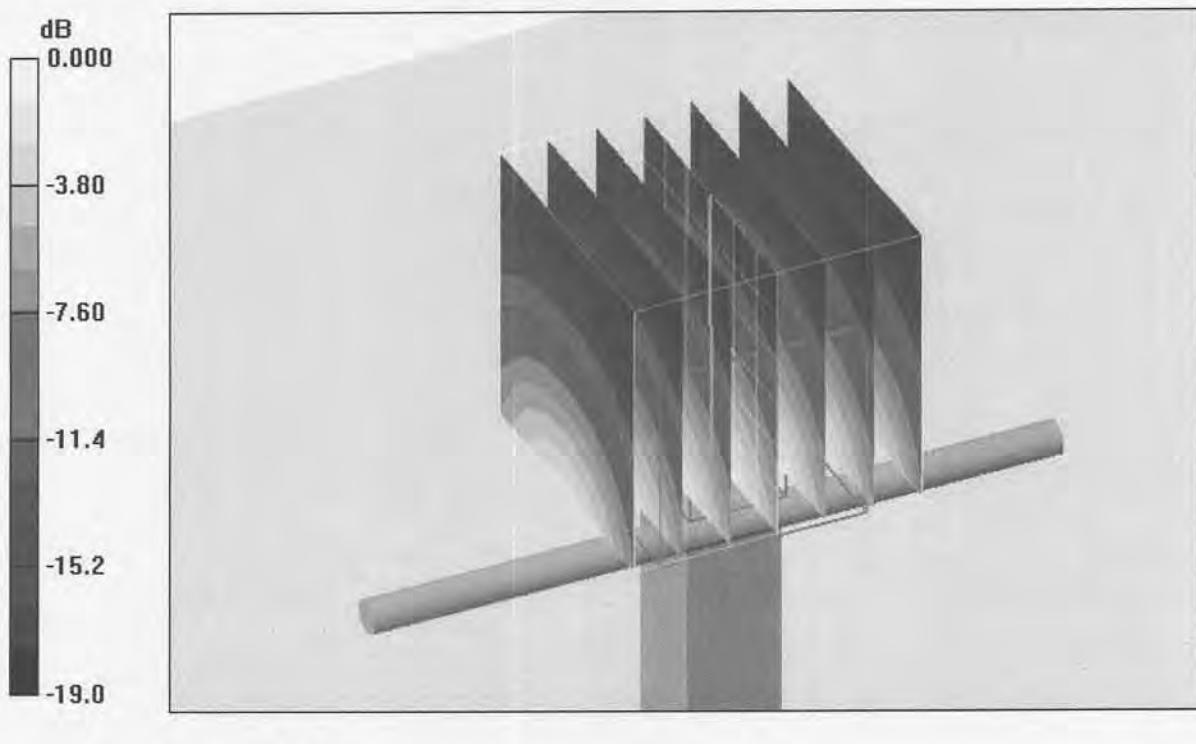
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.8 V/m; Power Drift = 0.012 dB

Peak SAR (extrapolated) = 17.3 W/kg

**SAR(1 g) = 10 mW/g; SAR(10 g) = 5.24 mW/g**

Maximum value of SAR (measured) = 11.3 mW/g



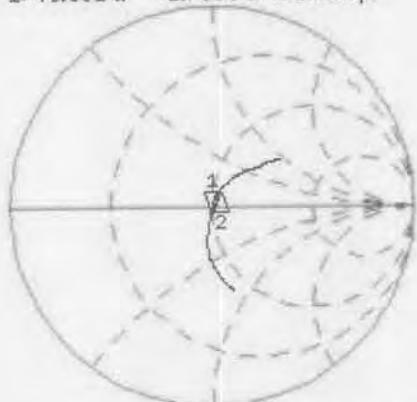
## Impedance Measurement Plot for Head TSL

17 Dec 2007 11:46:41  
CH1 S11 1 U FS 1: 49.682  $\Omega$  -2.7930  $\Delta$  29.223 pF 1 950.000 000 MHz

\*  
Del  
Cor

Avg  
16

↑



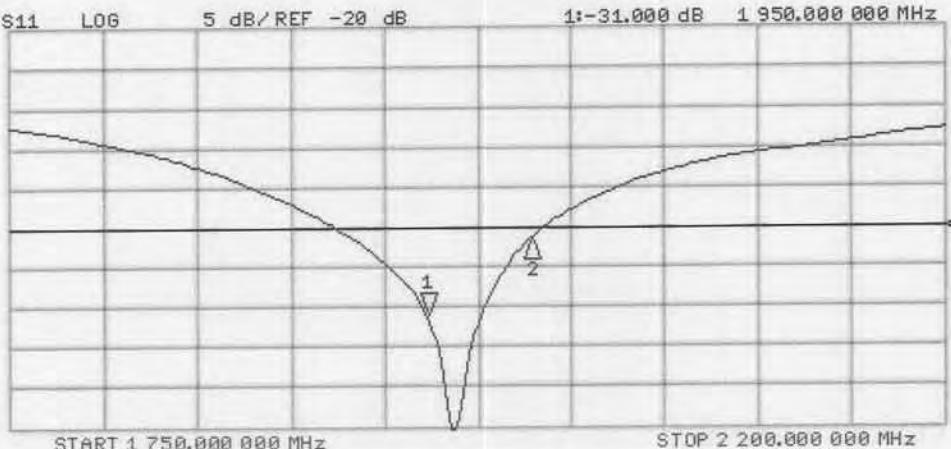
CH1 Markers  
1: 52.941  $\Omega$   
2: 8.2344  $\Omega$   
2.00000 GHz

CH2 S11 LOG 5 dB/REF -20 dB 1:-31.000 dB 1 950.000 000 MHz

Cor

Avg  
16

↑



CH2 Markers  
1:-31.000 dB  
2:-21.442 dB  
2.00000 GHz

# DASY4 Validation Report for Body TSL

Date/Time: 20.12.2007 14:08:46

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1950 MHz; Type: D1950V3; Serial: D1950V3 - SN1117**

Communication System: CW-1950; Frequency: 1950 MHz; Duty Cycle: 1:1  
Medium: MSL1950;

Medium parameters used:  $f = 1950$  MHz;  $\sigma = 1.51$  mho/m;  $\epsilon_r = 52.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507 (HF); ConvF(4.33, 4.33, 4.33); Calibrated: 26.10.2007
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.01.2007
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 172

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

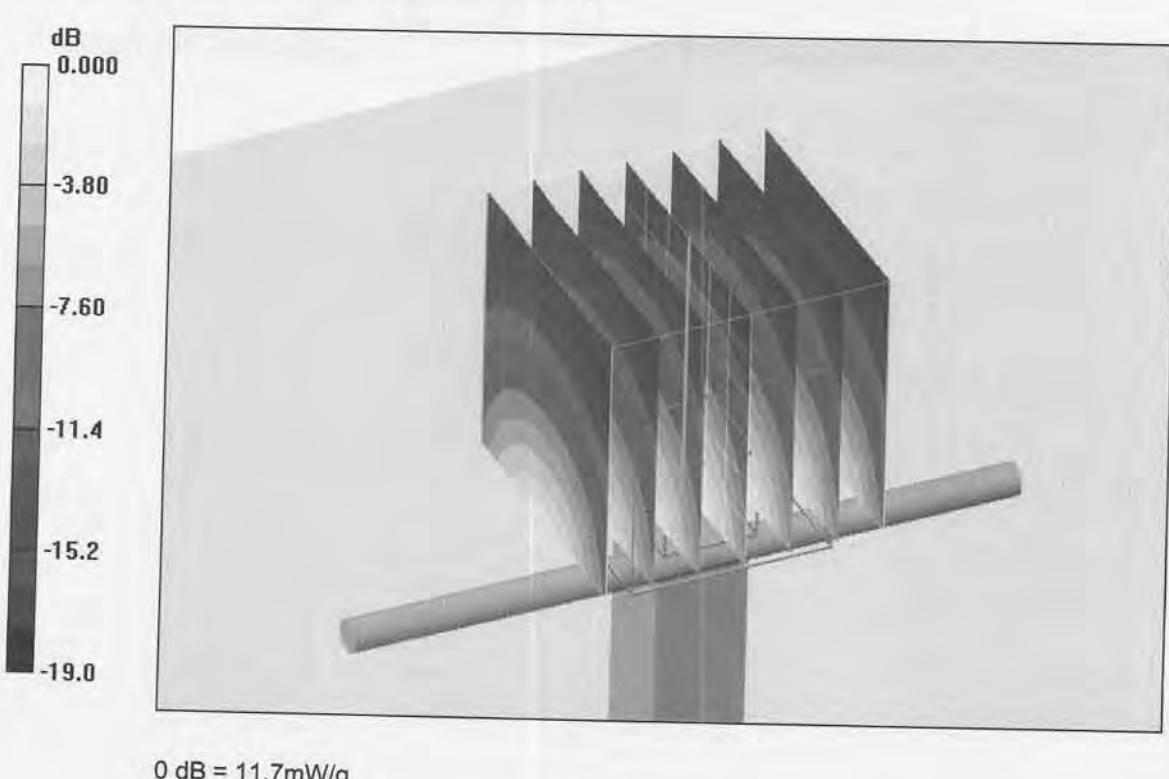
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.9 V/m; Power Drift = -0.007 dB

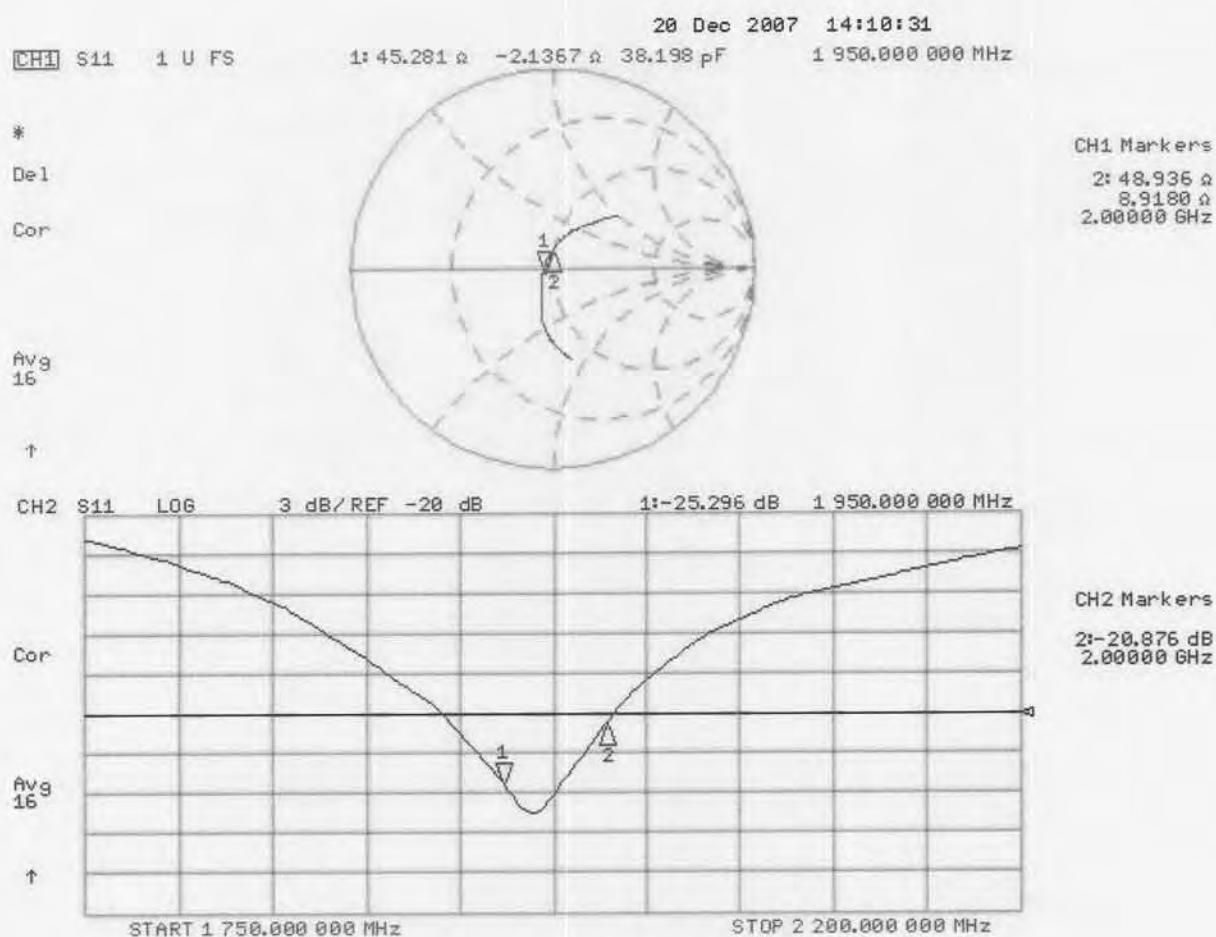
Peak SAR (extrapolated) = 18.0 W/kg

**SAR(1 g) = 10.3 mW/g; SAR(10 g) = 5.44 mW/g**

Maximum value of SAR (measured) = 11.7 mW/g



## Impedance Measurement Plot for Body TSL



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Engineering AG  
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accreditation No.: SCS 108

Client ATL (Auden)

Certificate No: ES3-3150\_Jan08

## CALIBRATION CERTIFICATE

Object ES3DV3 - SN:3150

Calibration procedure(s) QA CAL-01.v6  
Calibration procedure for dosimetric E-field probes

Calibration date: January 9, 2008

Condition of the calibrated item In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41495277	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Power sensor E4412A	MY41498087	29-Mar-07 (METAS, No. 217-00670)	Mar-08
Reference 3 dB Attenuator	SN: S5054 (3c)	8-Aug-07 (METAS, No. 217-00719)	Aug-08
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-07 (METAS, No. 217-00671)	Mar-08
Reference 30 dB Attenuator	SN: S5129 (30b)	8-Aug-07 (METAS, No. 217-00720)	Aug-08
Reference Probe ES3DV2	SN: 3013	2-Jan-08 (SPEAG, No. ES3-3013_Jan08)	Jan-09
DAE4	SN: 654	20-Apr-07 (SPEAG, No. DAE4-654_Apr07)	Apr-08

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-07)	In house check: Oct-08

Calibrated by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	

Approved by:	Fin Bomholt	R&D Director	

Issued: January 10, 2008

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**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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Accreditation No.: **SCS 108**

#### **Glossary:**

TSL	tissue simulating liquid
NORM $x,y,z$	sensitivity in free space
ConF	sensitivity in TSL / NORM $x,y,z$
DCP	diode compression point
Polarization $\varphi$	$\varphi$ 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:**

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

#### **Methods Applied and Interpretation of Parameters:**

- *NORM $x,y,z$* : Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM $x,y,z$  are only intermediate values, i.e., the uncertainties of NORM $x,y,z$  does not effect the  $E^2$ -field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORM $x,y,z$  \* frequency\_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z*: DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *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 $x,y,z$  \* ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  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.

ES3DV3 SN:3150

January 9, 2008

# Probe ES3DV3

SN:3150

Manufactured:

June 12, 2007

Calibrated:

January 9, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

## DASY - Parameters of Probe: ES3DV3 SN:3150

Sensitivity in Free Space <sup>A</sup>			Diode Compression <sup>B</sup>	
NormX	<b>1.24</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	89 mV
NormY	<b>1.25</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	93 mV
NormZ	<b>1.24</b> $\pm$ 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	98 mV

### Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

### Boundary Effect

TSL                    900 MHz            Typical SAR gradient: 5 % per mm

Sensor Center to Phantom Surface Distance	3.0 mm	4.0 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	11.0	6.8
SAR <sub>be</sub> [%]      With Correction Algorithm	0.8	0.5

TSL                    1810 MHz            Typical SAR gradient: 10 % per mm

Sensor Center to Phantom Surface Distance	3.0 mm	4.0 mm
SAR <sub>be</sub> [%]      Without Correction Algorithm	11.5	7.2
SAR <sub>be</sub> [%]      With Correction Algorithm	0.3	0.6

### Sensor Offset

Probe Tip to Sensor Center                    **2.0** mm

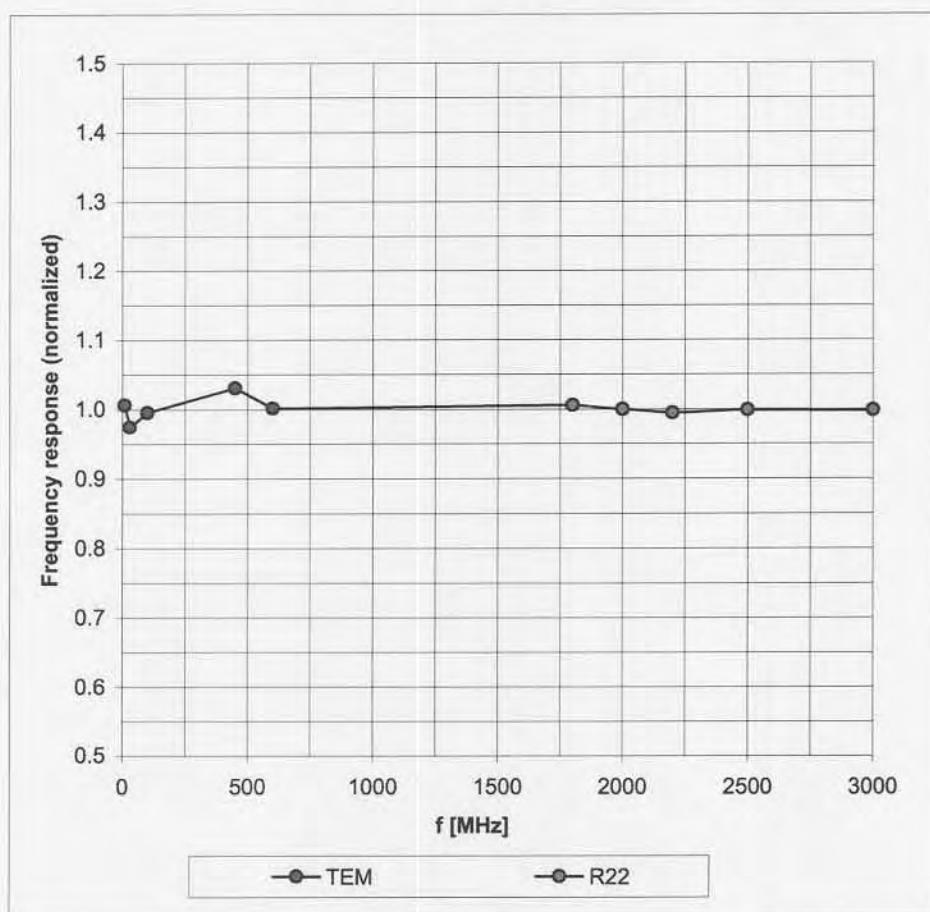
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor  $k=2$ , which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

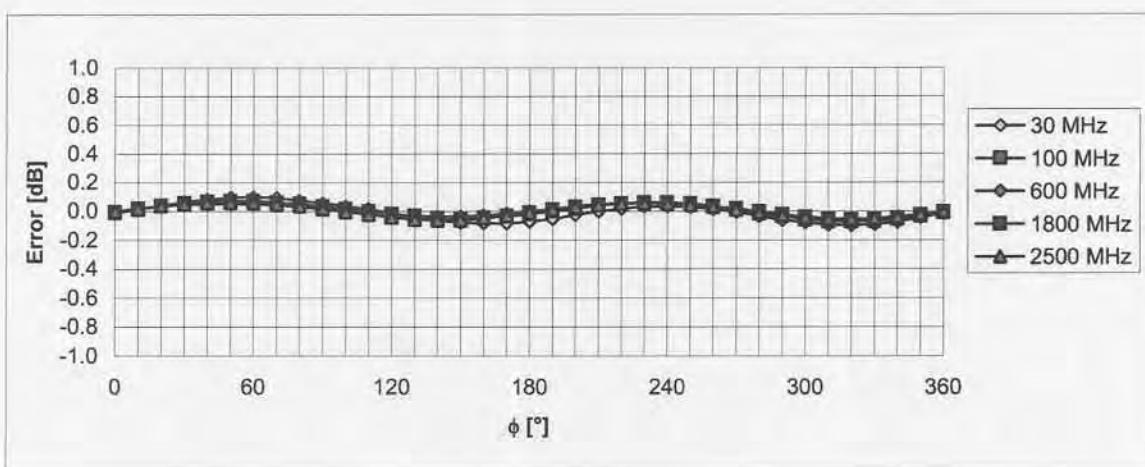
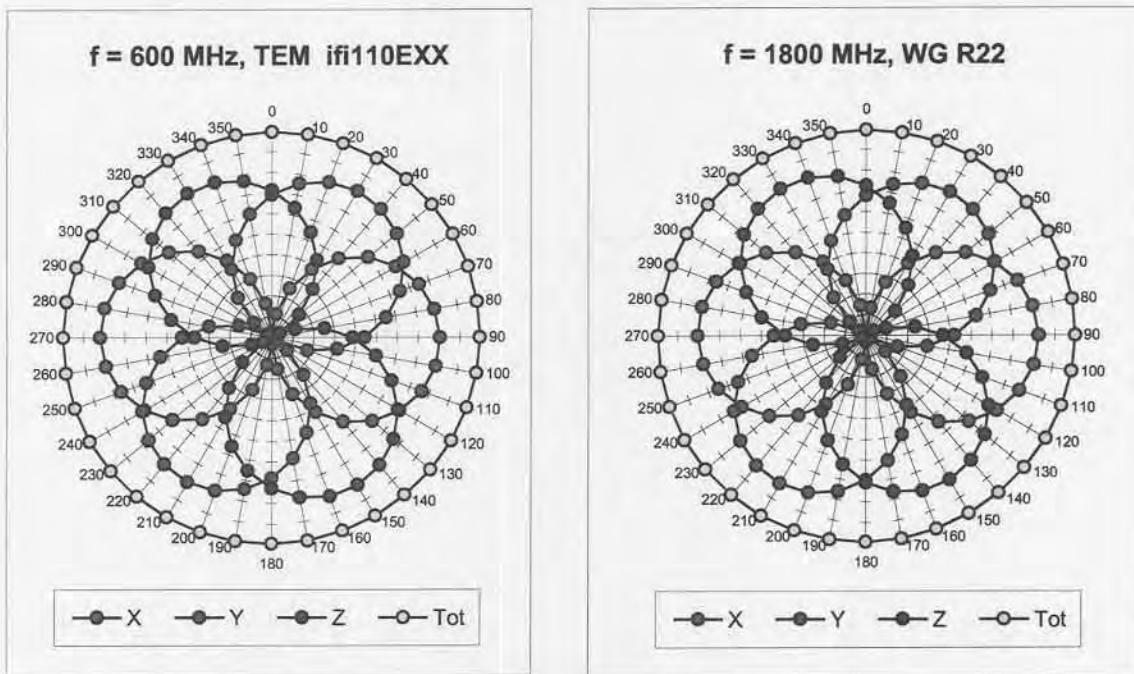
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

## Frequency Response of E-Field

(TEM-Cell:ifi110 EXX, Waveguide: R22)

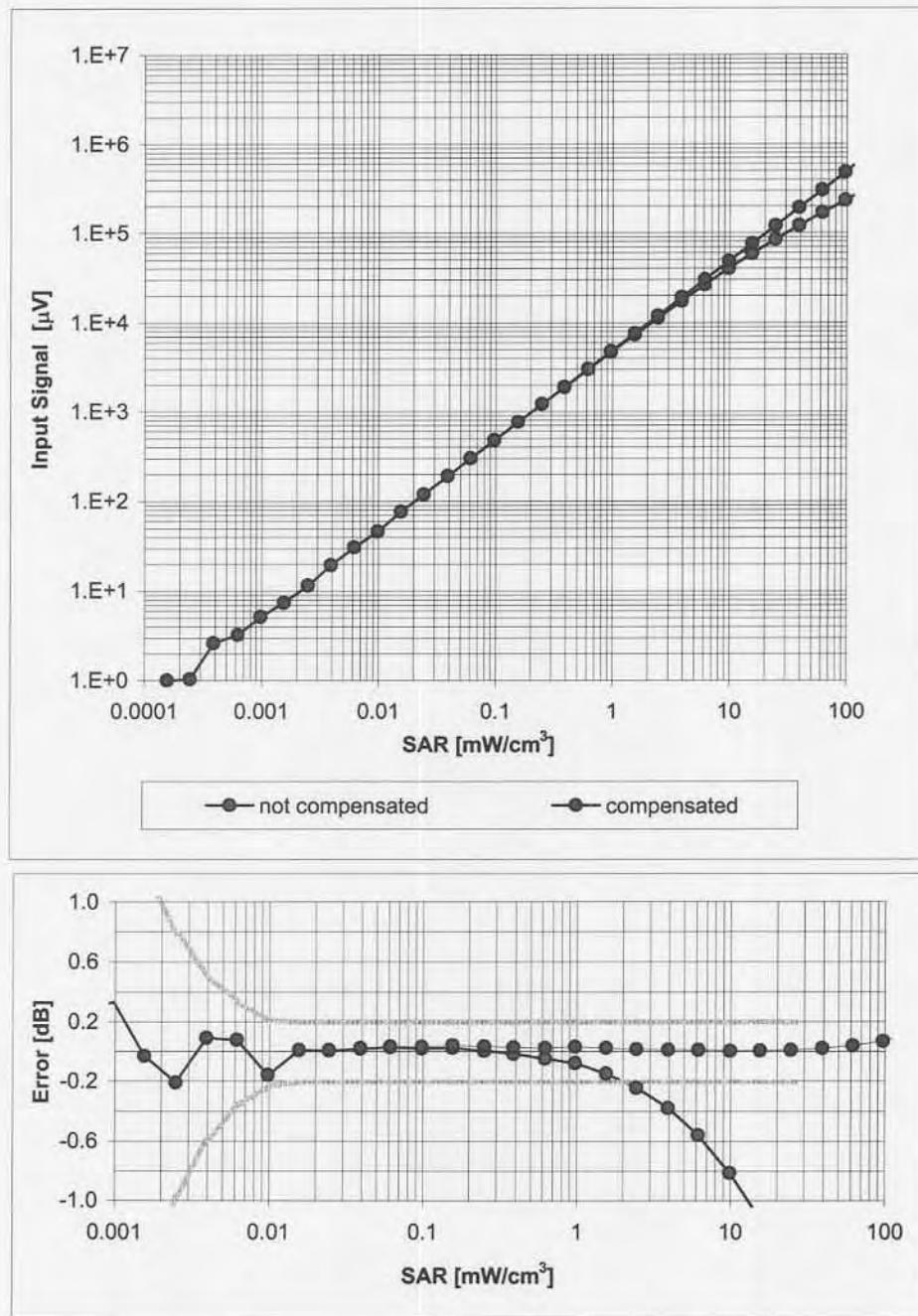


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

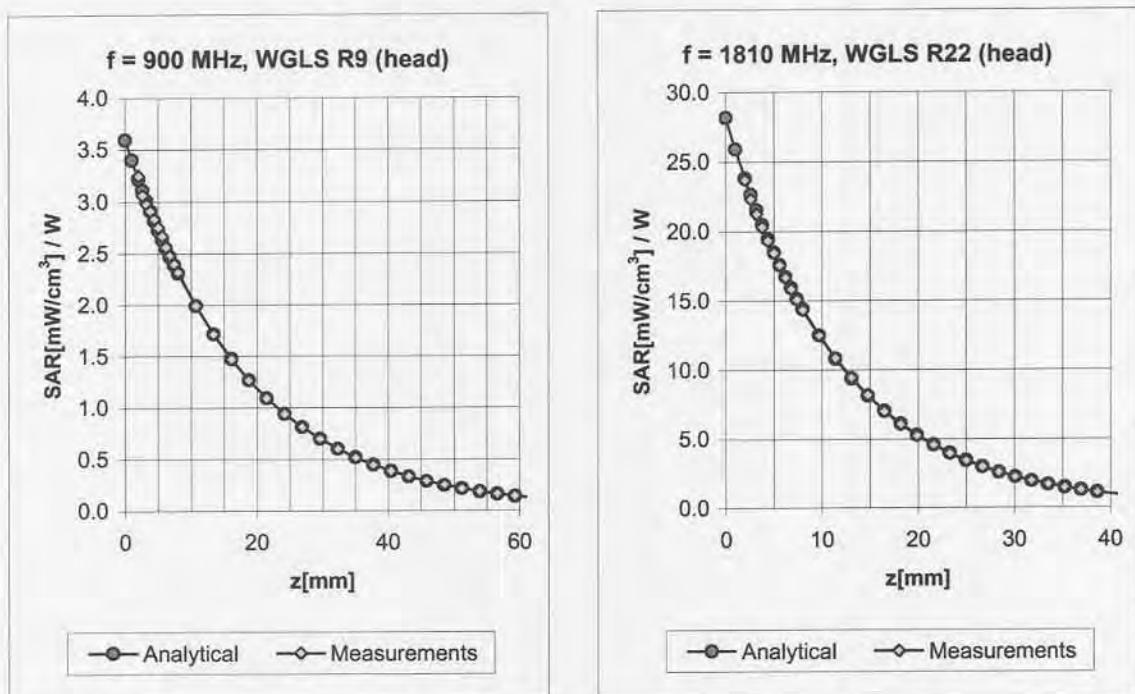
Receiving Pattern ( $\phi$ ),  $\vartheta = 0^\circ$ Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )

## Dynamic Range $f(\text{SAR}_{\text{head}})$

(Waveguide R22,  $f = 1800$  MHz)



## Conversion Factor Assessment



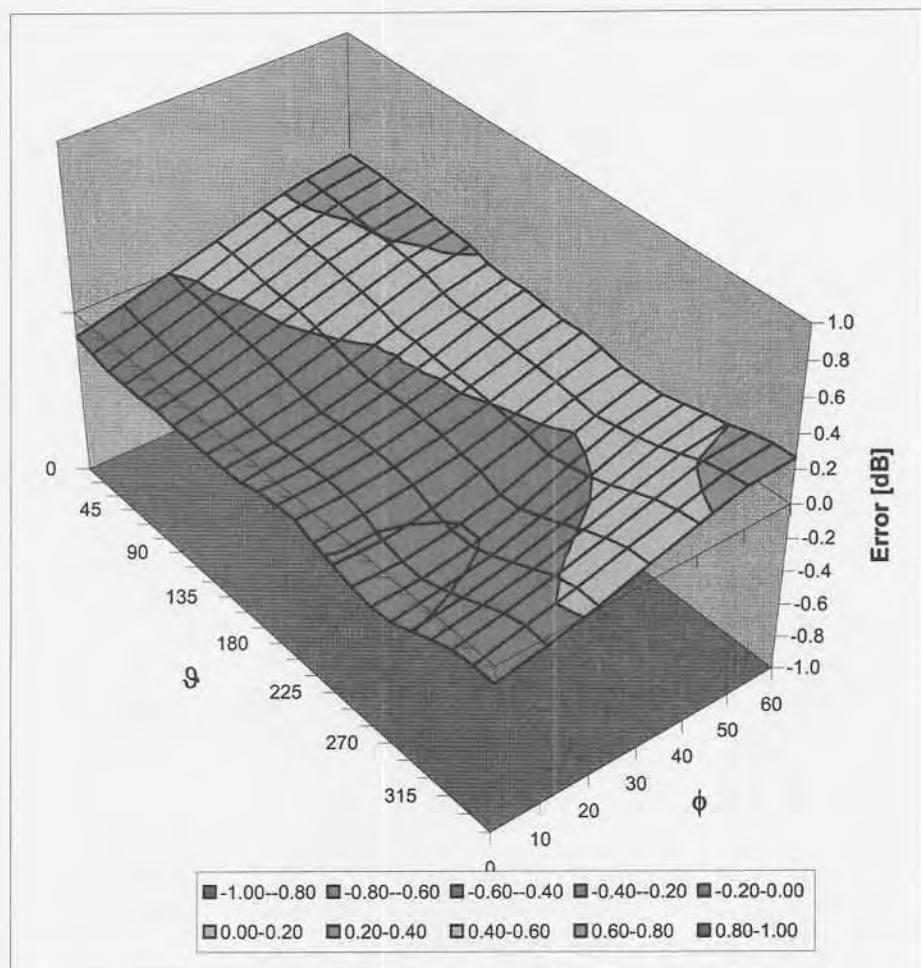
f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.77	1.35	6.23	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.89	1.24	5.11	± 11.0% (k=2)
2000	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.66	1.48	4.84	± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.63	1.52	4.54	± 11.8% (k=2)

900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.80	1.30	6.00	± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.96	1.12	4.95	± 11.0% (k=2)
2000	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.76	1.29	4.55	± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.63	1.48	4.19	± 11.8% (k=2)

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

## Deviation from Isotropy in HSL

Error ( $\phi, \theta$ ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment:  $\pm 2.6\%$  (k=2)



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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Client **ATL (Auden)**

Certificate No: **DAE4-541\_Feb08**

## **CALIBRATION CERTIFICATE**

Object **DAE4 - SD 000 D04 BA - SN: 541**

Calibration procedure(s) **QA CAL-06.v12**  
 Calibration procedure for the data acquisition electronics (DAE)

Calibration date: **February 21, 2008**

Condition of the calibrated item **In Tolerance**

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&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	04-Oct-07 (Elcal AG, No: 6467)	Oct-08
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-07 (Elcal AG, No: 6465)	Oct-08
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	25-Jun-07 (SPEAG, in house check)	In house check Jun-08

Calibrated by: **Dominique Steffen** **Technician**

Approved by: **Fin Bomholt** **R&D Director**

Issued: February 21, 2008

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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*: 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 =  $6.1\mu\text{V}$ , full range =  $-100\dots+300\text{ mV}$

Low Range: 1LSB =  $61\text{nV}$ , full range =  $-1\dots+3\text{mV}$

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

Calibration Factors	X	Y	Z
High Range	$404.553 \pm 0.1\% \text{ (k=2)}$	$404.428 \pm 0.1\% \text{ (k=2)}$	$404.184 \pm 0.1\% \text{ (k=2)}$
Low Range	$3.97173 \pm 0.7\% \text{ (k=2)}$	$3.93684 \pm 0.7\% \text{ (k=2)}$	$3.96862 \pm 0.7\% \text{ (k=2)}$

## Connector Angle

Connector Angle to be used in DASY system	$290^\circ \pm 1^\circ$
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## Appendix

### 1. DC Voltage Linearity

High Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	200000	199999.9	0.00
Channel X	+ Input	20000	20002.87	0.01
Channel X	- Input	20000	-19997.28	-0.01
Channel Y	+ Input	200000	199999.5	0.00
Channel Y	+ Input	20000	20001.43	0.01
Channel Y	- Input	20000	-20004.21	0.02
Channel Z	+ Input	200000	200000	0.00
Channel Z	+ Input	20000	20003.17	0.02
Channel Z	- Input	20000	-19998.79	-0.01

Low Range		Input (µV)	Reading (µV)	Error (%)
Channel X	+ Input	2000	1999.9	0.00
Channel X	+ Input	200	199.79	-0.11
Channel X	- Input	200	-200.09	0.05
Channel Y	+ Input	2000	2000.1	0.00
Channel Y	+ Input	200	198.90	-0.55
Channel Y	- Input	200	-200.97	0.48
Channel Z	+ Input	2000	2000	0.00
Channel Z	+ Input	200	199.31	-0.34
Channel Z	- Input	200	-201.36	0.68

### 2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (µV)	Low Range Average Reading (µV)
Channel X	200	11.16	10.95
	-200	-9.91	-9.67
Channel Y	200	1.42	1.42
	-200	-1.87	-2.26
Channel Z	200	0.58	0.99
	-200	-1.95	-1.99

### 3. Channel separation

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

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	2.35	0.20
Channel Y	200	-0.03	-	4.55
Channel Z	200	-0.58	1.56	-

#### 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	15942	16726
Channel Y	15760	15821
Channel Z	15963	16142

#### 5. Input Offset Measurement

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

Input 10MΩ

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	-0.11	-0.75	0.62	0.26
Channel Y	-0.69	-1.68	1.12	0.40
Channel Z	-0.80	-1.52	0.03	0.27

#### 6. Input Offset Current

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

#### 7. Input Resistance

	Zeroing (MΩ)	Measuring (MΩ)
Channel X	0.2000	198.4
Channel Y	0.2000	202.1
Channel Z	0.2000	202.2

#### 8. Low Battery Alarm Voltage (verified during pre test)

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

#### 9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9