

# Full SAR Test Report

**Applicant Name: RM Acquisition LLC**

**Applicant Address: 9855 Woods Drive Skokie. IL 60077 U.S.A**

The following samples were submitted and identified on behalf of the client as:

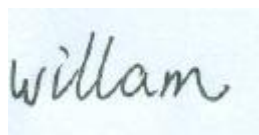
Sample Description	GPS
Model Number	TND 720 , RVND 7720
Final Software Version Tested	V1.0
Final Hardware Version Tested	A5.RM.2T720.120411.2
FCC ID	A4C-10001A
IC ID	10199A-10001A
Date Initial Sample Received	04-28,2012
Testing Start Date	05-03,2012
Testing End Date	05-03,2012

According to:

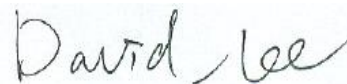
FCC 47CFR § 2.1093, IEEE Std C95.1-2005, IEEE Std C95.3-2005  
 IEEE1528-2003, OET Bulletin 65 Supplement C, RSS - 102 issue 4

Comments/ Conclusion:

The configuration tested complied to the certification requirements specified in this report.  
 Signed for on behalf of SGS



**Prepared**



**approved**

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## Change History

Version	Change Contents	Author	Date
V1.0	First edition	willam_wang	05-03, 2012
V2.0	Add AV power, add another model No. ,add RSS 102	willam_wang	05-13, 2012

## 1. Report Overview

This report details the results of testing carried out on the samples listed in section 17, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this test report is used in any configuration other than that detailed in the test report, the manufacturer must ensure the new configuration complies with all relevant standards and certification requirements. Any mention of SGS Shanghai EMC lab or testing done by SGS Shanghai EMC lab made in connection with the distribution or use of the tested product must be approved in writing by SGS Shanghai EMC lab.

## 2. Test Lab Declaration or Comments

None

## 3. Applicant Declaration or Comments

None

## 4. Full Test Report

A full test report contains, within the results section, all the applicable test cases from the certification requirements of the permanent reference documents of the listed certification bodies.

## 5. Partial Test Report

A partial test report contains within the results section a sub-set of all the applicable test cases from the certification requirements of the permanent reference documents of the listed certification bodies.

## 6. Measurement Uncertainty

Measurements and results are all in compliance with the standards listed in section 12 of this report. All measurements and results are recorded and maintained at the laboratory performing the tests and measurement uncertainties are taken into account when comparing measurements to pass/ fail criteria.

A	b1	c	d	e = f(d,k)	g	i = cxg/e	k
Uncertainty Component	Section in P1528	Tol (%)	Prob . Dist.	Div.	Ci (1g)	1g ui (%)	Vi (Veff)
Probe calibration	E.2.1	6.3	N	1	1	6.0	∞
Axial isotropy	E.2.2	0.5	R	$\sqrt{3}$	$(1-c_p)^{1/2}$	0.20	∞
hemispherical isotropy	E.2.2	2.6	R	$\sqrt{3}$	$\sqrt{c_p}$	1.06	∞
Boundary effect	E.2.3	0.8	R	$\sqrt{3}$	1	0.46	∞
Linearity	E.2.4	0.6	R	$\sqrt{3}$	1	0.35	∞
System detection limit	E.2.5	0.25	R	$\sqrt{3}$	1	0.15	∞
Readout electronics	E.2.6	0.3	N	1	1	0.3	∞
Response time	E.2.7	0	R	$\sqrt{3}$	1	0	∞
Integration time	E.2.8	2.6	R	$\sqrt{3}$	1	1.5	∞
RF ambient Condition –Noise	E.6.1	3	R	$\sqrt{3}$	1	1.73	∞
RF ambient Condition - reflections	E.6.1	3	R	$\sqrt{3}$	1	1.73	∞
Probe positioning- mechanical tolerance	E.6.2	1.5	R	$\sqrt{3}$	1	0.87	∞
Probe positioning- with respect to phantom	E.6.3	2.9	R	$\sqrt{3}$	1	1.67	∞
Max. SAR evaluation	E.5.2	1	R	$\sqrt{3}$	1	0.58	∞
Test sample positioning	E.4.2	4	N	1	1	3.7	9
Device holder uncertainty	E.4.1	3.6	N	1	1	3.6	∞
Output power variation –SAR drift measurement	6.62	5	R	$\sqrt{3}$	1	2.89	∞
Phantom uncertainty (shape and thickness tolerances)	E.3.1	4	R	$\sqrt{3}$	1	2.31	∞
Liquid conductivity - deviation from target values	E.3.2	5	R	$\sqrt{3}$	0.64	1.85	∞
Liquid conductivity - measurement uncertainty	E.3.2	4	N	1	0.64	2.56	5
Liquid permittivity - deviation from target values	E.3.3	5	R	$\sqrt{3}$	0.6	1.73	∞
Liquid permittivity - measurement uncertainty	E.3.3	4	N	1	0.6	2.40	5
Combined standard uncertainty				RSS		10.43	430
Expanded uncertainty (95% CONFIDENCE INTERVAL)				K=2		20.86	

## 7. Testing Environment

Normal Temperature	+20 to +24 °C
Relative Humidity	35 to 60 %

## 8. Primary Test Laboratory

Name:	SGS-CSTC Standards Technical Services(Shanghai) Co., Ltd
Address:	No.588, West Jindu Road, Songjiang District, Shanghai, China 201612
Telephone:	+86 (0) 21 6191 5664
Fax:	+86 (0) 21 6191 5678
Internet:	<a href="http://www.cn.sgs.com">http://www.cn.sgs.com</a>
Contact:	Mr. David.Lee
Email:	<a href="mailto:David-jc.lee@sgs.com">David-jc.lee@sgs.com</a>

## 9. Details of Applicant

Name:	RM Acquisition LLC
Address:	9855 Woods Drive Skokie. IL 60077 U.S.A
Telephone:	N/A
Fax:	N/A
Contact:	N/A
Email:	N/A

## 10. Details of Manufacturer

Name:	ELECTRONICS TECHNOLOGY(DONG GUAN)COMPANY LIMITED
Address:	No.161, Xin Min Road, Tong Luo Wei Industrial Zone, Jin Xia, Chang An Town, Dong Guan City, Guang Dong Province, China
Telephone:	N/A
Fax:	N/A
Contact:	N/A
Email:	N/A

## 11. Other testing Locations

Name:	Not Required
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<b>Address:</b>	--
<b>Telephone:</b>	--
<b>Contact:</b>	--
<b>Email:</b>	--

## 12. Referenced Documents

The Equipment under Test (EUT) has been tested at SGS's (own or subcontracted) laboratories according to FCC 47CFR § 2.1093, IEEE Std C95.1-2005, IEEE1528-2003, OET Bulletin 65 Supplement C, RSS - 102 issue 4

The following table summarizes the specific reference documents such as harmonized standards or test specifications which were used for testing at SGS's (own or subcontracted) laboratories.

Identity	Document Title	Version
FCC 47CFR § 2.1093	Radiofrequency radiation exposure evaluation: portable devices	2001
IEEE Std C95.1-2005	IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.	2005
IEEE1528-2003	IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques	2003
OET Bulletin 65 Supplement C	Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions	2001
RSS - 102 issue 4	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)	2010
KDB 447498 D01	Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies	2009
KDB 248227 D01	SAR Measurement Procedures for 802.11 a/b/g Transmitters	2007

Human Exposure	Uncontrolled Environment General Population
Spatial Peak SAR	1.60 W/kg (averaged over a mass of 1g)

Table 12-1 RF Exposure Limits

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Notes:

Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.

### 13. Primary Laboratory Accreditation Details

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

- **CNAS (No. CNAS L0599)**

CNAS has accredited SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing. Date of expiry: 2014-07-26.



## 14. Test Equipment Information

### 14.1 SPEAG DASY4

Test Platform	SPEAG DASY4 Professional			
Location	SGS SH Lab #8			
Manufacture	SPEAG			
Description	SAR Test System (Frequency range 300MHz-3GHz) 835, 900, 1800, 1900, 2000, 2450 frequency band HAC Extension			
Software Reference	DASY4: V4.7 Build 80 SEMCAD: V1.8 Build 186			
Hardware Reference				
Equipment	Model	Serial Number	Calibration Date	Due date of calibration
Robot	RX90L	F03/5V32A1/A01	n/a	n/a
Phantom	SAM 12	TP-1283	n/a	n/a
DAE	DAE3	569	2011-11-16	2012-11-15
E-Field Probe	ES3DV3	3088	2011-11-23	2012-11-22
Validation Kits	D2450V2	733	2011-11-09	2012-11-08
Agilent Network Analyzer	E5071B	MY42100549	2011-11-01	2012-10-31
RF Bi-Directional Coupler	ZABDC20-252H	n/a	2011-05-18	2012-05-17
Agilent Signal Generator	E4438C	14438CATO-1971 9	2011-11-01	2012-10-31
Mini-Circuits Preamplifier	ZHL-42	D041905	2011-11-01	2012-10-31
Agilent Power Meter	E4416A	GB41292095	2011-11-01	2012-10-31
Agilent Power Sensor	8481H	MY41091234	2011-11-01	2012-10-31
R&S Power Sensor	NRP-Z92	100025	2012-04-13	2013-04-12
R&S Universal Radio Communication Tester	CMU200	103633	2011-11-01	2012-10-31

## 14.2 The SAR Measurement System

A photograph of the SAR measurement System is given in Fig. 15-1.

This SAR Measurement System uses a Computer-controlled 3-D stepper motor system (Speag Dasy 4 professional system). A Model ES3DV3 3088 E-field probe is used to determine the internal electric fields. The SAR can be obtained from the equation  $SAR = \sigma (|E_i|^2) / \rho$  where  $\sigma$  and  $\rho$  are the conductivity and mass density of the tissue-stimulant.

The DASY4 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stabile RX family) with controller, teach pendant and software. An arm extension is for accommodation the data acquisition electronics (DAE).

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

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

The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.

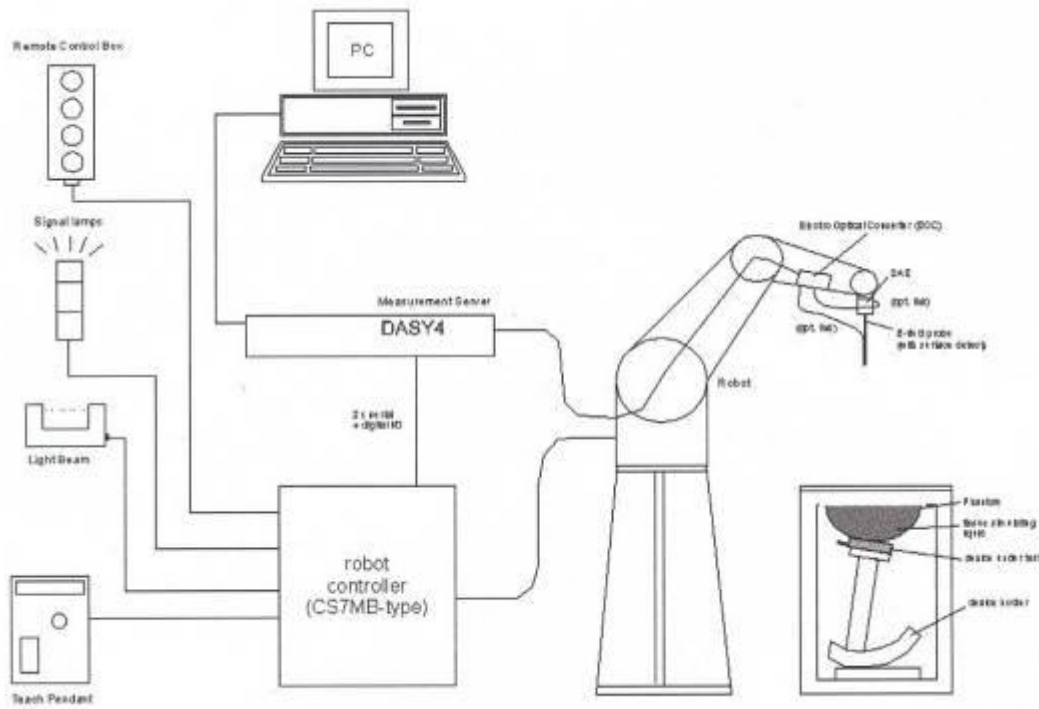


Fig. 15-1 SAR System Configuration

- ÷ The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- ÷ A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- ÷ A computer operating Windows 2000.
- ÷ DASY4 software.
- ÷ Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- ÷ The SAM twin phantom enabling testing left-hand, right-hand and BodyWorn usage.
- ÷ The device holder for handheld mobile phones.
- ÷ Tissue simulating liquid mixed according to the given recipes.
- ÷ Validation dipole kits allowing to validating the proper functioning of the system.

### 14.3 Isotropic E-field Probe ES3DV3

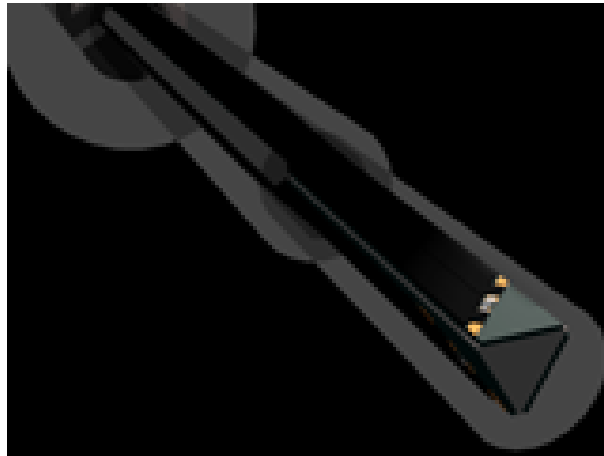
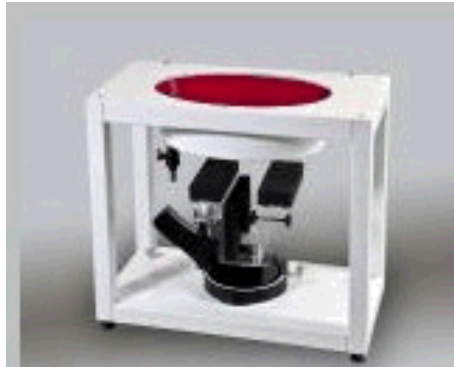


Fig. 15-2 E-field Probe

<b>Construction</b>	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
<b>Calibration</b>	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 900 and HSL 1810 Additional CF for other liquids and frequencies upon request
<b>Frequency</b>	10 MHz to 4 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 4 GHz)
<b>Directivity</b>	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.3$ dB in tissue material (rotation normal to probe axis)
<b>Dynamic Range</b>	5 $\mu$ W/g to > 100 mW/g; Linearity: $\pm 0.2$ dB
<b>Dimensions</b>	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
<b>Application</b>	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

#### 14.4 EL14 Phantom



Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.

<b>Material</b>	Vinylester, glass fiber reinforced (VE-GF)
<b>Liquid Compatibility</b>	Compatible with all SPEAG tissue simulating liquids (incl. DEGMBE type)
<b>Shell Thickness</b>	2.0 ± 0.2 mm (bottom plate)
<b>Dimensions</b>	Major axis: 600 mm Minor axis: 400 mm
<b>Filling Volume</b>	approx. 30 liters
<b>Wooden Support</b>	SPEAG standard phantom table
<b>Accessories</b>	<u>Mounting Device for Transmitters</u>

## 14.5 Device Holder for Transmitters



Fig. 15-4 Device Holder for Transmitters

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source in 5mm distance, a positioning uncertainty of  $\pm 0.5\text{mm}$  would produce a SAR uncertainty of  $\pm 20\%$ . An accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions, in which the devices must be measured, are defined by the standards.

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

The DASY device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity  $\epsilon=3$  and loss tangent  $\tan \delta=0.02$ . The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

## 15. Detailed Test Results

### 15.1 Summary of Results

#### 15.1.1 Measurement of RF conducted Power (dBm)

##### PK Power

Mode		802.11b			
Date Rate		1Mbps	2Mbps	5.5Mbps	11Mbps
Power(dBm)	1	15.98	15.78	16.86	17.33
	6	16.62	17.28	17.96	18.17
	11	17.08	17.78	17.89	18.56

Mode		802.11g							
Date Rate		6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
Power(dBm)	1	17.59	17.95	18.12	17.53	18.18	18.15	17.97	18.42
	6	17.50	17.65	17.79	17.98	18.28	18.45	18.77	19.02
	11	17.98	18.29	18.42	18.59	18.98	19.15	19.57	19.97

##### AV Power

Mode		802.11b			
Date Rate		1Mbps	2Mbps	5.5Mbps	11Mbps
Power(dBm)	1	14.12	14.05	15.31	15.67
	6	14.44	15.07	15.74	15.98
	11	14.84	15.52	15.65	16.40

Mode		802.11g							
Date Rate		6Mbps	9Mbps	12Mbps	18Mbps	24Mbps	36Mbps	48Mbps	54Mbps
Power(dBm)	1	11.55	11.94	12.06	11.43	12.08	12.10	11.96	12.29
	6	11.34	11.41	11.55	11.69	12.04	12.24	12.54	12.86
	11	11.75	12.04	12.28	12.33	12.74	12.97	13.39	13.74

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## 15.1.2 Measurement of SAR average value

### WIFI

Band	EUT Position	Mode	Test Configuration	Averaged SAR over 1g (W/kg)			SAR limit 1g (W/kg)	Verdict
				CH1	CH6	CH11		
				2412MHz	2437MHz	2462MHz		
WIFI 2450	Body Worn	802.11 b	Back of EUT facing phantom(1Mbps)	--	0.159	--	1.6	Passed
			Front of EUT facing phantom(1Mbps)	--	0.094	--	1.6	Passed
			Top of EUT facing phantom(1Mbps)	--	0.022	--	1.6	Passed
			Bottom of EUT facing phantom(1Mbps)	0.626	0.392	0.244	1.6	Passed
			Left of EUT facing phantom(1Mbps)	--	0.030	--	1.6	Passed
			Right of EUT facing phantom(1Mbps)	--	0.043	--	1.6	Passed
		Bottom of EUT facing phantom(11Mbps)	0.370	--	--	1.6	Passed	
		802.11 g	Bottom of EUT facing phantom(6Mbps)	0.237	--	--	1.6	Passed
			Bottom of EUT facing phantom(54Mbps)	0.154	--	--	1.6	Passed

## 15.2 Maximum Results

The maximum measured SAR values for BodyWorn configuration are given in section 15.2.1

### 15.2.1 Head Configuration

Frequency Band	EUT Position	Conducted Power (dBm)	SAR, Averaged over 1g (W/kg)	Power Drift (dB)	SAR limit (W/kg)	Verdict
2450MHz	Bottom of EUT facing phantom Low(802.11b)	14.12	0.626	0.088	1.6	Passed

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**15.2.2 Maximum Drift**

Maximum Drift during measurement	-0.201dB
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**15.2.3 Measurement Uncertainty**

Extended Uncertainty (k=2) 95%	20.86%
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**15.3 Operation Configurations**

The EUT is measured using chipset based test mode software to ensure the results are consistent and reliable, during tests.

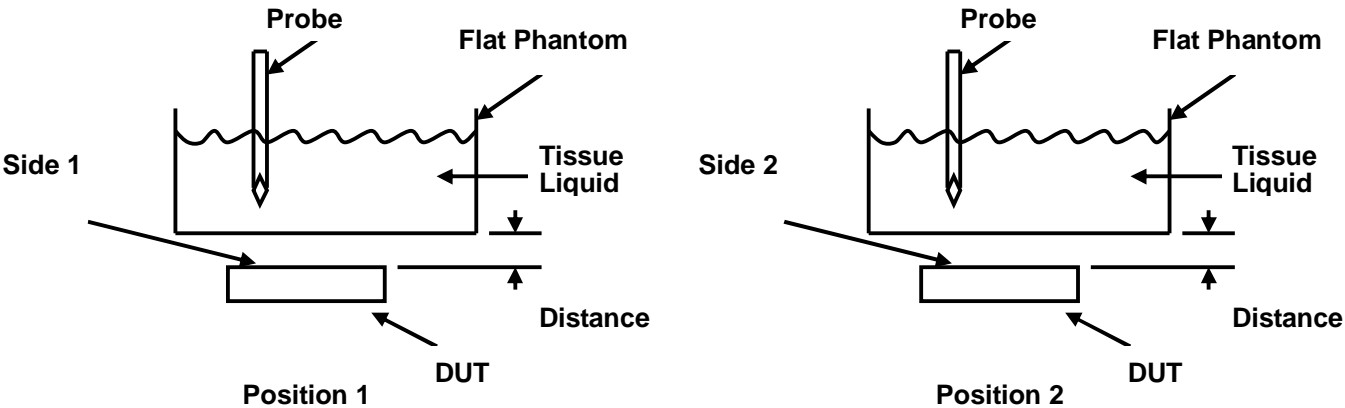
1. The EUT is tested at 1, 6 , 11 channels.
2. The EUT is tested at 100% duty factor.
3. Test reduction has been adopted according to conducted output power and produced SAR level:

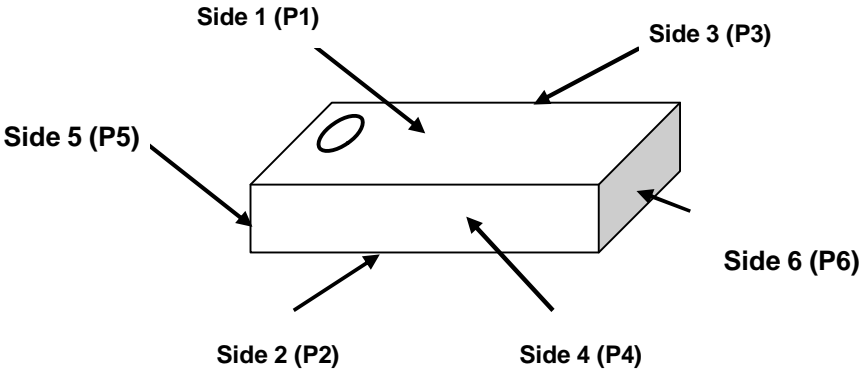
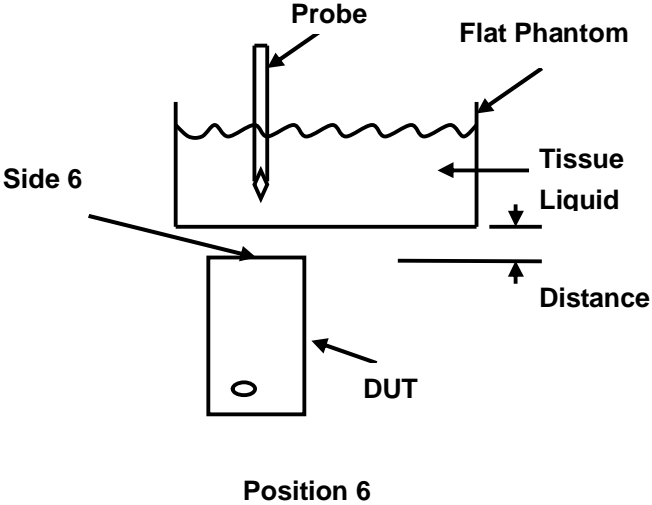
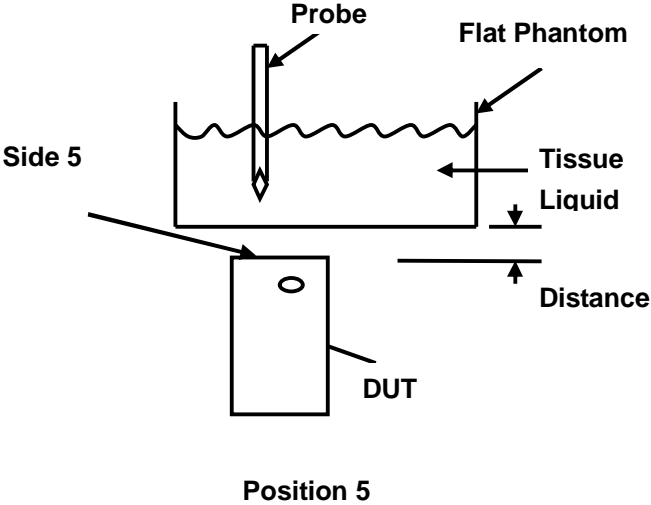
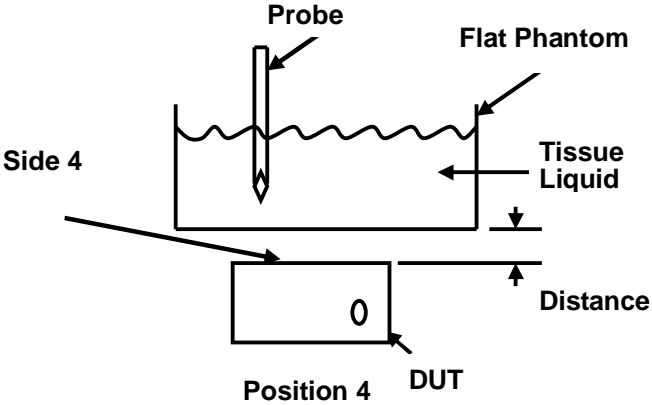
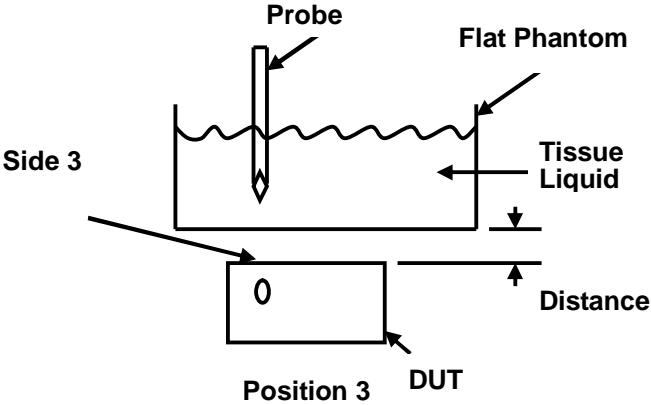
Low and High channel SAR are optional if SAR value produced in the middle channel is 3dB lower than the applicable SAR limit;

4. The (max. cube) labeling indicates that during the grid scanning an additional peak was found which within 2dB of the highest peak

5. Test positions of EUT(the distance between the EUT and the phantom is 0mm for all the six sides)

Note: P is abbreviation of position specified above.





## 15.4 Measurement procedure

### Step 1: Power reference measurement

The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.

### Step 2: Area scan

The SAR distribution at the exposed side of the head was measured at a distance of 4mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm\*15mm or 10mm\*10mm. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation.

### Step 3: Zoom scan

Around this point, a volume of 30mm\*30mm\*30mm (fine resolution volume scan, zoom scan) was assessed by measuring 7\*7\*7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

The data at the surface was extrapolated, since the center of the dipoles is 2.0mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. (This can be variable. Refer to the probe specification) the extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The volume was integrated with the trapezoidal algorithm. One thousand points (10\*10\*10) were interpolated to calculate the average. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

### Step 4: Power reference measurement (drift)

The SAR value at the same location as in step 1 was again measured. (If the value changed by more than 5%, the evaluation should be done repeatedly)

## 15.5 Detailed Test Results

### 16.5.1 802.11b-BackSide-Middle(1Mbps)

Date/Time: 2012-5-3 9:42:40

#### Test Laboratory: SGS-GSM

TND 720 802.11b BodyWorn Back side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

Communication System: 802.11b/g; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

#### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (101x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.158 mW/g

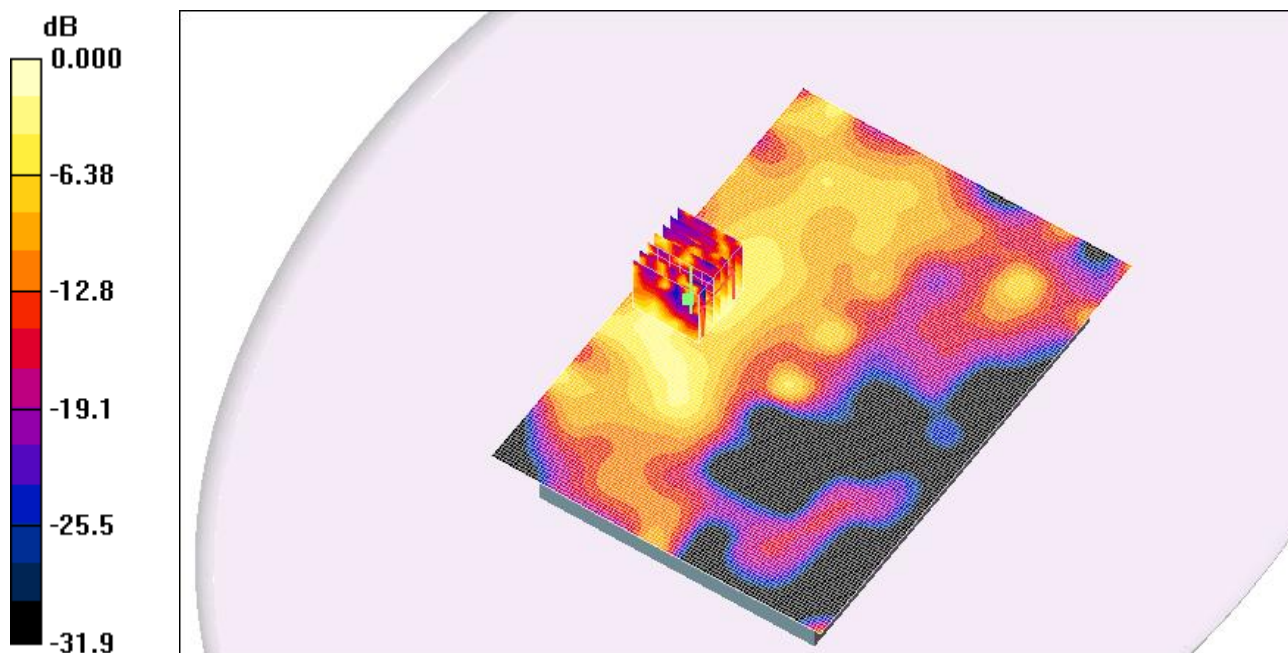
Back Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 1.58 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 0.404 W/kg

SAR(1 g) = 0.159 mW/g; SAR(10 g) = 0.071 mW/g

Maximum value of SAR (measured) = 0.201 mW/g



0 dB = 0.201mW/g

SHEMC

### 16.5.2 802.11b-FrontSide-Middle(1Mbps)

Date/Time: 2012-5-3 10:17:09

**Test Laboratory: SGS-GSM**

TND 720 802.11b BodyWorn Front side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2437 MHz;Duty Cycle: 1:1**

**Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>**

**Phantom section: Flat Section**

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (101x141x1): **Measurement grid: dx=15mm, dy=15mm**

**Maximum value of SAR (interpolated) = 0.098 mW/g**

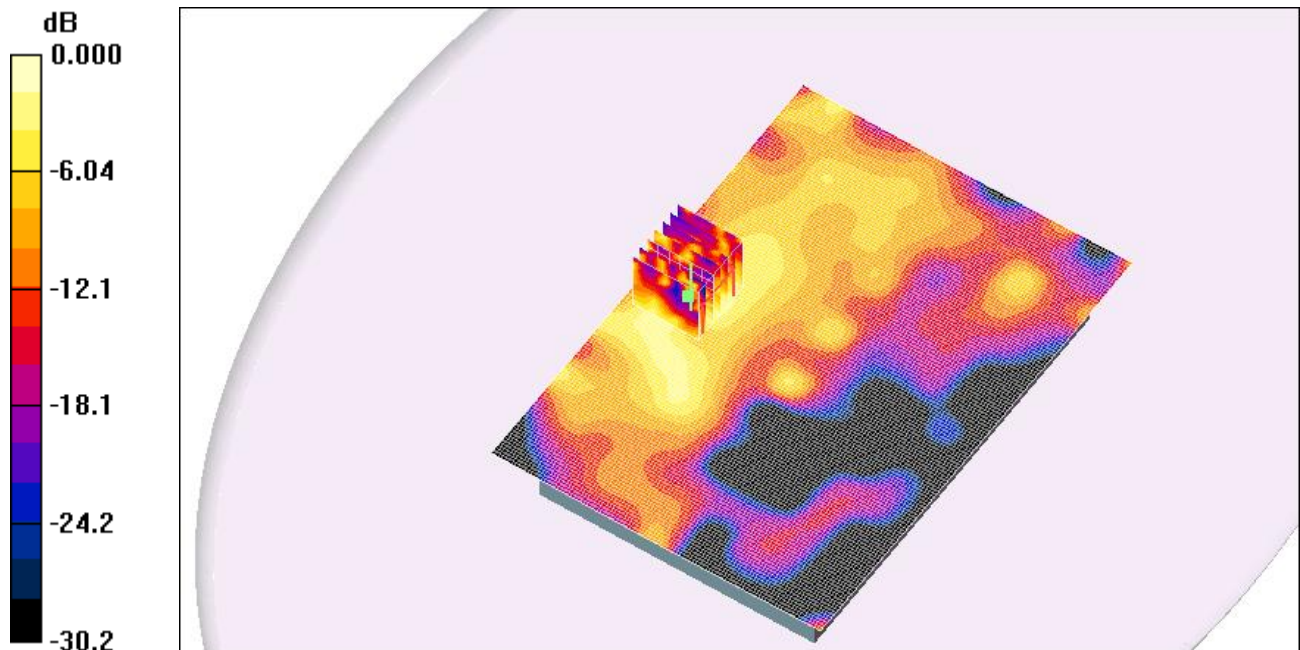
Back Middle/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm**

**Reference Value = 0.000 V/m; Power Drift =0.01 dB**

**Peak SAR (extrapolated) = 0.273 W/kg**

SAR(1 g) = 0.094 mW/g; SAR(10 g) = 0.042 mW/g

**Maximum value of SAR (measured) = 0.117 mW/g**



0 dB = 0.117mW/g

**SHEMC**

### 16.5.3 802.11b-TopSide-Middle(1Mbps)

Date/Time: 2012-5-3 13:08:54

**Test Laboratory: SGS-GSM**

TND 720 802.11b BodyWorn Top side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2437 MHz;Duty Cycle: 1:1**

**Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>**

**Phantom section: Flat Section**

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (51x15x1): **Measurement grid: dx=15mm, dy=15mm**

**Maximum value of SAR (interpolated) = 0.041 mW/g**

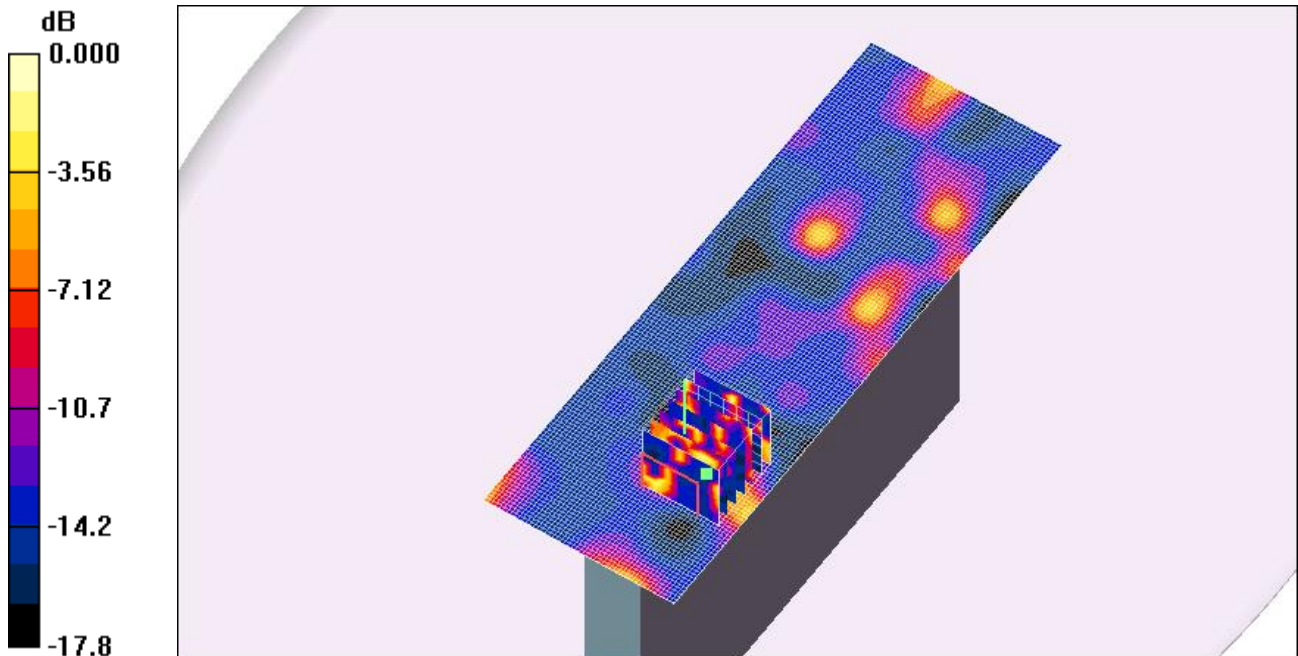
Back Middle/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm**

**Reference Value = 1.25 V/m; Power Drift = 0.16 dB**

**Peak SAR (extrapolated) = 0.073 W/kg**

SAR(1 g) = 0.022 mW/g; SAR(10 g) = 0.011 mW/g

**Maximum value of SAR (measured) = 0.068 mW/g**



0 dB = 0.068mW/g



### 16.5.4 802.11b-BottomSide-Middle(1Mbps)

Date/Time: 2012-5-3 13:45:41

#### Test Laboratory: SGS-GSM

TND 720 802.11b BodyWorn bottom side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

Communication System: 802.11b/g; Frequency: 2437 MHz;Duty Cycle: 1:1

Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

#### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (51x151x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.504 mW/g

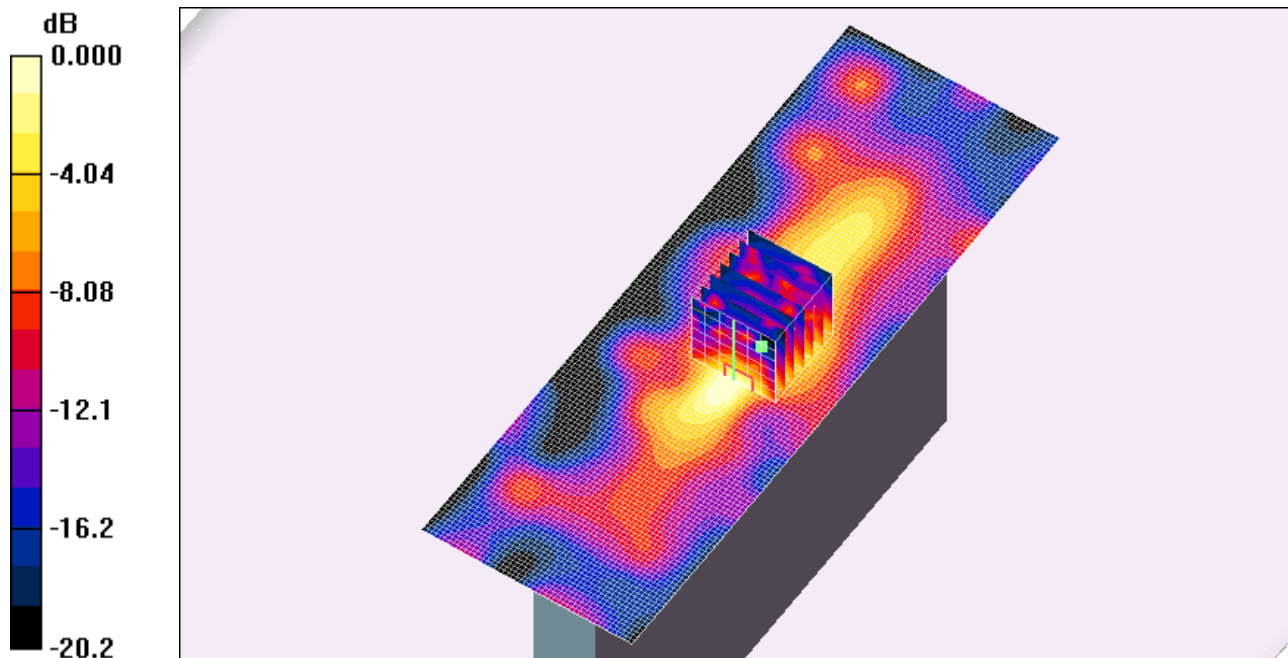
Back Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 12.0 V/m; Power Drift = -0.0792 dB

Peak SAR (extrapolated) = 0.821 W/kg

SAR(1 g) = 0.392 mW/g; SAR(10 g) = 0.186 mW/g

Maximum value of SAR (measured) = 0.440 mW/g



0 dB = 0.440mW/g

SHEMC

### 16.5.5 802.11b-LeftSide-Middle(1Mbps)

Date/Time: 2012-5-3 14:18:45

#### Test Laboratory: SGS-GSM

TND 720 802.11b BodyWorn Left side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

Communication System: 802.11b/g; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

#### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (41x101x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.056 mW/g

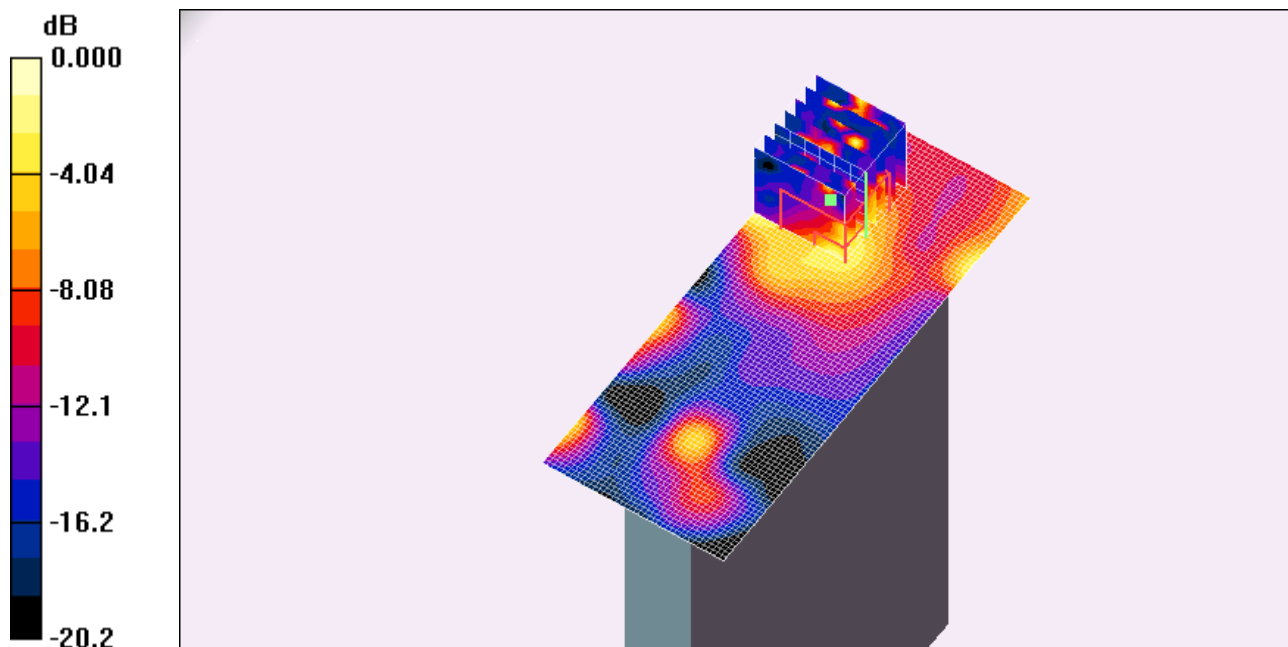
Back Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.59 V/m; Power Drift = -0.075 dB

Peak SAR (extrapolated) = 0.188 W/kg

SAR(1 g) = 0.030 mW/g; SAR(10 g) = 0.015 mW/g

Maximum value of SAR (measured) = 0.073 mW/g



0 dB = 0.073mW/g

SHEMC



### 16.5.6 802.11b-RightSide-Middle(1Mbps)

Date/Time: 2012-5-3 14:55:27

**Test Laboratory: SGS-GSM**

TND 720 802.11b BodyWorn Right side Middle

DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2437 MHz;Duty Cycle: 1:1**

**Medium: HSL2450-Body Medium parameters used:  $f = 2437$  MHz;  $\sigma = 1.99$  mho/m;  $\epsilon_r = 51.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>**

**Phantom section: Flat Section**

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Middle/Area Scan (51x101x1): **Measurement grid: dx=15mm, dy=15mm**

**Maximum value of SAR (interpolated) = 0.050 mW/g**

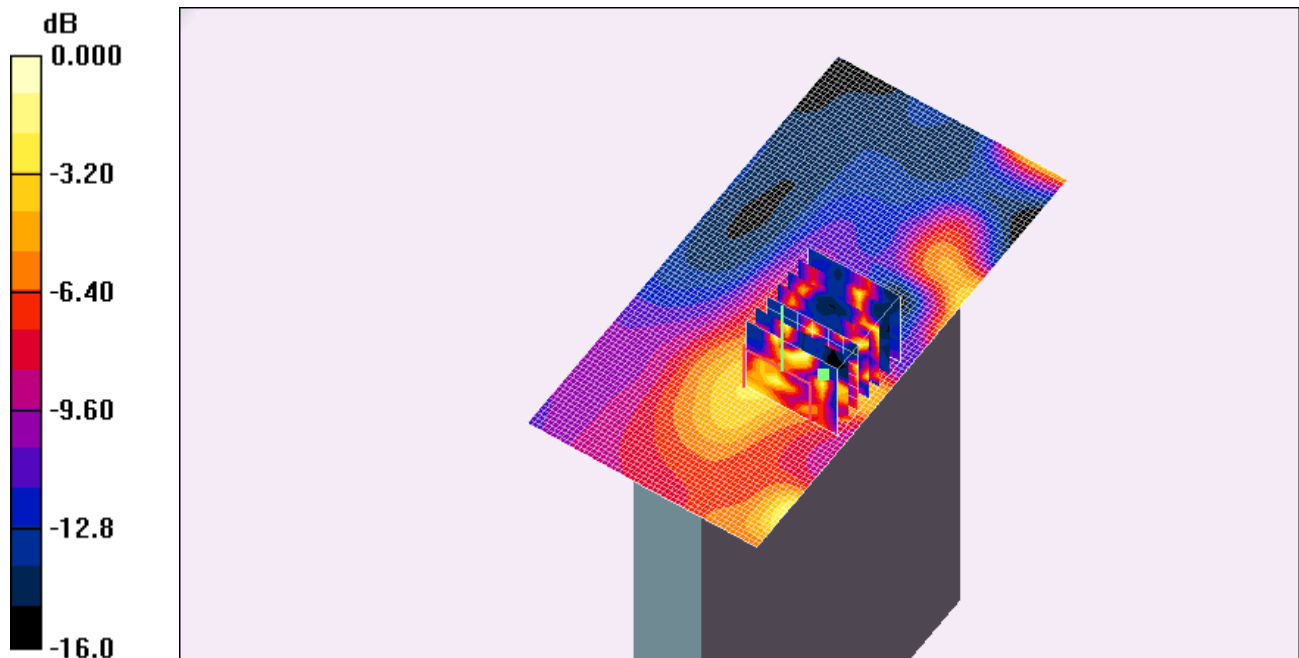
Back Middle/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm**

**Reference Value = 3.18 V/m; Power Drift = 0.174 dB**

**Peak SAR (extrapolated) = 0.122 W/kg**

SAR(1 g) = 0.043 mW/g; SAR(10 g) = 0.018 mW/g

**Maximum value of SAR (measured) = 0.074 mW/g**



0 dB = 0.074mW/g

**SHEMC**

### 16.5.7 802.11b-BottomSide-High(1Mbps)

Date/Time: 2012-5-3 16:02:39

#### Test Laboratory: SGS-GSM

TND 720 802.11b BodyWorn bottom side High

DUT: TND720; Type: WIFI b/g; Serial: 100077565

Communication System: 802.11b/g; Frequency: 2462 MHz;Duty Cycle: 1:1

Medium: HSL2450-Body Medium parameters used:  $f = 2462$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 51.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

#### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back High/Area Scan (51x151x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.291 mW/g

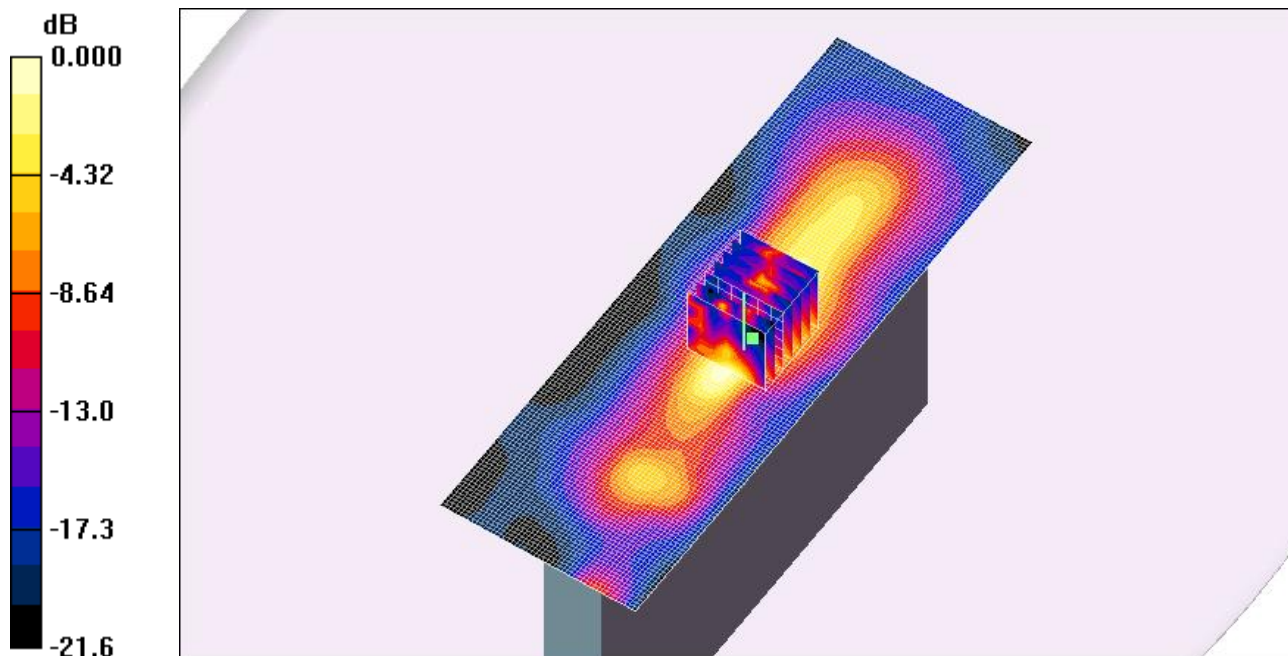
Back High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.33 V/m; Power Drift = -0.0767 dB

Peak SAR (extrapolated) = 0.820 W/kg

SAR(1 g) = 0.244 mW/g; SAR(10 g) = 0.115 mW/g

Maximum value of SAR (measured) = 0.283 mW/g



0 dB = 0.283mW/g

SHEMC

### 16.5.8 802.11b- BottomSide-Low(1Mbps)

Date/Time: 2012-5-3 16:02:47

**Test Laboratory: SGS-GSM**

TND 720 802.11b BodyWorn bottom side low

DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2412 MHz;Duty Cycle: 1:1**

**Medium: HSL2450-Body Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 51.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>**

**Phantom section: Flat Section**

**DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Low/Area Scan (51x151x1): **Measurement grid: dx=15mm, dy=15mm**

**Maximum value of SAR (interpolated) = 0.669 mW/g**

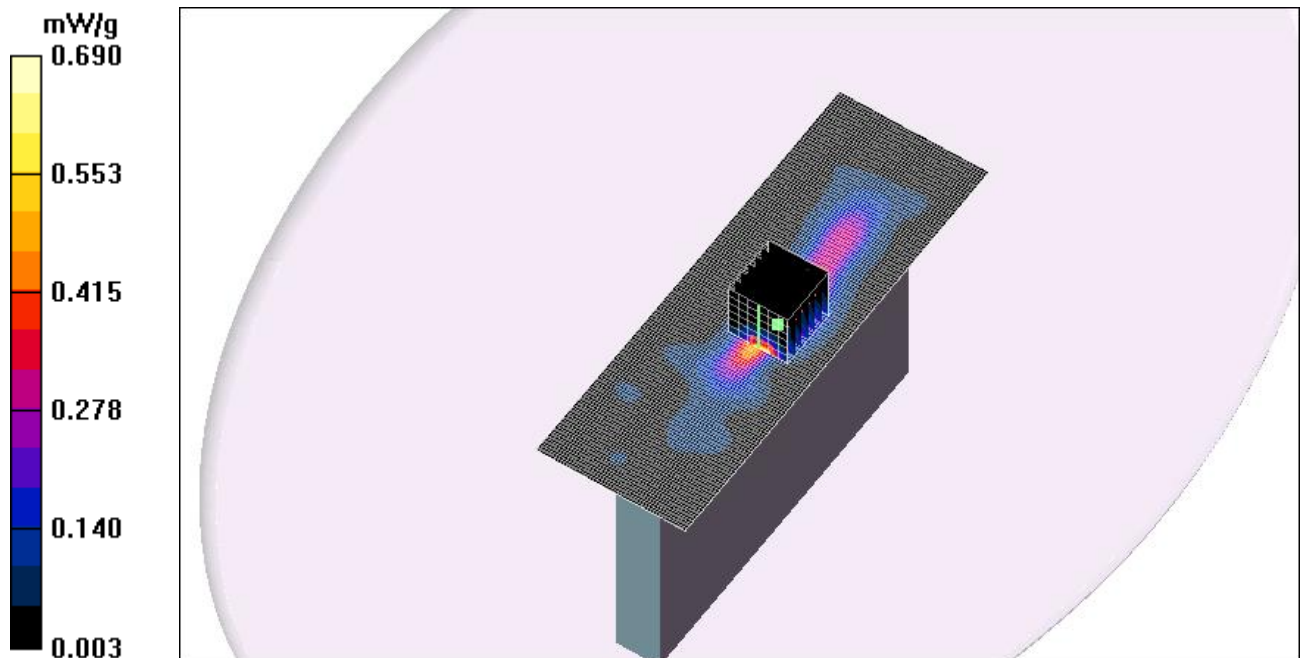
Back Low/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm**

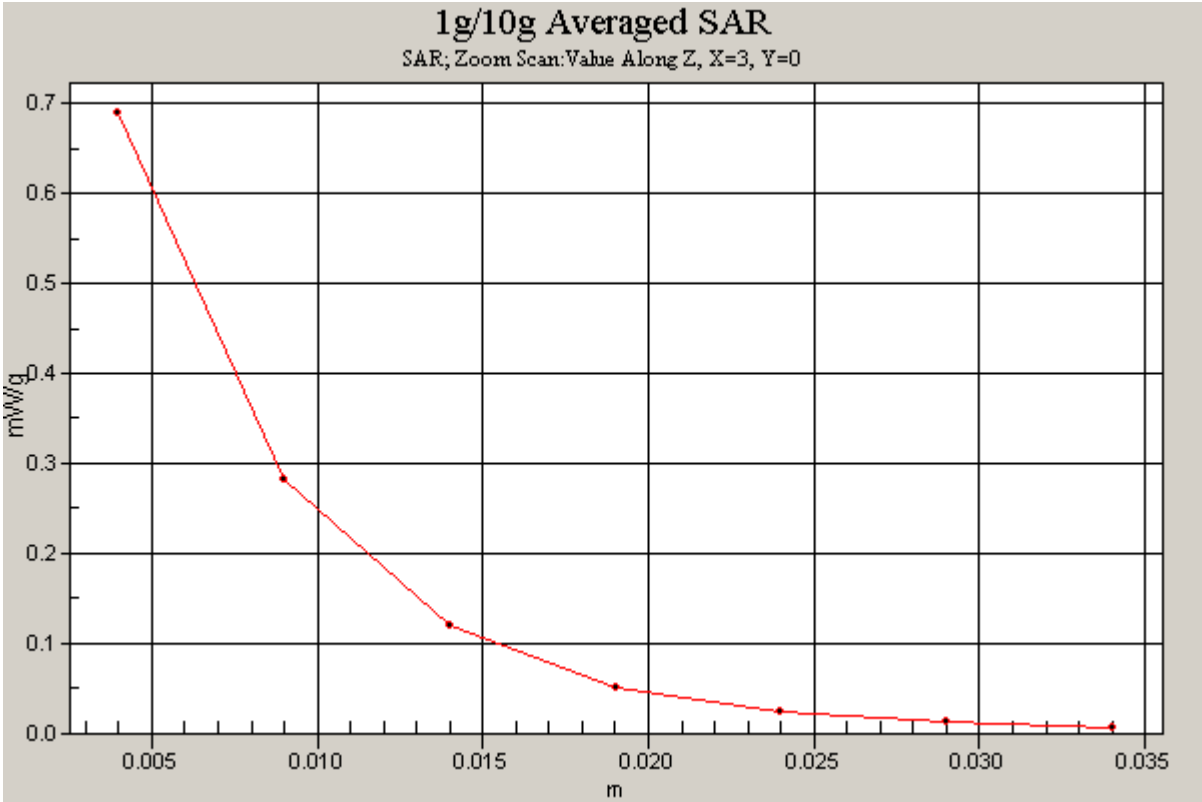
**Reference Value = 12.4 V/m; Power Drift = 0.088 dB**

**Peak SAR (extrapolated) = 1.94 W/kg**

SAR(1 g) = 0.626 mW/g; SAR(10 g) = 0.278 mW/g

**Maximum value of SAR (measured) = 0.690 mW/g**





**16.5.9 802.11b-BottomSide-Low (11Mbps)**

Date/Time: 2012-5-3 17:08:19

**Test Laboratory: SGS-GSM**

TND 720 802.11b BodyWorn bottom side Low 11Mbps

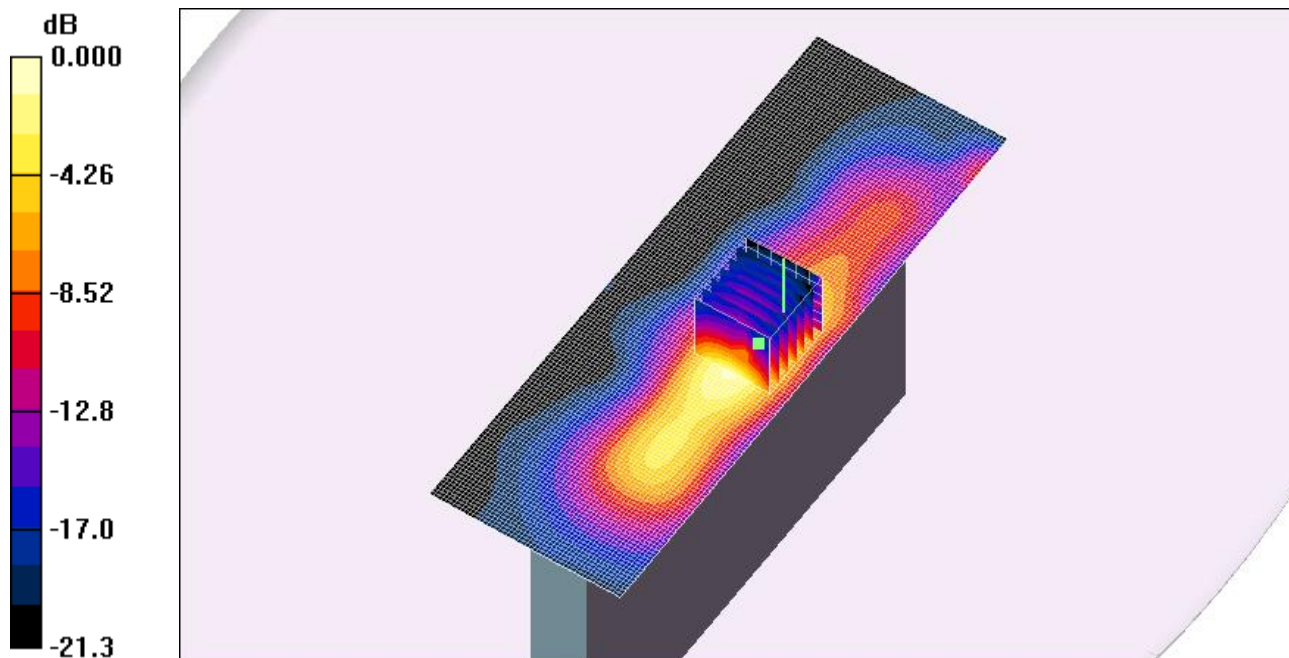
DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2412 MHz;Duty Cycle: 1:1****Medium: HSL2450-Body Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 51.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>****Phantom section: Flat Section****DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Low 11Mbps/Area Scan (51x151x1): **Measurement grid: dx=15mm, dy=15mm****Maximum value of SAR (interpolated) = 0.387 mW/g**Back Low 11Mbps/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm****Reference Value = 5.75 V/m; Power Drift = -0.021 dB****Peak SAR (extrapolated) = 1.13 W/kg**

SAR(1 g) = 0.370 mW/g; SAR(10 g) = 0.173 mW/g

**Maximum value of SAR (measured) = 0.430 mW/g**

0 dB = 0.430mW/g

**SHEMC**

**16.5.10 802.11g-BottomSide-Low (6Mbps)**

Date/Time: 2012-5-3 17:46:16

**Test Laboratory: SGS-GSM**

TND 720 802.11g BodyWorn bottom side Low

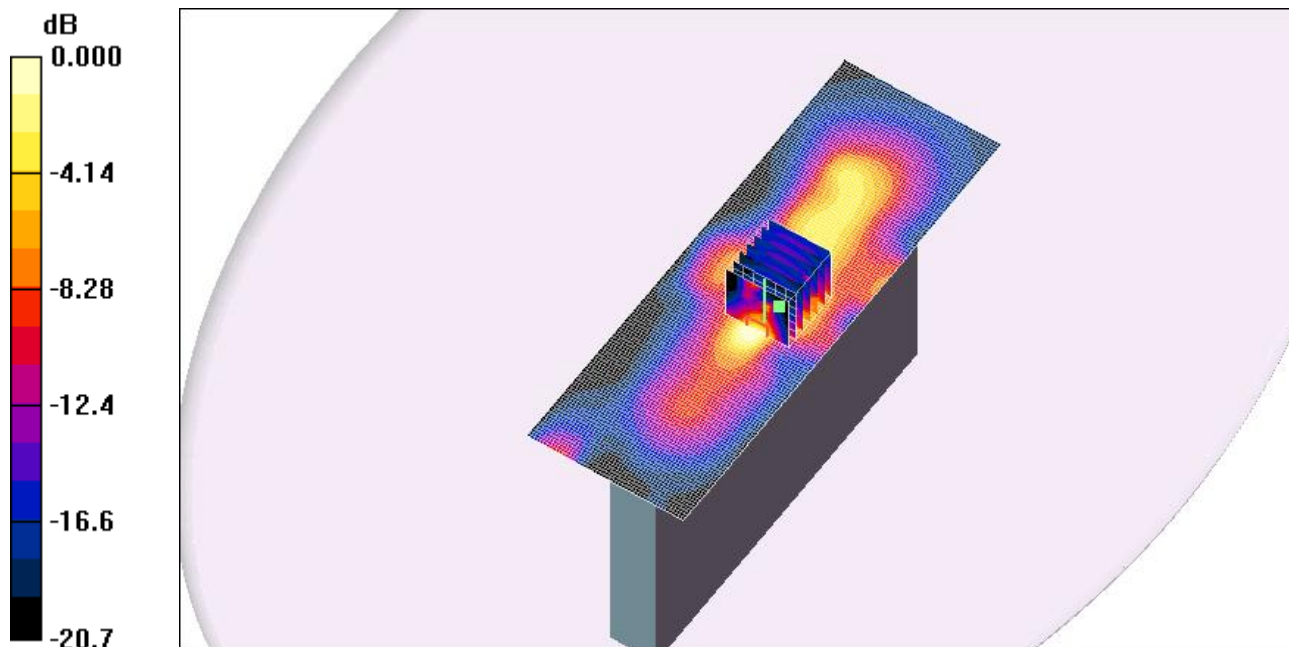
DUT: TND720; Type: WIFI b/g; Serial: 100077565

**Communication System: 802.11b/g; Frequency: 2412 MHz;Duty Cycle: 1:1****Medium: HSL2450-Body Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 51.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>****Phantom section: Flat Section****DASY4 Configuration:**

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Low/Area Scan (51x151x1): **Measurement grid: dx=15mm, dy=15mm****Maximum value of SAR (interpolated) = 0.306 mW/g**Back Low/Zoom Scan (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm****Reference Value = 8.56 V/m; Power Drift = -0.044 dB****Peak SAR (extrapolated) = 0.970 W/kg**

SAR(1 g) = 0.237 mW/g; SAR(10 g) = 0.101 mW/g

**Maximum value of SAR (measured) = 0.287 mW/g**

0 dB = 0.287mW/g

**SHEMC**



### 16.5.11 802.11g-BottomSide-Low (54Mbps)

Date/Time: 2012-5-3 18:17:36

#### Test Laboratory: SGS-GSM

TND 720 802.11g BodyWorn bottom side Low 54Mbps

DUT: TND720; Type: WIFI b/g; Serial: 100077565

Communication System: 802.11b/g; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: HSL2450-Body Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 51.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

#### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Back Low 54Mbps/Area Scan (51x151x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.185 mW/g

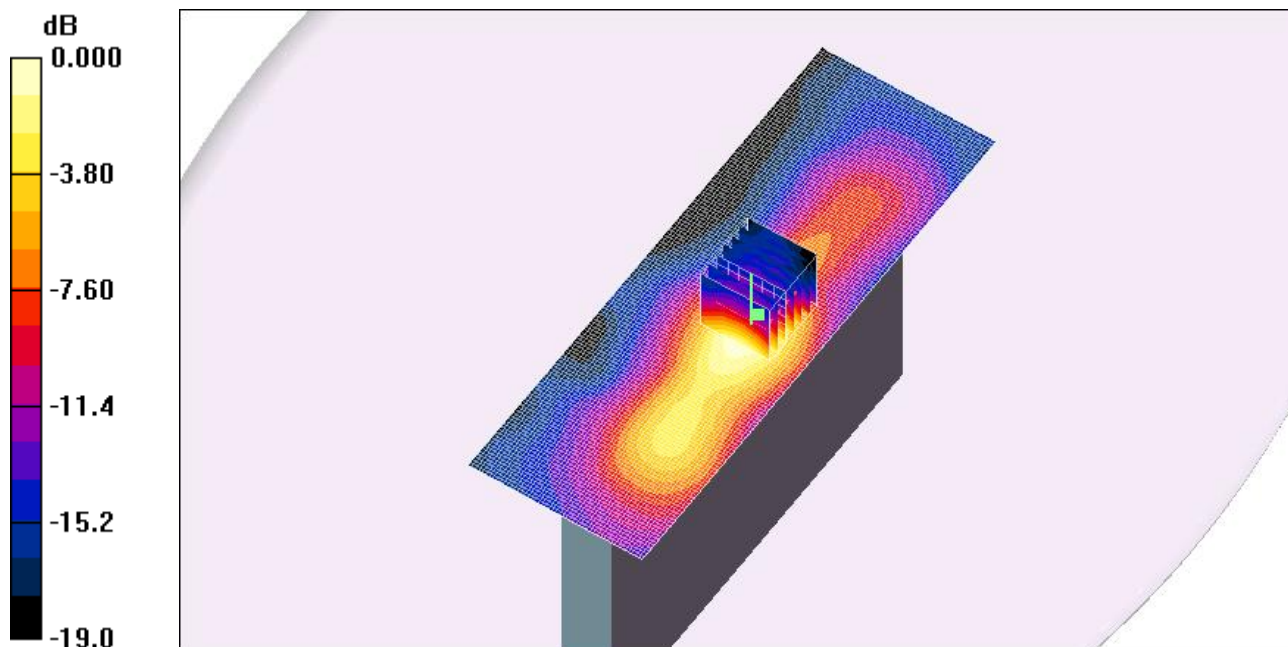
Back Low 54Mbps/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.39 V/m; Power Drift = -0.138 dB

Peak SAR (extrapolated) = 0.319 W/kg

SAR(1 g) = 0.154 mW/g; SAR(10 g) = 0.077 mW/g

Maximum value of SAR (measured) = 0.171 mW/g



0 dB = 0.171mW/g

SHEMC

**16. Identification of Samples**


Product Definition	Production Unit	
Device Type	Portable	
Limit Type	General Population/Uncontrolled	
Product Name	GPS	
Mode Name	TND 720 , RVND 7720	
Brand Name	N/A	
Final Hardware Version	V1.0	
Final Software Version	A5.RM.2T720.120411.2	
Battery Type	N/A	
	3.7V/1600mAh	
Antenna Type	Inner antenna	
WLAN Frequency Bands	802.11b	Tx/Rx: 2.412~2.462GHz
	802.11g	Tx/Rx: 2.412~2.462GHz
Modulation Mode	QPSK/DBPSK/BPSK	
IMEI	100077565	
Date of receipt	04-28,2012	
Date of Testing Start	05-03,2012	
Date of Testing End	05-03,2012	



RM Acquisition LLC  
**Model Confirmation Letter**

We, RM Acquisition LLC certify the product: GPS  
And item No.: TND 720, RVND 7720  
Their electrical circuit design, layout, components used and internal wiring are identical,  
Only the different on model No. and appearance.

Agency Agreement Expiration Date: 12 months

By:  Emad S. Isaac  
(Signature<sup>1</sup>) (Print name)

Title: Sr. Vice President Chief Technology Officer

On behalf of: RM Acquisition LLC  
(Company Name)

Telephone: 8473296498

17. Photographs of EUT



Fig.17-1 Front View



Fig.17-2 Back View

Annex A Photographs of Test Setup

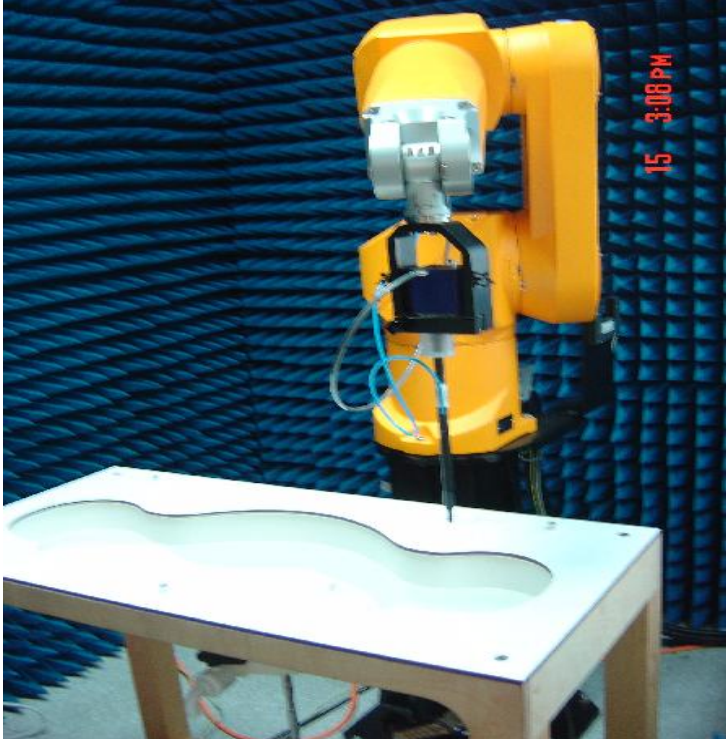


Fig.A-1 Photograph of the SAR measurement System

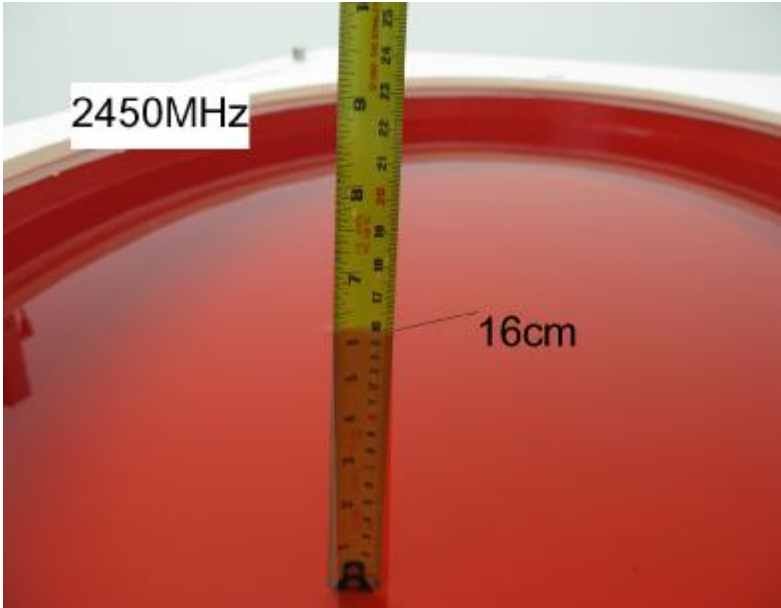


Fig.A-2 Photograph of the Tissue Simulant Liquid depth 15cm for Body Worn



Fig.A-3a Photograph of Back side of the EUT status



Fig.A-3b Photograph of Front side of the EUT status



Fig.A-3c Photograph of Left side of the EUT status



Fig.A-3d Photograph of Right side of the EUT status



Fig.A-3e Photograph of Top side of the EUT status



Fig.A-3f Photograph of Bottom side of the EUT status

## Annex B

## Tissue Simulant Liquid

Annex B.1  
Liquid

## Recipes for Tissue Simulant

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

Frequency (MHz)	835		900		1800-2000		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body
<b>Ingredient (% by weight)</b>								
Water	40.30	50.75	40.30	50.75	55.24	70.17	62.7	73.26
Salt (NaCl)	1.38	0.94	1.38	0.94	0.31	0.39	0.5	0.04
Sucrose	57.90	48.21	57.90	48.21	0	0	0	0
HEC	0.24	0	0.24	0	0	0	0	0
Bactericide	0.18	0.10	0.10	0.10	0	0	0	0
DGBE	0	0	0	0	44.45	29.44	36.8	26.7
<b>Measurement dielectric parameters</b>								
Dielectric Constant	41.9	55.0	41.1	54.5	39.2	53.2	39.8	52.5
Conductivity (S/m)	0.93	0.97	1.04	1.06	1.45	1.59	1.88	1.78
<b>Target values</b>								
Dielectric Constant	41.5	55.2	41.5	55.0	40.0	53.3	39.2	52.7
Conductivity (S/m)	0.90	0.97	0.97	1.05	1.40	1.52	1.80	1.95
Salt: 99+% Pure Sodium Chloride					Sucrose: 98+% Pure Sucrose			
Water: De-ionized, 16 MΩ <sup>+</sup> resistivity					HEC: Hydroxyethyl Cellulose			
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]								

Table B-1 Recipe of Tissue Simulat Liquid

**Annex B.2  
 Simulant Liquid**

**Measurement for Tissue**

The dielectric properties for this Tissue Simulant Liquids were measured by using the Agilent Model 85070D Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with Agilent E5071B Network Analyzer (300 KHz-8500 MHz). The Conductivity ( $\sigma$ ) and Permittivity ( $\rho$ ) are listed in Table 1. For the SAR measurement given in this report. The temperature variation of the Tissue Simulant Liquids was  $22\pm 2^\circ\text{C}$ .

Frequency (MHz)	Tissue Type	Limit/Measured	Permittivity ( $\rho$ )	Conductivity ( $\sigma$ )	Temp ( $^\circ\text{C}$ )
2450	Body	Recommended Limit	52.7 $\pm$ 5% (50.07~55.34)	1.95 $\pm$ 5% (1.85~2.05)	22 $\pm$ 2
		Measured, 05-03,2012	51.3	2.01	21.5
2412	Body	Measured, 05-03,2012	51.6	1.96	
2437		Measured, 05-03,2012	51.4	1.99	
2462		Measured, 05-03,2012	51.1	2.01	

Table B-2 Measurement result of Tissue electric parameters

**Annex C**

**SAR System Validation**

The microwave circuit arrangement for system verification is sketched in Fig. C-1. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR values. These tests were done at 835&1900MHz. The tests were conducted on the same days as the measurement of the EUT. The obtained results from the system accuracy verification are displayed in the table C-1 (A power level of 250mw was input to the dipole antenna). During the tests, the ambient temperature of the laboratory was in the range  $22^\circ\text{C}$ , the relative humidity was in the range 60% and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

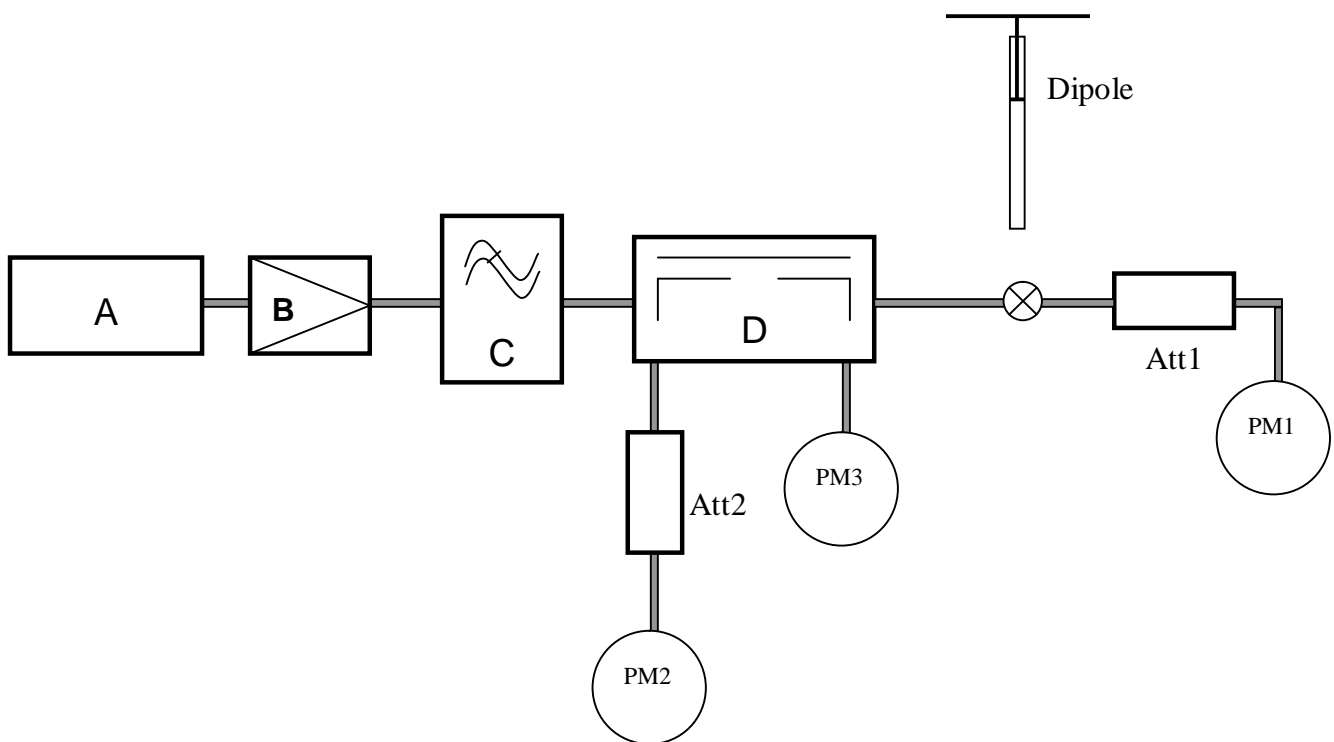


Fig. C-1 the microwave circuit arrangement used for SAR system verification

- A. Agilent E4438C Signal Generator
- B. Mini-Circuit ZHL-42 Preamplifier
- C. Mini-Circuit VLF-2500+ Low Pass Filter
- D. Mini-Circuits ZABDC20-252H-N+ Bi-DIR Coupling
- PM1. Power Sensor NRP-Z92
- PM2. Agilent Model E4416A Power Meter
- PM3. Power Sensor NRP-Z92

Validation Kit	Frequency (MHz)	Tissue Type	Limit/Measurement		
			Condition	Recommended/Measured	1g
D2450V2	2450	Body	Calibration data		13.2
			Nomalized to 1mW(for nominal Head TSL parameters)	Recommended Limit	52.8±10% (47.52-58.08)
			Nomalized to 1W(for nominal Head TSL parameters)	-	48.8
			250mW input power	Measured, 05-03, 2012	12.2

Table C-1 SAR System Validation Result



## System Performance Check at 2450MHzBody

Date/Time: 2012-5-3 08:34:40

### Test Laboratory: SGS-GSM

System Performance Check at 2450MHzBody

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:733

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

Medium: HSL2450-Body Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 51.3$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

### DASY4 Configuration:

- Probe: ES3DV3 - SN3088; ConvF(4.35, 4.35, 4.35); Calibrated: 2011-11-23
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn569; Calibrated: 2011-11-16
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: xxxx
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

d=10mm, Pin=250mW /Area Scan (61x101x1): **Measurement grid: dx=15mm, dy=15mm**

**Maximum value of SAR (interpolated) = 15.0 mW/g**

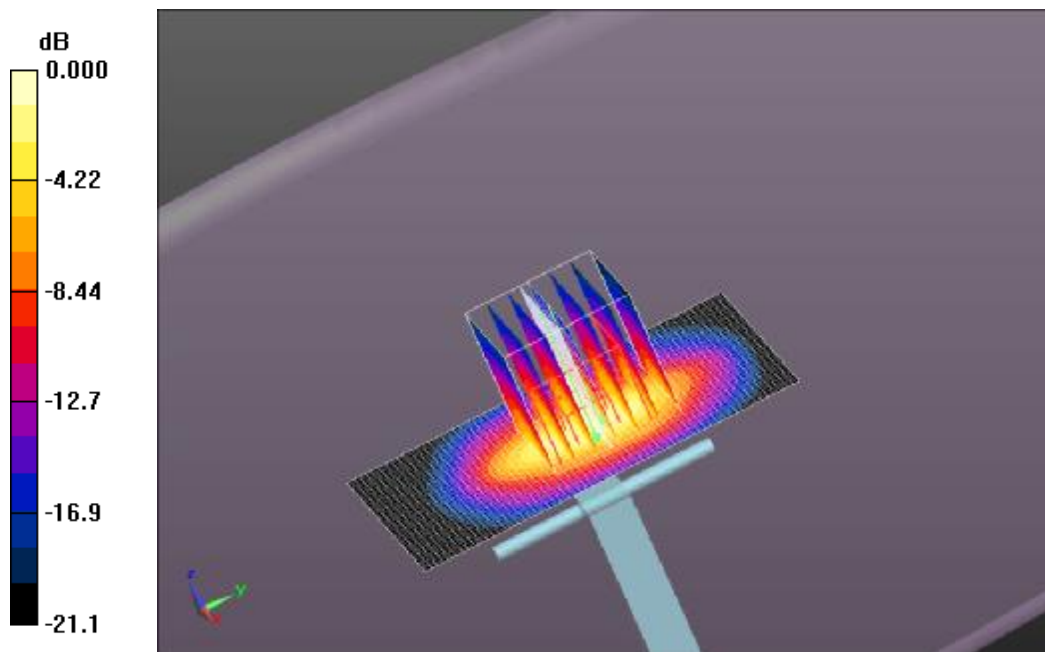
d=10mm, Pin=250mW /Zoom Scan (7x7x7) (7x7x7)/Cube 0: **Measurement grid: dx=5mm, dy=5mm, dz=5mm**

**Reference Value = 84.1 V/m; Power Drift = -0.069 dB**

**Peak SAR (extrapolated) = 23.1 W/kg**

SAR(1 g) = 12.2 mW/g; SAR(10 g) = 5.73 mW/g

**Maximum value of SAR (measured) = 14.0 mW/g**



0 dB = 14.0mW/g

**SHEMC**

Annex D Calibration certificate

Annex D.1 Probe Calibration certificate

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



**S** Schweizerischer Kalibrierdienst  
**C** Service suisse d'étalonnage  
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Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client: **SGS-SH (Auden)**

Certificate No: **ES3-3088\_Nov11**

CALIBRATION CERTIFICATE	
Object	ES3DV3 - SN:3088
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	November 23, 2011
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.	
All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.	
Calibration Equipment used (M&TE critical for calibration)	

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3n)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	3-May-11 (No. IDAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
			Issued: November 23, 2011
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			

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Engineering AG**  
Zeughausstrasse 43, 8004 Zurich, Switzerland



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Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

#### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
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:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

#### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not affect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub>** = NORM<sub>x,y,z</sub> \* frequency\_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP<sub>x,y,z</sub>**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>**: A, B, C are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  MHz to  $\pm 100$  MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

ES3DV3 – SN:3088

November 23, 2011

# Probe ES3DV3

## SN:3088

Manufactured: July 20, 2005  
Calibrated: November 23, 2011

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



ES3DV3- SN:3088

November 23, 2011

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3088

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu\text{V}/(\text{V/m})^2$ ) <sup>A</sup>	1.29	1.27	1.20	$\pm 10.1\%$
DCP (mV) <sup>B</sup>	95.8	94.9	95.8	

### Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc <sup>E</sup> (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	147.7	$\pm 2.5\%$
			Y	0.00	0.00	1.00	112.2	
			Z	0.00	0.00	1.00	138.9	

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

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

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

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

ES3DV3-SN:3088

November 23, 2011

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3088

### Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	6.09	6.09	6.09	0.80	1.00	± 12.0 %
900	41.5	0.97	5.96	5.96	5.96	0.80	1.22	± 12.0 %
1810	40.0	1.40	5.13	5.13	5.13	0.80	1.26	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.80	1.23	± 12.0 %
1950	40.0	1.40	4.90	4.90	4.90	0.80	1.24	± 12.0 %
2450	39.2	1.80	4.41	4.41	4.41	0.80	1.26	± 12.0 %

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

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

ES3DV3- SN:3088

November 23, 2011

## DASY/EASY - Parameters of Probe: ES3DV3- SN:3088

### Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	6.13	6.13	6.13	0.80	1.00	± 12.0 %
1900	53.3	1.52	4.80	4.80	4.80	0.80	1.31	± 12.0 %
2450	52.7	1.95	4.35	4.35	4.35	0.80	1.22	± 12.0 %

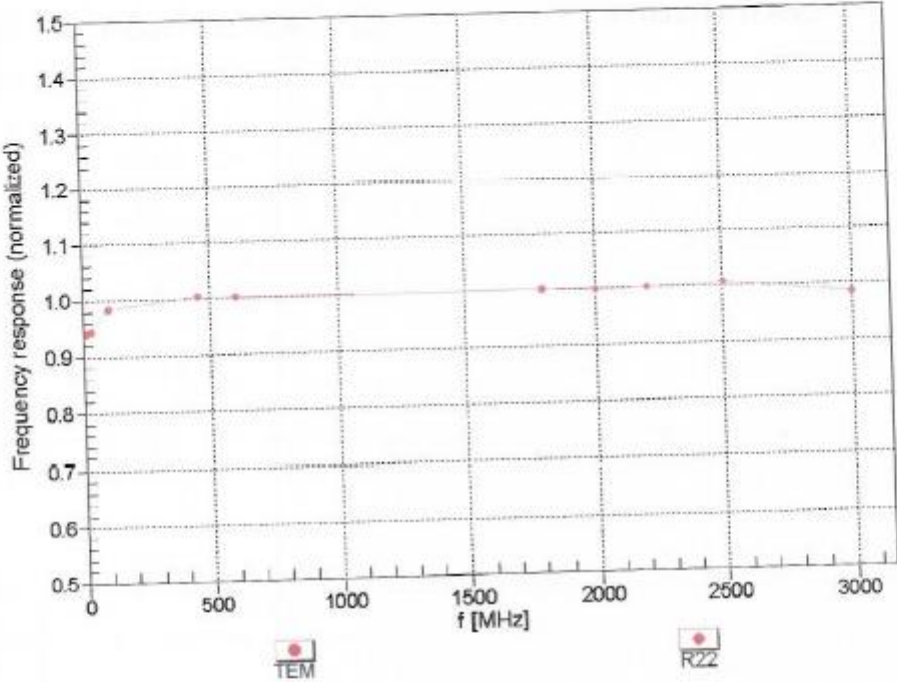
<sup>c</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

ES3DV3-SN:3088

November 23, 2011

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



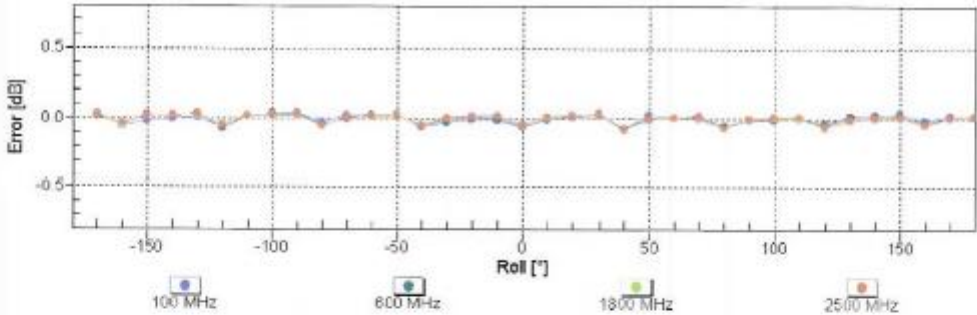
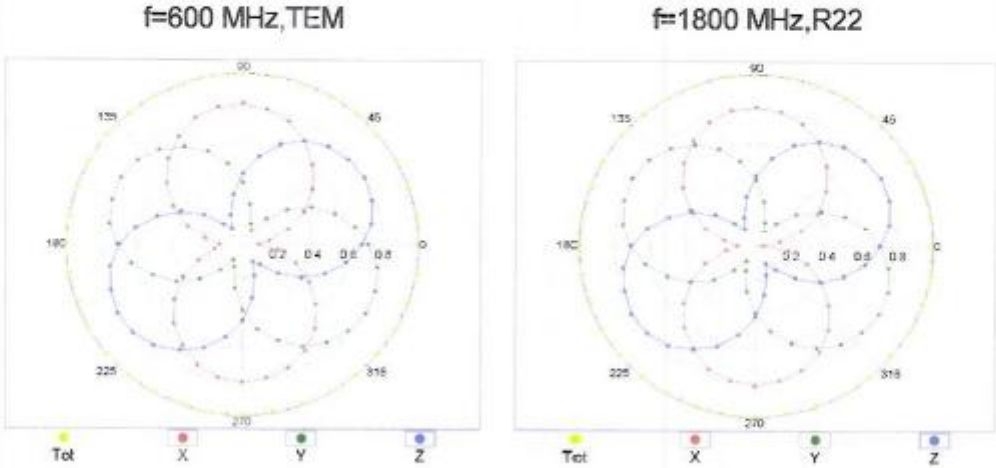
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)



ES3DV3- SN:3088

November 23, 2011

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

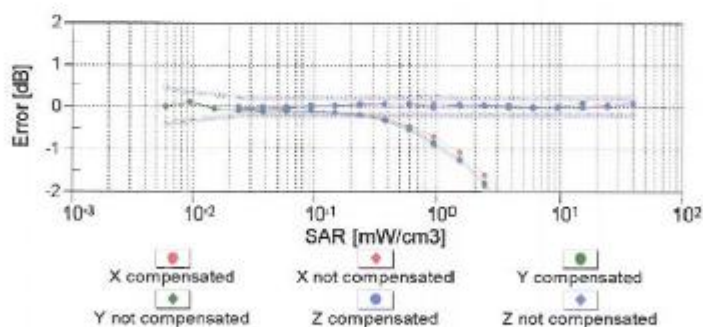
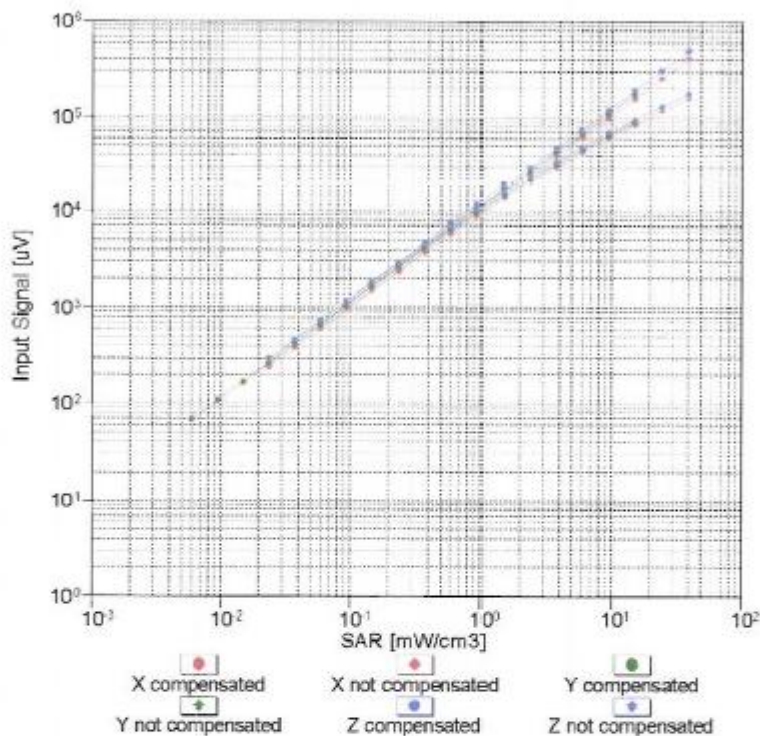


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

ES3DV3- SN:3088

November 23, 2011

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

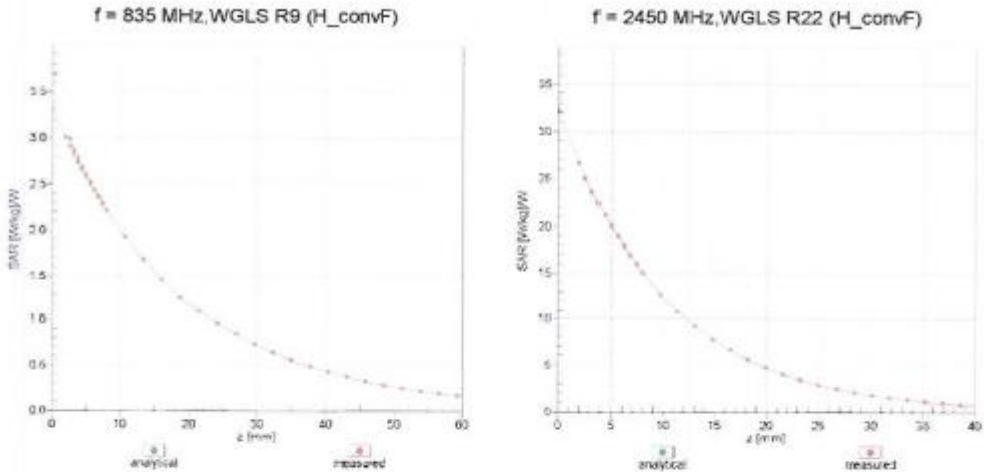


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

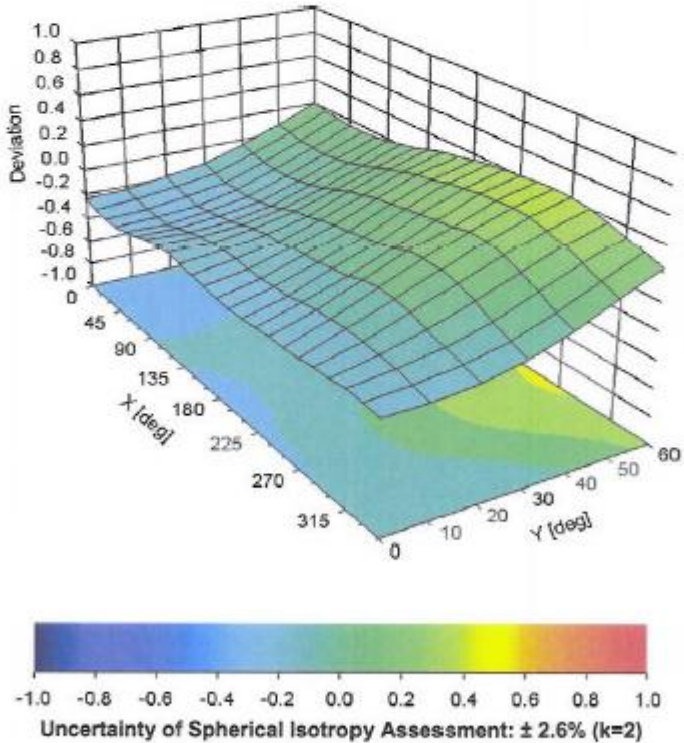
ES3DV3- SN:3088

November 23, 2011

### Conversion Factor Assessment



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



ES3DV3- SN:3088

November 23, 2011

## DASY/EASY - Parameters of Probe: ES3DV3 - SN:3088

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

Annex D.2 DAE Calibration certification

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



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

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

Accreditation No.: **SCS 108**

Client **SGS - SH (Auden)**

Certificate No: **DAE3-569\_Nov11**

CALIBRATION CERTIFICATE																			
Object	DAE3 - SD 000 D03 AA - SN: 569																		
Calibration procedure(s)	QA CAL-06.v23 Calibration procedure for the data acquisition electronics (DAE)																		
Calibration date:	November 16, 2011																		
<p>This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity &lt; 70%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Primary Standards</th> <th>ID #</th> <th>Cal Date (Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Keithley Multimeter Type 2001</td> <td>SN: 0810278</td> <td>28-Sep-11 (No:11450)</td> <td>Sep-12</td> </tr> <tr> <th>Secondary Standards</th> <th>ID #</th> <th>Check Date (in house)</th> <th>Scheduled Check</th> </tr> <tr> <td>Calibrator Box V1.1</td> <td>SE UMS 006 AB 1004</td> <td>08-Jun-11 (in house check)</td> <td>In house check: Jun-12</td> </tr> </tbody> </table>				Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration	Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12	Secondary Standards	ID #	Check Date (in house)	Scheduled Check	Calibrator Box V1.1	SE UMS 006 AB 1004	08-Jun-11 (in house check)	In house check: Jun-12
Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration																
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Secondary Standards	ID #	Check Date (in house)	Scheduled Check																
Calibrator Box V1.1	SE UMS 006 AB 1004	08-Jun-11 (in house check)	In house check: Jun-12																
Calibrated by:	Name Andrea Guntli	Function Technician	Signature 																
Approved by:	Fin Bomholt	R&D Director																	
			Issued: November 16, 2011																
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.																			



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**S** Swiss Calibration Service

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The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

## Glossary

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

## Methods Applied and Interpretation of Parameters

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

**DC Voltage Measurement**

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	402.918 ± 0.1% (k=2)	403.325 ± 0.1% (k=2)	403.506 ± 0.1% (k=2)
Low Range	3.94257 ± 0.7% (k=2)	3.94078 ± 0.7% (k=2)	3.92857 ± 0.7% (k=2)

**Connector Angle**

Connector Angle to be used in DASY system	263.0 ° ± 1 °
---	---------------

## Appendix

## 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	200007.5	1.98	0.00
Channel X + Input	19999.63	-1.17	-0.01
Channel X - Input	-19997.26	2.24	-0.01
Channel Y + Input	200006.9	2.80	0.00
Channel Y + Input	20001.35	1.55	0.01
Channel Y - Input	-19997.50	2.70	-0.01
Channel Z + Input	200004.2	0.86	0.00
Channel Z + Input	19994.71	-4.99	-0.02
Channel Z - Input	-20001.67	-1.57	0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	1999.4	-0.60	-0.03
Channel X + Input	200.87	1.07	0.53
Channel X - Input	-199.13	0.77	-0.39
Channel Y + Input	2000.1	0.21	0.01
Channel Y + Input	200.59	0.59	0.29
Channel Y - Input	-201.62	-1.72	0.86
Channel Z + Input	2000.1	0.03	0.00
Channel Z + Input	198.40	-1.60	-0.80
Channel Z - Input	-201.77	-1.97	0.99

## 2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	-0.68	-2.49
	-200	3.05	1.36
Channel Y	200	5.33	4.90
	-200	-6.28	-6.47
Channel Z	200	-13.18	-13.80
	-200	11.54	11.47

## 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	2.33	-0.60
Channel Y	200	2.89	-	1.02
Channel Z	200	3.15	0.34	-



**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	16177	17130
Channel Y	16550	16855
Channel Z	15783	17570

**5. Input Offset Measurement**

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

Input 10M $\Omega$ 

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.10	-1.63	1.64	0.67
Channel Y	-0.72	-2.14	0.76	0.67
Channel Z	-1.16	-2.30	0.64	0.50

**6. Input Offset Current**

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

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

	Zeroing (k $\Omega$ m)	Measuring (M $\Omega$ m)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

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

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

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

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

## Annex D.3 Dipole Calibration certification

D2450V2

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



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

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

Accreditation No.: **SCS 108**

Client **SGS-SH (Auden)**

Certificate No: **D2450V2-733\_Nov11**

**CALIBRATION CERTIFICATE**

Object **D2450V2 - SN: 733**

Calibration procedure(s) **QA CAL-05.v8  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **November 09, 2011**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	29-Apr-11 (No. ES3-3205_Apr11)	Apr-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	<b>Name</b>	<b>Function</b>	<b>Signature</b>
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: November 9, 2011

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

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



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Accreditation No.: **SCS 108**

**Glossary:**

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

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

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



**Measurement Conditions**

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

DASY Version	DASY5	V52.6.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

**Head TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	37.7 ± 6 %	1.84 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Head TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.7 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>53.7 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	<b>25.0 mW / g ± 16.5 % (k=2)</b>

**Body TSL parameters**

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	50.9 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

**SAR result with Body TSL**

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>51.6 mW / g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.11 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	<b>24.1 mW / g ± 16.5 % (k=2)</b>

**Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	54.0 $\Omega$ + 2.2 j $\Omega$
Return Loss	- 27,1 dB

**Antenna Parameters with Body TSL**

Impedance, transformed to feed point	49.5 $\Omega$ + 3.7 j $\Omega$
Return Loss	- 28.6 dB

**General Antenna Parameters and Design**

Electrical Delay (one direction)	1.151 ns
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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	May 07, 2003

**DASY5 Validation Report for Head TSL**

Date: 09.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 733**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.84$  mho/m;  $\epsilon_r = 37.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205, ConvF(4.45, 4.45, 4.45), Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

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

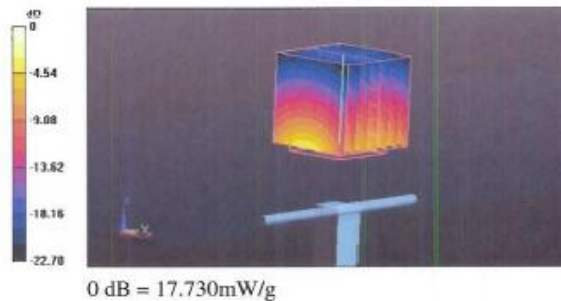
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 102.3 V/m; Power Drift = 0.03 dB

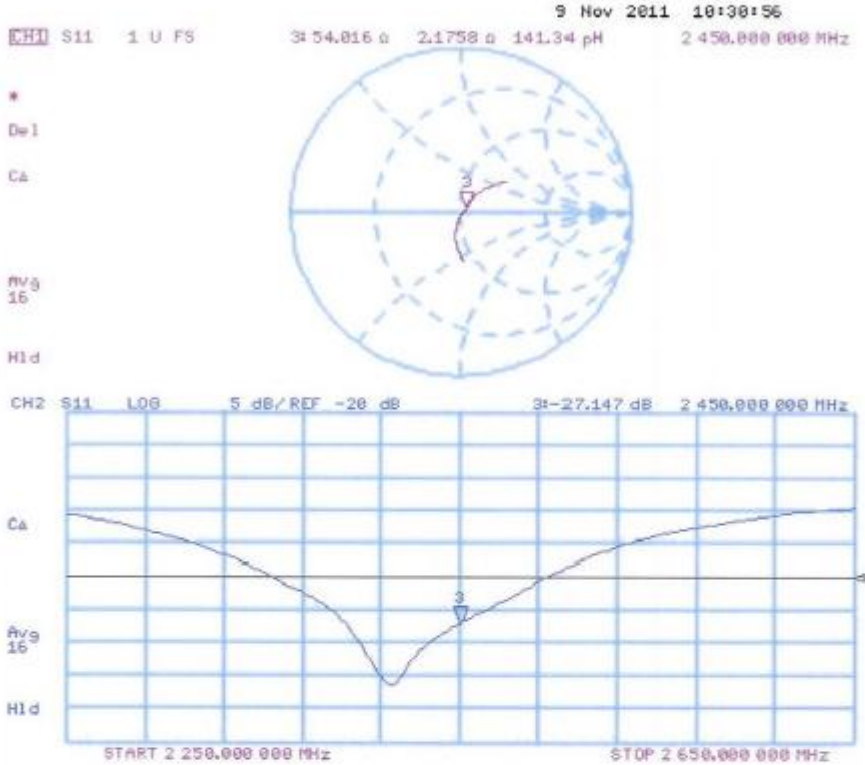
Peak SAR (extrapolated) = 28.483 W/kg

**SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.33 mW/g**

Maximum value of SAR (measured) = 17.733 mW/g



Impedance Measurement Plot for Head TSL





**DASY5 Validation Report for Body TSL**

Date: 09.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 733**

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  mho/m;  $\epsilon_r = 50.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probc: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

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

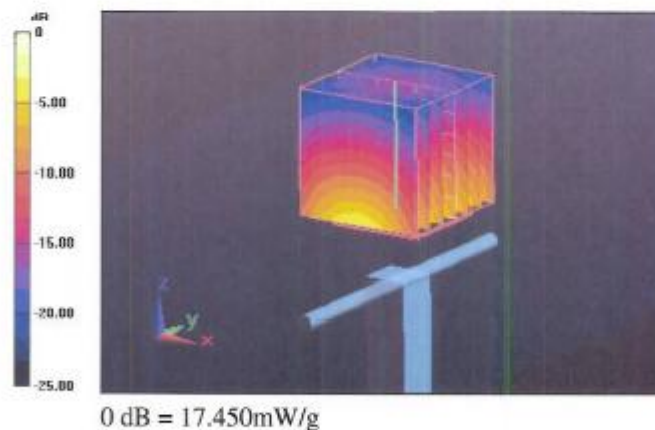
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.475 V/m; Power Drift = -0.01 dB

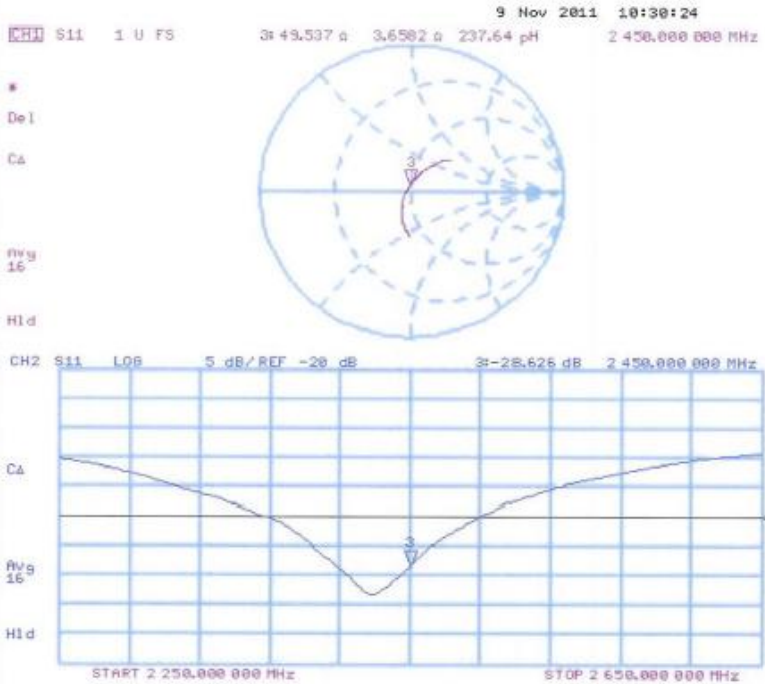
Peak SAR (extrapolated) = 27.319 W/kg

**SAR(1 g) = 13.2 mW/g; SAR(10 g) = 6.11 mW/g**

Maximum value of SAR (measured) = 17.446 mW/g



Impedance Measurement Plot for Body TSL



END OF REPORT

SHEMC