SAR TEST REPORT

No. 2010EEB00391

For

Shenzhen Timeway Technology Consulting Co.,Ltd

Transceiver

NF-173

NanFone

With

Hardware Version: v1.0

Software Version: v1.0

FCCID: UUPNF173

Issued Date: 2010-06-30

Deutscher Akkreditierungs Rat

No. DGA-PL-114/01-02

检 测
CNAS L0442

Note:

The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of TMC Beijing.

Test Laboratory:

TMC Beijing, Telecommunication Metrology Center of MIIT

No. 52, Huayuan Bei Road, Haidian District, Beijing, P. R. China 100191.

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工业和信息化部通信计量中心
检验报告专用章

TABLE OF CONTENT

1 Test Laboratory

1.1 Testing Location

Company Name:	TMC Shenzhen, Telecommunication Metrology Center of MIIT
Address:	No 12 Building,Shangsha Innovation and Technology Park,Futian District,Shenzhen,P.R.China
Postal Code:	518048
Telephone:	+86-755-33322000
Fax:	+86-755-33322001

1.2 Testing Environment

Temperature:	18°C~25 °C,
Relative humidity:	30%~ 70%
Ground system resistance:	< 0.5 Ω

Ambient noise is checked and found very low and in compliance with requirement of standards.
Reflection of surrounding objects is minimized and in compliance with requirement of standards.

1.3 Project Data

Project Leader:	Zhou Yi
Test Engineer:	Zhu Zhiqiang
Testing Start Date:	June 4, 2010
Testing End Date:	June 25, 2010

1.4 Signature

朱志强

Zhu Zhiqiang

(Prepared this test report)

Zhou Yi

(Reviewed this test report)

Xiao Li

Deputy Director of the laboratory

(Approved this test report)

2 Client Information

2.1 Applicant Information

Company Name:	Shenzhen Timeway Technology Consulting Co.,Ltd
Address /Post:	East 5/block 4,Anhua Industrial Zone,No.8,Tairan Rd.Chegongmiao,Futian District,Shenzhen, P.R.China
City:	Shenzhen
Postal Code:	518000
Country:	P. R. China
Telephone:	+86-755-83448688-833
Fax:	+86-755-83442996

2.2 Manufacturer Information

Company Name:	XINWEI ELECTRONIC CO.LTD QUANZHOU
Address /Post:	WAN AN TANG XI INDUSTRIAL AREA QUANZHOU FUJIAN CHINA
City:	QUANZHOU
Postal Code:	362000
Country:	P. R. China
Telephone:	\
Fax:	\

3 Equipment Under Test (EUT) and Ancillary Equipment (AE)

3.1 About EUT

EUT Description:	FM Transceiver
Model Name:	NF-173
Marketing Name:	NanFone
Frequency Band:	450MHz

Picture 1: Constituents of the sample

3.2 Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version
EUT1	\	V1.0	V1.0

*EUT ID: is used to identify the test sample in the lab internally.

3.3 Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
AE1	Battery charger	NF-173 adaptor	\	XINWEI ELECTRONIC CO.LTD QUANZHOU
AE2	Battery	SRLIB170	\	jianLiDa Battery Co.,Ltd

*AE ID: is used to identify the test sample in the lab internally.

4 CHARACTERISTICS OF THE TEST

4.1 Applicable Limit Regulations

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **8.0 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the controlled environment.

4.2 Applicable Measurement Standards

EN 62209-1–2006: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz).

IEEE 1528–2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

OET Bulletin 65 (Edition 97-01) and Supplement C(Edition 01-01): Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits.

IEC 62209-1: Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1:Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)

IEC 62209-2 (Edition 1.0): Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures – Part 2: Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

KDB 447498 D01: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies v03r02

They specify the measurement method for demonstration of compliance with the SAR limits for such equipments.

5 OPERATIONAL CONDITIONS DURING TEST

5.1 Schematic Test Configuration

During SAR test, EUT is in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up by pushing the transmit button. The traffic channel is allocated 1,7 and 14 respectively in the case of FM 450 MHz. Its internal traffic channel and coresponding frequency is as follow:

Channel No.	Frequency(MHz)	Channel No.	Frequency(MHz)
1	446.00625	8	446.09375
2	446.01875	9	\
3	446.03125	10	463.975
4	446.04375	11	464.125
5	446.05625	12	464.175
6	446.06875	13	464.325
7	446.08125	14	464.375

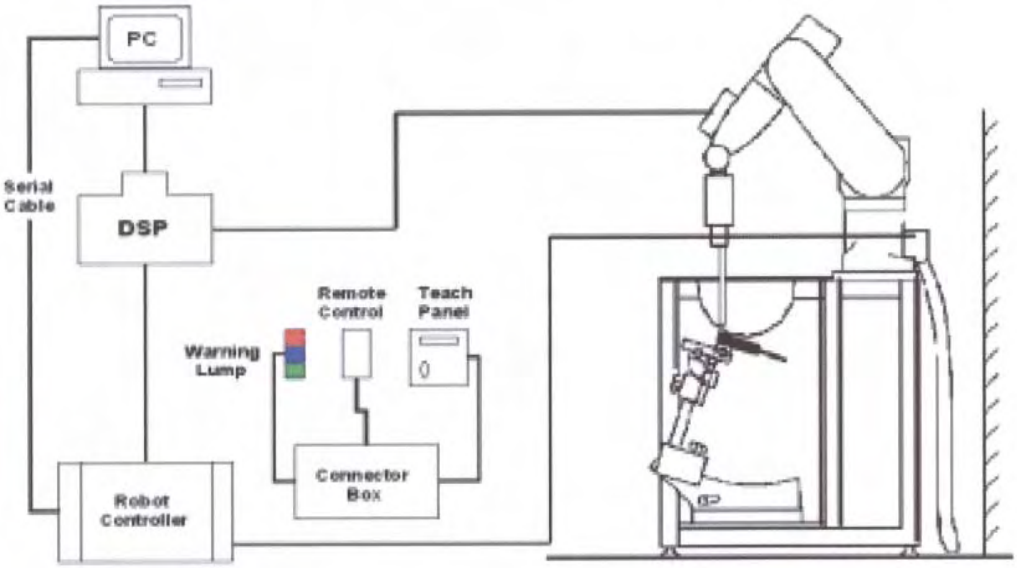
According to appendix D in OET Bulletin 65 (Edition 97-01) and Supplement C(Edition 01-01),Transmitters that are designed to operate in front of a person's face, in push-to-talk configurations, should be tested for SAR compliance with the front of the device positioned at 2.5 cm from a flat phantom. AS the EUT can be carried next to the body, SAR compliance should be tested with the belt-clip attached to the device and positioned against a flat phantom in normal use configurations.

The EUT shall use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link is used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the handset by at least 30 dB.

5.2 SAR Measurement Set-up

These measurements were performed with the automated near-field scanning system DASY5 NEO 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 ± 0.02mm. 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, is used to drive the robot motors. The PC consists of Inter® Core™ CPU 6300 @1.86GHz,1.58GHz computer with Windows XP system and SAR Measurement Software DASY5 NEO, A/D interface card, monitor, mouse, and keyboard. The Stäubli 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 coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.



Picture 2: SAR Lab Test Measurement Set-up

The DAE 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.

5.3 Dasy5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3,EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe has been calibrated according to the standard procedure with an accuracy of better than ± 10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB.

ES3DV3 Probe Specification

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

Calibration	Basic Broad Band Calibration in air
Conversion Factors (CF) for HSL 900 and HSL 1810
Additional CF for other liquids and frequencies upon request

Picture 3: ES3DV3 E-field

Frequency	10 MHz to 4 GHz; Linearity: ± 0.2 dB (30 MHz to 4 GHz)

Directivity	± 0.2 dB in HSL (rotation around probe axis)
± 0.3 dB in tissue material (rotation normal to probe axis)

Dynamic Range	5 µW/g to > 100 mW/g; Linearity: ± 0.2 dB

Dimensions	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

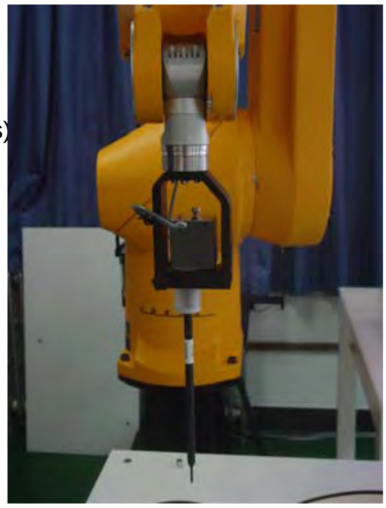
Application	General dosimetry up to 4 GHz
Dosimetry in strong gradient fields
Compliance tests of mobile phones

Picture4:ES3DV3 E-field probe

EX3DV4 Probe Specification

Picture 5: EX3DV4 E-field

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 900 and HSL 1750 Additional CF for other liquids and frequencies upon request
Frequency	10 MHz to 6 GHz; Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Distance from probe tip to dipole centers: 1mm
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.



Picture6:EX3DV4 E-field probe

5.4 E-field Probe Calibration

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

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

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

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

Where: Δt = Exposure time (30 seconds),
C = Heat capacity of tissue (brain or muscle),
ΔT = Temperature increase due to RF exposure.

Or

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

Where:
σ = Simulated tissue conductivity,
ρ = Tissue density (kg/m^3).

Picture 7: Device Holder

5.5 Other Test Equipment

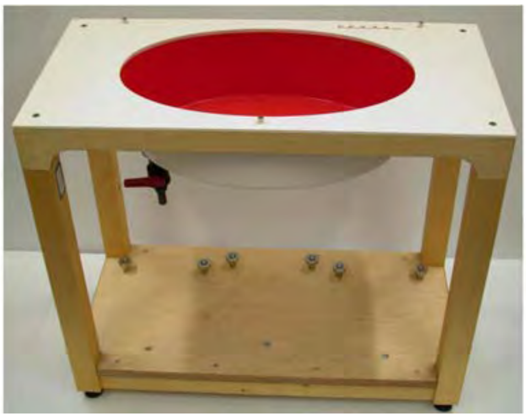
5.5.1 Device Holder for Transmitters

In combination with the Generic Twin Phantom V3.0 and ELI4 phantom, 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 repeatable positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

5.5.2 Phantom

The ELI4 phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30MHz to 6GHz. ELI4 is fully compatible with the latest standard IEC 62209-2 and all known tissue simulating liquids. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness	2±0. l mm
Filling Volume	Approx. 20 liters
Dimensions	810 x l000 x 500 mm (H x L x W)
Available	Special



Picture 8: ELI4 Phantom

5.6 Equivalent Tissues

The liquid used for the frequency 450 MHz consisted of water, sugar, salt and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table 1 and 2 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528.

Table 1. Composition of the Head Tissue Equivalent Matter

MIXTURE %	FREQUENCY 450MHz
Water	38.56
Sugar	56.32
Salt	3.95
Preventol	0.19
Cellulose	0.98
Dielectric Parameters Target Value	f=450MHz ε=43.5 σ=0.87

Table 2. Composition of the Body Tissue Equivalent Matter

MIXTURE %	FREQUENCY 450MHz
Water	53.51
Sugar	44.16
Salt	1.79
Preventol	0.05
Cellulose	0.49
Dielectric Parameters Target Value	f=450MHz ε=56.7 σ=0.94

5.7 System Specifications

Specifications

Positioner: Stäubli Unimation Corp. Robot Model: TX90XL
Repeatability: ±0.02 mm
No. of Axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Inter® Core™ CPU 6300
Clock Speed: 1.86GHz
Operating System: Windows XP

Data Converter

Features: Signal Amplifier, multiplexer, A/D converter, and control logic
Software: DASY5 software
Connecting Lines: Optical downlink for data and status info.
Optical uplink for commands and clock

6 LABORATORY ENVIRONMENT

Table 3: The Ambient Conditions during EMF Test

Temperature	Min. = 15 °C, Max. = 30 °C
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surroundi objects is minimized and in compliance with requirement of standards.	

7 CONDUCTED OUTPUT POWER MEASUREMENT

7.1 Summary

During the process of testing, the EUT was set to tansmit by pushing the PTT button. This result contains conducted output power for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

7.2 Conducted Power

7.2.1 Measurement Methods

The EUT was set up for Transmit model. The channel power was measured with Agilent Spectrum Analyzer E4440A. These measurements were done at low, middle and high channels.

7.2.2 Measurement result

The conducted power for FM,450 MHz is as following:

FM 450	Measured Power (dBm)		
	1	7	14
	32.40	32.35	33.00

7.2.3 Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 7 and 8 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

8 TEST RESULTS

8.1 Dielectric Performance

Table 4: Dielectric Performance of Head Tissue Simulating Liquid

Measurement is made at temperature 23.0 °C and relative humidity 56%.
Liquid temperature during the test: 22.5°C
Measurement Date : **June 4, 2010**

/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	450 MHz	43.5	0.87
Measurement value (Average of 10 tests)	450MHz	44.2	0.83

Table 5: Dielectric Performance of Body Tissue Simulating Liquid

Measurement is made at temperature 22.3 °C and relative humidity 61%. Liquid temperature during the test: 22.5°C Measurement Date : **June 25, 2010**			
/	**Frequency**	**Permittivity ε**	**Conductivity σ (S/m)**
Target value	450 MHz	56.7	0.94
Measurement value (Average of 10 tests)	450 MHz	58.0	0.92

8.2 System Validation

Table 6: System Validation of Head

Measurement is made at temperature 23.0 °C and relative humidity 56%. Liquid temperature during the test: 22.5°C Measurement Date : 450 MHz **June 4, 2010**							
Liquid parameters	Dipole calibration Target value	**Frequency**		**Permittivity ε**		**Conductivity σ (S/m)**	
		450 MHz		43.5		0.87	
	Actural Measurement value	450 MHz		44.2		0.83	
Verification results	**Frequency**	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**	
		10g Average	**1g Average**	**10g Average**	**1g Average**	**10g Average**	**1g Average**
	450 MHz	0.841	1.232	0.82	1.19	-2.50%	-3.41%
Measurement is made at temperature 22.3 °C and relative humidity 61%. Liquid temperature during the test: 22.5°C Measurement Date : 450 MHz **June 25, 2010**							
Liquid parameters	Dipole calibration Target value	**Frequency**		**Permittivity ε**		**Conductivity σ (S/m)**	
		450 MHz		43.5		0.87	
	Actural Measurement value	450 MHz		43.9		0.83	
Verification results	**Frequency**	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**	
		10g Average	**1g Average**	**10g Average**	**1g Average**	**10g Average**	**1g Average**
	450 MHz	0.841	1.232	0.86	1.22	2.26%	-0.97%

Note：1.Target values are the data of the dipole validation results, please check Annex F for the Dipole Calibration Certificate.

2.250 mw is used as feeding power to the calibrated dipole.

8.3 Summary of Measurement Results

Table 7: SAR Values (FM 450MHz,face held)

Limit of SAR (W/kg)	**1 g Average**	**Power Drift (dB)**
	8.0	
Test Case	**Measurement Result (W/kg)**	
	1 g Average	
Towards Phantom, Top frequency (See Fig.1)	0.931	-0.173
Towards Phantom, Mid frequency (See Fig.2)	1.59	-0.161
Towards Phantom, Bottom frequency (See Fig.3)	1.98	-0.106

Table 8: SAR Values (FM 450MHz,body-worn with belt clip)

Limit of SAR (W/kg)	**1 g Average**	**Power Drift (dB)**
	8.0	
Test Case	**Measurement Result (W/kg)**	
	1 g Average	
Towards Ground, Top frequency (See Fig.4)	2.39	-0.159
Towards Ground, Mid frequency (See Fig.5)	5.57	0.195
Towards Ground, Bottom frequency (See Fig.6)	4.9	-0.110

8.4 Conclusion

Localized Specific Absorption Rate (SAR) of this portable wireless device has been measured in all cases requested by the relevant standards cited in Clause 4.2 of this report. Maximum localized SAR is below exposure limits specified in the relevant standards cited in Clause 4.1 of this test report.

9 Measurement Uncertainty

No.	Error source	Type	Uncertainty Value (%)	Probability Distribution	k	c_i	Standard Uncertainty (%) u_i' (%)	Degree of freedom V_{eff} or v_i
1	System repeatability	A	0.5	N	1	1	0.5	9
	Measurement system							
2	—probe calibration	B	3.5	N	1	1	3.5	∞
3	—axial isotropy of the probe	B	4.7	R	$\sqrt{3}$	0.5	4.3	∞
4	— hemisphere isotropy of the probe	B	9.4	R	$\sqrt{3}$			

5	—space resolution	B	0	R	$\sqrt{3}$	1	0	∞
6	—boundary effect	B	11.0	R	$\sqrt{3}$	1	6.4	∞
7	—probe linearity	B	4.7	R	$\sqrt{3}$	1	2.7	∞
8	—detection limit	B	1.0	R	$\sqrt{3}$	1	0.6	∞
9	—readout electronics	B	1.0	N	1	1	1.0	∞
10	—RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
11	—Probe Positioner Mechanical Tolerance	B	0.4	R	$\sqrt{3}$	1	0.2	∞
12	— Probe Positioning with respect to Phantom Shell	B	2.9	R	$\sqrt{3}$	1	1.7	∞
13	— Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	B	3.9	R	$\sqrt{3}$	1	2.3	∞
	Test sample Related							
14	—Test Sample Positioning	A	4.9	N	1	1	4.9	5
15	—Device Holder	A	6.1	N	1	1	6.1	5
16	— Output Power Variation - SAR drift measurement	B	5.0	R	$\sqrt{3}$	1	2.9	∞
	Phantom and Tissue Parameters							
17	—Phantom Uncertainty (shape and thickness tolerances)	B	1.0	R	$\sqrt{3}$	1	0.6	∞
18	—liquid conductivity (deviation from target)	B	5.0	R	$\sqrt{3}$	0.6	1.7	∞
19	— liquid conductivity (measurement error)	A	0.23	N	1	1	0.23	9
20	-liquid permittivity (deviation from target)	B	5.0	R	$\sqrt{3}$	0.6	1.7	∞
21	— liquid permittivity (measurement error)	A	0.46	N	1	1	0.46	9

Combined standard uncertainty	$u_c^{'} = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$	/		12.2	88.7
Expanded uncertainty (confidence interval of 95 %)	$u_e = 2u_c$	N	k=2	24.4	/

10 MAIN TEST INSTRUMENTS

Table 9: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Network analyzer	Agilent E5071C	MY46103759	January 18,2010	One year
02	Power meter	NRVD	101253	March 9,2010	One year
03	Power sensor	NRV-Z5	100333		
04	Power sensor	NRV-Z6	100011	September 1, 2009	One year
05	Signal Generator	Agilent E4438C	MY45095825	January 18,2010	One Year
06	Amplifier	VTL5400	0505	No Calibration Requested	
07	E-field Probe	SPEAG ES3DV3	3151	April 28, 2010	One year
08	E-field Probe	SPEAG EX3DV4	3633	January 8,2010	One year
09	DAE	SPEAG DAE4	786	November 23, 2009	One year
10	Dipole Validation Kit	IXD-045	0111	December 20,2008	Two years

END OF REPORT BODY

ANNEX A MEASUREMENT PROCESS

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the reference point was measured and was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the phantom was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the flat phantom and the horizontal grid spacing was 10 mm x 10 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

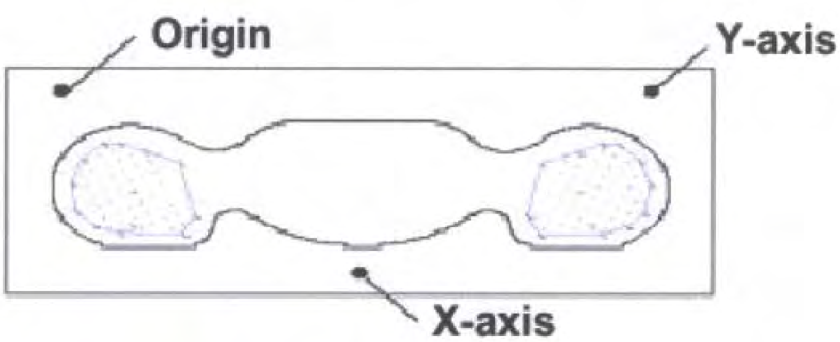
Step 3: Around this point, a volume of 30 mm x 30 mm x 30 mm was assessed by measuring 7 x 7x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

a. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. 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.

b. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot"-condition (in x ~ y and z-directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

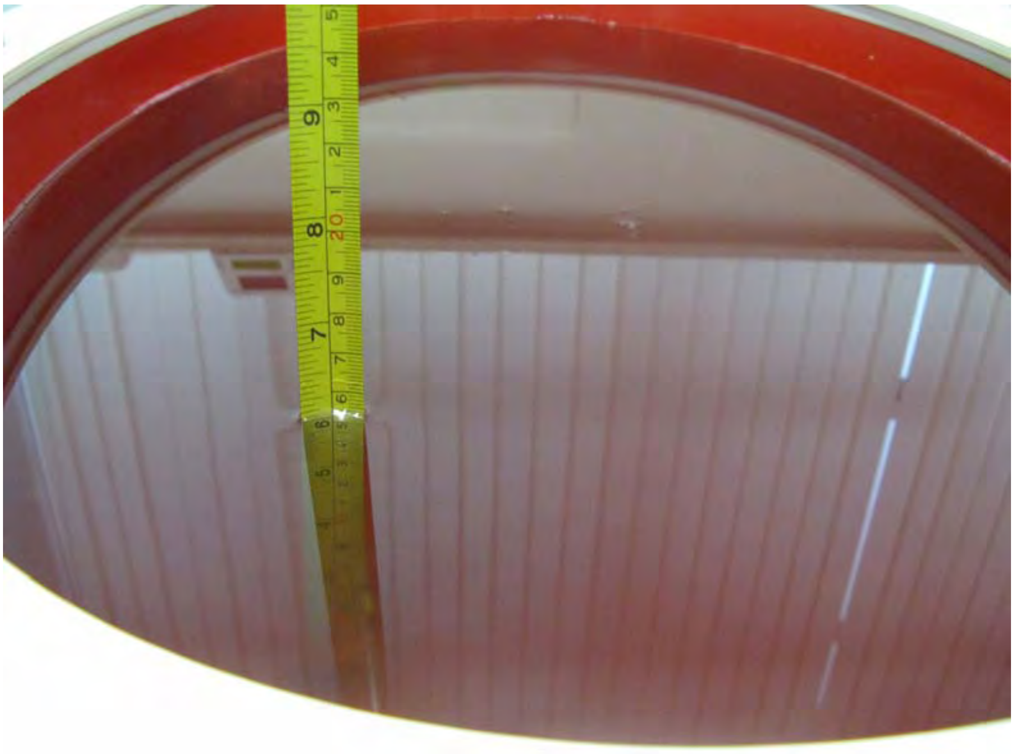
Step 4: Re-measurement the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation is repeated.



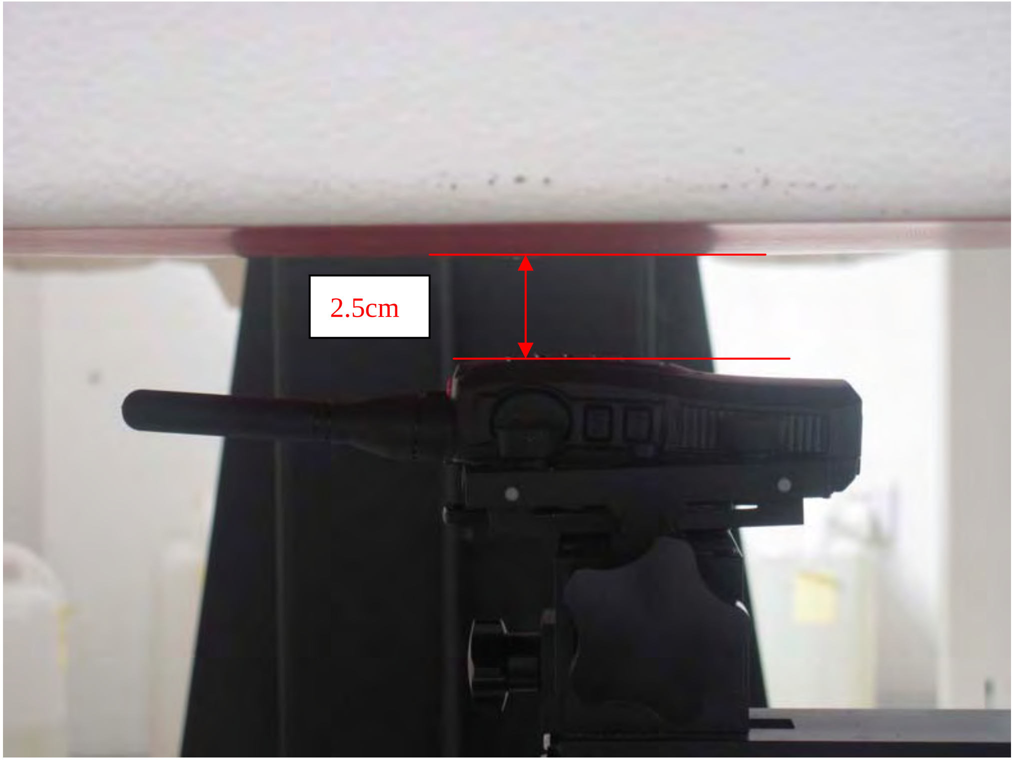
Picture A: SAR Measurement Points in Area Scan

ANNEX B TEST LAYOUT

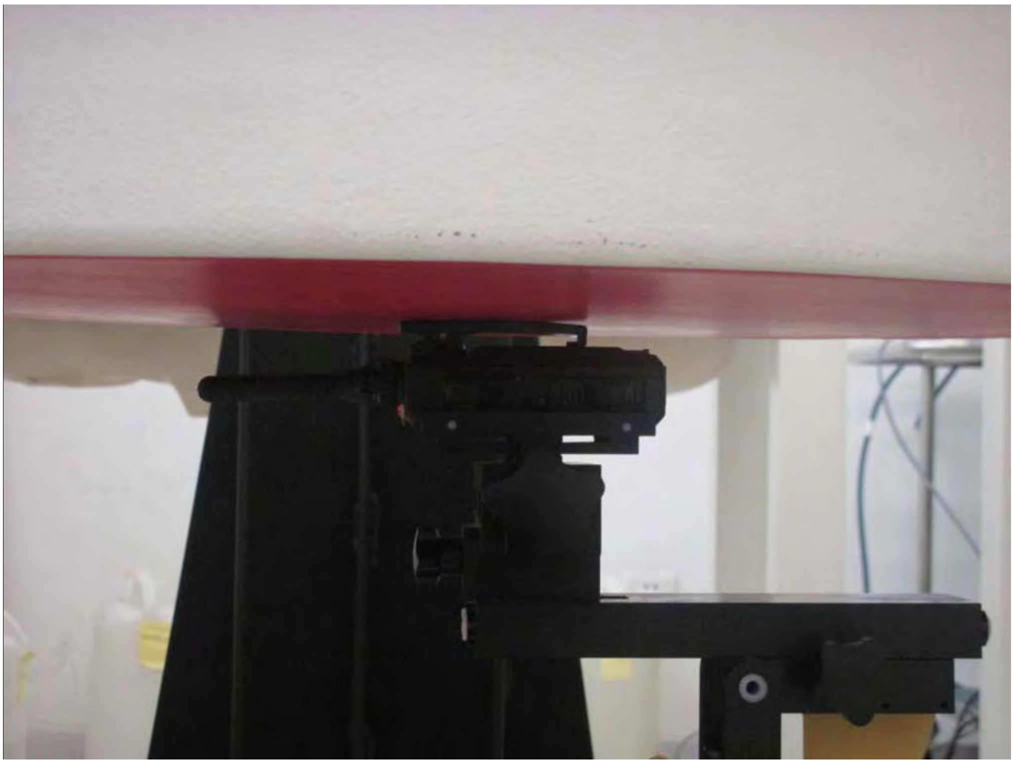
Picture B1: Specific Absorption Rate Test Layout



Picture B2: Liquid depth in the Flat Phantom (450 MHz)



Picture B3: Face held Position (towards Phantom, the distance from transceiver to the bottom of the Phantom is 2.5cm)



Picture B4: Body-worn Position (towards ground with the belt clip, the transceiver is in direct contact against the bottom of the Phantom)

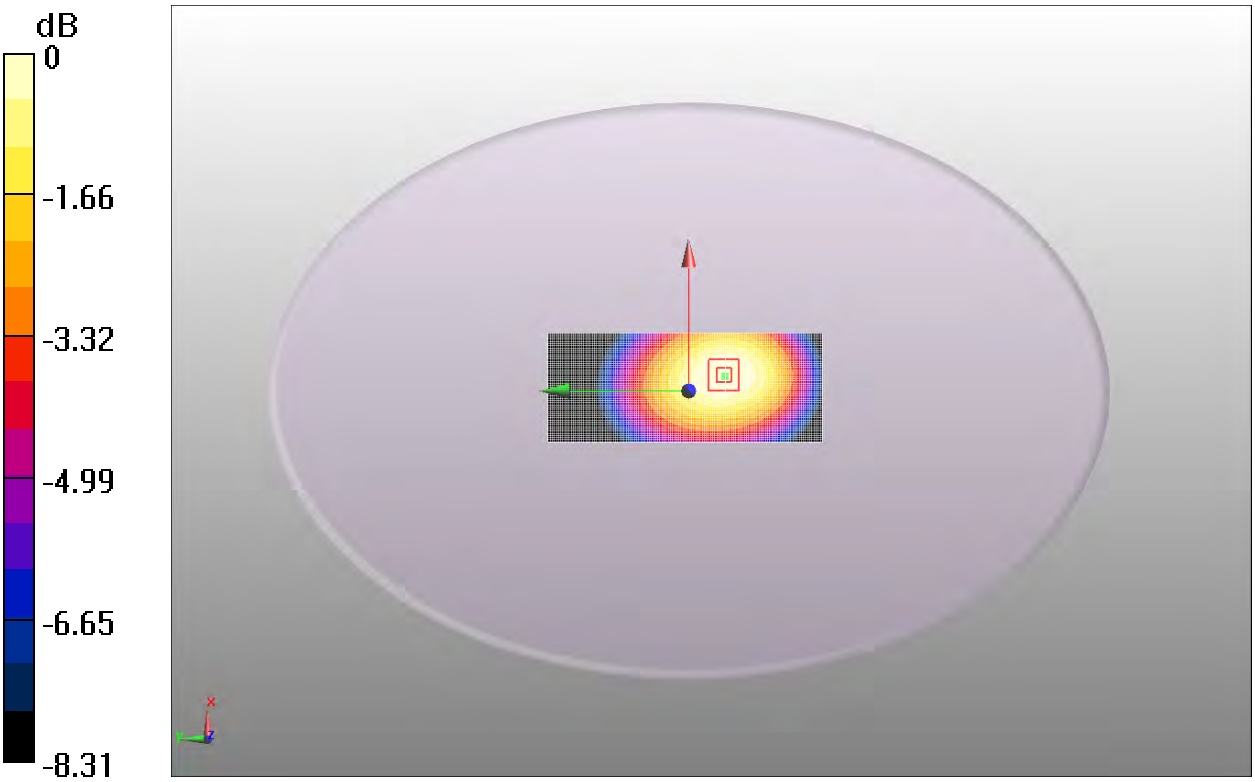
ANNEX C GRAPH RESULTS

450 Towards Phantom Top

Date/Time: 6/4/2010 2:10:51 PM,
Electronics: DAE4 Sn786
Medium: Head 450MHz
Medium parameters used: f = 465 MHz; σ = 0.847 mho/m; ε_r = 43.9; ρ = 1000 kg/m^3
Ambient Temperature:23.0℃ Liqiud Temperature: 22.5℃
Communication System: FM Frequency: 464.375 MHz Duty Cycle: 1:2
Probe: ES3DV3 - SN3151 ConvF(7.42, 7.42, 7.42)

Towards phantom Top/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1 mW/g

Towards phantom Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 32 V/m; Power Drift = -0.173 dB
Peak SAR (extrapolated) = 1.19 W/kg
SAR(1 g) = 0.931 mW/g; SAR(10 g) = 0.683 mW/g
Maximum value of SAR (measured) = 0.985 mW/g



0 dB = 0.985mW/g

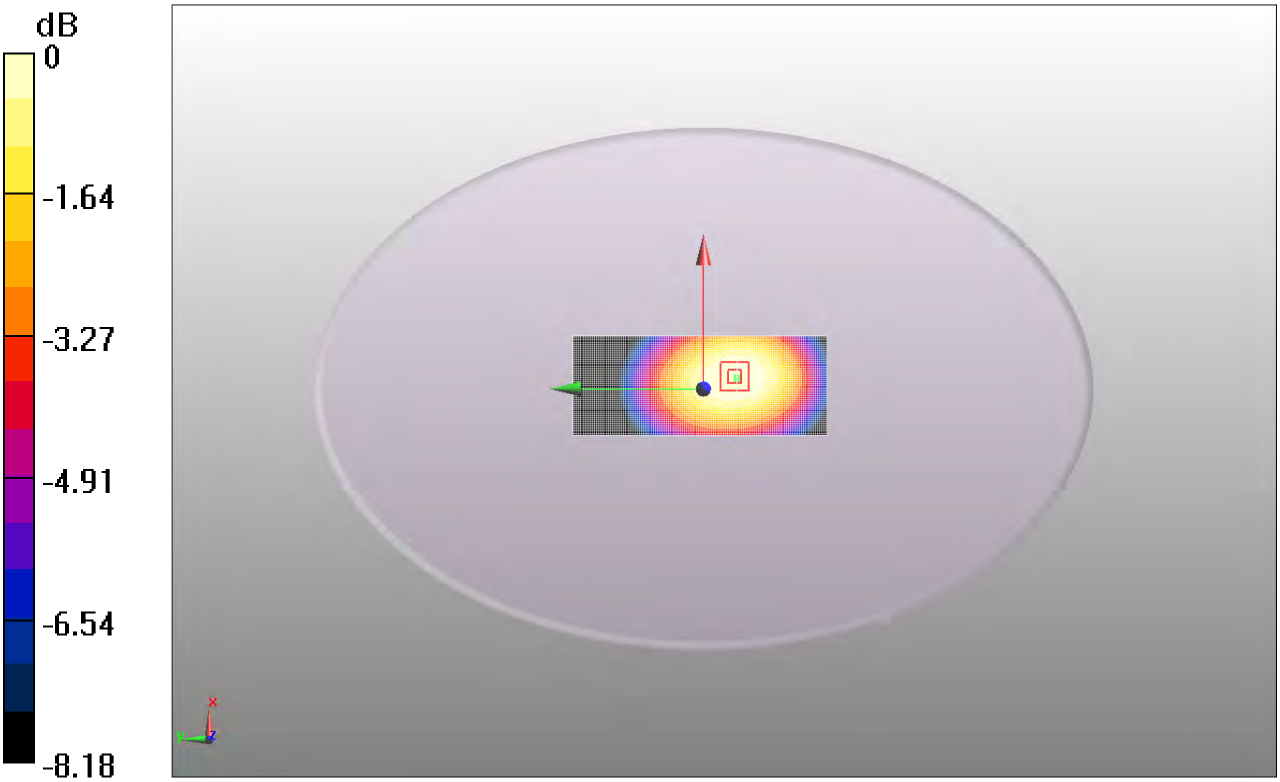
Fig.1 450MHz CH14 face held

450 Towards Phantom Middle

Date/Time: 6/4/2010 2:42:35 PM,
Electronics: DAE4 Sn786
Medium: Head 450MHz
Medium parameters used (interpolated): f = 446.081 MHz; σ = 0.83 mho/m; ε_r = 44.3; ρ = 1000 kg/m^3
Ambient Temperature:23.0℃ Liqiud Temperature: 22.5℃
Communication System: FM Frequency: 446.081 MHz Duty Cycle: 1:2
Probe: ES3DV3 - SN3151 ConvF(7.42, 7.42, 7.42)

Towards phantom Middle/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.77 mW/g

towards phantom Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 44.5 V/m; Power Drift = -0.161 dB
Peak SAR (extrapolated) = 2.02 W/kg
SAR(1 g) = 1.59 mW/g; SAR(10 g) = 1.17 mW/g
Maximum value of SAR (measured) = 1.68 mW/g



0 dB = 1.68mW/g

Fig.2 450MHz CH7 face held

450 Towards Phantom Bottom

Date/Time: 6/4/2010 3:22:40 PM

Electronics: DAE4 Sn786

Medium: Head 450MHz

Medium parameters used (interpolated): f = 446.006 MHz; σ = 0.83 mho/m; ε_r = 44.3; ρ = 1000 kg/m^3

Ambient Temperature:23.0℃ Liqiud Temperature: 22.5℃

Communication System: FM Frequency: 446.006 MHz Duty Cycle: 1:2

Probe: ES3DV3 - SN3151 ConvF(7.42, 7.42, 7.42)

Towards phantom Bottom/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.2 mW/g

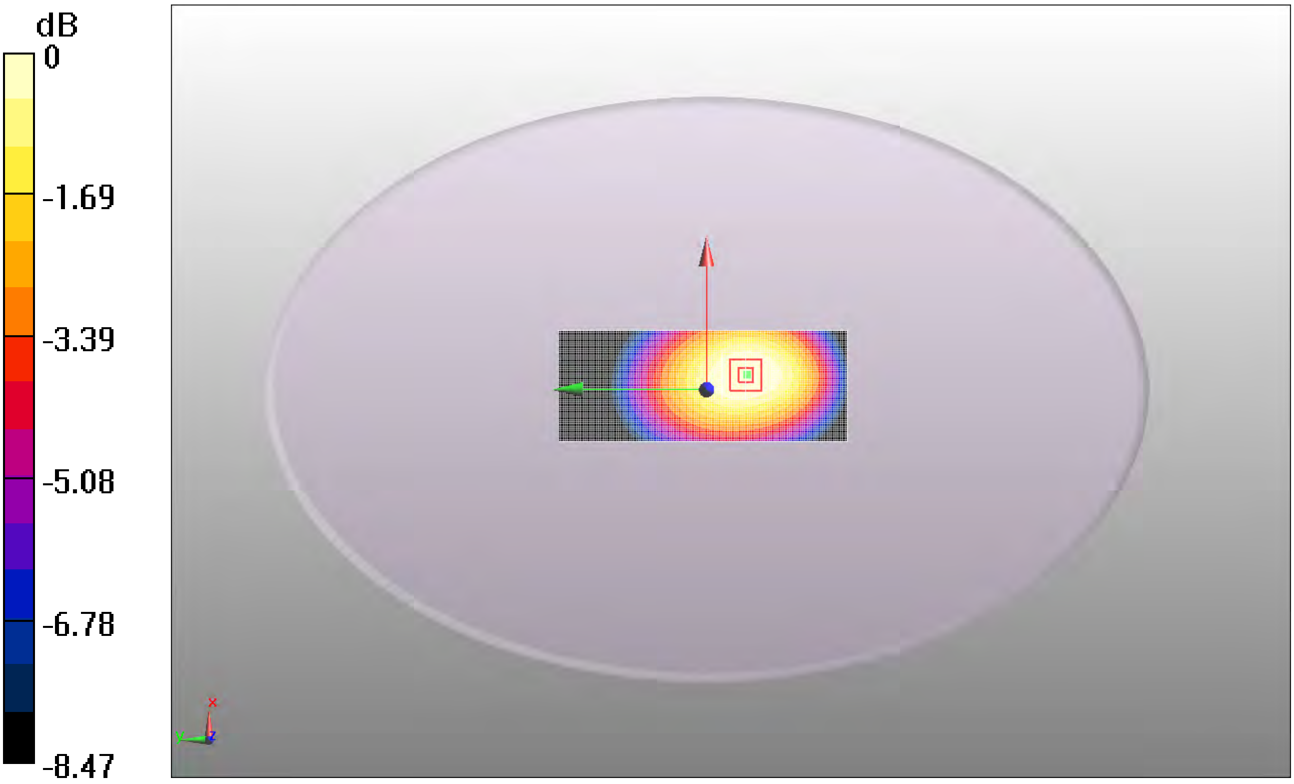
Towards phantom Bottom/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 49 V/m; Power Drift = -0.106 dB

Peak SAR (extrapolated) = 2.54 W/kg

SAR(1 g) = 1.98 mW/g; SAR(10 g) = 1.44 mW/g

Maximum value of SAR (measured) = 2.09 mW/g



0 dB = 2.09mW/g

Fig.3 450MHz CH1 face held

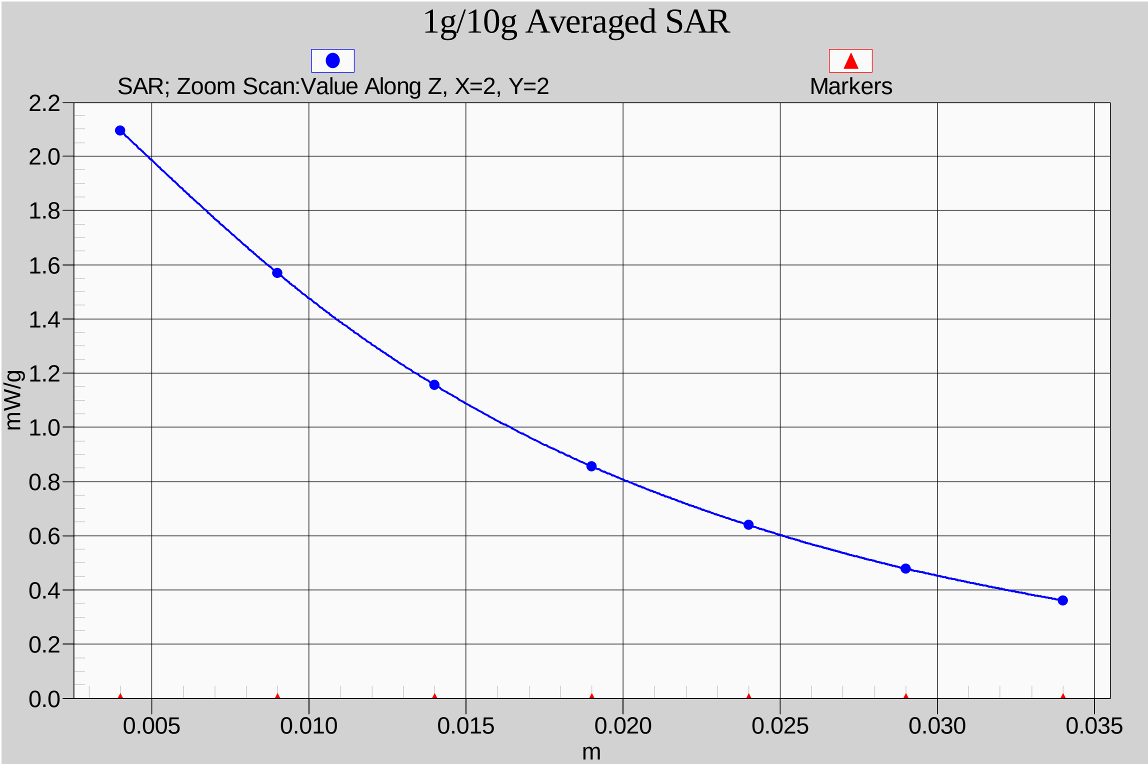


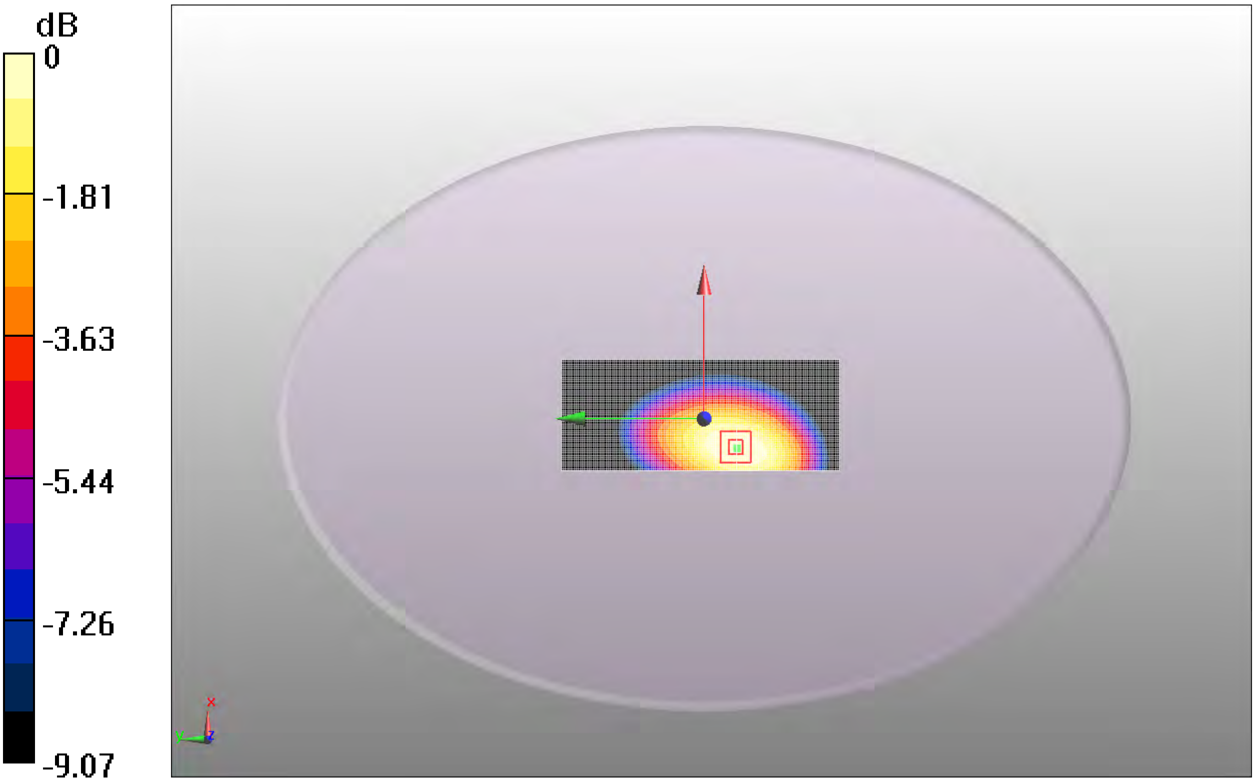
Fig. 3-1 Z-Scan at power reference point (450 MHz CH1 face held)

450 Towards Ground Top

Date/Time: 6/25/2010 2:37:07 PM
Electronics: DAE4 Sn786
Medium: Body 450MHz
Medium parameters used: f = 465 MHz; σ = 0.936 mho/m; ε_r = 57.8; ρ = 1000 kg/m^3
Ambient Temperature:22.3℃ Liqiud Temperature: 22.5℃
Communication System: FM Frequency: 464.375 MHz Duty Cycle: 1:2
Probe: EX3DV4 - SN3633 ConvF(9.23, 9.23, 9.23)

Towards Ground Top/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 2.59 mW/g

Towards Ground Top/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 42.5 V/m; Power Drift = -0.159 dB
Peak SAR (extrapolated) = 3.34 W/kg
SAR(1 g) = 2.39 mW/g; SAR(10 g) = 1.68 mW/g
Maximum value of SAR (measured) = 2.54 mW/g



0 dB = 2.54mW/g

Fig.4 450MHz CH14 body-worn

450 Towards Ground Middle

Date/Time: 6/25/2010 2:12:10 PM

Electronics: DAE4 Sn786

Medium: Body 450MHz

Medium parameters used (interpolated): f = 446.081 MHz; σ = 0.92 mho/m; ε_r = 58.1; ρ = 1000 kg/m^3

Ambient Temperature:22.3℃ Liqiud Temperature: 22.5℃

Communication System: FM Frequency: 446.081 MHz Duty Cycle: 1:2

Probe: EX3DV4 - SN3633 ConvF(9.23, 9.23, 9.23)

towards ground Middle/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 6.29 mW/g

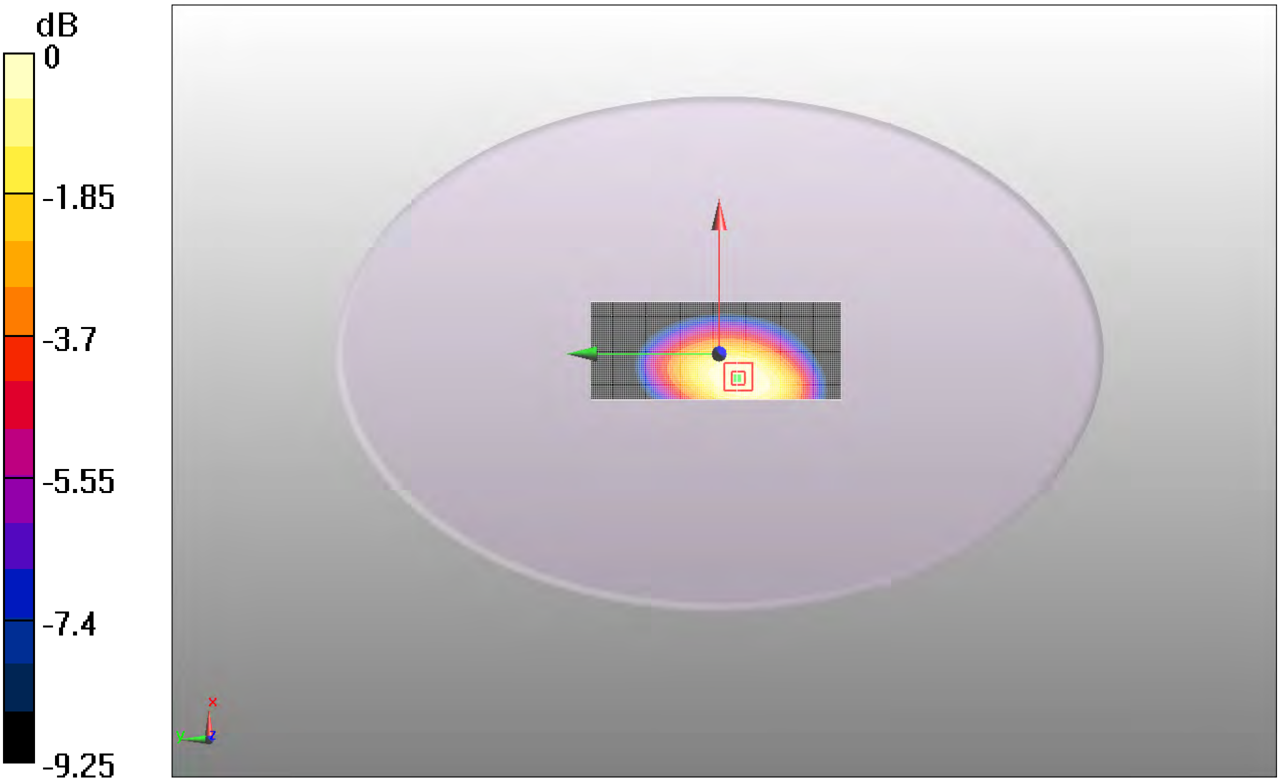
towards ground Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 60.5 V/m; Power Drift = 0.195 dB

Peak SAR (extrapolated) = 7.83 W/kg

SAR(1 g) = 5.57 mW/g; SAR(10 g) = 3.9 mW/g

Maximum value of SAR (measured) = 5.92 mW/g



0 dB = 5.92mW/g

Fig.5 450MHz CH7 body-worn

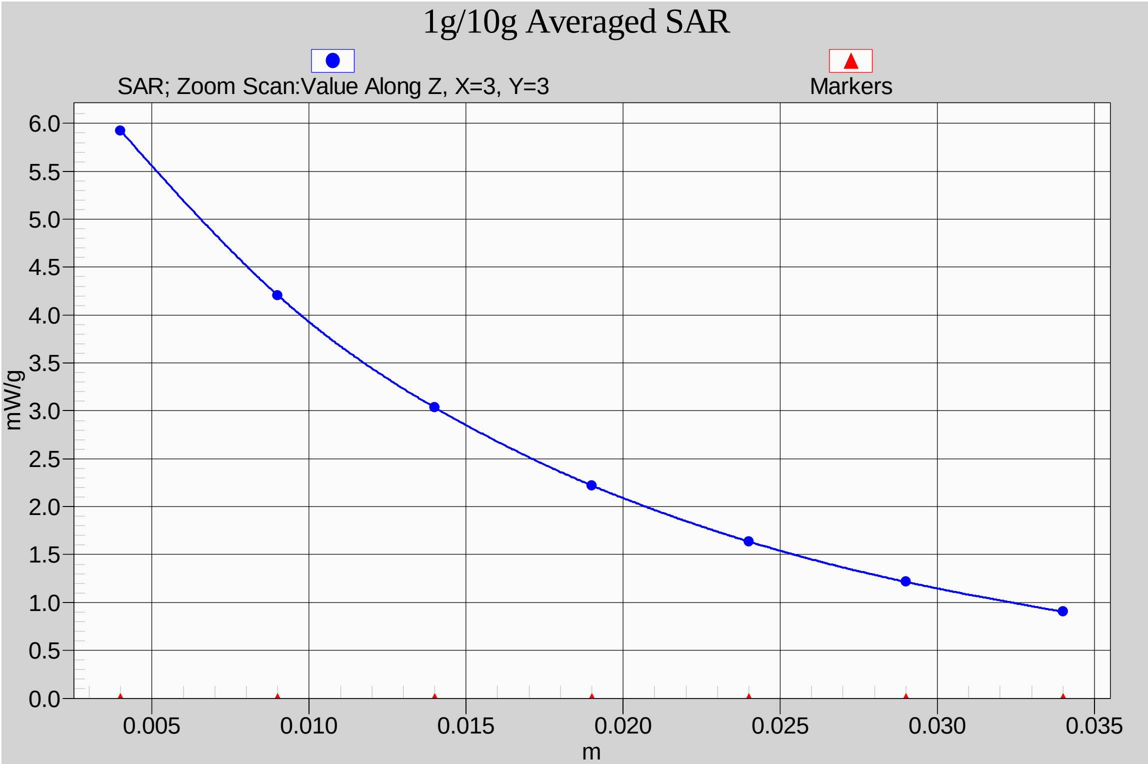


Fig. 5-1 Z-Scan at power reference point (450 MHz CH7 body-worn)

450 Towards Ground Bottom

Date/Time: 6/25/2010 2:59:47 PM

Electronics: DAE4 Sn786

Medium: Body 450MHz

Medium parameters used (interpolated): f = 446.006 MHz; σ = 0.92 mho/m; ε_r = 58.1; ρ = 1000 kg/m^3

Ambient Temperature:22.3℃ Liqiud Temperature: 22.5℃

Communication System: FM Frequency: 446.006 MHz Duty Cycle: 1:2

Probe: EX3DV4 - SN3633 ConvF(9.23, 9.23, 9.23)

towards ground Bottom/Area Scan (51x131x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 5.3 mW/g

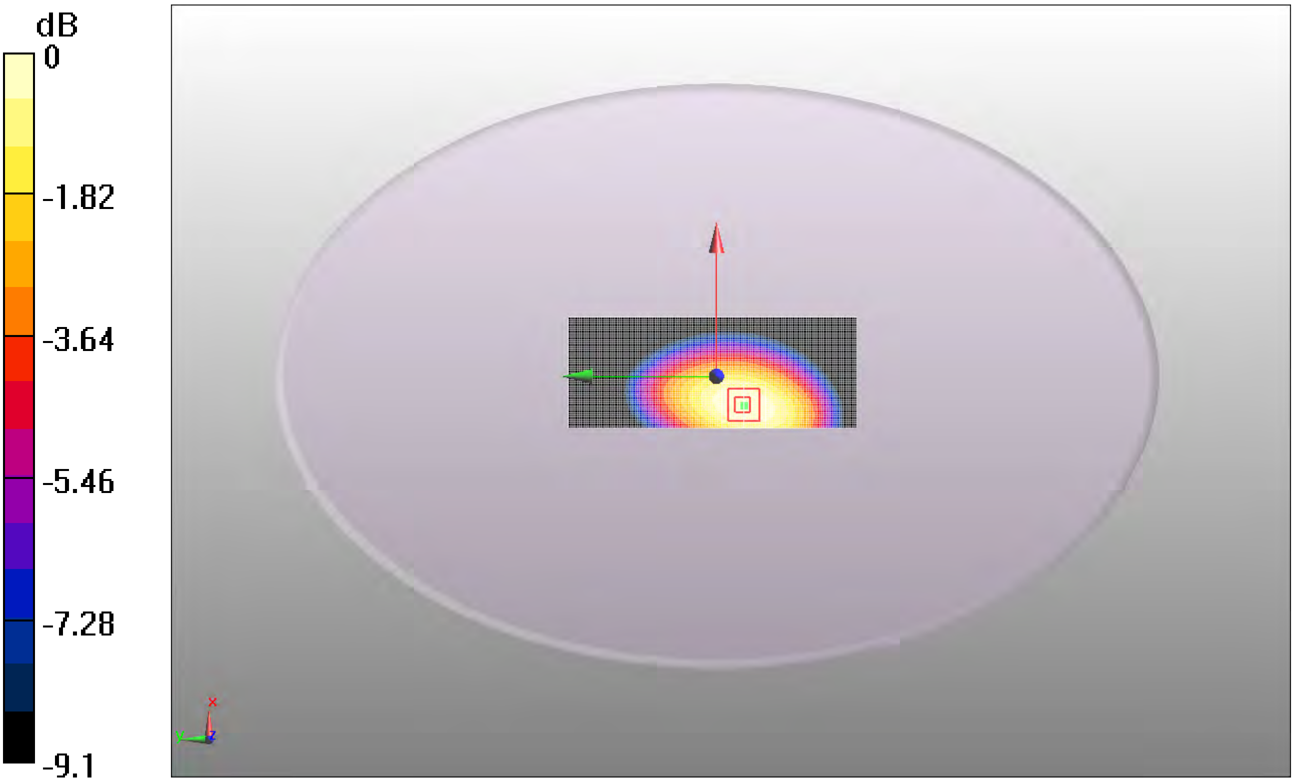
towards ground Bottom/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 62.3 V/m; Power Drift = -0.110 dB

Peak SAR (extrapolated) = 6.87 W/kg

SAR(1 g) = 4.9 mW/g; SAR(10 g) = 3.43 mW/g

Maximum value of SAR (measured) = 5.2 mW/g



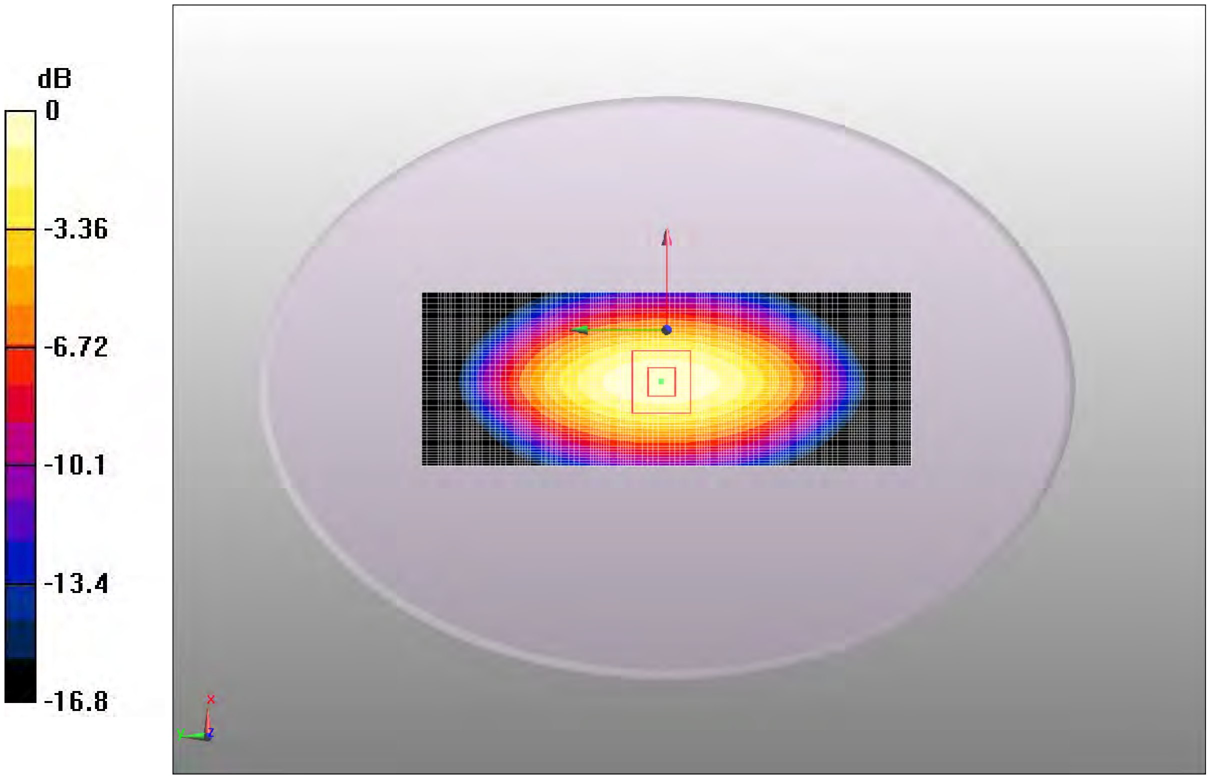
0 dB = 5.2mW/g

Fig.6 450MHz CH1 body-worn

ANNEX D SYSTEM VALIDATION RESULTS

450MHz

Date/Time: 6/4/2010 10:42:35 AM,
Electronics: DAE4 Sn786
Medium: Head 450MHz
Medium parameters used (interpolated): f =450 MHz; σ = 0.83 mho/m; ε_r = 44.3; ρ = 1000 kg/m^3
Ambient Temperature:23.0℃ Liqiud Temperature: 22.5℃
Communication System: CW Frequency: 450 MHz Duty Cycle: 1:1
Probe: ES3DV3 - SN3151 ConvF(7.42, 7.42, 7.42)
System Validation/Area Scan (101x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.39 mW/g
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.5 V/m; Power Drift = 0.071 dB
Peak SAR (extrapolated) = 1.56 W/kg
SAR(1 g) = 1.19 mW/g; SAR(10 g) = 0.82 mW/g
Maximum value of SAR (measured) = 1.27 mW/g

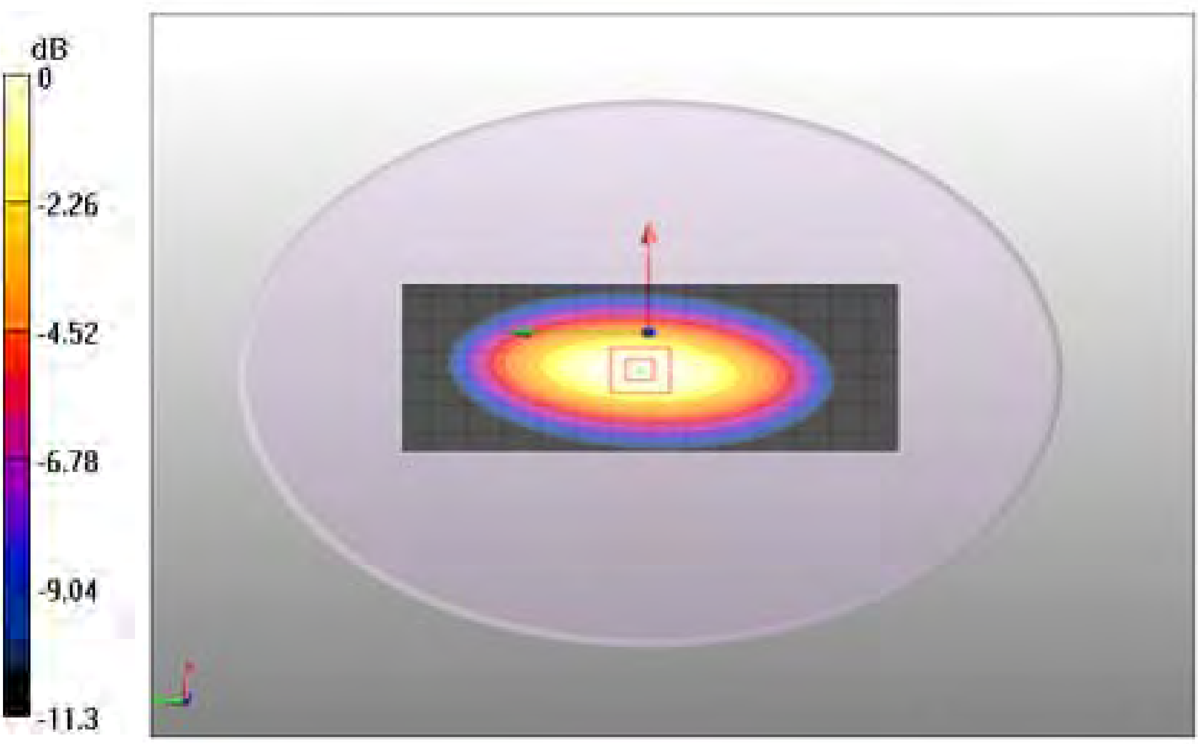


0 dB = 1.27mW/g

Fig.7 validation 450MHz 250mW

450MHz

Date/Time: 6/25/2010 1:22:12 PM,
Electronics: DAE4 Sn786
Medium: Head 450MHz
Medium parameters used (interpolated): f =450 MHz; σ = 0.83 mho/m; ε_r = 44.3; ρ = 1000 kg/m^3
Ambient Temperature:22.3℃ Liqiud Temperature: 22.5℃
Communication System: CW Frequency: 450 MHz Duty Cycle: 1:1
Probe: EX3DV4 - SN3633 ConvF(9.64, 9.64, 9.64)
System Validation/Area Scan (101x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.44 mW/g
System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.7 V/m; Power Drift = 0.065 dB
Peak SAR (extrapolated) = 1.63 W/kg
SAR(1 g) = 1.22 mW/g; SAR(10 g) = 0.86 mW/g
Maximum value of SAR (measured) = 1.32 mW/g



0 dB = 1.32mW/g

Fig.8 validation 450MHz 250mW

ANNEX E PROBE CALIBRATION CERTIFICATE

Probe:ES3DV3 3151

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

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

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

Accreditation No.: **SCS 108**

Client Telecommunication Metrology Center of MIIT

Certificate No: ES3DV3-3151_Apr10

CALIBRATION CERTIFICATE

Object	**ES3DV3-SN: 3151**
Calibration procedure(s)	**QA CAL-01.v6** **Calibration procedure for dosimetric E-field probes**
Calibration date:	**April 28, 2010**
Condition of the calibrated item	**In Tolerance**

This calibration certify 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 at an environment temperature (22±3)^{0}C and humidity<70%

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Data (Calibrated by, Certification NO.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-09 (METAS, NO. 251-00388)	May-10
Power sensor E4412A	MY41495277	5-May-09 (METAS, NO. 251-00388)	May-10
Reference 3 dB Attenuator	SN:S5054 (3c)	10-Aug-09 (METAS, NO. 251-00403)	Aug-10
Reference 20 dB Attenuator	SN:S5086 (20b)	3-May-09 (METAS, NO. 251-00389)	May-10
Reference 30 dB Attenuator	SN:S5129 (30b)	10-Aug-09 (METAS, NO. 251-00404)	Aug-10
DAE4	SN:617	10-Jun-09 (SPEAG, NO.DAE4-907_Jun09)	Jun-10
Reference Probe ES3DV2	SN: 3013	11-Jan-10 (SPEAG, NO. ES3-3013_Jan10)	Jan-11

Secondary Standards	ID#	Check Data (in house)	Scheduled Calibration
RF generator HP8648C	US3642U01700	4-Aug-99(SPEAG, in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01(SPEAG, in house check Nov-09)	In house check: Nov-10

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: April 28, 2010

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

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

ilac-MRA

SWISS CALIBRATION

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

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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 ≤ 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 *NORMx,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 ± 50 MHz to ± 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.

Probe ES3DV3

SN: 3151

Manufactured: June 12, 2007

Calibrated: April 28, 2010

Calibrated for DASY4 System

ES3DV3 SN: 3151 April 28, 2010

DASY – Parameters of Probe: ES3DV3 SN:3151

Sensitivity in Free Space[A]

NormX	1.18±10.1%	$\mu V/(V/m)^2$
NormY	1.25±10.1%	$\mu V/(V/m)^2$
NormZ	1.21±10.1%	$\mu V/(V/m)^2$

Diode Compression[B]

DCP X	93mV
DCP Y	96mV
DCP Z	94mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)
Please see Page 8

Boundary Effect

TSL 900MHz Typical SAR gradient: 5% per mm

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SARbe[%]	Without Correction Algorithm	10.9	6.7
SARbe[%]	With Correction Algorithm	1.0	0.5

TSL 1810MHz Typical SAR gradient: 10% per mm

Sensor Center to Phantom Surface Distance		3.0 mm	4.0 mm
SARbe[%]	Without Correction Algorithm	10.3	5.5
SARbe[%]	With Correction Algorithm	0.8	0.7

Sensor Offset

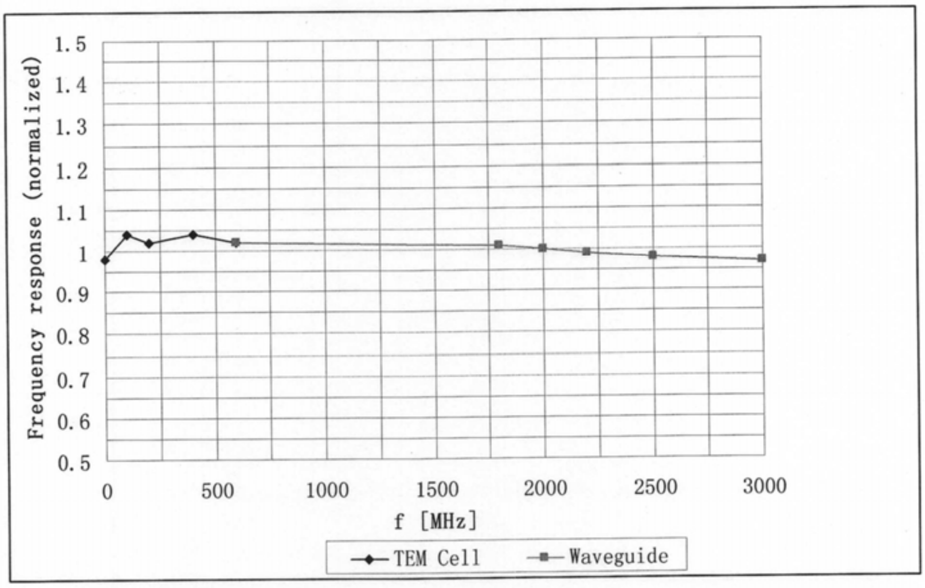
Probe Tip to Sensor Center 2.0 mm

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.

ES3DV3 SN: 3151 April 28, 2010

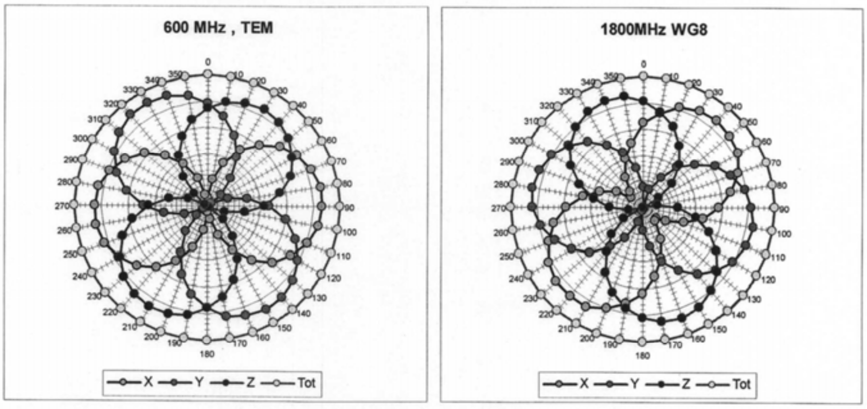
Frequency Response of E-Field

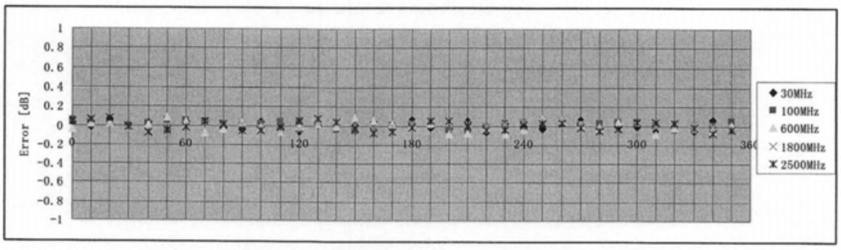


Uncertainty of Frequency Response of E-field: ±6.3% (k=2)

ES3DV3 SN: 3151 April 28, 2010

Receiving Pattern (ϕ), θ =0°

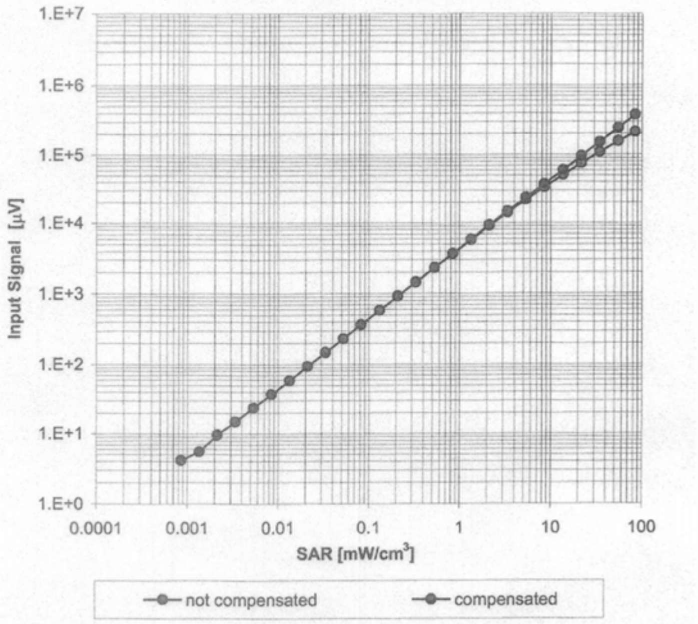


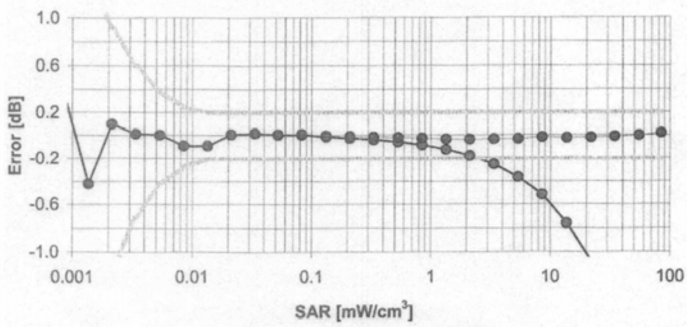


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

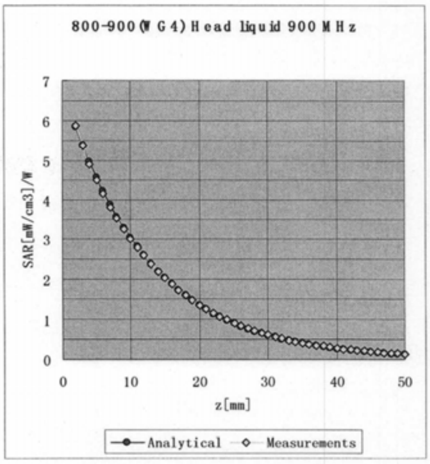
(Waveguide: WG8, f = 1800 MHz)

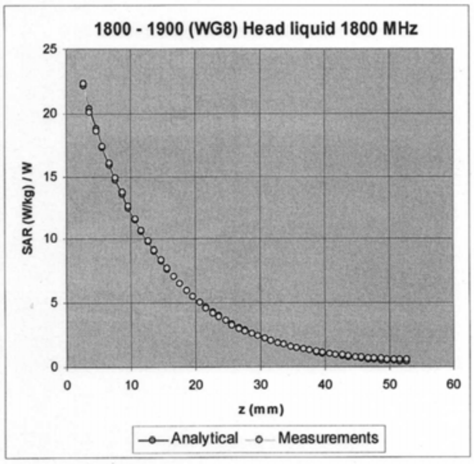




Uncertainty of Linearity Assessment: ±0.6% (k=2)

Conversion Factor Assessment



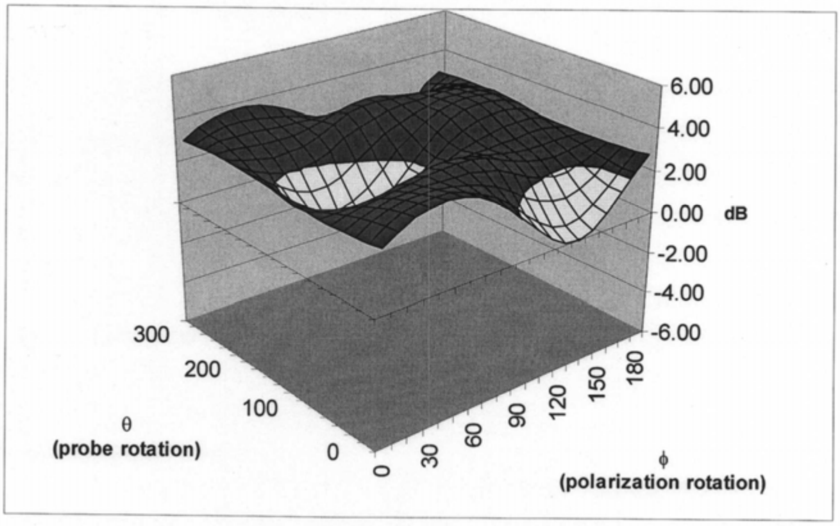


f[MHz]	Validity[MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
450	±50 /±100	Head	43.5±5%	0.87±5%	0.82	1.44	7.42	±13.3% (k=2)
900	±50 /±100	Head	41.5±5%	0.97±5%	0.80	1.29	6.23	±11.0% (k=2)
1810	±50 /±100	Head	40.0±5%	1.40±5%	0.61	1.57	5.08	±11.0% (k=2)
1900	±50 /±100	Head	40.0±5%	1.40±5%	0.63	1.44	4.98	±11.0% (k=2)
2100	±50 /±100	Head	39.8±5%	1.49±5%	0.66	1.34	4.58	±11.0% (k=2)
900	±50 /±100	Body	55.0±5%	1.05±5%	0.99	1.06	6.02	±11.0% (k=2)
1810	±50 /±100	Body	53.3±5%	1.52±5%	0.75	1.34	4.87	±11.0% (k=2)
1900	±50 /±100	Body	53.3±5%	1.52±5%	0.62	1.47	4.73	±11.0% (k=2)
2100	±50 /±100	Body	53.5±5%	1.57±5%	0.68	1.34	4.35	±11.0% (k=2)
2450	±50 /±100	Body	52.7±5%	1.95±5%	0.60	1.40	3.72	±11.0% (k=2)

[C] 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

Error (ϕ , θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ±2.6% (k=2)

Probe:EX3DV4 3633

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

S Schweizerischer Kalibrierdienst
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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 Telecommunication Metrology Center of MIIT | Certificate No: EX3DV4-3633_Jan10

CALIBRATION CERTIFICATE

Object	**EX3DV4-SN: 3633**
Calibration procedure(s)	**QA CAL-01.v6** **Calibration procedure for dosimetric E-field probes**
Calibration date:	**Jan 8, 2010**
Condition of the calibrated item	**In Tolerance**

This calibration certify 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 at an environment temperature (22±3)°C and humidity<70%

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID#	Cal Data (Calibrated by, Certification NO.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-09 (METAS, NO. 251-00388)	May-10
Power sensor E4412A	MY41495277	5-May-09 (METAS, NO. 251-00388)	May-10
Reference 3 dB Attenuator	SN:S5054 (3c)	10-Aug-09 (METAS, NO. 251-00403)	Aug-10
Reference 20 dB Attenuator	SN:S5086 (20b)	3-May-09 (METAS, NO. 251-00389)	May-10
Reference 30 dB Attenuator	SN:S5129 (30b)	10-Aug-09 (METAS, NO. 251-00404)	Aug-10
DAE4	SN:617	10-Jun-09 (SPEAG, NO.DAE4-907_Jun09)	Jun-10
Reference Probe ES3DV2	SN: 3013	11-Jan-09 (SPEAG, NO. ES3-3013_Jan09)	Jan-10

Secondary Standards	ID#	Check Data (in house)	Scheduled Calibration
RF generator HP8648C	US3642U01700	4-Aug-99(SPEAG, in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01(SPEAG, in house check Nov-09)	In house check: Nov-10

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: January 8, 2010

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

Calibration Laboratory of
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S Schweizerischer Kalibrierdienst
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S Servizio svizzero di taratura
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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 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:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,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 ≤ 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 *NORMx,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 ± 50 MHz to ± 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.

Probe EX3DV4

SN: 3633

Manufactured: November 1, 2007

Calibrated: January 8, 2010

Calibrated for DASY4 System

DASY – Parameters of Probe: EX3DV4 SN:3633

Sensitivity in Free Space[A] Diode Compression[B]

NormX	0.420±10.1%	$\mu V/(V/m)^2$	DCP X	86mV
NormY	0.390±10.1%	$\mu V/(V/m)^2$	DCP Y	84mV
NormZ	0.410±10.1%	$\mu V/(V/m)^2$	DCP Z	83mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)
Please see Page 8

Boundary Effect

TSL 900MHz Typical SAR gradient: 5% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	0.8	0.1
SARbe[%]	With Correction Algorithm	0.2	0.2

TSL 1810MHz Typical SAR gradient: 10% per mm

Sensor Center to Phantom Surface Distance		2.0 mm	3.0 mm
SARbe[%]	Without Correction Algorithm	4.2	1.8
SARbe[%]	With Correction Algorithm	0.2	0.9

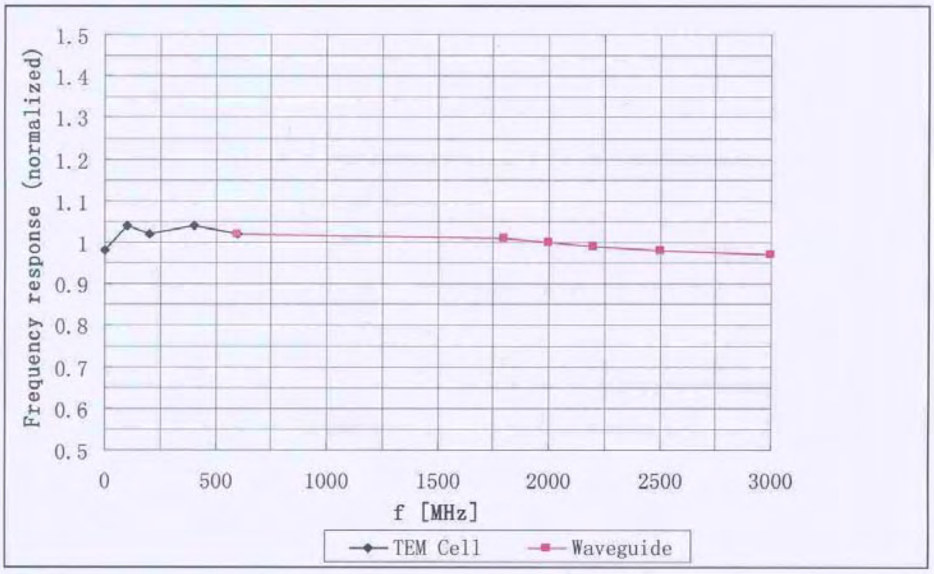
Sensor Offset

Probe Tip to Sensor Center 1.0 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 distributio Corresponds to a coverage probability of approximately 95%.

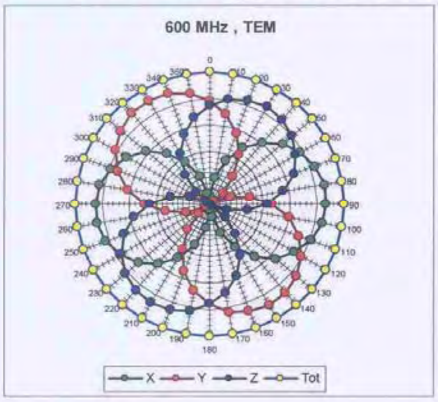
[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.

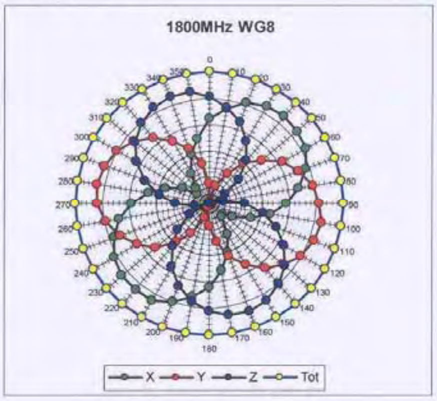
Frequency Response of E-Field

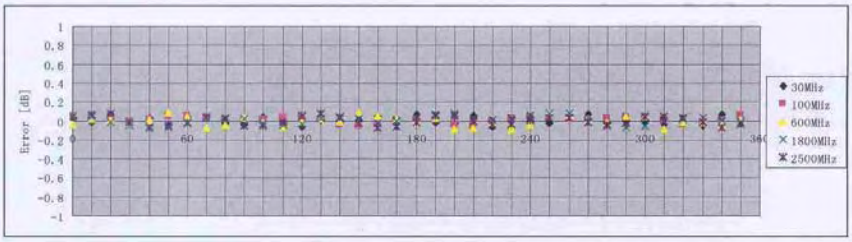


Uncertainty of Frequency Response of E-field: ±6.3% (k=2)

Receiving Pattern (φ), θ = 0°



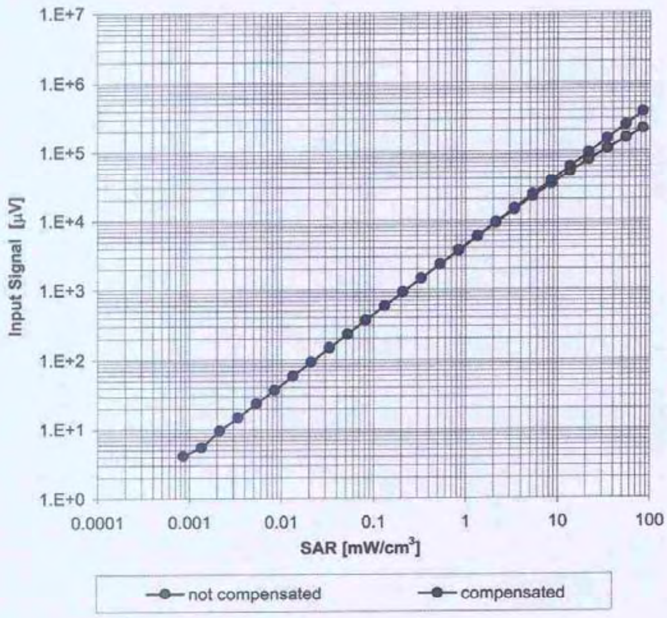


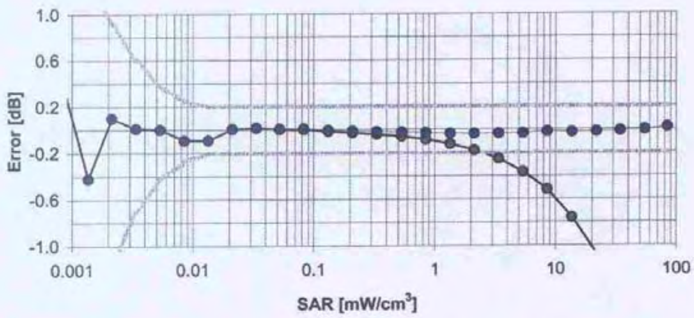


Uncertainty of Axial Isotropy Assessment: ±0.5% (k=2)

Dynamic Range f(SAR_{head})

(Waveguide: WG8, f = 1800 MHz)

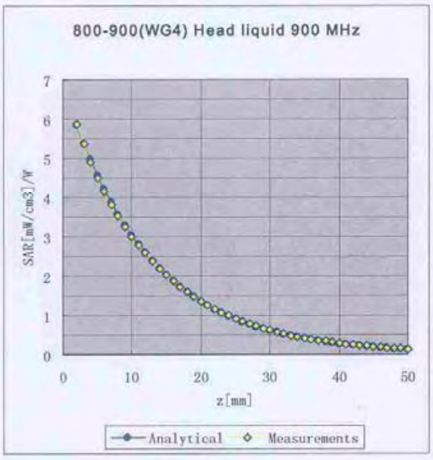


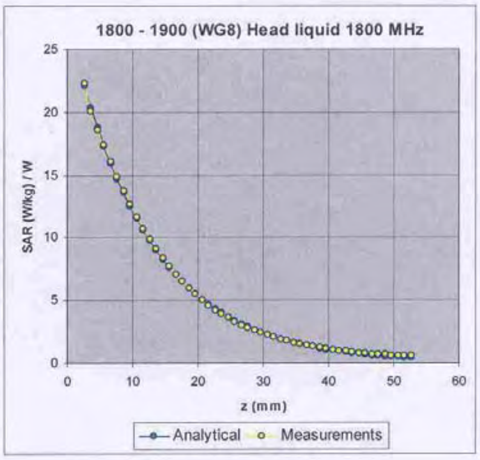


Uncertainty of Linearity Assessment: ±0.6% (k=2)

EX3DV4 SN: 3633 January 8, 2010

Conversion Factor Assessment



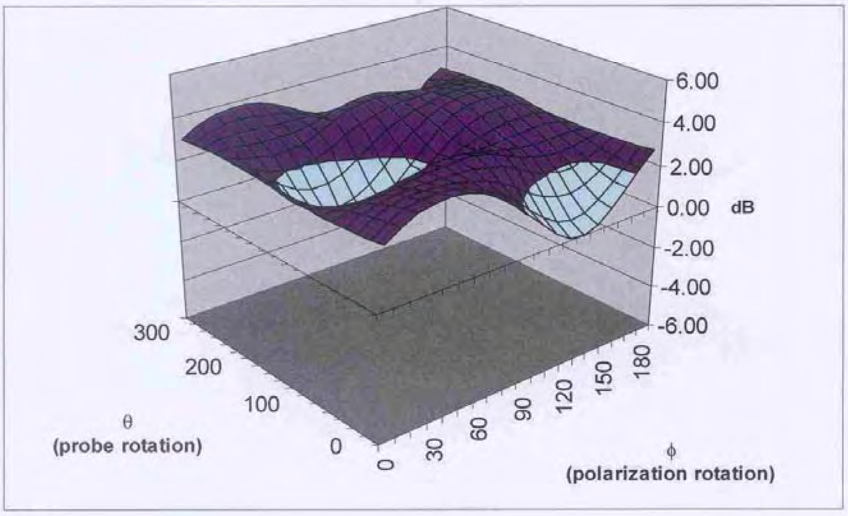


f[MHz]	Validity[MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
450	±50 /±100	Head	43.5±5%	0.87±5%	0.49	0.93	9.64	±13.3% (k=2)
900	±50 /±100	Head	41.5±5%	0.97±5%	0.61	0.72	8.93	±11.0% (k=2)
1810	±50 /±100	Head	40.0±5%	1.40±5%	0.61	0.72	7.48	±11.0% (k=2)
450	±50 /±100	Body	56.7±5%	0.94±5%	0.47	0.85	9.23	±13.3% (k=2)

[C] 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

Error (ϕ , θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ±2.6% (k=2)

ANNEX F DIPOLE CALIBRATION CERTIFICATE

450 MHz Dipole Calibration Certificate

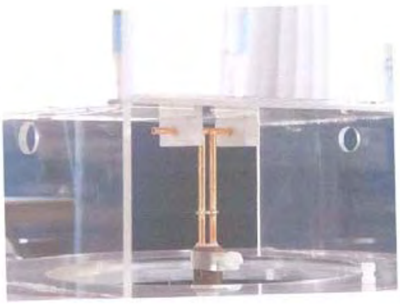
INDEXSAR

Report No. SN0111_450
December 20,2008

INDEXSAR
450MHz validation Dipole
Type IXD-045 **S/N 0111**

Performance measurements

MI Manning



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e-mail: enquiries@indexsar.com

1. Measurement Conditions

Measurements were performed using a box-shaped phantom made of PMMA with dimensions designed to meet the accuracy criteria for reasonably-sized phantoms that do not have liquid capacities substantially in excess of the volume of liquid required to fill the Indexsar upright SAM phantoms used for SAR testing of handsets against the ear.

An Anritsu MS4623B vector network analyser was used for the return loss measurements.
The dipole was placed in a special holder made of low-permittivity, low-loss materials. This holder enables the dipole to be positioned accurately in the centre of the base of the Indexsar box-phantom used for flat-surface testing and validation checks.

The validation dipoles are supplied with special spacers made from a low-permittivity, low-loss foam material. These spacers are fitted to the dipole arms to ensure that, when the dipole is offered up to the phantom surface, the spacing between the dipole and the liquid surface is accurately aligned according to the guidance in the relevant standards documentation. The spacers are rectangular with a central hole equal to the dipole arm diameter and dimensioned so that the longer side can be used to ensure a spacing of 15mm from the liquid in the phantom (for tests at 900MHz and below) and the shorter side can be used for tests at 1800MHz and above to ensure a spacing of 10mm from the liquid in the phantom. The spacers are made on a CNC milling machine with an accuracy of 1/40th mm but they may suffer wear and tear and need to be replaced periodically. The material used is Rohacell, which has a relative permittivity of approx. 1.05 and a negligible loss tangent.

The apparatus supplied by Indexsar for dipole validation tests thus includes:

Balanced dipoles for each frequency required are dimensioned according to the guidelines given in IEEE 1528 [1]. The dipoles are made from semi-rigid 50 Ohm co-ax, which is joined by soldering and is gold-plated subsequently. The constructed dipoles are easily deformed, if mis-handled, and periodic checks need to be made of their symmetry.

Rohacell foam spacers designed for presenting the dipoles to 2mm thick PMMA box phantoms. These components also suffer wear and tear and should be replaced when the central hole is a loose-fit on the dipole arms or if the edges are too worn to ensure accurate alignment. The standard spacers are dimensioned for use with 2mm wall thickness (additional spacers are available for 4mm wall thickness).

2. Typical SAR Measurement

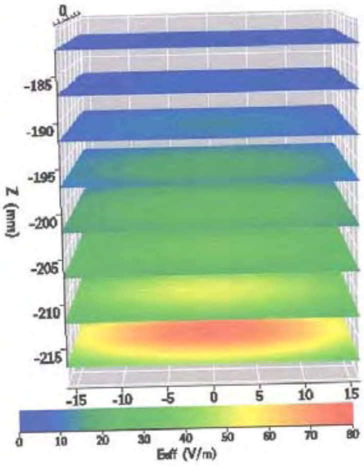
A SAR validation check is performed with the box-phantom located on the SARA2 phantom support base on the SARA2 robot system. Tests are then conducted at a feed power level of approx. 0.25W. The actual power level is recorded and used to normalise the results obtained to the standard input power conditions of 1W (forward power). The ambient temperature is 22°C +/- 1°C and the relative humidity is around 40% during the measurements.

The phantom is filled with a 450MHz brain liquid using a recipe from [1], which has the following electrical parameters (measured using an Indexsar DiLine kit) at 450MHz:

Relative Permittivity	**43.5**
Conductivity	**0.87 S/m**

The SARA2 software version 2.2 VPM is used with an Indexsar probe previously calibrated using waveguides.

The 3D measurements made using the dipole at the bottom of the phantom box is shown below:



The results, normalised to an input power of 1W (forward power) are typically:

Averaged over 1 cm3 (1g) of tissue	**4.926 W/kg**
Averaged over 10cm3 (10g) of tissue	**3.365 W/kg**

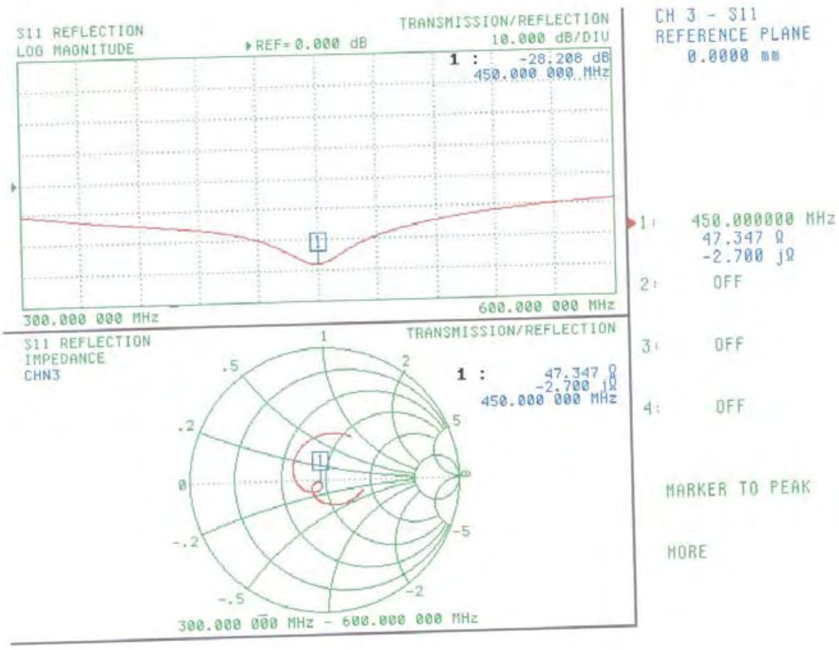
These results can be compared with Table 8.1 in [1]. The agreement is within 10%.

3. Dipole impedance and return loss

The dipoles are designed to have low return loss ONLY when presented against a lossy-phantom at the specified distance. A Vector Network Analyser (VNA) was used to perform a return loss measurement on the specific dipole when in the measurement-location against the box phantom. The distance was as specified in the standard i.e. 10mm from the liquid (for 450MHz). The Indexsar foam spacers (described above) were used to ensure this condition during measurement.

The impedance was measured at the SMA-connector with the network analyser. The following parameters were measured:

Dipole impedance at 450 MHz	Re{Z} = **47.347 Ω** Im{Z} = **2.700 mΩ**
Return loss at 450MHz	**-28.208 dB**



4. Dipole handling

The dipoles are made from standard, copper-sheathed coaxial cable. In assembly, the sections are joined using ordinary soft-soldering. This is necessary to avoid excessive heat input in manufacture, which would destroy the polythene dielectric used for the cable. The consequence of the construction material and the assembly technique is that the dipoles are fragile and can be deformed by rough handling. Conversely, they can be straightened quite easily as described in this report.

If a dipole is suspected of being deformed, a normal workshop lathe can be used as an alignment jig to restore the symmetry. To do this, the dipole is first placed in the headstock of the lathe (centred on the plastic or brass spacers) and the headstock is rotated by hand (do NOT use the motor). A marker (lathe tool or similar) is brought up close to the end of one dipole arm and then the headstock is rotated by 0.5 rev. to check the opposing arm. If they are not balanced, judicious deformation of the arms can be used to restore the symmetry.

If a dipole has a failed solder joint, the dipole can be fixed down in such a way that the arms are co-linear and the joint re-soldered with a reasonably-powerful electrical soldering iron. Do not use gas soldering irons. After such a repair, electrical tests must be performed as described below.

Please note that, because of their construction, the dipoles are short-circuited for DC signals.

5. Tuning the dipole

The dipole dimensions are based on calculations that assumed specific liquid dielectric properties. If the liquid dielectric properties are somewhat different, the dipole tuning will also vary. A pragmatic way of accounting for variations in liquid properties is to 'tune' the dipole (by applying minor variations to its effective length). For this purpose, Indexsar can supply short brass tube lengths to extend the length of the dipole and thus 'tune' the dipole. It cannot be made shorter without removing a bit from the arm. An alternative way to tune the dipole is to use copper shielding tape to extend the effective length of the dipole. Do both arms equally.

It should be possible to tune a dipole as described, whilst in place in the measurement position as long as the user has access to a VNA for determining the return loss.

6. References

[1] Draft recommended practice for determining the peak spatial-average specific absorption rate (SAR) in the human body due to wireless communications devices: Experimental Techniques.