SAR TEST REOIRT
FOR
INVENTEC BESTA CO., LTD.
Electronic Dictionary
Model No.: CD-920
FCC ID: U6OCA012
Brand: BESTA

Prepared for : INVENTEC BESTA CO., LTD.
10FL., No.36, Lane 513, Rui Guang Road,
Nei Hu Dist., Taipei 114, Taiwan

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File Number : C1M1306243
Report Number : EM-F1020468
Date of Test : Jul. 16, 2013
Date of Report : Jul. 16, 2013

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Description Page

TEST REPORT VERIFICATION

Applicant	:	INVENTEC BESTA CO., LTD.
EUT Description	:	Electronic Dictionary
FCC ID	:	U6OCA012

(A) Model NO.	:	CD-920
(B) Serial NO.	:	N/A
(C) Brand	:	tina_huang
(D) Power Supply	:	(1)DC 5V (Via USB)
		(2)DC 5V (Via Switching Power Supply)
		(3)DC 3.7V (Via Battery)

Measurement Standards Used:

FCC 47 CFR Part 2 (§2.1093)
IEEE 1528-2003
FCC OET Bulletin 65 Supplement C, June 2001

(Measurement: KDB 248227 D01, KDB 447498 D01v05, KDB 941225 D07v01)

The device described above was tested by AUDIX Technology Corporation. The measurement results were contained in this test report and AUDIX Technology Corporation was assumed full responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT to be technically compliance with the FCC OET Bulletin 65 Supplement C & IEEE 1528 requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of AUDIX Technology Corporation.

Date of Test: Jul. 16, 2013 Date of Report: Jul. 16, 2013

Producer: Tina Huang
(Tina Huang/Administrator)

Signatory: Ben Cheng
(Ben Cheng/Manager)

1. GENERAL INFORMATION

1.1. Description of Device (EUT)

Product	Electronic Dictionary
Model Number	CD-920
Serial Number	N/A
Brand Name	BESTA
Applicant	INVENTEC BESTA CO., LTD. 10FL., No.36, Lane 513, Rui Guang Road, Nei Hu Dist., Taipei 114, Taiwan
SAR Evaluation (Total SAR)	**SAR 1g : WLAN: 0.888(W/kg)**
FCC ID	U6OCA012
Fundamental Range	802.11b/g: 2412MHz ~ 2462MHz 802.11n-HT20: 2412MHz ~ 2462MHz 802.11n-HT40: 2422MHz ~ 2452MHz
Frequency Channel	802.11b/g: 11 channels 802.11n-HT20: 2.4GHz: 11 channels 802.11n-HT40: 2.4GHz: 7 channels
Radio Technology	802.11b: DSSS Modulation (DBPSK/DQPSK/CCK) 802.11g: OFDM Modulation (BPSK/QPSK/16QAM/64QAM) 802.11n: OFDM Modulation (SISO) (BPSK/QPSK/16QAM/64QAM)
Data Transfer Rate	802.11b: 1/2/5.5/11Mbps 802.11g: 6/9/12/18/24/36/48/54Mbps 802.11n: up to 150Mbps
Switching Power Supply (2Pin)	Something High Electric (Xiamen) Co., Ltd. M/N: P12USB050200 US Input: AC 100-240V~, 50/60Hz, 0.3A ; Output: DC 5.0V, 2.0A USB Cable: Shielded, Detachable, 0.9m, Bonded a ferrite core +Shielded, Undetachable, 1.0m
Earphone	Non-Shielded, Detachable, 1.0m
Test software	adb.exe
Date of Receipt of Sample	Jun. 21, 2013
Date of Test	Jul. 16, 2013

1.2. Antenna Information

Antenna Part Number	Manufacture	Antenna Type	Peak Gain	
			Frequency	Max Gain
WLAN Antenna P/N: HWGA01-LAP 4002	Magic Wireless Technology CO., LTC.	PCB	2400MHz	0.62dBi
			2450MHz	1.25dBi
			2500MHz	1.28dBi

1.3. Test Environment

Ambient conditions in the laboratory:

Item	Require	Actual
Temperature (℃)	18-25	22 ± 2
Humidity (%RH)	30-70	48 ± 2

1.4. Description of Test Facility

Name of Firm	:	**AUDIX Technology Corporation** **EMC Department** No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan, R.O.C.
Test Site	:	No. 53-11, Dingfu, Linkou Dist., New Taipei City 244, Taiwan, R.O.C.
NVLAP Lab. Code	:	200077-0
TAF Accreditation No	:	1724

1.5. Measurement Uncertainty

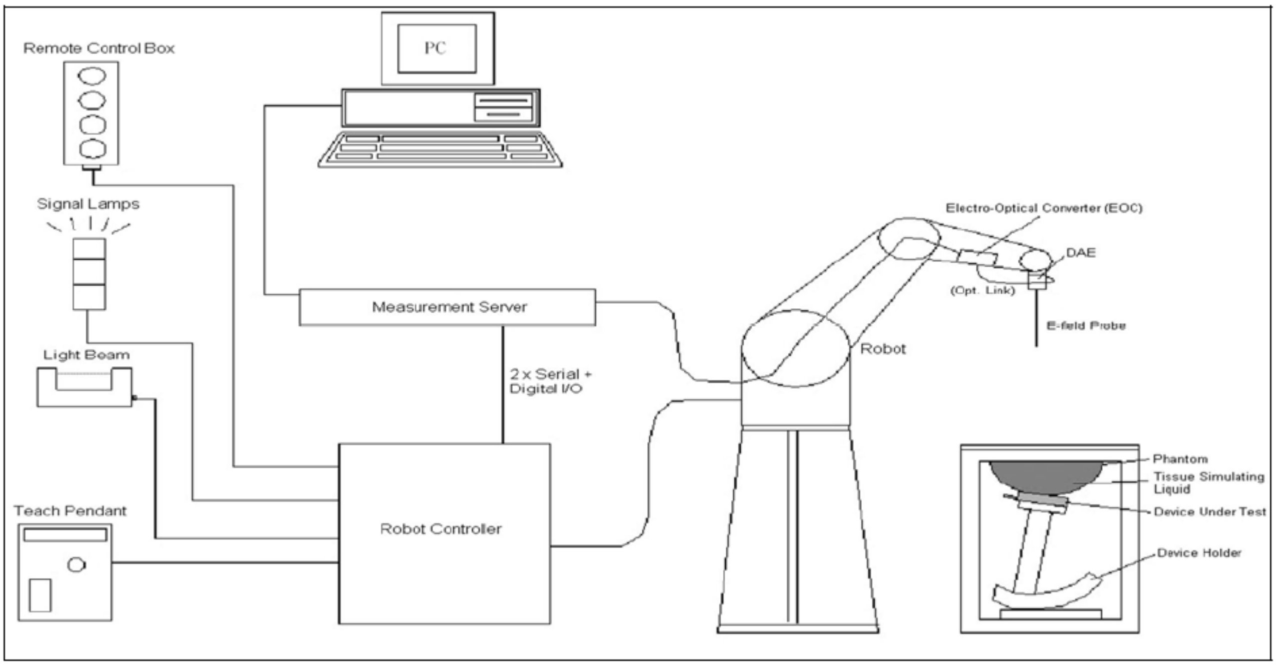
DASY5 Uncertainty Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram / 10 gram.								
Error Description	Uncert. value	Prob. Dist.	Div.	(c_i) 1g	(c_i) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) v_{eff}
Measurement System								
Probe Calibration	±6.0%	N	1	1	1	±6.0%	±6.0%	∞
Axial Isotropy	±4.7%	R	$\sqrt{3}$	0.7	0.7	±1.9%	±1.9%	∞
Hemispherical Isotropy	±9.6%	R	$\sqrt{3}$	0.7	0.7	±3.9%	±3.9%	∞
Boundary Effects	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Linearity	±4.7%	R	$\sqrt{3}$	1	1	±2.7%	±2.7%	∞
System Detection Limits	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Readout Electronics	±0.3%	N	1	1	1	±0.3%	±0.3%	∞
Response Time	±0.8%	R	$\sqrt{3}$	1	1	±0.5%	±0.5%	∞
Integration Time	±2.6%	R	$\sqrt{3}$	1	1	±1.5%	±1.5%	∞
RF Ambient Noise	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
RF Ambient Reflections	±3.0%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Probe Positioner	±0.4%	R	$\sqrt{3}$	1	1	±0.2%	±0.2%	∞
Probe Positioning	±2.9%	R	$\sqrt{3}$	1	1	±1.7%	±1.7%	∞
Max. SAR Eval.	±1.0%	R	$\sqrt{3}$	1	1	±0.6%	±0.6%	∞
Test Sample Related								
Device Positioning	±2.9%	N	1	1	1	±2.9%	±2.9%	145
Device Holder	±3.6%	N	1	1	1	±3.6%	±3.6%	5
Power Drift	±5.0%	R	$\sqrt{3}$	1	1	±2.9%	±2.9%	∞
Phantom and Setup								
Phantom Uncertainty	±4.0%	R	$\sqrt{3}$	1	1	±2.3%	±2.3%	∞
Liquid Conductivity (target)	±5.0%	R	$\sqrt{3}$	0.64	0.43	±1.8%	±1.2%	∞
Liquid Conductivity (meas.)	±2.5%	N	1	0.64	0.43	±1.6%	±1.1%	∞
Liquid Permittivity (target)	±5.0%	R	$\sqrt{3}$	0.6	0.49	±1.7%	±1.4%	∞
Liquid Permittivity (meas.)	±2.5%	N	1	0.6	0.49	±1.5%	±1.2%	∞
Combined Std. Uncertainty						±11%	±10.8%	387
Expanded STD Uncertainty						±22%	±21.5%	

2. TEST EQUIPMENT

Item	Type	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
1.	Stäubli Robot TX90 XL	Stäubli	TX90	F12/5K9SA1/ A101	N/A	N/A
2.	Controller	SPEAG	CS8c	N/A	N/A	N/A
3.	SAM Twin Phantom	SPEAG	QD000 P40 CD	Tp 1515	N/A	N/A
4.	Device Holder	SPEAG	N/A	N/A	N/A	N/A
5.	Data Acquisition Electronic	SPEAG	DAE4	1337	May 07, 12’	Sep. 12, 13’
6.	E-Field Probe	SPEAG	EX3DV4	3855	May 09, 12’	Sep. 12, 13’
7.	SAR Software	SPEAG	DASY52	V52.8.2.843	N/A	N/A
8.	Network Analyzer	Agilent	E5071C	Y46214331	May 26, 12’	Sep. 12, 13’
9.	Signal Generator	Aglient	N5181A	MY50143917	May 08, 12’	Sep. 12, 13’
10.	Power Meter	Aglient	ML2487A	MY52180007	May 16, 12’	Sep. 12, 13’
11.	Power Sensor	Aglient	N10149	MY52080006	May 16, 12’	Sep. 12, 13’
12.	Dipole Antenna	SPEAG	D2450V2	888	May 02, 12’	Sep. 12, 14’

3. SAR MEASUREMENT SYSTEM

3.1. DASY5 System Description



The DASY5 system for performing compliance tests consists of the following items:

- ♦ A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- ♦ A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- ♦ The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- ♦ The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- ♦ A computer running WinXP and the DASY5 software.
- ♦ Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- ♦ The phantom, the device holder and other accessories according to the targeted measurement.

3.1.1. Applications

Predefined procedures and evaluations for automated compliance testing with all worldwide standards, e.g., IEEE 1528, OET 65, IEC 62209-1, IEC 62209-2, EN 50360, EN 50383 and others.

3.1.2. Area Scans

Area scans are defined prior to the measurement process being executed with a user defined variable spacing between each measurement point (integral) allowing low uncertainty measurements to be conducted. Scans defined for FCC applications utilize a $10mm^2$ step integral, with 1mm interpolation used to locate the peak SAR area used for zoom scan assessments.

When an Area Scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE 1528-2003, EN 50361 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan).

3.1.3. Zoom Scan (Cube Scan Averaging)

Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. A density of 1000 kg/m^3 is used to represent the head and body tissue density and not the phantom liquid density, in order to be consistent with the definition of the liquid dielectric properties, i.e. the side length of the 1 g cube is 10mm, with the side length of the 10 g cube 21,5mm.

The zoom scan integer steps can be user defined so as to reduce uncertainty, but normal practice for typical test applications (including FCC) utilize a physical step of 5x5x7 (8mmx8mmx5mm) providing a volume of 32mm in the X & Y axis, and 30mm in the Z axis.

3.1.4. Uncertainty of Inter-/Extrapolation and Averaging

In order to evaluate the uncertainty of the interpolation, extrapolation and averaged SAR calculation algorithms of the Postprocessor, DASY5 allows the generation of measurement grids which are artificially predefined by analytically based test functions. Therefore, the grids of area scans and zoom scans can be filled with uncertainty test data, according to the SAR benchmark functions of IEEE 1528.The three analytical functions shown in equations as below are used to describe the possible range of the expected SAR distributions for the tested handsets.

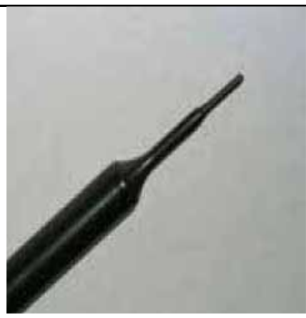
The field gradients are covered by the spatially flat distribution f1, the spatially steep distribution f3 and f2 accounts for H-field cancellation on the phantom/tissue surface.

$$f_1(x,y,z) = Ae^{-\frac{z}{2a}}\cos^2\left(\frac{\pi}{2}\frac{\sqrt{x'^2+y'^2}}{5a}\right)$$
$$f_2(x,y,z) = Ae^{-\frac{z}{a}}\frac{a^2}{a^2+x'^2}\left(3-e^{-\frac{2z}{a}}\right)\cos^2\left(\frac{\pi}{2}\frac{y'}{3a}\right)$$
$$f_3(x,y,z) = A\frac{a^2}{\frac{a^2}{4}+x'^2+y'^2}\left(e^{-\frac{2z}{a}}+\frac{a^2}{2(a+2z)^2}\right)$$

3.2. DASY5 E-Field Probe

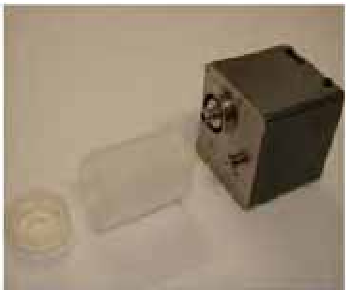
The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SPEAG conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN 62209-1, IEC 62209, etc.) under ISO 17025. The calibration data are in Appendix D.

3.2.1. Isotropic E-Field Probe Specification

<table>
<tr><td>Model</td><td colspan="2">Ex3DV4</td></tr>
<tr><td>Construction</td><td colspan="2">Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)</td></tr>
<tr><td>Frequency</td><td>10 MHz to 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)</td><td rowspan="4"></td></tr>
<tr><td>Directivity</td><td>± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)</td></tr>
<tr><td>Dynamic Range</td><td>10 μW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μW/g)</td></tr>
<tr><td>Dimensions</td><td>Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm</td></tr>
<tr><td>Application</td><td colspan="2">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%.</td></tr>
</table>

3.2.2. Boundary Detection Unit and Probe Mounting Device

The DASY probes use a precise connector and an additional holder for the probe, consisting of a plastic tube and a flexible silicon ring to center the probe. The connector at the DAE is flexibly mounted and held in the default position with magnets and springs. Two switching systems in the connector mount detect frontal and lateral probe collisions and trigger the necessary software response.



3.2.3. DATA Acquisition Electronics (DAE) and Measurement Server

The data acquisition electronics (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 measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

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Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The input impedance of the DAE4 is 200M Ohm; the inputs are symmetrical and floating. Common mode rejection is above 80dB.

The DASY5 measurement server is based on a PC/104 CPU board with a 400MHz intel ULV Celeron, 128MB chipdisk and 128MB RAM. The necessary circuits for communication with the DAE electronics box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY5 I/O board, which is directly connected to the PC/104 bus of the CPU board.

3.3. Robot

The DASY5 system uses the high precision robots TX90 XL type out of the newer series from Stäubli SA (France). For the 6-axis controller DASY5 system, the CS8C robot controller version from Stäubli is used.

The XL robot series have many features that are important for our application:

- ♦ High precision (repeatability 0.02 mm)
- ♦ High reliability (industrial design)
- ♦ Jerk-free straight movements
- ♦ Low ELF interference (the closed metallic construction shields against motor control fields)
- ♦ 6-axis controller

3.4. Light Beam Unit

The light beam switch allows automatic "tooling" of the probe. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip.

The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.

3.5. Device Holder

The DASY5 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 center for both scales is the ear reference point (EPR).

Thus the device needs no repositioning when changing the angles.

The DASY5 device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon r = 3$ and loss tangent $\delta = 0.02$. 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.

3.6. SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas:

- ♦ Left head
- ♦ Right head
- ♦ Flat phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

4. TISSUE SIMULATING LIQUID

4.1. The Recipes for 2450MHz Simulating Liquid Table

Ingredient	Body Simulating Liquid 2450MHz
Water	69.83%
DGMBE	30.17
Salt	NA
Dielectric Parameters at 22℃	f=2450MHz ε=52.7± 5% σ=1.95± 5% S/m

4.2. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using Aligent Dielectric Probe Kit and Aligent E5071C Vector Network Analyzer.

Body Tissue Simulate Measurement				
Frequency [MHz]	Description	Dielectric Parameters		Tissue Temp. [℃]
		ε_r	σ [s/m]	
2450MHz	Reference result ± 5% window	52.7 50.065 to 55.335	1.95 1.853 to 2.048	N/A
	Jul. 16, 2013	50.71	2.02	22.0

4.3. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

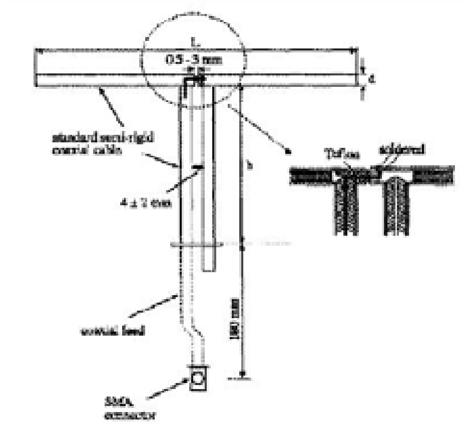
Target Frequency [MHz]	Head		Body	
	ε_r	σ [s/m]	ε_r	σ [s/m]
150	52.3	0.76	61.9	0.80
300	445.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

5. SAR MEASUREMENT PROCEDURE

5.1. SAR System Check

5.1.1. Dipoles



The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of both IEEE and FCC Supplement C. the table below provides details for the mechanical and electrical specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	53.5	30.4	3.6

5.1.2. System Check Result

System Performance Check at WLAN (2450MHz) Dipole Kit: D2450V2 (Body)				
Frequency [MHz]	Description	SAR [w/kg] 1g	Tissue Temp. [℃]	Lab Temp.[℃]
2450MHz	Reference result ± 10% window	51.2 46.08 to 56.32	N/A	N/A
	Jul. 16, 2013	50.2	22.0	24.0
Note: All SAR values are normalized to 1W forward power.				

5.1.3. SAR System Check Data

Date/Time: 7/16/2013 AM 08:54:58

Test Laboratory: Audix_SAR Lab

CW D2450

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:888

Communication System: CW; Communication System Band: D2450 (2450.0 MHz); Frequency: 2450 MHzDuty Cycle: 1:1

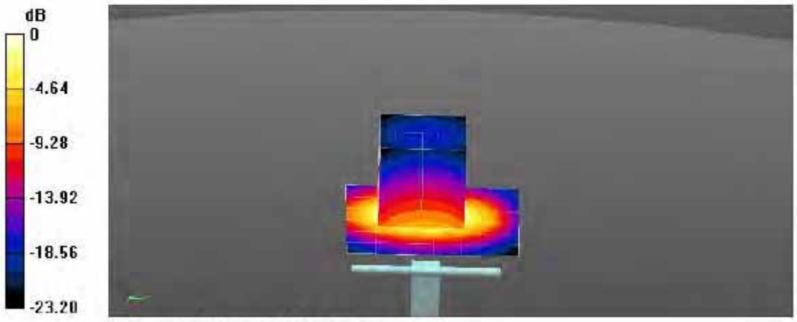
Medium parameters used: f = 2450 MHz; σ = 2.02 S/m; ε_r = 50.71; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection), z = 1.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/CW 2450/Area Scan (7x7x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 69.6 W/kg

Configuration/CW 2450/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 163.2 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 109 W/kg
SAR(1 g) = 50.2 W/kg; SAR(10 g) = 22.3 W/kg
Maximum value of SAR (measured) = 58.7 W/kg



0 dB = 58.7 W/kg = 17.68 dBW/kg

5.2. SAR Measurement Procedure

The Dasy5 calculates SAR using the following equation,

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

σ: represents the simulated tissue conductivity

ρ: represents the tissue density

The EUT is set to transmit at the required power in line with product specification, at each frequency relating to the LOW, MID, and HIGH channel settings.

Pre-scans are made on the device to establish the location for the transmitting antenna, using a large area scan in either air or tissue simulation fluid.

The EUT is placed against the Universal Phantom where the maximum area scan dimensions are larger than the physical size of the resonating antenna. When the scan size is not large enough to cover the peak SAR distribution, it is modified by either extending the area scan size in both the X and Y directions, or the device is shifted within the predefined area.

The area scan is then run to establish the peak SAR location (interpolated resolution set at $1mm^2$) which is then used to orient the center of the zoom scan. The zoom scan is then executed and the 1g and 10g averages are derived from the zoom scan volume (interpolated resolution set at $1mm^3$).

5.3. SAR Exposure Limits

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

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

Type Exposure	Uncontrolled Environment Limit
Spatial Peak SAR (1g cube tissue for brain or body)	1.60 W/kg
Spatial Average SAR (whole body)	0.08 W/kg
Spatial Peak SAR (10g for hands, feet, ankles and wrist)	4.00 W/kg

5.4. Conducted Power Measurement

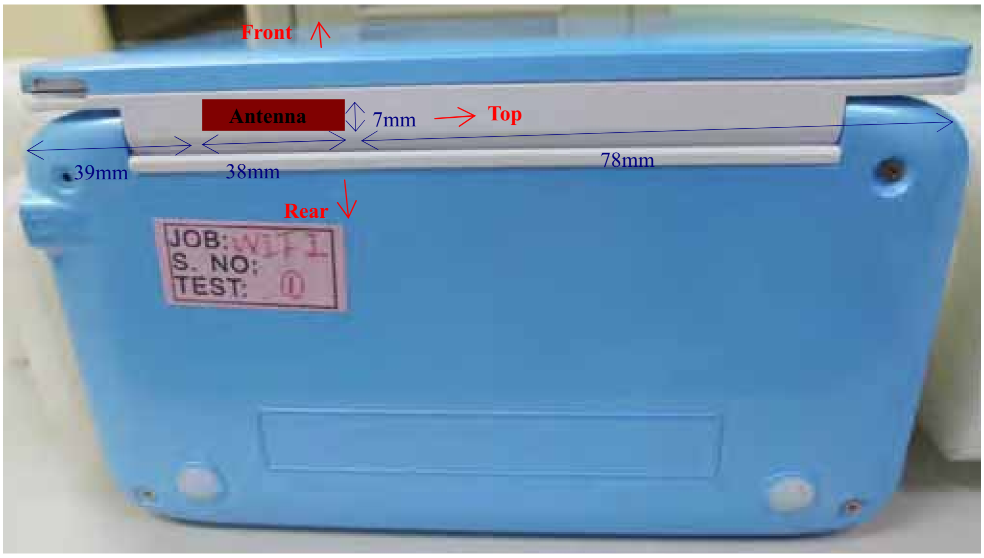
5.4.1. WLAN Function

Test Date: Jul. 16, 2013 Temperature: 24℃ Humidity: 46%

Type of Network	Channel	Frequency (MHz)	Average Output Power (dBm)	Duty cycle
802.11b	CH 1	2412	12.20	100%
	CH 6	2437	12.52	
	CH 11	2462	12.55	
802.11g	CH 1	2412	12.07	100%
	CH 6	2437	12.48	
	CH 11	2462	12.49	
802.11n-HT20	CH 1	2412	12.01	100%
	CH 6	2437	12.44	
	CH 11	2462	12.42	
802.11n-HT40	CH 3	2422	12.02	100%
	CH 6	2437	12.47	
	CH 9	2452	12.50	

5.5. Exposure Positions Consideration

<Electronic Dictionary>



Remark: We do not test for other sides for distance to the edge is more than 25mm.

5.6. SAR Test Result

5.6.1. WLAN Function

Test Date: Jul. 16, 2013 Temperature : 24℃ Humidity : 25%

Liquid Temperature : 22℃					Depth of Liquid: > 15cm		
Test Mode: 2.4GHz							
Test Position Body	Antenna Position	Frequency		Conducted power (dBm)	SAR 1g (W/kg)	Limit (W/kg)
		Channel	MHz			
802.11b						
Top	Fixed	1	2412	12.20	**0.820**	1.6
Top	Fixed	6	2437	12.52	**0.833**	1.6
Top	Fixed	11	2462	12.55	**0.888**	1.6
*Top	Fixed	11	2462	12.55	**0.865**	1.6
Front	Fixed	11	2462	12.55	**0.188**	1.6
Rear	Fixed	11	2462	12.55	**0.499**	1.6

*: Pursuant to KDB 865664 D01 v01r01 section 2.8.1 2), the highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once. The result is ≤ 20% variation.

Test Mode: 2.4GHz, 802.11b, CH 2412, Top

Date/Time: 7/16/2013 PM 02:20:09

Test Laboratory: Audix_SAR Lab

b2412_Top

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2412 MHzDuty Cycle: 1:1

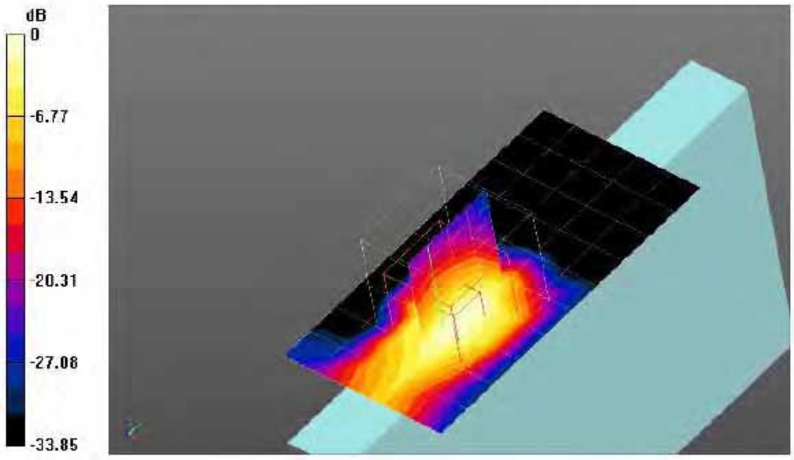
Medium parameters used (interpolated): f = 2412 MHz; σ = 1.968 S/m; ε_r = 50.861; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.28 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 16.587 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 2.20 W/kg
SAR(1 g) = 0.820 W/kg; SAR(10 g) = 0.305 W/kg



Test Mode: 2.4GHz, 802.11b, CH 2437, Top

Date/Time: 7/16/2013 PM 01:59:00

Test Laboratory: Audix_SAR Lab

b2437_Top

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2437 MHzDuty Cycle: 1:1

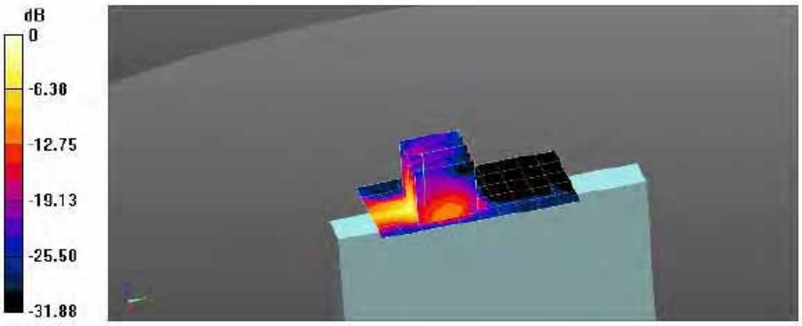
Medium parameters used (interpolated): f = 2437 MHz; σ = 2.013 S/m; ε_r = 50.739; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.33 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 16.482 V/m; Power Drift = 0.20 dB
Peak SAR (extrapolated) = 2.26 W/kg
SAR(1 g) = 0.833 W/kg; SAR(10 g) = 0.309 W/kg
Maximum value of SAR (measured) = 1.31 W/kg



Test Mode: 2.4GHz, 802.11b, CH 2462, Top

Date/Time: 7/16/2013 AM 11:45:08

Test Laboratory: Audix_SAR Lab

b2462_Top

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2462 MHzDuty Cycle: 1:1

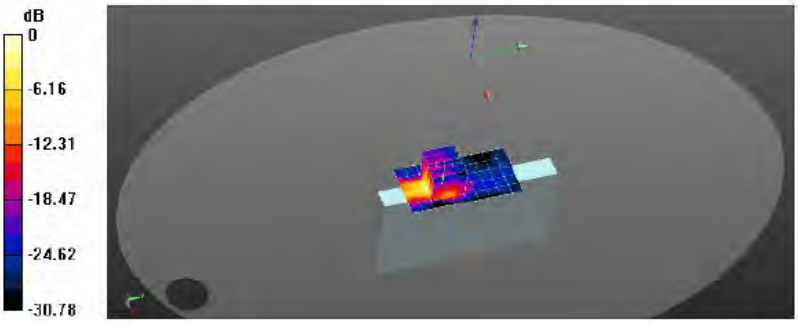
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.048 S/m; ε_r = 50.622; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.35 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 15.893 V/m; Power Drift = -0.33 dB
Peak SAR (extrapolated) = 2.42 W/kg
SAR(1 g) = 0.888 W/kg; SAR(10 g) = 0.328 W/kg
Maximum value of SAR (measured) = 1.38 W/kg



Date/Time: 7/16/2013 PM 07:03:43

Test Laboratory: Audix_SAR Lab

b2462_Top check

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2462 MHzDuty Cycle: 1:1.

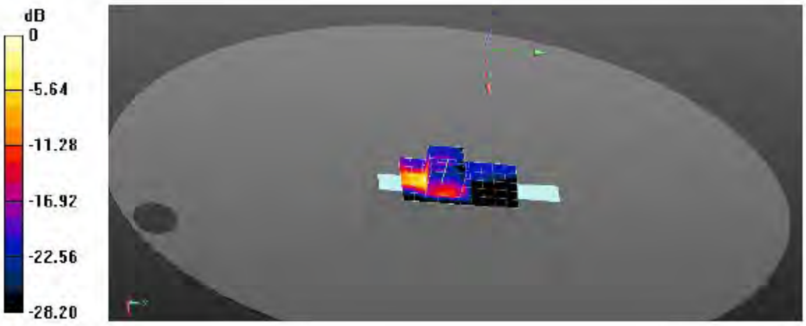
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.048 S/m; ε_r = 50.622; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.39 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 17.229 V/m; Power Drift = -0.52 dB
Peak SAR (extrapolated) = 2.27 W/kg
SAR(1 g) = 0.865 W/kg; SAR(10 g) = 0.325 W/kg
Maximum value of SAR (measured) = 1.35 W/kg



Test Mode: 2.4GHz, 802.11b, CH 2462, Front

Date/Time: 7/16/2013 PM 03:00:52

Test Laboratory: Audix_SAR Lab

b2462_Front

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2462 MHzDuty Cycle: 1:1

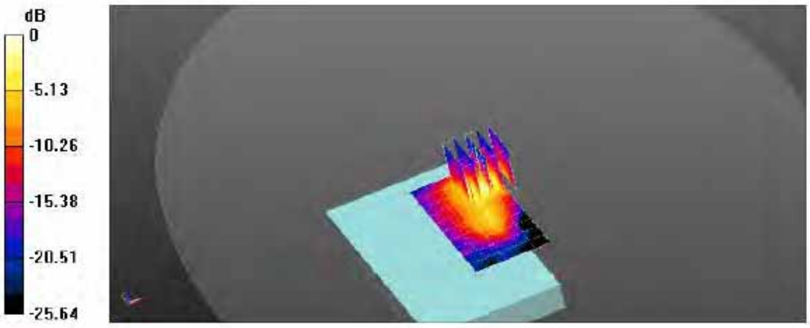
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.048 S/m; ε_r = 50.622; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.312 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 3.905 V/m; Power Drift = 1.53 dB
Peak SAR (extrapolated) = 0.582 W/kg
SAR(1 g) = 0.188 W/kg; SAR(10 g) = 0.072 W/kg
Maximum value of SAR (measured) = 0.392 W/kg



Test Mode: 2.4GHz, 802.11b, CH 2462, Rear

Date/Time: 7/16/2013 PM 05:40:46

Test Laboratory: Audix_SAR Lab

b2462_Rear

DUT: CD-920; Type: Besta; Serial: N/A

Communication System: 802.11b; Communication System Band: 802.11B 1Mbps; Frequency: 2462 MHzDuty Cycle: 1:1

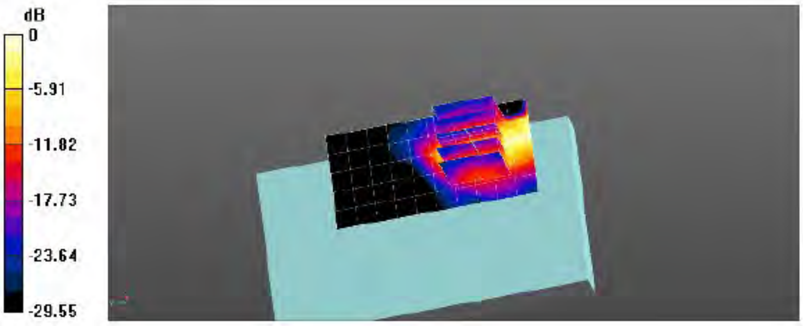
Medium parameters used (interpolated): f = 2462 MHz; σ = 2.048 S/m; ε_r = 50.622; ρ = 1000 kg/m^3 ;
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY Configuration:

- Probe: EX3DV4 - SN3855; ConvF(7.36, 7.36, 7.36); Calibrated: 5/9/2012;
- Sensor-Surface: 2mm (Mechanical Surface Detection), z = 11.0, 31.0
- Electronics: DAE4 Sn1337; Calibrated: 5/7/2012
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1170
- DASY52 52.8.4(1052); SEMCAD X 14.6.8(7028)

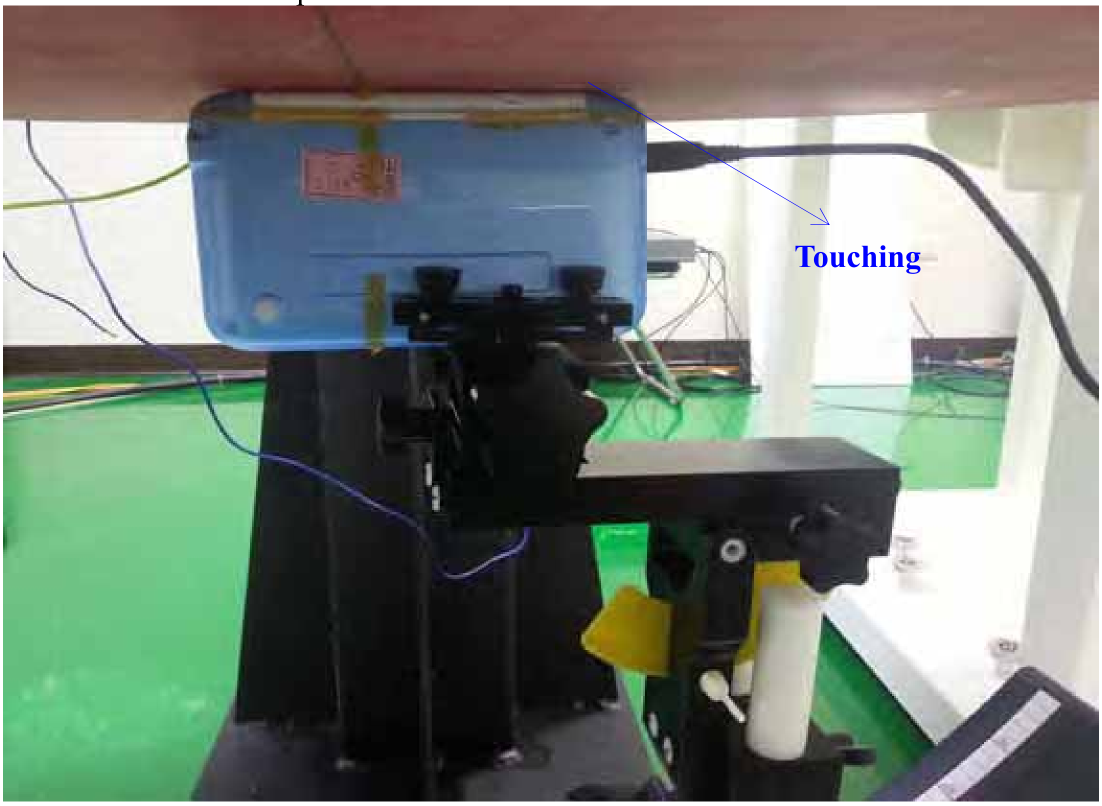
Configuration/MAIN/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.834 W/kg

Configuration/MAIN/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=7.5mm, dy=7.5mm, dz=5mm
Reference Value = 2.436 V/m; Power Drift = 3.01 dB
Peak SAR (extrapolated) = 1.38 W/kg
SAR(1 g) = 0.499 W/kg; SAR(10 g) = 0.190 W/kg
Maximum value of SAR (measured) = 0.904 W/kg



6. PHOTOGRAPHS OF MEASUREMENT

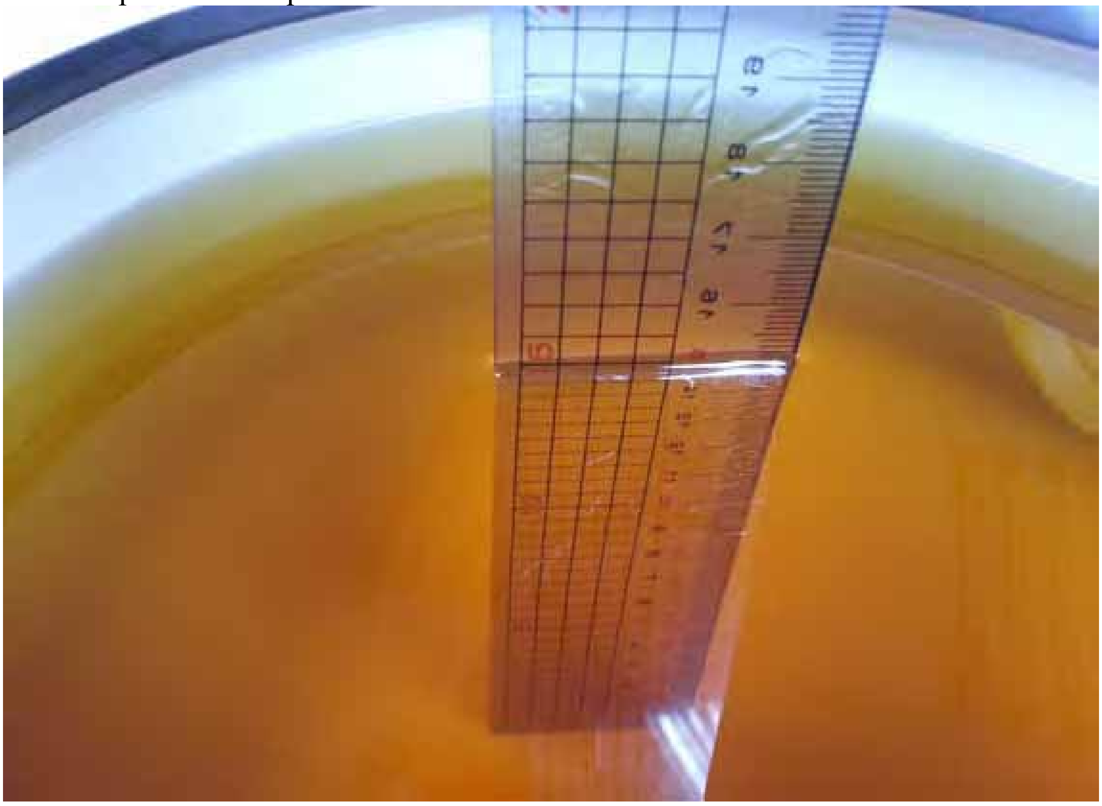
Test Position: Top



Test Position: Front

Test Position: Rear

Depth of the Liquid in the Phantom-Zoom In



APPENDIX I

Test Equipment Calibration Data

Audix Technology Corporation

EMC Department:
No. 53-11, Dingfu, Linkou Dist., New Taipei City, Taiwan, R.O.C.
Tel: 886-2-26099301 / 26092133
Fax: 886-2-26099303
E-mail: emc@audixtech.com

Statement of Due Date for Dipole Calibration

We have defined that the calibration interval of following dipole which use for SAR system is 2 years.

SPEAG	D1750V2	1065
SPEAG	D900V2	1d133
SPEAG	D750V3	1056
SPEAG	D835V2	4d136
SPEAG	D1900V2	5d156
SPEAG	D2000V2	1061
SPEAG	D2450V2	888
SPEAG	D2600V2	1048
SPEAG	D5GHzV2	1124
SPEAG	CD2450V3	1161
SPEAG	CD1880V3	1173
SPEAG	CD835V3	1187

Please note that the Cal Interval may be other than 1 year, e.g. 2 years or 3 years.

Also we have determined that the original calibration result of these instruments are not significantly affected before the first-time use of them, when they are stored in good condition.

According to the above reasons, the dipole calibration Due Date described as below:

Example:

Date tested at SPEAG: May 9, 2012

Example Calibration Interval: 2 Years

First-Time Use of Instrument: September 13, 2012

First-Time Use + Selected Interval = Date for Next Calibration

---

September 13, 2012 + 2 Years = September 12, 2014

Leon Liu

Leon Liu / Quality Manager

Dipole Verified Data

Model Name: D2450V2

SN:888

Pursuant to KDB 865664 D01 V01r01 section 3.2.2 that the reference dipole calibration can be extended to 3 years if Lab. does a confirmation on return loss and impedance annually, and compliance with following conditions,

1. Return loss deviates by less than 20% from the previous measurement and have 20 dB minimum return-loss requirement
2. The real or imaginary parts of the impedance, measured at least annually, deviates by less than 5 Ω from the previous measurement.

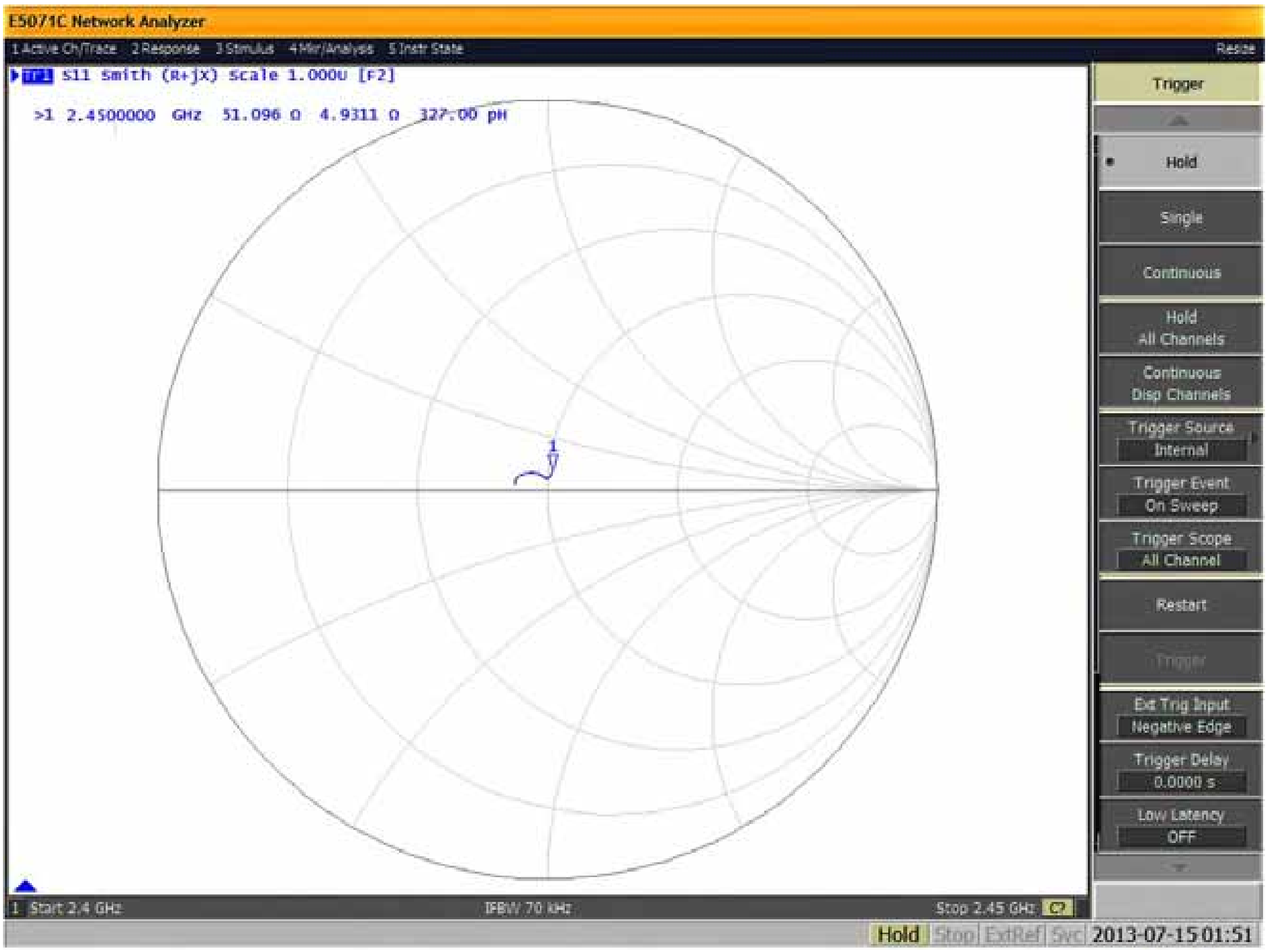
Antenna Parameters with Head Tissue

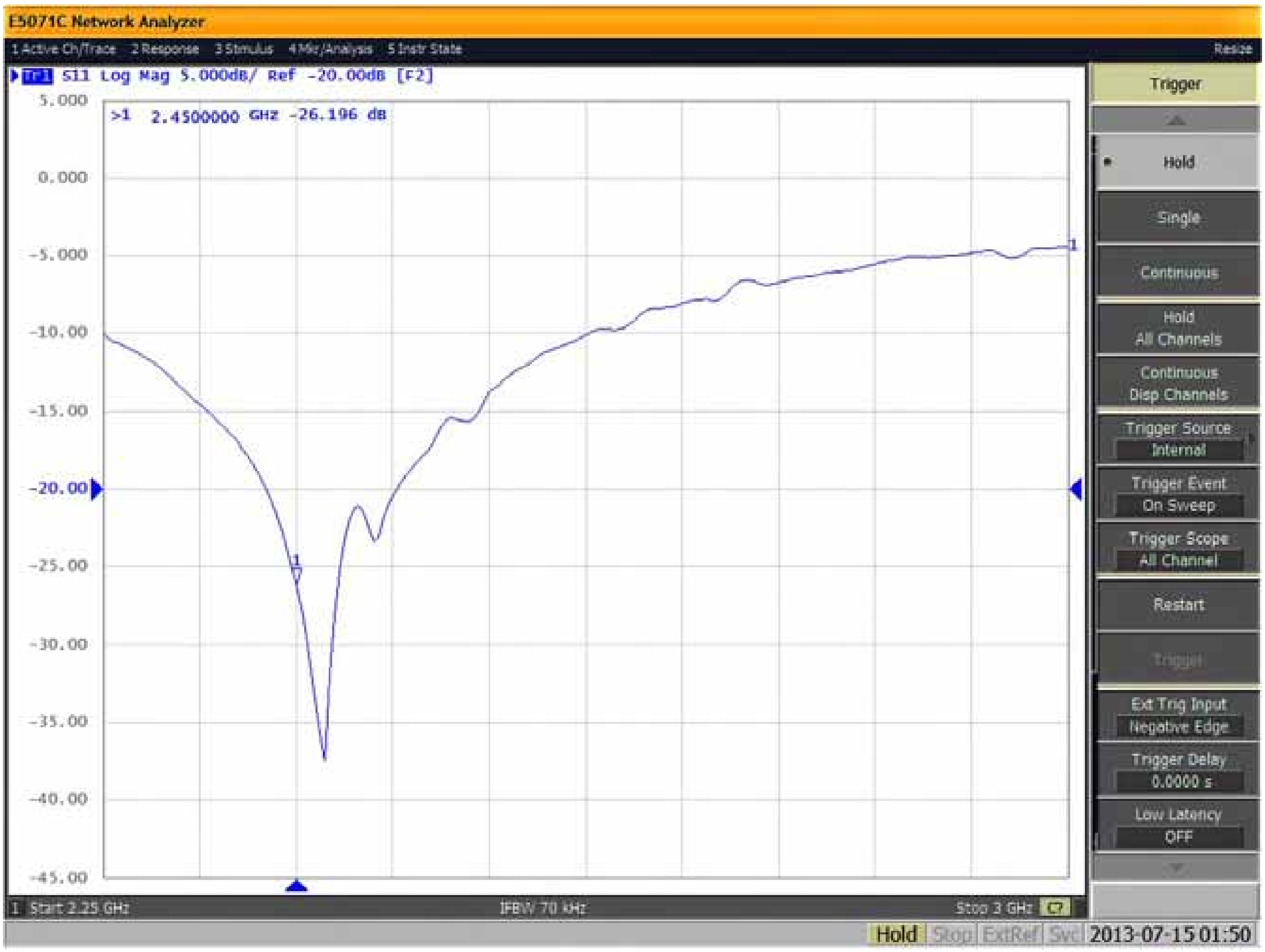
Item	Verified on 7/15, 2013	Original Cal. Result	Deviation
Impedance, transformed to feed point	**51.096Ω+4.93jΩ**	**53.8Ω+3.3jΩ**	**< 5Ω**
Return Loss	**-26.196 dB**	**-26.3 dB**	**0.39%**

Antenna Parameters with Body Tissue

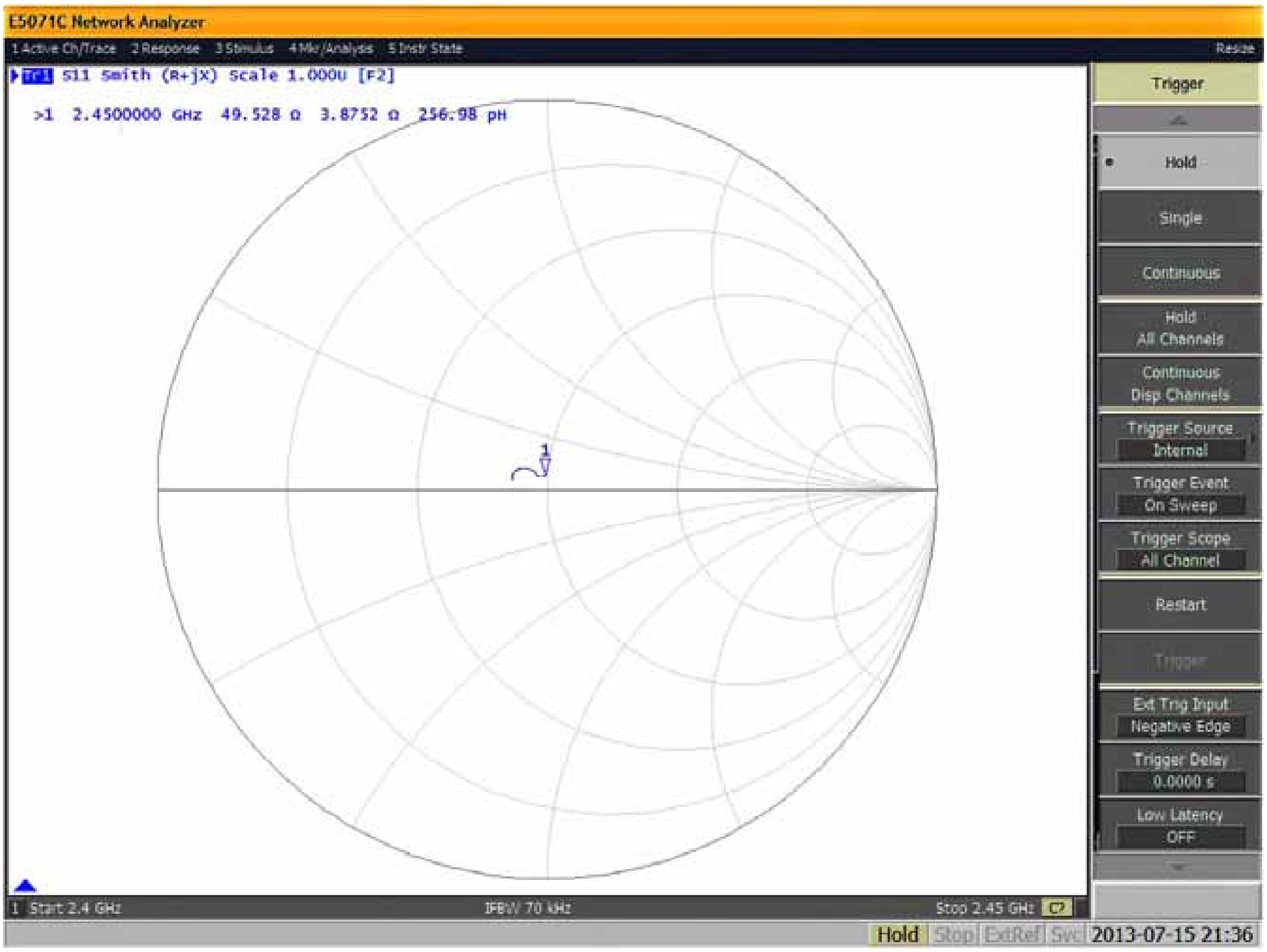
Item	Verified on 7/15, 2013	Original Cal. Result	Deviation
Impedance, transformed to feed point	**49.528Ω+3.87jΩ**	**50.2Ω+4.7jΩ**	**< 5Ω**
Return Loss	**-23.31 dB**	**-26.6 dB**	**12.37%**

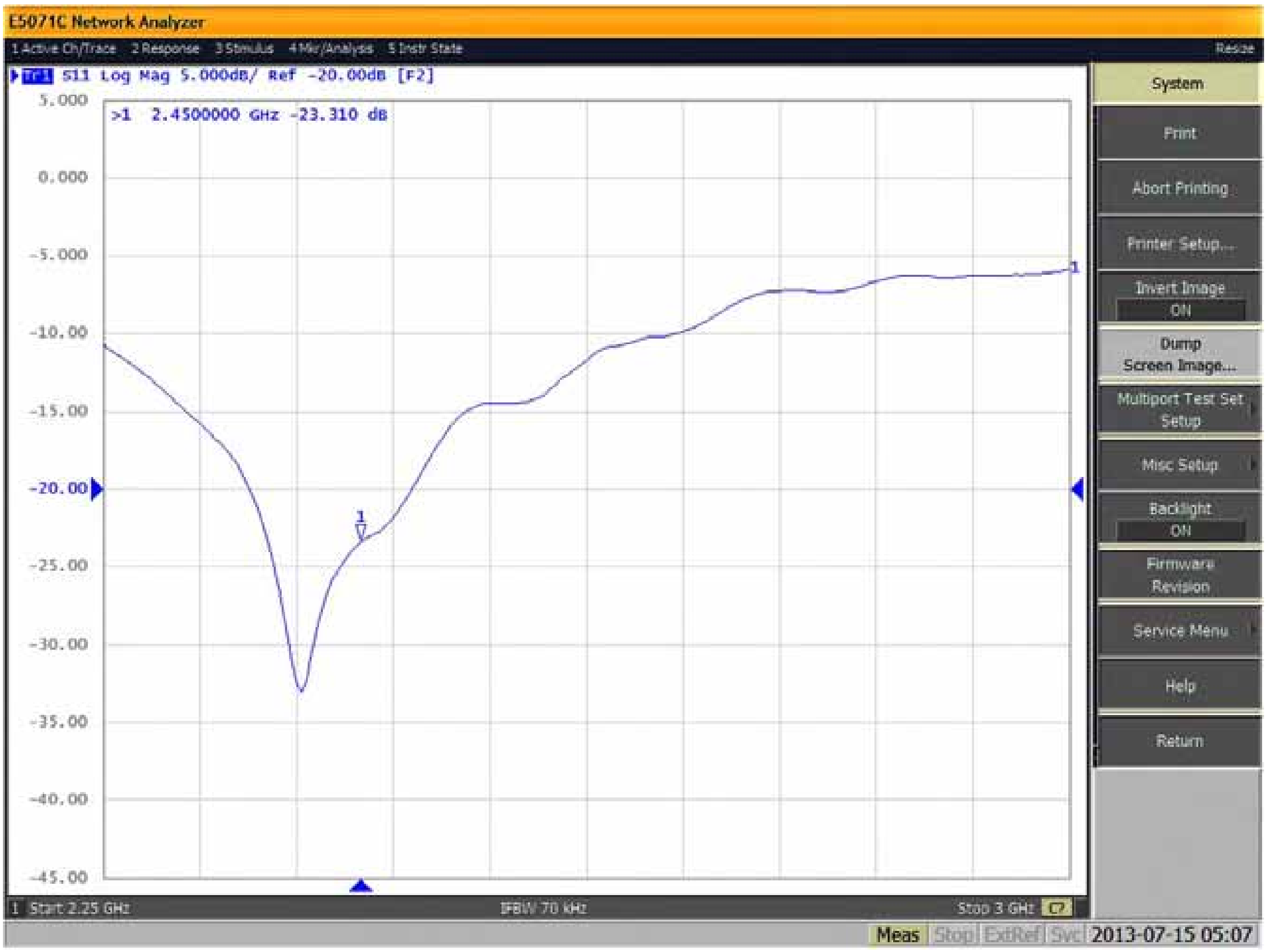
Plot for Antenna Parameters with Head Tissue





Plot for Antenna Parameters with Body Tissue





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
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 **Audix-TW (Auden)**

Certificate No: **D2450V2-888_May12**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 888
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	May 02, 2012

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: 5058 (20k)	27-Mar-12 (No. 217-01530)	Apr-13
Type-N mismatch combination	SN: 5047.2 / 06327	27-Mar-12 (No. 217-01533)	Apr-13
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-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

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israa El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: May 7, 2012

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:

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
c) 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:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.1
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	39.6 ± 6 %	1.81 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.4 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.10 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.4 mW /g ± 16.5 % (k=2)**

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	52.4 ± 6 %	1.98 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.2 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.02 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8 Ω + 3.3 jΩ
Return Loss	- 26.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.2 Ω + 4.7 jΩ
Return Loss	- 26.6 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.158 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	October 06, 2011

DASY5 Validation Report for Head TSL

Date: 02.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 888

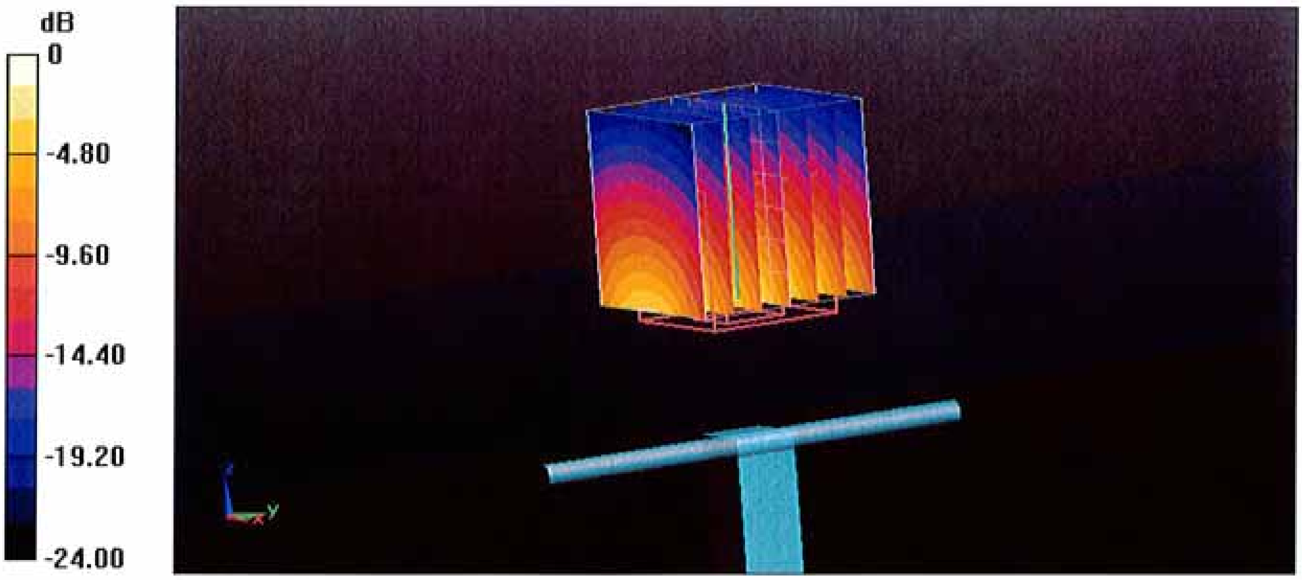
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.81 mho/m; ε_r = 39.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

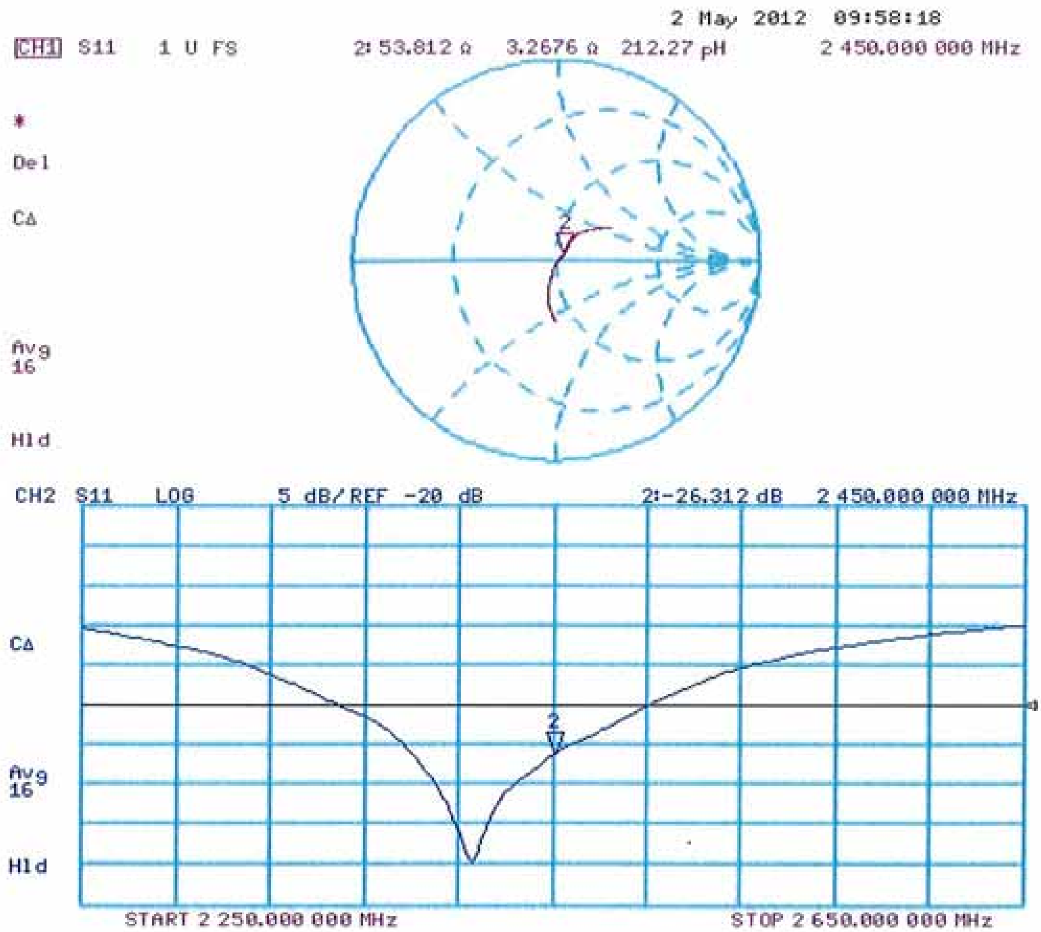
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.760 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.041 mW/g
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.1 mW/g
Maximum value of SAR (measured) = 16.8 mW/g



0 dB = 16.8 mW/g = 24.51 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 02.05.2012

Test Laboratory: SPEAG, Zurich, Switzerland

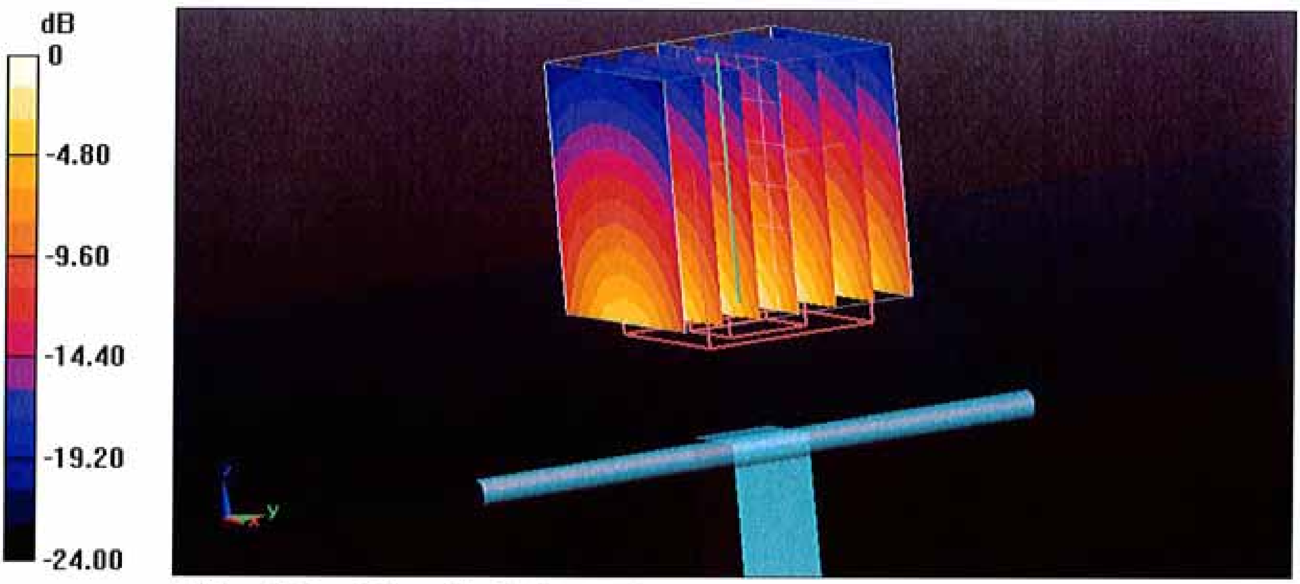
DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 888

Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.98 mho/m; ε_r = 52.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

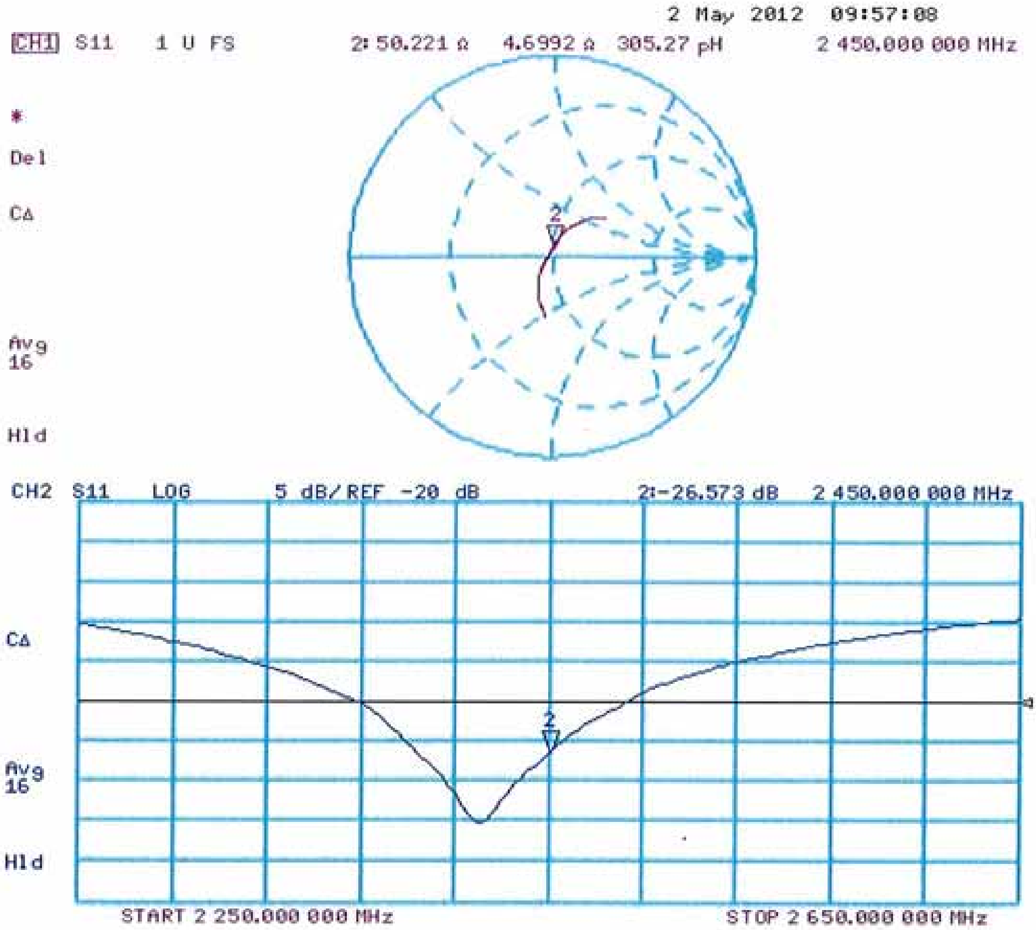
- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.1(838); SEMCAD X 14.6.5(6469)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.994 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 26.345 mW/g
SAR(1 g) = 12.9 mW/g; SAR(10 g) = 6.02 mW/g
Maximum value of SAR (measured) = 17.0 mW/g



0 dB = 17.0 mW/g = 24.61 dB mW/g

Impedance Measurement Plot for Body TSL



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Statement of Due Date for DAE Calibration

We have defined that the calibration interval of following Data Acquisition Electronics (DAE) which use for SAR system is 1 year.

SPEAG	DAE4	1337

Please note that the Cal Interval may be other than 1 year, e.g. 2 years or 3 years.

Also we have determined that the original calibration result of these instruments are not significantly affected before the first-time use of them, when they are stored in good condition.

According to the above reasons, the DAE calibration Due Date described as below:

Example:

Date tested at SPEAG: May 7, 2012

Example Calibration Interval: 1 Year

First-Time Use of Instrument: September 13, 2012

First-Time Use + Selected Interval = Date for Next Calibration

----

September 13, 2012 + 1 Year = September 12, 2013

Leon Liu

Leon Liu / Quality Manager

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IMPORTANT NOTICE

USAGE OF THE DAE 4

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

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

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

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

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

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

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

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

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

Schmid & Partner Engineering

Calibration Laboratory of
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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 **Audix-TW (Auden)**

Certificate No: DAE4-1337_May12

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BJ - SN: 1337
Calibration procedure(s)	QA CAL-06.v24 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	May 07, 2012

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
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-11 (No:11450)	Sep-12
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Calibrator Box V2.1	SE UWS 053 AA 1001	05-Jan-12 (in house check)	In house check: Jan-13

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Technician	
Approved by:	Fin Bomholt	R&D Director	i.V.

Issued: May 7, 2012

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

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	404.769 ± 0.1% (k=2)	404.739 ± 0.1% (k=2)	404.965 ± 0.1% (k=2)
Low Range	3.98638 ± 0.7% (k=2)	3.99974 ± 0.7% (k=2)	3.96882 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	269.0 ° ± 1 °

Appendix

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199996.78	0.80	0.00
Channel X	+ Input	20003.07	2.82	0.01
Channel X	- Input	-19998.03	2.66	-0.01
Channel Y	+ Input	199997.92	2.05	0.00
Channel Y	+ Input	19998.26	-2.01	-0.01
Channel Y	- Input	-20001.07	-0.28	0.00
Channel Z	+ Input	199997.89	1.56	0.00
Channel Z	+ Input	19997.95	-2.30	-0.01
Channel Z	- Input	-20001.72	-0.86	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2002.23	1.53	0.08
Channel X	+ Input	200.33	-0.77	-0.38
Channel X	- Input	-198.96	-0.24	0.12
Channel Y	+ Input	2000.01	-0.54	-0.03
Channel Y	+ Input	200.73	-0.26	-0.13
Channel Y	- Input	-200.12	-1.33	0.67
Channel Z	+ Input	2000.76	0.22	0.01
Channel Z	+ Input	200.33	-0.60	-0.30
Channel Z	- Input	-199.06	-0.31	0.16

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-6.59	-8.94
	- 200	11.43	8.92
Channel Y	200	6.70	6.39
	- 200	-9.50	-9.44
Channel Z	200	-15.62	-15.51
	- 200	13.73	14.06

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	0.26	-3.30
Channel Y	200	8.08	-	2.73
Channel Z	200	10.15	3.72	-

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	16198	16057
Channel Y	16237	15845
Channel Z	16346	15485

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.95	-0.82	3.97	0.78
Channel Y	-0.84	-2.26	0.94	0.62
Channel Z	-0.42	-2.43	0.98	0.53

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

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Statement of Due Date for Field Probe Calibration

We have defined that the calibration interval of following E-Field Probe which use for SAR system is 1 year.

SPEAG	EX3DV4	3855
SPEAG	TMFS	1039
SPEAG	ER3DV6	2531
SPEAG	H3DV6	6348
SPEAG	AM1DV3	3110

Please note that the Cal Interval may be other than 1 year, e.g. 2 years or 3 years.

Also we have determined that the original calibration result of these instruments are not significantly affected before the first-time use of them, when they are stored in good condition.

According to the above reasons, the E-Field Probe calibration Due Date described as below:

Example:

Date tested at SPEAG: May 8, 2012

Example Calibration Interval: 1 Year

First-Time Use of Instrument: September 13, 2012

First-Time Use + Selected Interval = Date for Next Calibration

----

September 13, 2012 + 1 Year = September 12, 2013

Leon Liu

Leon Liu / Quality Manager

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Accreditation No.: SCS 108

Client **Audix-TW (Auden)**

Certificate No: EX3-3855_May12

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3855
Calibration procedure(s)	QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	May 9, 2012

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	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	10-Jan-12 (No. DAE4-660_Jan12)	Jan-13
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: May 9, 2012

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Swiss Calibration Service

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Accreditation No.: SCS 108

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
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., $\vartheta = 0$ is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (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 affect 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 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
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: 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 ≤ 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:3855

Manufactured: January 23, 2012
Calibrated: May 9, 2012

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3855

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.47	0.17	0.13	± 10.1 %
DCP (mV)[B]	94.7	94.0	93.8	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
0	CW	0.00	X	0.00	0.00	1.00	113.4	±3.0 %
			Y	0.00	0.00	1.00	110.9	
			Z	0.00	0.00	1.00	88.2	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3855

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	10.18	10.18	10.18	0.63	0.66	± 12.0 %
835	41.5	0.90	9.76	9.76	9.76	0.71	0.62	± 12.0 %
900	41.5	0.97	9.66	9.66	9.66	0.43	0.74	± 12.0 %
1750	40.1	1.37	9.04	9.04	9.04	0.55	0.68	± 12.0 %
1900	40.0	1.40	8.57	8.57	8.57	0.37	0.89	± 12.0 %
2000	40.0	1.40	8.48	8.48	8.48	0.59	0.68	± 12.0 %
2450	39.2	1.80	7.48	7.48	7.48	0.38	0.86	± 12.0 %
2600	39.0	1.96	7.32	7.32	7.32	0.29	1.13	± 12.0 %

[C] 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

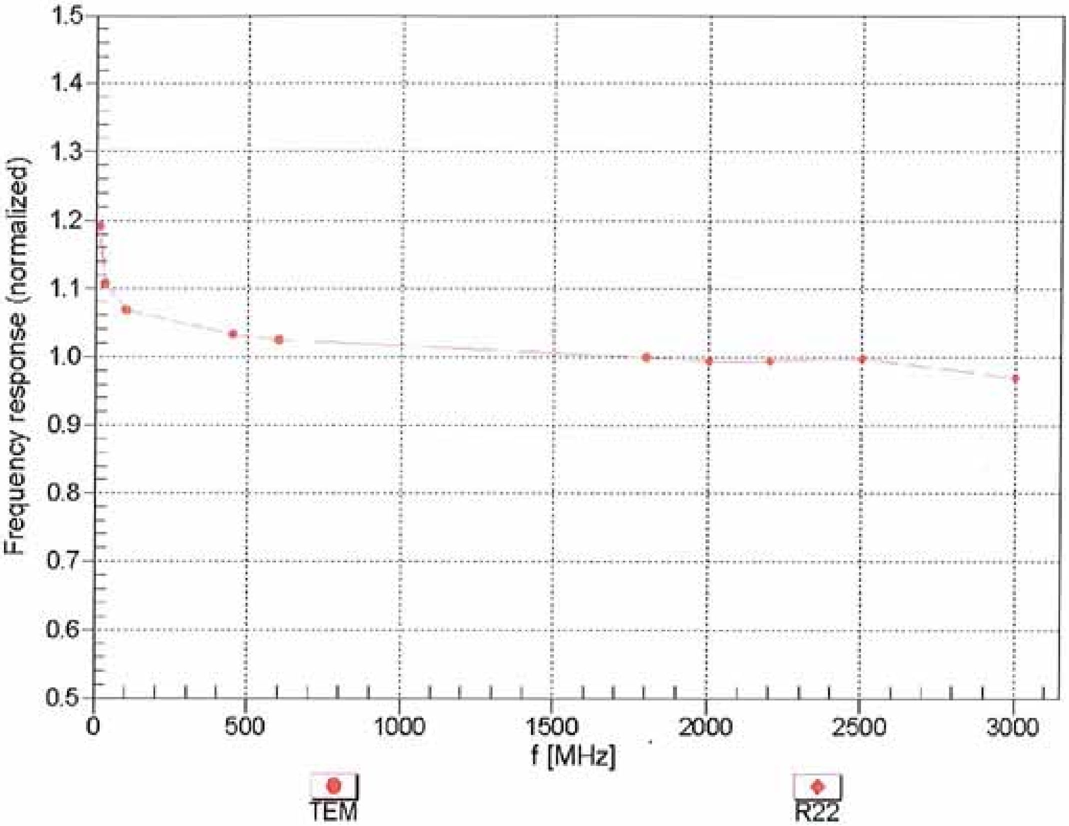
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3855

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	10.05	10.05	10.05	0.60	0.69	± 12.0 %
835	55.2	0.97	9.78	9.78	9.78	0.37	0.90	± 12.0 %
900	55.0	1.05	9.75	9.75	9.75	0.53	0.76	± 12.0 %
1750	53.4	1.49	8.10	8.10	8.10	0.67	0.61	± 12.0 %
1900	53.3	1.52	7.61	7.61	7.61	0.65	0.67	± 12.0 %
2000	53.3	1.52	7.78	7.78	7.78	0.40	0.79	± 12.0 %
2450	52.7	1.95	7.36	7.36	7.36	0.44	0.80	± 12.0 %
2600	52.5	2.16	7.19	7.19	7.19	0.20	1.44	± 12.0 %
5200	49.0	5.30	4.37	4.37	4.37	0.55	1.90	± 13.1 %
5300	48.9	5.42	4.28	4.28	4.28	0.55	1.90	± 13.1 %
5500	48.6	5.65	3.90	3.90	3.90	0.60	1.90	± 13.1 %
5600	48.5	5.77	4.17	4.17	4.17	0.40	1.90	± 13.1 %
5800	48.2	6.00	3.94	3.94	3.94	0.60	1.90	± 13.1 %

[C] 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

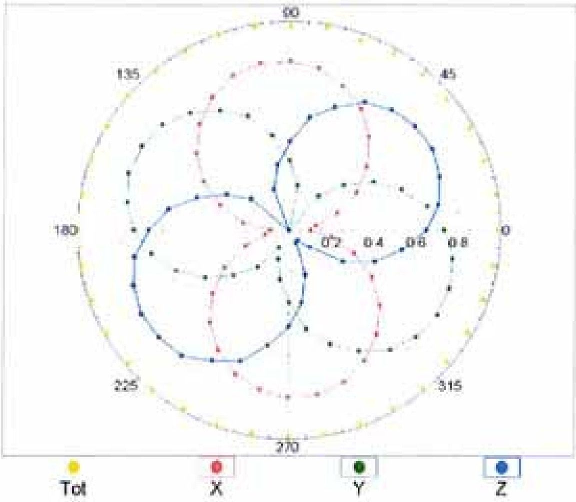
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



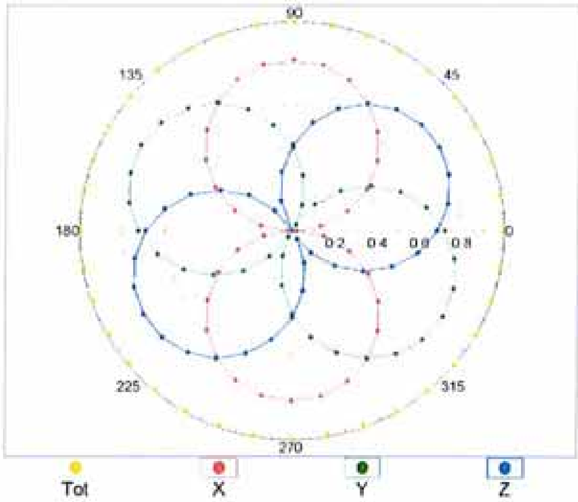
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

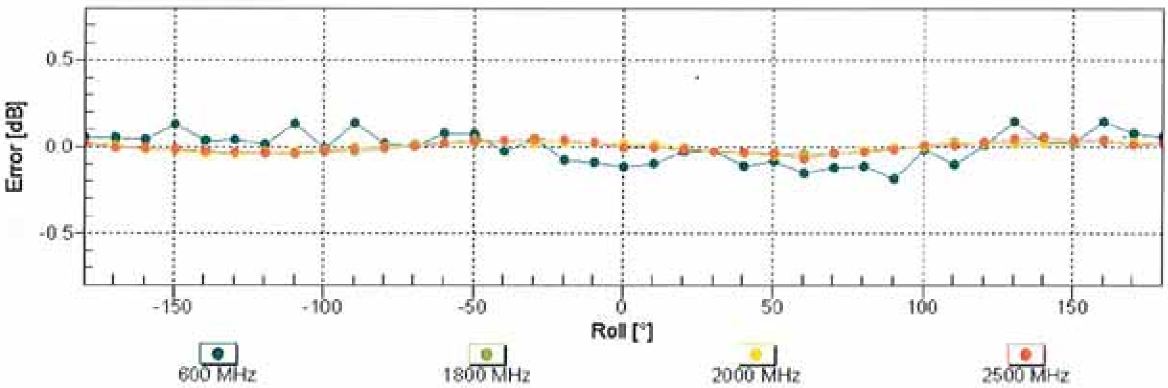
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



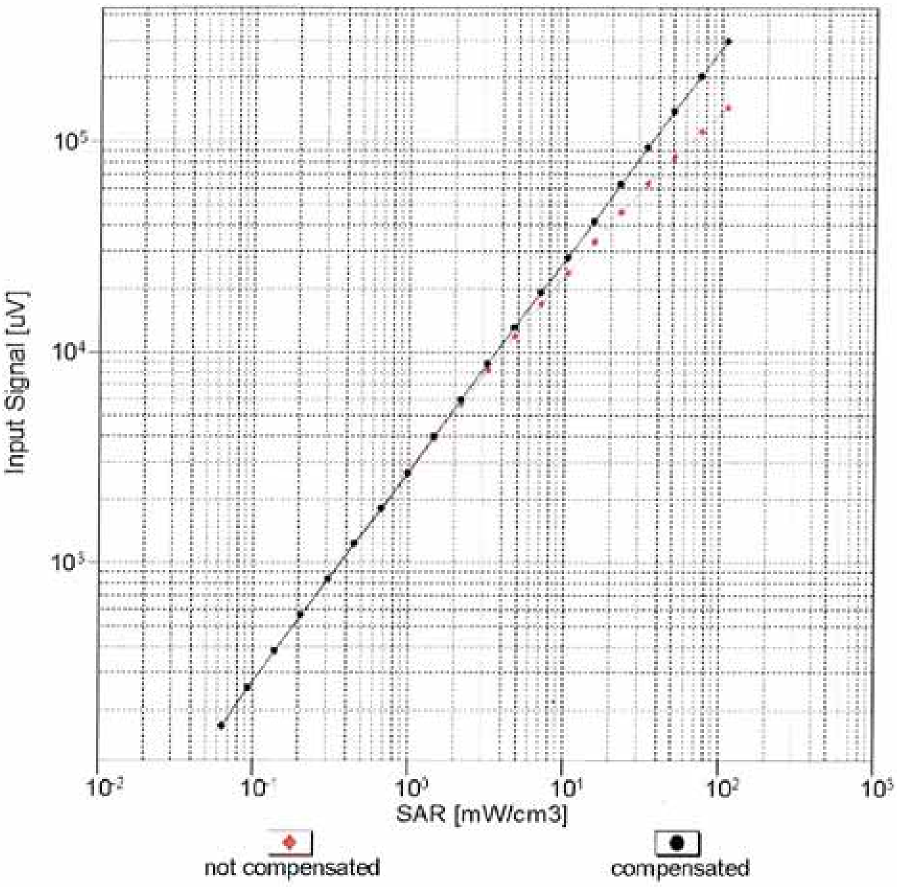
f=1800 MHz,R22

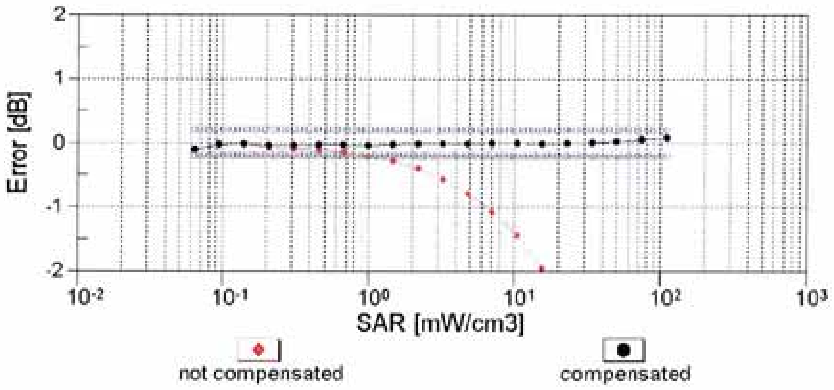




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

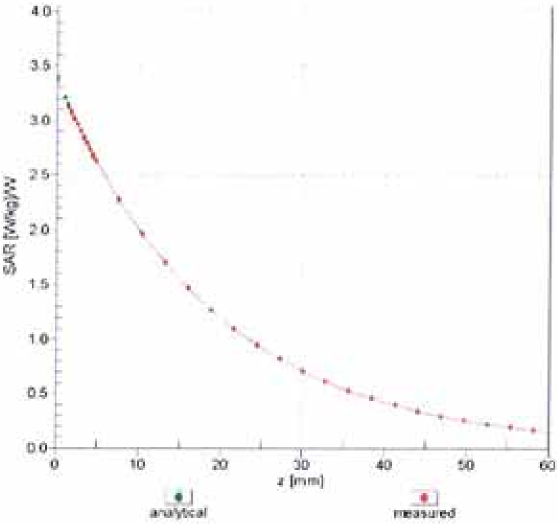
Dynamic Range f(SAR_{head})
(TEM cell , f = 900 MHz)

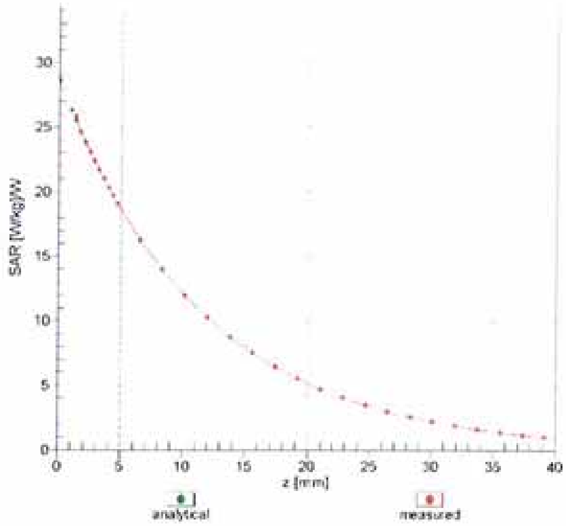




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

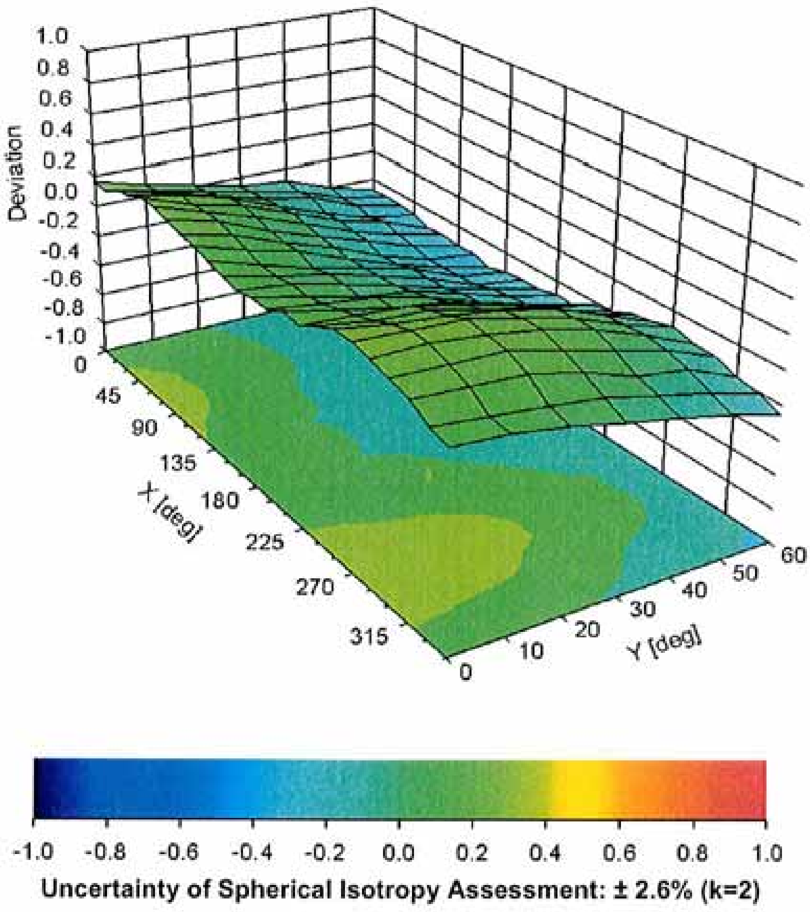
Conversion Factor Assessment





Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3855

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	20.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm