

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: AR5B225 1x1 802.11bgn PCIe Module

To: OET Bulletin 65 Supplement C: (2001-01)

Test Report Serial No:
RFI/SAR/RP80583JD01A V1.0

This Test Report Is Issued Under The Authority
Of Chris Guy, Head of Global Approvals:



(APPROVED SIGNATORY)

Checked By: Richelieu Quoi



(APPROVED SIGNATORY)

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1. Customer Information

Company Name:	ATHEROS COMMUNICATIONS, INC.
Address:	1700 Technology Drive San Jose CA 95110 USA

2. Equipment Under Test (EUT)

2.1. Identification of Equipment Under Test (EUT)

Description:	802.11bgn 1x1 with BT 2.1+EDR PCIe Module and Antenna
Brand Name:	Atheros
Model Name or Number:	AR5B225
Serial Number:	None Stated
FCC ID Number:	PPD-AR5B225
Country of Manufacture:	None Stated
Date of Receipt:	01 February 2011

2.2. Description of EUT

The Equipment Under Test is AR5B225 PCIe Module and Antenna. The EUT operates in WiFi 2.45 GHz band.

2.3. Modifications Incorporated in the EUT

There were no modifications incorporated in the EUT.

2.4. Accessories

The following accessories were supplied with the EUT during testing:

Description:	Laptop
Brand Name:	Lenovo
Model Name or Number:	0769
Serial Number:	None Stated
Cable Length and Type:	Not Applicable
Country of Manufacture:	China
Connected to Port	PCMCIA Port

2.5. Additional Information Related to Testing

Equipment Category	WiFi802.11b/g/n		
Type of Unit	Portable Transceiver		
Intended Operating Environment:	Within WiFi802.11b/g/n 2.4 GHz Coverage		
Transmitter Maximum Output Power Characteristics:	WiFi802.11b	EUT setup in test mode to transmit at a maximum power of up to 18.2 dBm.	
Transmitter Frequency Range:	WiFi802.11b/g/n	(2412 to 2462) MHz	
Transmitter Frequency Allocation of EUT When Under Test:	Channel Number	Channel Description	Frequency (MHz)
	1	Low	2412
	6	Middle	2437
	11	High	2462
Modulation(s):	CCK (WiFi): 0 Hz		
Modulation Scheme (Crest Factor):	CCK (WiFi): 1		
Antenna Type:	Externally Mounted		
Antenna Length:	49 mm		
Number of Antenna Positions:	4: Horizontal-Down Horizontal-Up Vertical-Down Vertical-Up		
Power Supply Requirement:	3 v – 5 v PCMCIA Port		
Battery Type(s):	Not Applicable		

3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	OET Bulletin 65 Supplement C: (2001-01)
Title:	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields.
Purpose of Test:	To determine whether the equipment met the basic restrictions as defined in OET Bulletin 65 Supplement C: (2001-01) using the SAR averaging method as described in the test specification above.

3.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

Federal Communications Commission, "Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields", OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

Thomas Schmid, Oliver Egger and Neils Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE Transaction on microwave theory and techniques, Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

KDB 616227 D03 SAR Supplement consideration for Notebook/Netbook /Laptop and Tablet

KDB 248227 D01 SAR measurement procedures for 802.11a/b/g transmitters

3.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

4. Deviations from the Test Specification

Test was performed as per "KDB 616227 D03 SAR Supplement consideration for Notebook/Netbook/Laptop and Tablet, KDB 248227 D01 SAR measurement procedures for 802.11a/b/g transmitters, according to the body-worn procedures in IEEE Std 1528-2003 and OET Bulletin 65 Supplement C 01-01.

As per the FCC Public Notice DA 02-1438 by the SCC-34/SC-2 and KDB publication 447498 D01 v04, for SAR measurement performed on the middle channel with levels < 50% of the SAR limit and corresponding channel < 100 MHz, SAR evaluation on the low and high channels are not required and therefore not evaluated.

5. Operation and Configuration of the EUT during Testing

5.1. Operating Modes

The EUT was tested in the following operating mode(s) unless otherwise stated:

- WiFi802.11 b Data allocated test mode using manufacturer customised software "New Artheros Radio Test (NART-GUI)". The EUT was setup in test mode to transmit at a maximum power of up to 18.2 dBm at 1Mbps as per the manufacturer setup power table.
- Simultaneous transmission is not supported and therefore not evaluated.

5.2. Configuration and Peripherals

The EUT was tested in the following configuration(s) unless otherwise stated:

- Powered via Laptop PCMCIA Port.
- Tested in Body configuration with 20mm separation distance to flat section of the SAR phantom. The following configurations were applied for body-worn use; Horizontal-Up, Horizontal-Down, Vertical-Up and Vertical-Down. See Appendix 4.

Body Configuration

- a) The EUT was placed in a normal operating position where the centre of EUT was aligned with the centre reference point on the flat section of the 'SAM' phantom.
- b) With the EUT touching the phantom at an imaginary centre line. The EUT was aligned with a marked plane (X and Y axis) consisting of two lines.
- c) For the touch-safe position the handset was gradually moved towards the flat section of the 'SAM' phantom until any point of the EUT touched the phantom.
- d) For position(s) greater than 0mm separation the EUT was positioned as per the touch-safe position, and then the vertical height was decreased/adjusted as required.
- e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.
- f) The device was keyed to operate continuously in the transmit mode for the duration of the test.
- g) The location of the maximum spatial SAR distribution (hot spot) was determined relative to the EUT and its antenna.
- h) The EUT was transmitting at full power throughout the duration of the test powered by a fully charged battery.

6. Summary of Test Results

Test Name	Specification Reference	Result
Specific Absorption Rate-WiFi802.11b 1Mbps Body Configuration 1g	OET Bulletin 65 Supplement C: (2001-01)	Complied

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Pavilion A, Ashwood Park, Ashwood Way, Basingstoke, Hampshire, RG23 8BG United Kingdom

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

7.2. Test Results

7.2.1. Specific Absorption Rate – WiFi802.11b 1 Mbps Body Configuration 1g

Test Summary:

Tissue Volume:	1g
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Maximum Level (W/kg):	0.264
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Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
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Temperature Variation in Liquid (°C):	22.1 to 22.8
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Results:

EUT Position	Phantom Configuration	Channel Number	Level (W/kg)	Limit (W/kg)	Margin (W/kg)	Note(s)	Result
Horizontal Up	Flat (SAM)	6	0.264	1.600	1.336	1	Complied
Horizontal Down	Flat (SAM)	6	0.185	1.600	1.415	1	Complied
Vertical Up	Flat (SAM)	6	0.080	1.600	1.520	1	Complied
Vertical Down	Flat (SAM)	6	0.036	1.600	1.565	1	Complied

Note(s):

1. SAR measurements were performed with the EUT at a separation distance of 20mm from the 'SAM' phantom flat section.
2. SAR test was measured using 802.11b mode only as per the manufacturer power table and setting requirements. The output power for 802.11g/n were greater than $\frac{1}{4}$ dB less than 802.11b mode, therefore as per KDB 248227 D01 SAR test was not performed on mode 'g' and 'n'.

7.2.2. Specific Absorption Rate – Enhanced Energy Coupling WLAN 802.11b 1Mbps

Environmental Conditions:

Temperature Variation in Lab (°C):	24.0 to 24.0
Temperature Variation in Liquid (°C):	22.1 to 22.8

Results:

EUT Position	Antenna to Phantom Distance (mm)	Peak SAR (W/kg)	E-Field (V/m)	Peak SAR Level Lower Than Initial (%)
Horizontal Up	10 (Initial)	0.155	25.76	-
	15	0.080	17.33	48.39
	20	0.035	12.65	77.42
	25	0.027	9.40	82.58
	30	0.014	7.88	90.97
Horizontal Down	15 (Initial)	0.024	17.44	-
	20	0.013	8.73	45.83
	25	0.008	4.86	66.67
	30	0.008	3.12	66.67
Vertical Up	10 (Initial)	0.026	6.79	-
	15	0.022	5.67	15.38
	20	0.015	4.96	42.31
	25	0.010	4.46	61.54
	30	0.010	4.14	61.54
Vertical Down	10 (Initial)	0.036	10.65	-
	15	0.034	8.54	5.56
	20	0.023	6.95	36.11
	25	0.012	5.97	66.67
	30	0.009	5.32	75.00

7.2.3. Conducted Average Power Measurement

Channel Number	Frequency (GHz)	TX Power before Test (dBm) (Main)	Note
6	2.437	18.2	2.4GHz 802.11b (1Mbps) Software Gain setting to achieve level was set to 15.5 dBm

7.3. Conducted Average Power Measurements (Provided by Customer)

Channel Number	Frequency (GHz)	TX Power before Test (dBm) (Main)	Note
1	2.412	18.2	2.4GHz 802.11b
6	2.437	18.2	
11	2.462	18.0	
1	2.412	14.3	2.4GHz 802.11g
6	2.437	18.1	
11	2.462	12.9	
1	2.412	13.4	2.4GHz 802.11n (HT20)
6	2.437	16.1	
11	2.462	12.0	
1	2.412	10.9	2.4GHz 802.11n (HT40)
6	2.437	13.2	
11	2.462	10.0	

8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

Test Name	Confidence Level	Calculated Uncertainty
Specific Absorption Rate- WLAN 802.11 b/g/n Body Configuration 1g	95%	±19.34%

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

8.1. Specific Absorption Rate- WLAN 802.11b/g/n Body Configuration 1g

Type	Source of uncertainty	+ Value	- Value	Probability Distribution	Divisor	c _i (10g)	Standard Uncertainty		v _i or v _{eff}
							+ u (%)	- u (%)	
B	Probe calibration	11.000	11.000	normal (k=2)	2.0000	1.0000	5.500	5.500	11.000
B	Axial Isotropy	0.500	0.500	normal (k=2)	2.0000	1.0000	0.250	0.250	0.500
B	Hemispherical Isotropy	2.600	2.600	normal (k=2)	2.0000	1.0000	1.300	1.300	2.600
B	Spatial Resolution	0.500	0.500	Rectangular	1.7321	1.0000	0.289	0.289	0.500
B	Boundary Effect	0.769	0.769	Rectangular	1.7321	1.0000	0.444	0.444	0.769
B	Linearity	0.600	0.600	Rectangular	1.7321	1.0000	0.346	0.346	0.600
B	Detection Limits	0.200	0.200	Rectangular	1.7321	1.0000	0.115	0.115	0.200
B	Readout Electronics	0.320	0.320	normal (k=2)	2.0000	1.0000	0.160	0.160	0.320
B	Response Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	0.000
B	Integration Time	0.000	0.000	Rectangular	1.7321	1.0000	0.000	0.000	0.000
B	RF Ambient conditions	3.000	3.000	Rectangular	1.7321	1.0000	1.732	1.732	3.000
B	Probe Positioner Mechanical Restrictions	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	4.000
B	Probe Positioning with regard to Phantom Shell	2.850	2.850	Rectangular	1.7321	1.0000	1.645	1.645	2.850
B	Extrapolation and integration/ Maximum SAR evaluation	5.080	5.080	Rectangular	1.7321	1.0000	2.933	2.933	5.080
A	Test Sample Positioning	2.570	2.570	normal (k=1)	1.0000	1.0000	2.570	2.570	2.570
A	Device Holder uncertainty	0.154	0.154	normal (k=1)	1.0000	1.0000	0.154	0.154	0.154
B	Phantom Uncertainty	4.000	4.000	Rectangular	1.7321	1.0000	2.309	2.309	4.000
B	Drift of output power	5.000	5.000	Rectangular	1.7321	1.0000	2.887	2.887	5.000
B	Liquid Conductivity (target value)	5.000	5.000	Rectangular	1.7321	0.6400	1.848	1.848	5.000
A	Liquid Conductivity (measured value)	4.900	4.900	normal (k=1)	1.0000	0.6400	3.136	3.136	4.900
B	Liquid Permittivity (target value)	5.000	5.000	Rectangular	1.7321	0.6000	1.732	1.732	5.000
A	Liquid Permittivity (measured value)	4.920	4.920	normal (k=1)	1.0000	0.6000	2.952	2.952	4.920
	Combined standard uncertainty			t-distribution			9.87	9.87	
	Expanded uncertainty			k = 1.96			19.34	19.34	

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A034	Narda 20W Termination	Narda	374BNM	8706	Calibrated as part of system	-
A1097	SMA Directional Coupler	Midisco	MDC6223-30	None	Calibrated as part of system	-
A1137	3dB Attenuator	Narda	779	04690	Calibrated as part of system	-
A1174	Dielectric Probe Kit	Agilent Technologies	85070C	Us99360072	Calibrated before use	-
A1328	Handset Positioner	Schmid & Partner Engineering AG	Modification	SD 000 H01 DA	-	-
A1182	Handset Positioner	Schmid & Partner Engineering AG	V3.0	None	-	-
A1184	Data Acquisition Electronics	Schmid & Partner Engineering AG	DAE3	394	19 April 2010	12
A1238	SAM Phantom	Schmid & Partner Engineering AG	SAM b	001	Calibrated before use	-
A1378*	Probe	Schmid & Partner Engineering AG	EX3 DV3	3508	15 July 2010	12
A1497	Amplifier	Mini-Circuits	zhl-42w (sma)	e020105	Calibrated as part of system	-
A1566	SAM Phantom	Schmid & Partner Engineering AG	SAM a	002	Calibrated before use	-
A1990	Digital Camera	Samsung	E515	A23WC90 8A05431K	-	-
A215	20 dB Attenuator	Narda	766-20	9402	Calibrated as part of system	-
A1531	Antenna	AARONIA AG	7025	02458	-	-
C1042	Network Analyzer Cable	Agilent	8120-4779	349	-	-
C1145	Cable	Rosenberger MICRO-COAX	FA147A F003003030	41843-1	Calibrated as part of system	-
C1146	Cable	Rosenberger MICRO-COAX	FA147A F030003030	41752-1	Calibrated as part of system	-
G0528	Robot Power Supply	Schmid & Partner Engineering AG	DASY4	None	Calibrated before use	-
G087	PSU	Thurlby Thandar	CPX200	100701	Calibrated before use	-

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
L1018*	Probe	Schmid & Partner Engineering AG	ET3DV6	1583	16 Nov 2010	12
L1020	2450 MHz Dipole Kit	Schmid & Partner Engineering AG	D2450V2	702	11 May 2010	24
M1015	Network Analyser	Agilent Technologies	8753ES	US39172406	27 Sept 2010	12
M1047	Robot Arm	Staubli	RX908 L	F00/SD8 9A1/A/01	Calibrated before use	-
M1159	Signal Generator	Agilent Technologies	E8241A	US42110332	Internal Checked 15 Dec 2010	4
M1071	Spectrum Analyzer	Agilent	HP8590E	3647U00514	(Monitoring use only)	-
M1270	Temperature/ Humidity/ Pressure Meter	RS Components	None	None	Internal Checked 31 March 2010	12
M1071	Spectrum Analyzer	Agilent	HP8590E	3647U00514	(Monitoring use only)	-
M1044	Diode Power Sensor	Rohde & Schwarz	NRV-Z1	893350/019	26 May 2010	12
M265	Diode Power Sensor	Rohde & Schwarz	NRV-Z1	893350/017	26 May 2010	12
M263	Dual Channel Power Meter	Rohde & Schwarz	NRVD	826558/004	27 May 2010	12
S256	SAR Lab	RFI	Site 56	N/A	Calibrated before use	-

*Note: Two different probes were used to carry on testing, since they were hired on short term loan.

A.1.1. Calibration Certificates

This section contains the calibration certificates and data for the Probe(s) and Dipole(s) used, which are not included in the total number of pages for this report.

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



checked by AD
 DATE: 19-07-2010

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

Client

RFI

Accreditation No.: **SCS 108**

RFI Asset: A1378

Certificate No: **EX3-3508_Jul10**

CALIBRATION CERTIFICATE

Object **EX3DV3 - SN:3508**

Calibration procedure(s) **QA CAL-01 v6, QA CAL-12 v6, QA CAL-23 v3 and QA CAL-25 v2**
 Calibration procedure for dosimetric E-field probes

Calibration date: **July 15, 2010 (Additional Conversion Factors)**

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	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-09)	In house check: Oct10

Calibrated by:	Name	Function	Signature
	Jeton Kastrati	Laboratory Technician	

Approved by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	

Issued: July 15, 2010

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



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
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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:

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

Methods Applied and Interpretation of Parameters:

- $NORM_{x,y,z}$: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). $NORM_{x,y,z}$ are only intermediate values, i.e., the uncertainties of $NORM_{x,y,z}$ does not effect the E²-field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency_response$ (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCPx,y,z$: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- $Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z$: 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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 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 EX3DV3

SN:3508

Additional Conversion Factors

Manufactured:	December 19, 2003
Last calibrated:	February 19, 2010
Recalibrated:	July 15, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV3 SN:3508

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.77	0.63	0.65	$\pm 10.1\%$
DCP (mV) ^B	99.8	95.0	92.6	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc ^E (k=2)
10000	CW	0.00	X Y Z	0.00 0.00 0.00	0.00 0.00 0.00	1.00 1.00 1.00	300 300 300	$\pm 1.5\%$

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the maximum deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV3 SN:3508

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	43.5 ± 5%	0.87 ± 5%	10.81	10.81	10.81	0.11	1.00 ± 13.3%
750	± 50 / ± 100	41.9 ± 5%	0.89 ± 5%	10.80	10.80	10.80	0.38	0.75 ± 11.0%
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	10.08	10.08	10.08	0.38	0.77 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	9.09	9.09	9.09	0.52	0.63 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	8.75	8.75	8.75	0.35	0.76 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	7.95	7.95	7.95	0.31	0.80 ± 11.0%

^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.

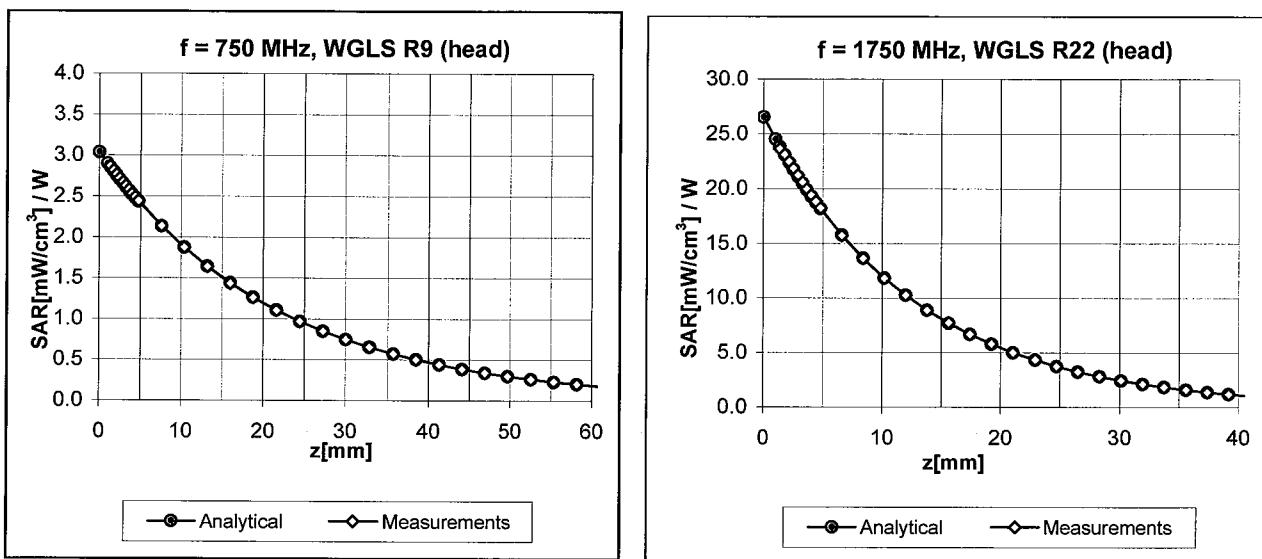
DASY/EASY - Parameters of Probe: EX3DV3 SN:3508

Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
450	± 50 / ± 100	56.7 ± 5%	0.94 ± 5%	11.71	11.71	11.71	0.02	1.00 ± 13.3%
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	10.45	10.45	10.45	0.50	0.74 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	8.79	8.79	8.79	0.39	0.77 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	8.45	8.45	8.45	0.36	0.80 ± 11.0%
2150	± 50 / ± 100	53.0 ± 5%	1.75 ± 5%	8.50	8.50	8.50	0.22	1.14 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	8.19	8.19	8.19	0.34	0.80 ± 11.0%

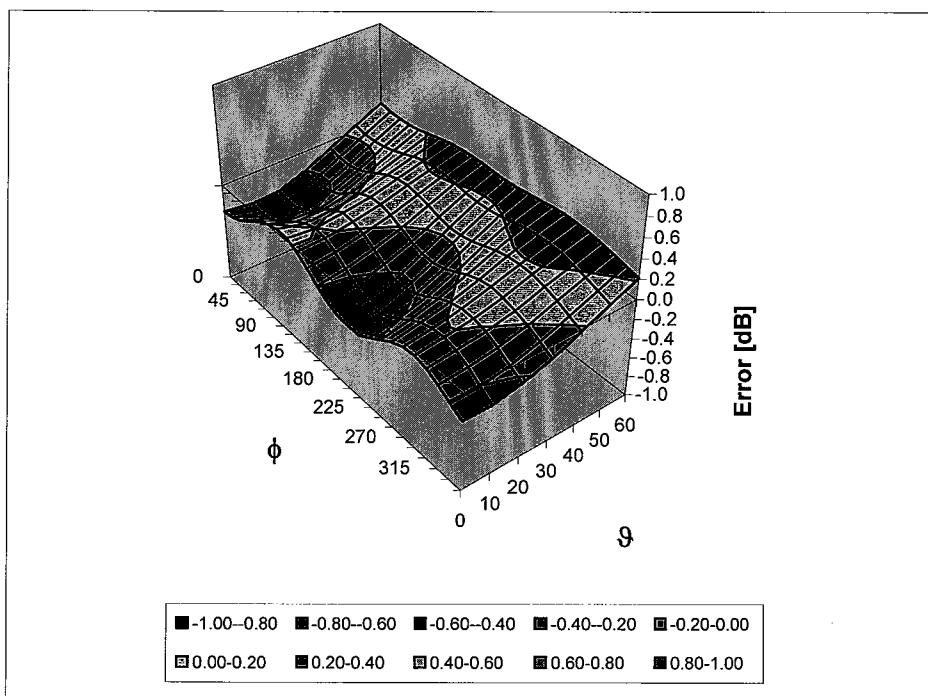
^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Conversion Factor Assessment



Deviation from Isotropy in HSL

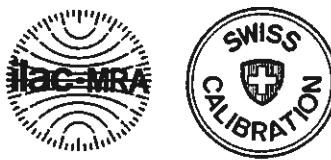
Error (ϕ, θ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	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



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Accreditation No.: SCS 108

Client Sony Ericsson UK

Certificate No: ET3-1583_Nov10

CALIBRATION CERTIFICATE

Object ET3DV6 - SN:1583

Calibration procedure(s) QA CAL-01.v6, QA CAL-23.v3 and QA CAL-25.v2
Calibration procedure for dosimetric E-field probes

Calibration date: November 16, 2010

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	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	1-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	1-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	30-Dec-09 (No. ES3-3013_Dec09)	Dec-10
DAE4	SN: 660	20-Apr-10 (No. DAE4-660_Apr10)	Apr-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: November 18, 2010

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Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORM x,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORM x,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 9	9 rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., 9 = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM x,y,z : Assessed for E-field polarization 9 = 0 ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM x,y,z are only intermediate values, i.e., the uncertainties of NORM x,y,z does not effect the E²-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.
- 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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORMx,y,z * ConvF$ 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 ET3DV6

SN:1583

Manufactured:	May 7, 2001
Last calibrated:	November 18, 2009
Recalibrated:	November 16, 2010

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ET3DV6 SN:1583

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.85	2.06	1.97	$\pm 10.1\%$
DCP (mV) ^B	99.2	97.2	96.1	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dBuV	C	VR mV	Unc ^E (k=2)
10000	CW	0.00	X Y Z	0.00 0.00 0.00	0.00 0.00 0.00	1.00 1.00 1.00	149.6 151.8 152.9	$\pm 3.1\%$

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the maximum deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ET3DV6 SN:1583

Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
835	± 50 / ± 100	41.5 ± 5%	0.90 ± 5%	6.65	6.65	6.65	0.45	2.09 ± 11.0%
900	± 50 / ± 100	41.5 ± 5%	0.97 ± 5%	6.50	6.50	6.50	0.39	2.30 ± 11.0%
1750	± 50 / ± 100	40.1 ± 5%	1.37 ± 5%	5.53	5.53	5.53	0.55	2.43 ± 11.0%
1900	± 50 / ± 100	40.0 ± 5%	1.40 ± 5%	5.24	5.24	5.24	0.66	2.15 ± 11.0%
2450	± 50 / ± 100	39.2 ± 5%	1.80 ± 5%	4.57	4.57	4.57	0.99	1.60 ± 11.0%

^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.

DASY/EASY - Parameters of Probe: ET3DV6 SN:1583

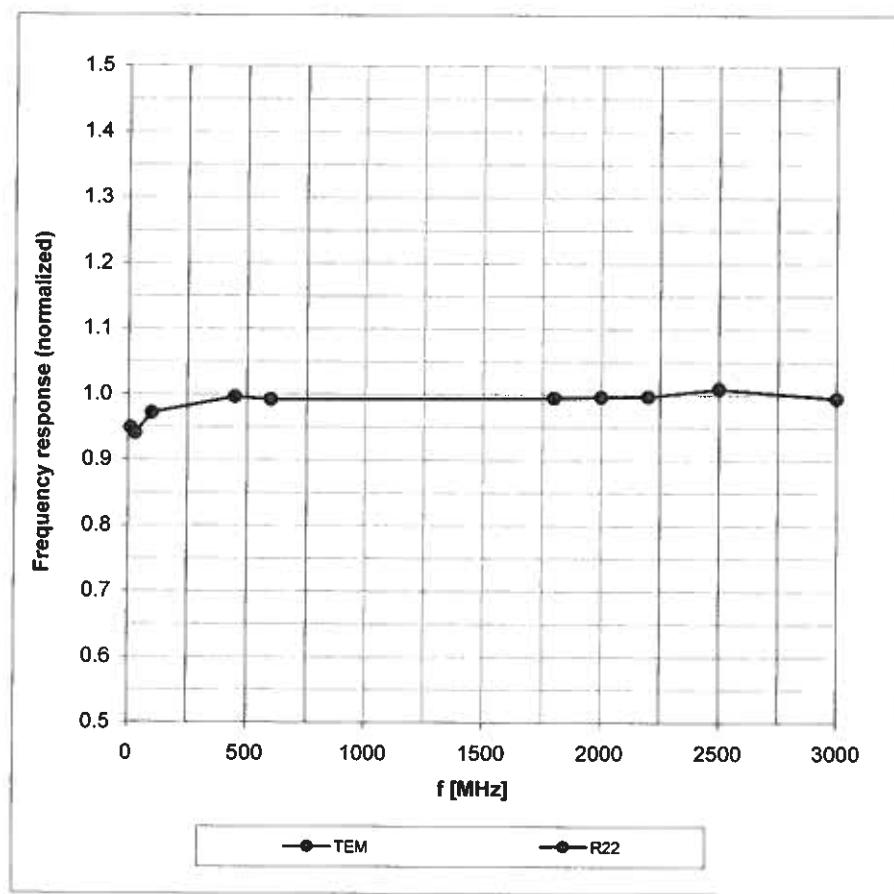
Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz]	Validity [MHz] ^c	Permittivity	Conductivity	ConvF X	ConvF Y	ConvF Z	Alpha	Depth Unc (k=2)
835	± 50 / ± 100	55.2 ± 5%	0.97 ± 5%	6.45	6.45	6.45	0.35	2.61 ± 11.0%
900	± 50 / ± 100	55.0 ± 5%	1.05 ± 5%	6.41	6.41	6.41	0.37	2.59 ± 11.0%
1750	± 50 / ± 100	53.4 ± 5%	1.49 ± 5%	4.93	4.93	4.93	0.59	3.08 ± 11.0%
1900	± 50 / ± 100	53.3 ± 5%	1.52 ± 5%	4.68	4.68	4.68	0.86	2.40 ± 11.0%
2450	± 50 / ± 100	52.7 ± 5%	1.95 ± 5%	4.23	4.23	4.23	0.99	1.75 ± 11.0%

^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.

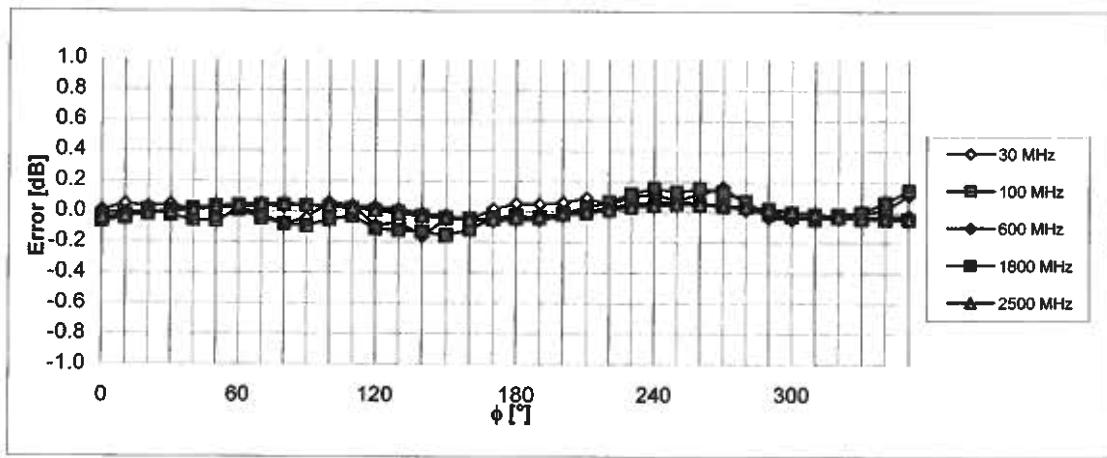
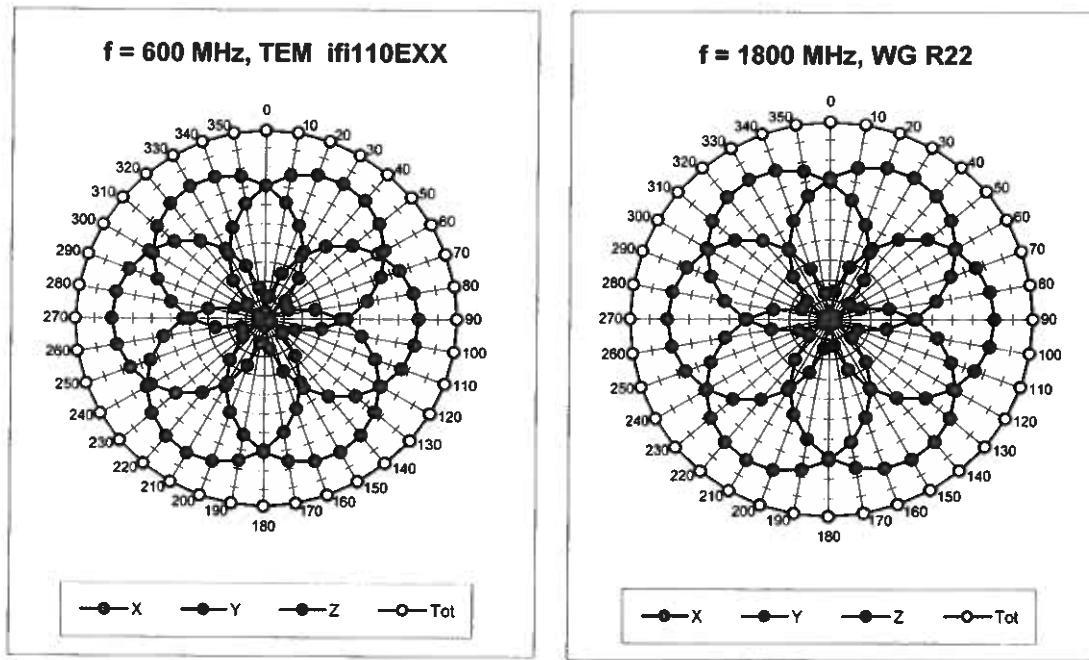
Frequency Response of E-Field

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



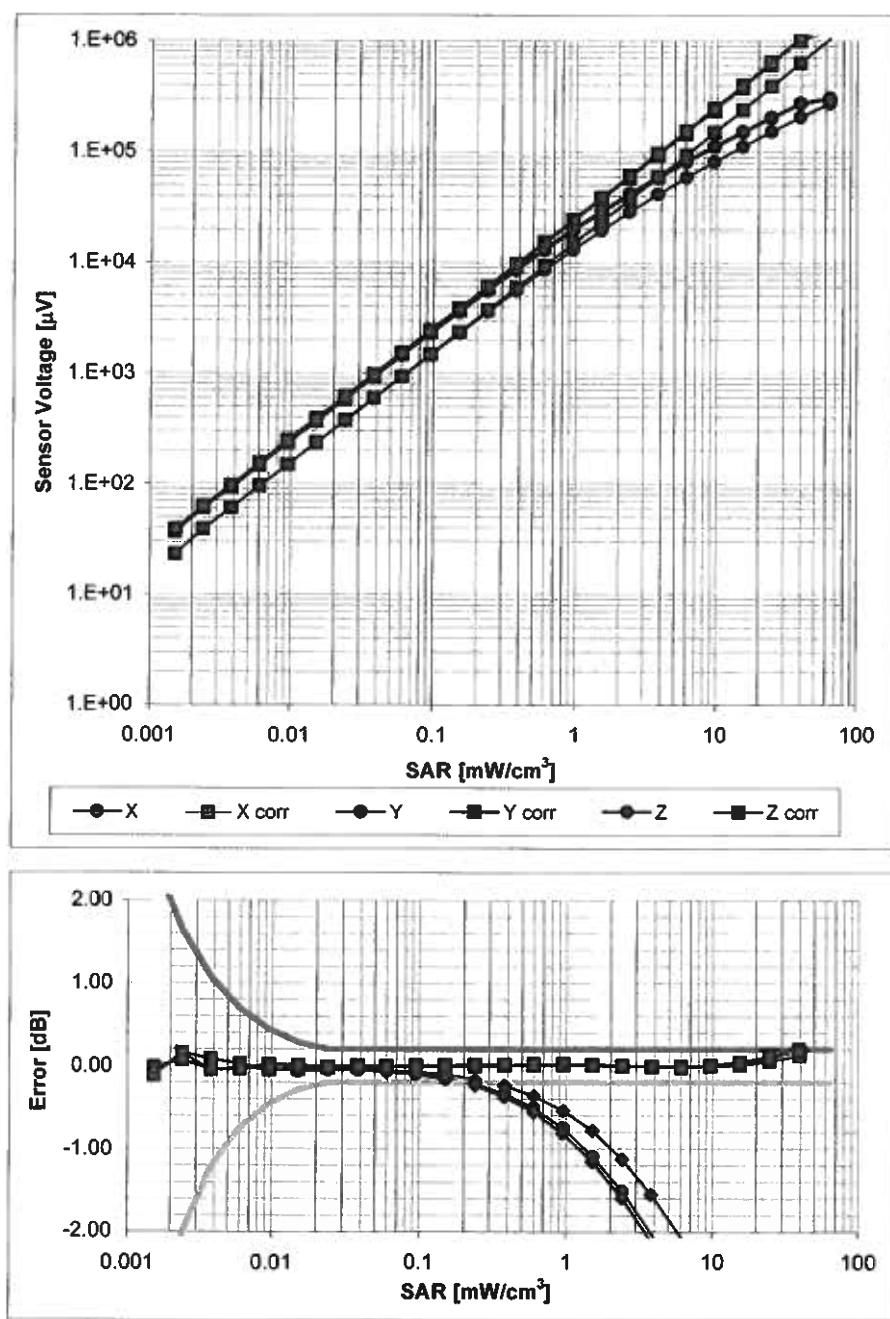
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$



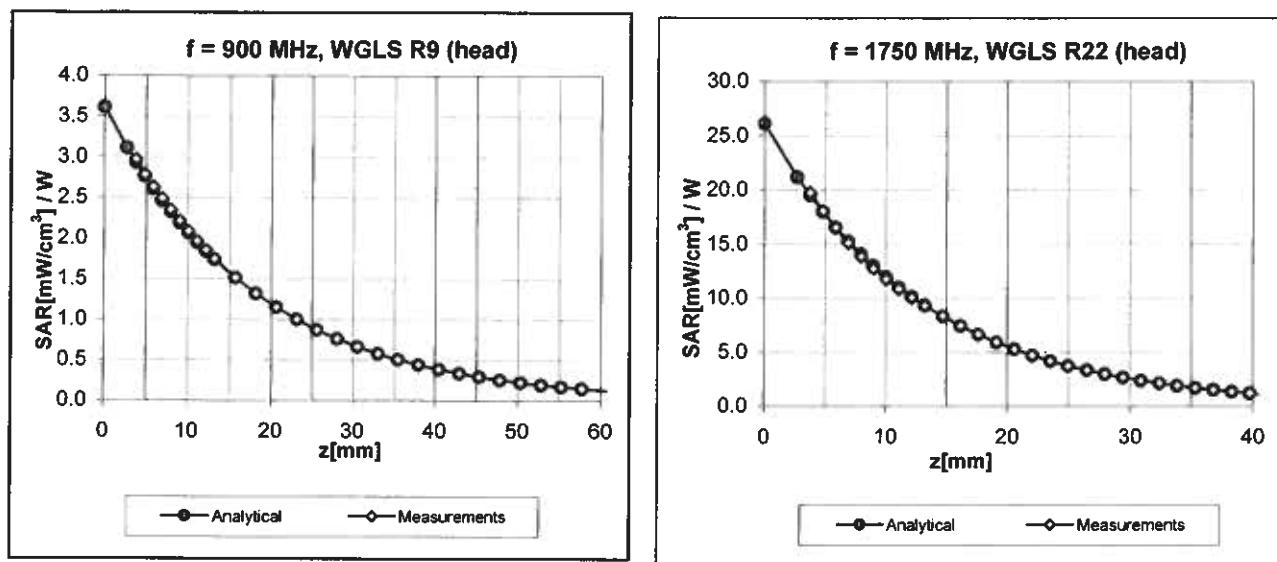
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



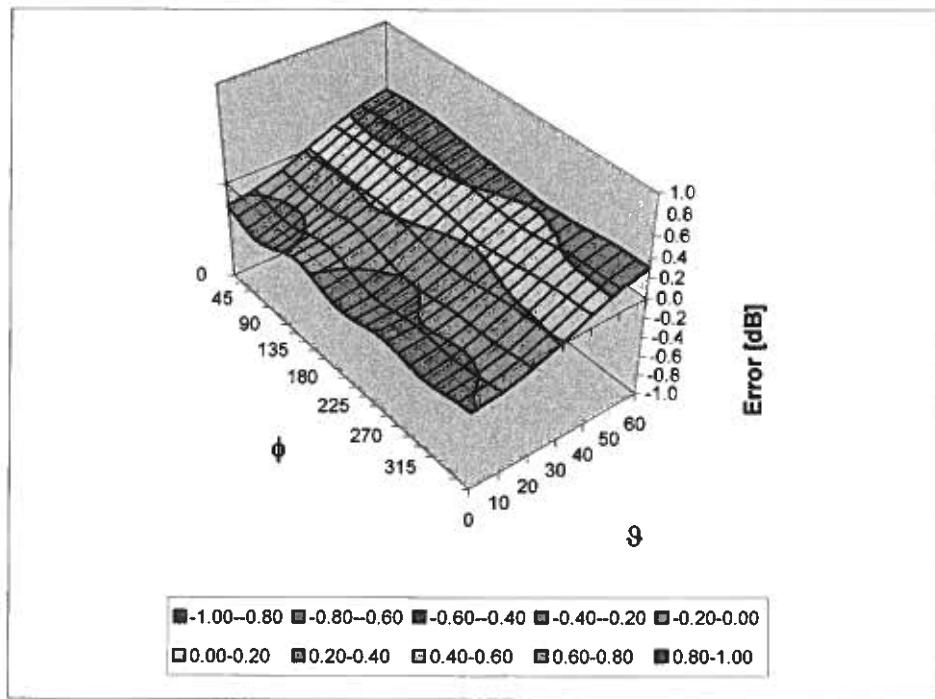
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in HSL

Error (ϕ, θ), f = 900 MHz



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	6.8 mm
Probe Tip to Sensor X Calibration Point	2.7 mm
Probe Tip to Sensor Y Calibration Point	2.7 mm
Probe Tip to Sensor Z Calibration Point	2.7 mm
Recommended Measurement Distance from Surface	3.7 mm



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Accreditation No.: **SCS 108**

Client **Sony Ericsson UK**

Certificate No: **D2440V2-702_May10**

CALIBRATION CERTIFICATE

Object	D2440V2 - SN: 702
Calibration procedure(s)	QA CAL-05.v7 Calibration procedure for dipole validation kits
Calibration date:	May 11, 2010

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	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe ES3DV3	SN: 3205	30-Apr-10 (No. ES3-3205_Apr10)	Apr-11
DAE4	SN: 601	02-Mar-10 (No. DAE4-601_Mar10)	Mar-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-09)	In house check: Oct-10

Calibrated by: **Jeton Kastrati** **Laboratory Technician**

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

Issued: May 12, 2010

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Measurement Conditions

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

DASY Version	DASY5	V5.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz \pm 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 \pm 0.2) °C	39.0 \pm 6 %	1.76 mho/m \pm 6 %
Head TSL temperature during test	(22.0 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.1 mW / g
SAR normalized	normalized to 1W	52.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	52.9 mW / g \pm 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.11 mW / g
SAR normalized	normalized to 1W	24.4 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	24.5 mW / g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.2 ± 6 %	2.01 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	---	---

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.7 mW / g
SAR normalized	normalized to 1W	54.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	54.3 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.38 mW / g
SAR normalized	normalized to 1W	25.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	25.5 mW / g ± 16.5 % (k=2)



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	49.3 Ω - 7.8 $j\Omega$
Return Loss	- 22.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.8 Ω - 6.2 $j\Omega$
Return Loss	- 21.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.149 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 24, 2000

DASY5 Validation Report for Head TSL

Date/Time: 11.05.2010 14:02:38

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN:702

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

Medium: HSL U11 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.76$ mho/m; $\epsilon_r = 39$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

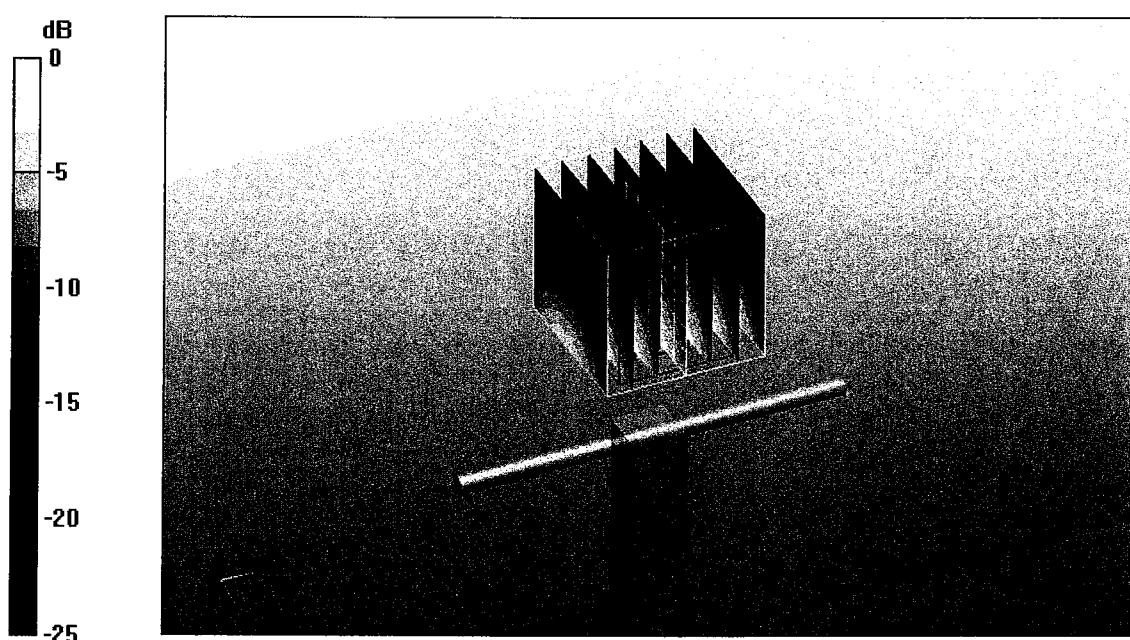
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.8 V/m; Power Drift = 0.037 dB

Peak SAR (extrapolated) = 26.9 W/kg

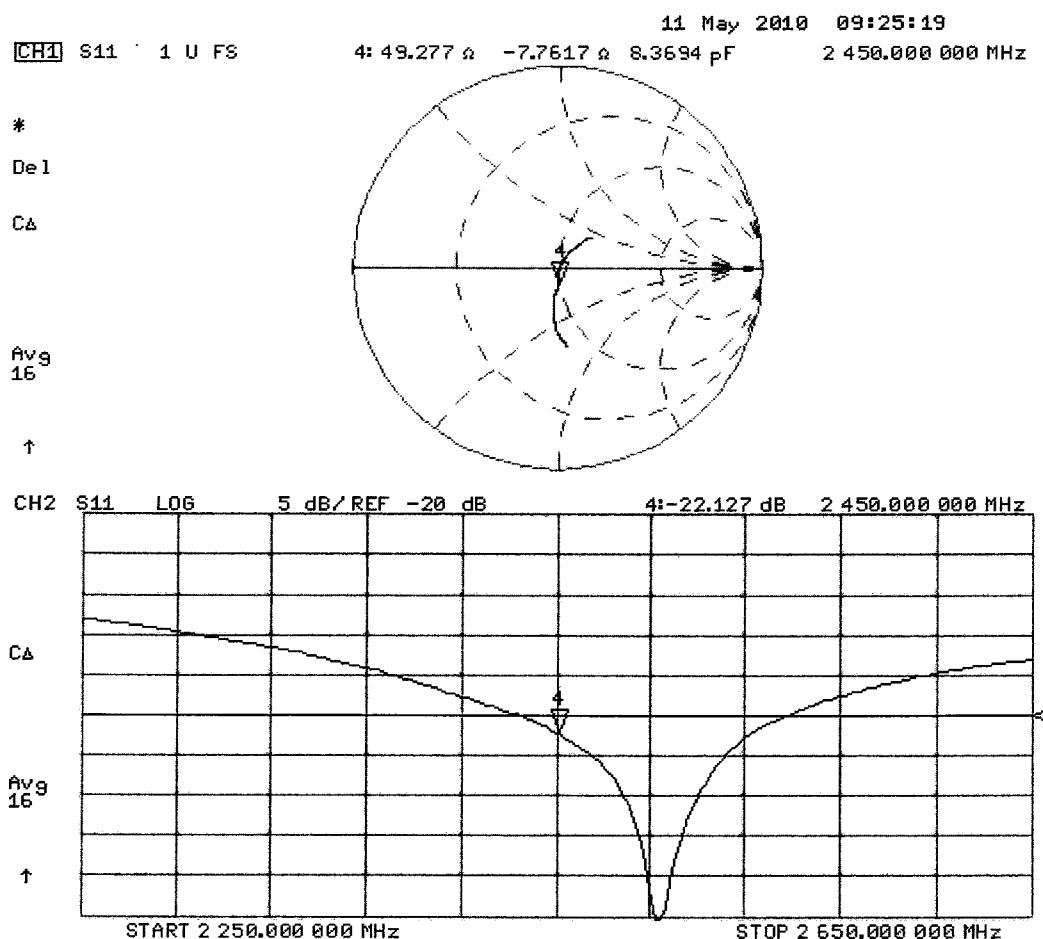
SAR(1 g) = 13.1 mW/g; SAR(10 g) = 6.11 mW/g

Maximum value of SAR (measured) = 17.1 mW/g



0 dB = 17.1mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 07.05.2010 12:21:14

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN:702

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

Medium: MSL U11 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 2.01$ mho/m; $\epsilon_r = 54.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 02.03.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

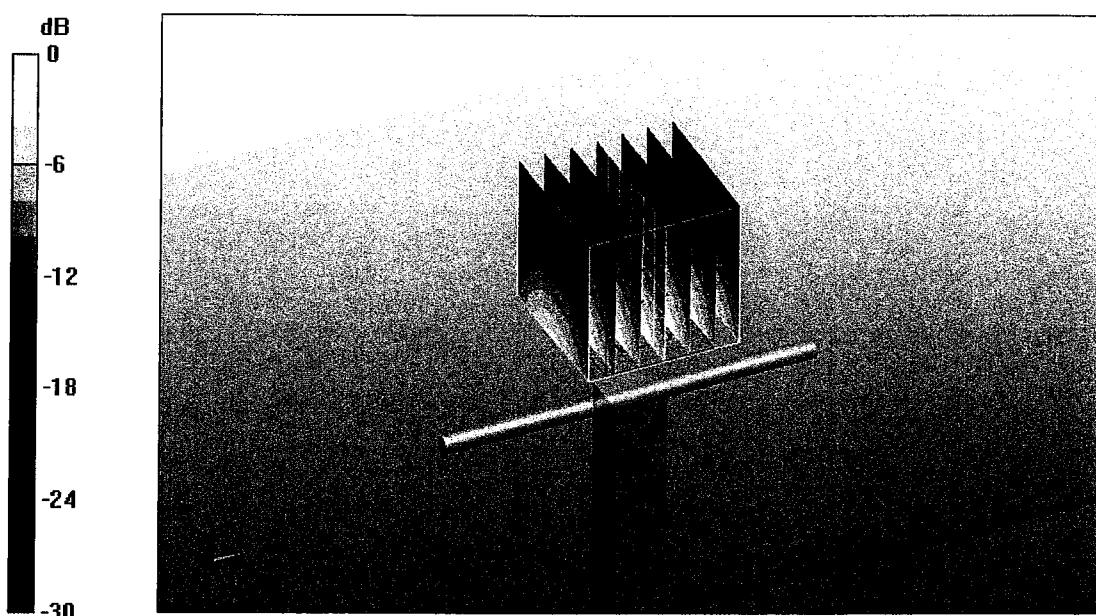
Pin250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.7 V/m; Power Drift = -0.000238 dB

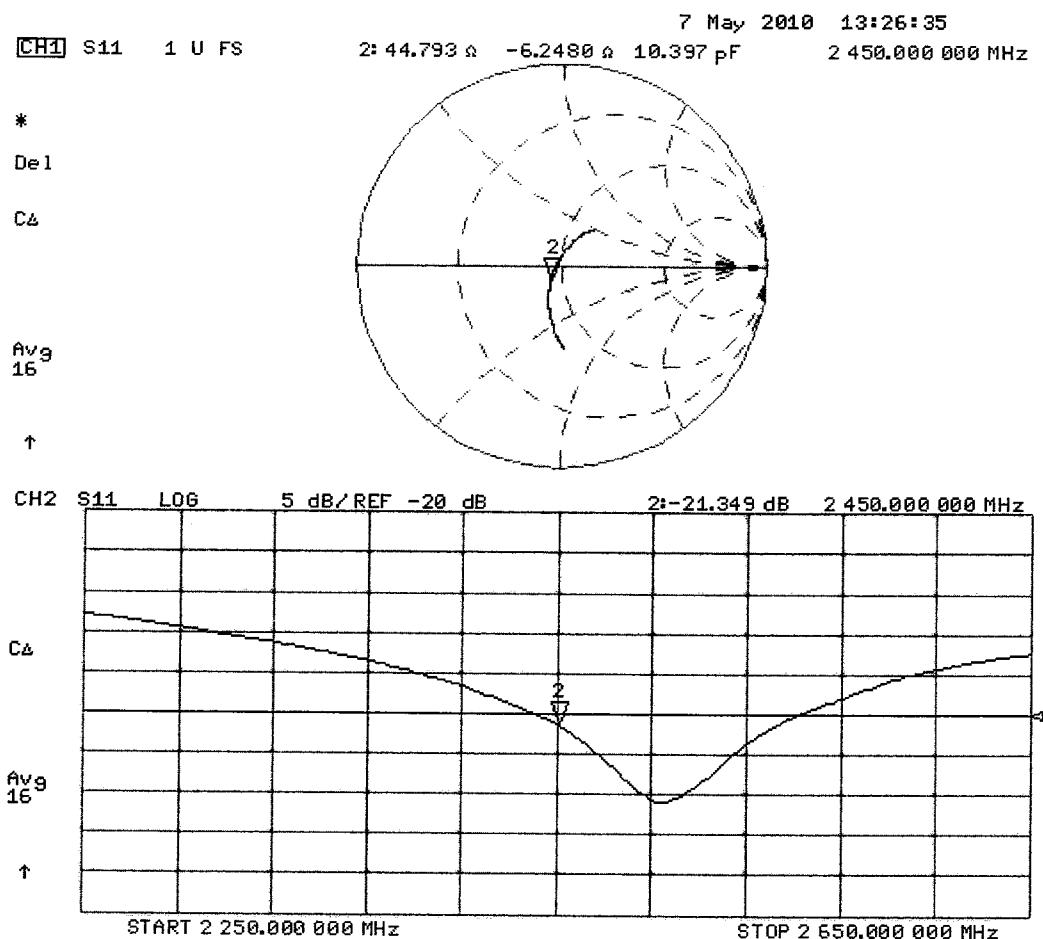
Peak SAR (extrapolated) = 28.4 W/kg

SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.38 mW/g

Maximum value of SAR (measured) = 18.2 mW/g



Impedance Measurement Plot for Body TSL



Appendix 2. Measurement Methods

A.2.1. Evaluation Procedure

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

- a) (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices worn about the ear during normal operation, both the left and right ear positions were evaluated at the centre frequency of the band at maximum power. The side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by the test specification identified in section 3.1 of this report.
(ii) For body worn devices or devices which can be operated within 20 cm of the body, the flat section of the SAM phantom was used were the size of the device(s) is normal. for bigger devices and base station the 2mm Oval phantom is used for evaluation. The type of device being evaluated dictated the distance of the EUT to the outer surface of the phantom flat section.
- b) The SAR was determined by a pre-defined procedure within the DASY4 software. The exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm or appropriate resolution.
- c) A 7x7x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d) If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

A.2.2. Specific Absorption Rate (SAR) Measurements to OET Bulletin 65 Supplement C: (2001-01)

Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields

SAR measurements were performed in accordance with Appendix D of the standard FCC OET Bulletin 65 Supplement C: 2001, IEEE 1528 and FCC KDB procedures, against appropriate limits for each measurement position in accordance with the standard. In some cases the FCC was contacted using a PBA or KDB process to ensure test is performed correctly.

The test was performed in a shielded enclosure with the temperature controlled to remain between +18.0°C and +25.0°C. The tissue equivalent material fluid temperature was controlled to give a maximum variation of $\pm 2.0^{\circ}\text{C}$

Prior to any SAR measurements on the EUT, system validation and material dielectric property measurements were conducted. In the absence of a detailed procedure within the specification, system validation and material dielectric property measurements were performed in accordance with Appendix C and Appendix D of FCC OET Bulletin 65 Supplement C: 2001 and FCC KDB publication 450824.

Following the successful system validation and material dielectric property measurements, a SAR versus time sweep shall be performed within 10 mm of the phantom inner surface. If the EUT power output is stable after three minutes then the measurement probe will perform a coarse surface level scan at each test position in order to ascertain the location of the maximum local SAR level. Once this area had been established, a 7x7x7 cube of 343 points (5 mm spacing in each axis $\approx 27\text{g}$) will be centred at the area of concern. Extrapolation and interpolation will then be carried out on the 27g of tissue and the highest averaged SAR over a 10g cube determined.

Once the maximum interpolated SAR measurement is complete; the coarse scan is visually assessed to check for secondary peaks within 50% of the maximum SAR level. If there are any further SAR measurements required, extra 7x7x7 cubes shall be centred on each of these extra local SAR maxima.

At the end of each position test case a second time sweep shall be performed to check whether the EUT has remained stable throughout the test.

Appendix 3. SAR Distribution Scans

This appendix contains SAR distribution scans which are included in the total number of pages for this report.

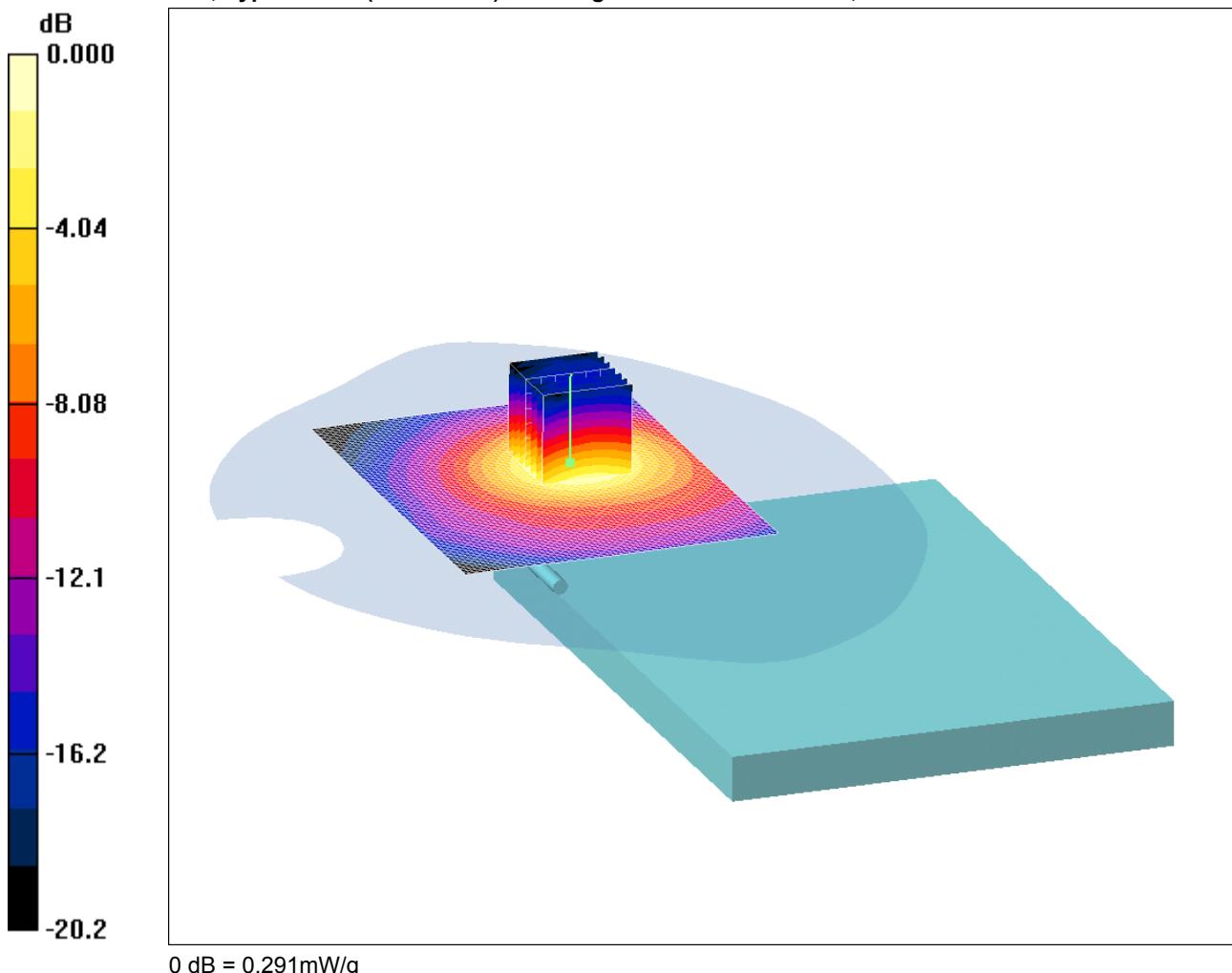
Scan Reference Number	Title
SCN/80583JD01/001	Horizontal Up Facing Phantom WiFi 802.11b CH6 1Mbps
SCN/80583JD01/002	Horizontal Down Facing Phantom WiFi 802.11b CH6 1Mbps
SCN/80583JD01/003	Vertical Up Facing Phantom WiFi 802.11b CH6 1Mbps
SCN/80583JD01/004	Vertical Down Facing Phantom WiFi 802.11b CH6 1Mbps
SCN/80583JD01/005	System Performance Check 2450MHz Body 03 02 11
SCN/80583JD01/006	System Performance Check 2450MHz Body 04 02 11*
SCN/80583JD01/007	System Performance Check 2450MHz Body 04 02 11*

*Note: Two different probes were used to carry on testing, since they were hired on short term loan.

SCN/80583JD01/001: Horizontal up Facing Phantom WiFi 802.11b CH6 1Mbps

Date: 03/02/2011

DUT: AR5BWB; Type: 0025A (TH1124100) 802.11bgn 1x1 With BT2.0+EDR; Serial: None Stated



Communication System: WLAN; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn394; Calibrated: 19/04/2010
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Horizontal-Up of EUT Facing Phantom - Middle/Area Scan (71x91x1): Measurement grid: dx=15mm, dy=15mm

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

Horizontal-Up of EUT Facing Phantom - Middle/Zoom Scan 7x7x7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.32 V/m; Power Drift = 0.026 dB

Peak SAR (extrapolated) = 0.483 W/kg

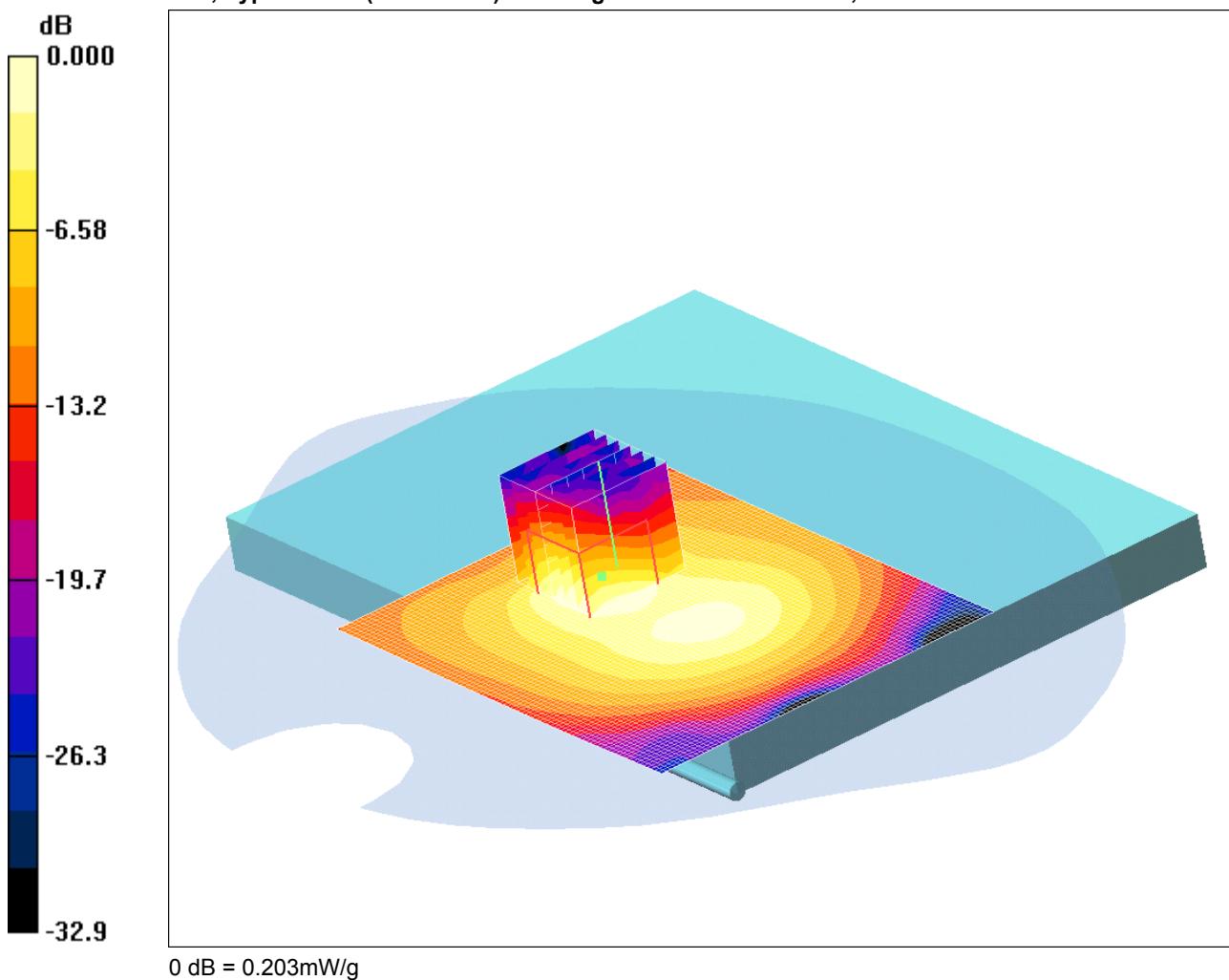
SAR(1 g) = 0.264 mW/g; SAR(10 g) = 0.143 mW/g

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

SCN/80583JD01/002: Horizontal-Down Facing Phantom WiFi 802.11b CH6 1Mbps

Date: 03/02/2011

DUT: AR5BWB; Type: 0025A (TH1124100) 802.11bgn 1x1 With BT2.0+EDR; Serial: None Stated



Communication System: WLAN; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn394; Calibrated: 19/04/2010

- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Horizontal-Down of EUT Facing Phantom - Middle/Area Scan (71x91x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.282 mW/g

Horizontal-Down of EUT Facing Phantom - Middle/Zoom Scan 7x7x7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.88 V/m; Power Drift = -0.441 dB

Peak SAR (extrapolated) = 0.659 W/kg

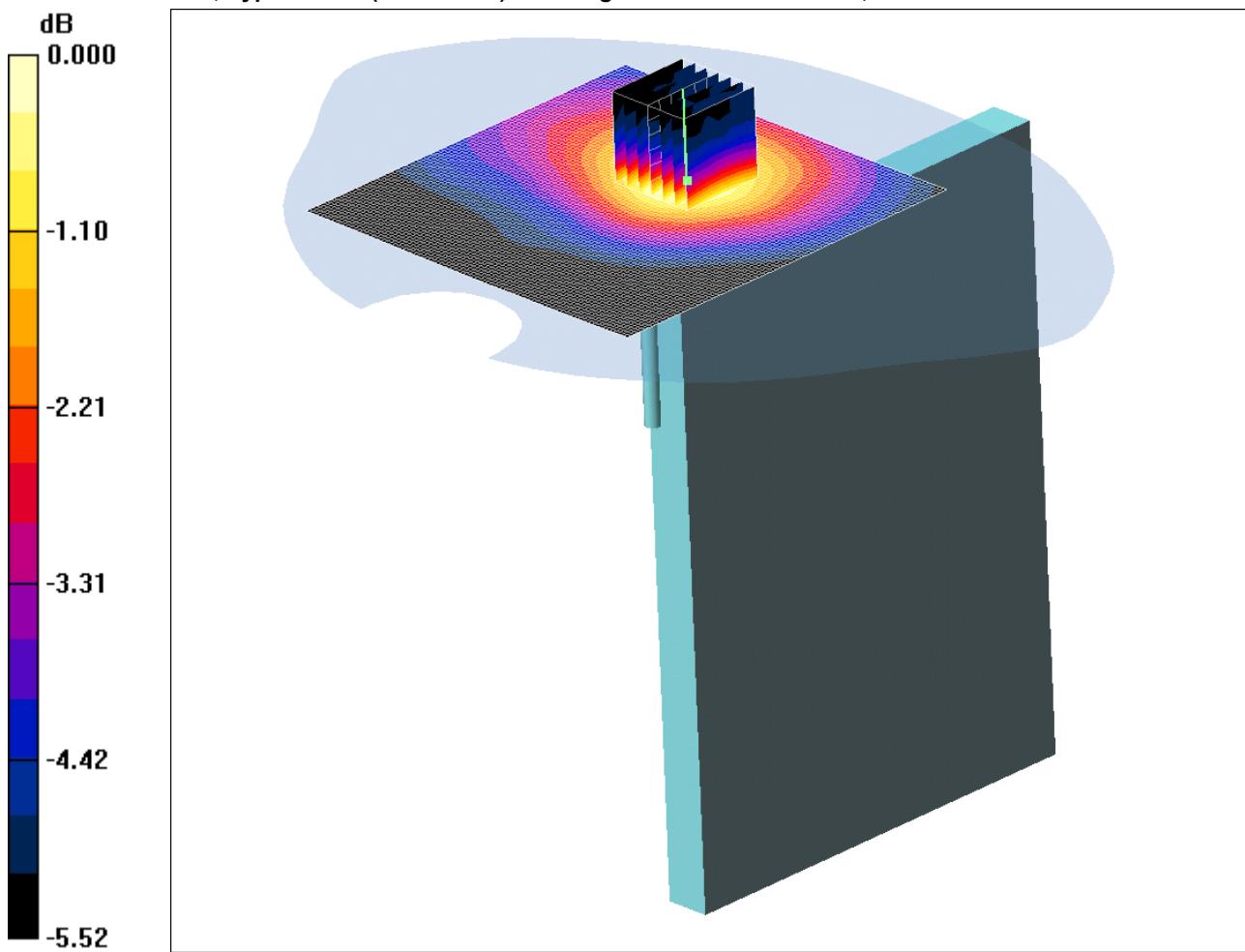
SAR(1 g) = 0.185 mW/g; SAR(10 g) = 0.088 mW/g

Maximum value of SAR (measured) = 0.203 mW/g

SCN/80583JD01/003: Vertical-Up Facing Phantom WiFi 802.11b CH6 1Mbps

Date: 04/02/2011

DUT: AR5BWB; Type: 0025A (TH1124100) 802.11bgn 1x1 With BT2.0+EDR; Serial: None Stated



Communication System: WLAN; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn394; Calibrated: 19/04/2010
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Vertical-Up of EUT Facing Phantom - Middle 2 2/Area Scan (91x91x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.083 mW/g

Vertical-Up of EUT Facing Phantom - Middle 2 2/Zoom Scan 7x7x7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.75 V/m; Power Drift = -0.135 dB

Peak SAR (extrapolated) = 0.128 W/kg

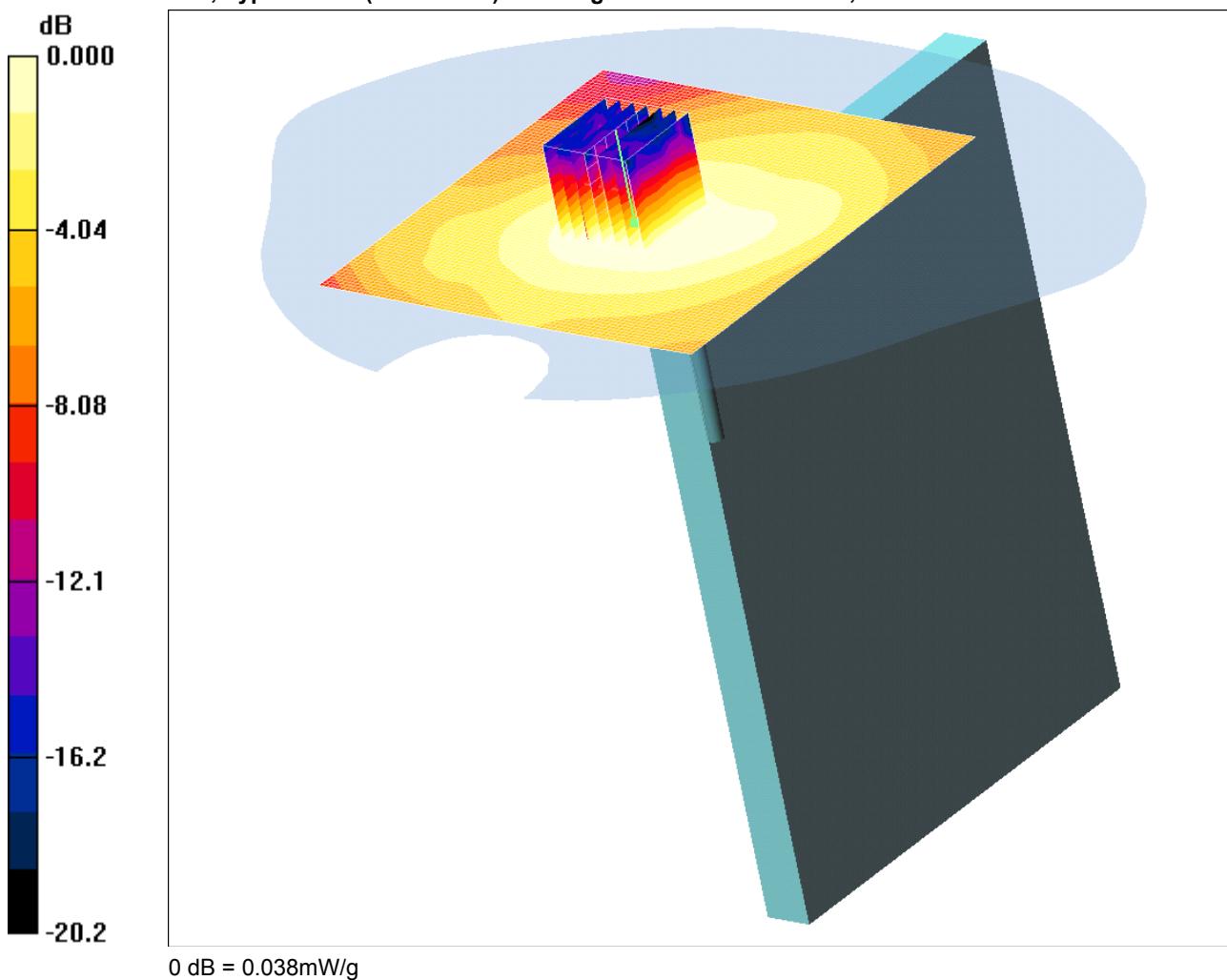
SAR(1 g) = 0.080 mW/g; SAR(10 g) = 0.056 mW/g

Maximum value of SAR (measured) = 0.083 mW/g

SCN/80583JD01/004: Vertical-Down Facing Phantom WiFi 802.11b CH6 1Mbps

Date: 04/02/2011

DUT: AR5BWB; Type: 0025A (TH1124100) 802.11bgn 1x1 With BT2.0+EDR; Serial: None Stated



Communication System: WLAN; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: 2450 MHz MSL Medium parameters used (interpolated): $f = 2437$ MHz; $\sigma = 1.99$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn394; Calibrated: 19/04/2010

- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

Vertical-Down of EUT Facing Phantom - Middle 2 2/Area Scan (91x91x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.038 mW/g

Vertical-Down of EUT Facing Phantom - Middle 2 2/Zoom Scan 7x7x7 (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 4.96 V/m; Power Drift = -0.321 dB

Peak SAR (extrapolated) = 0.064 W/kg

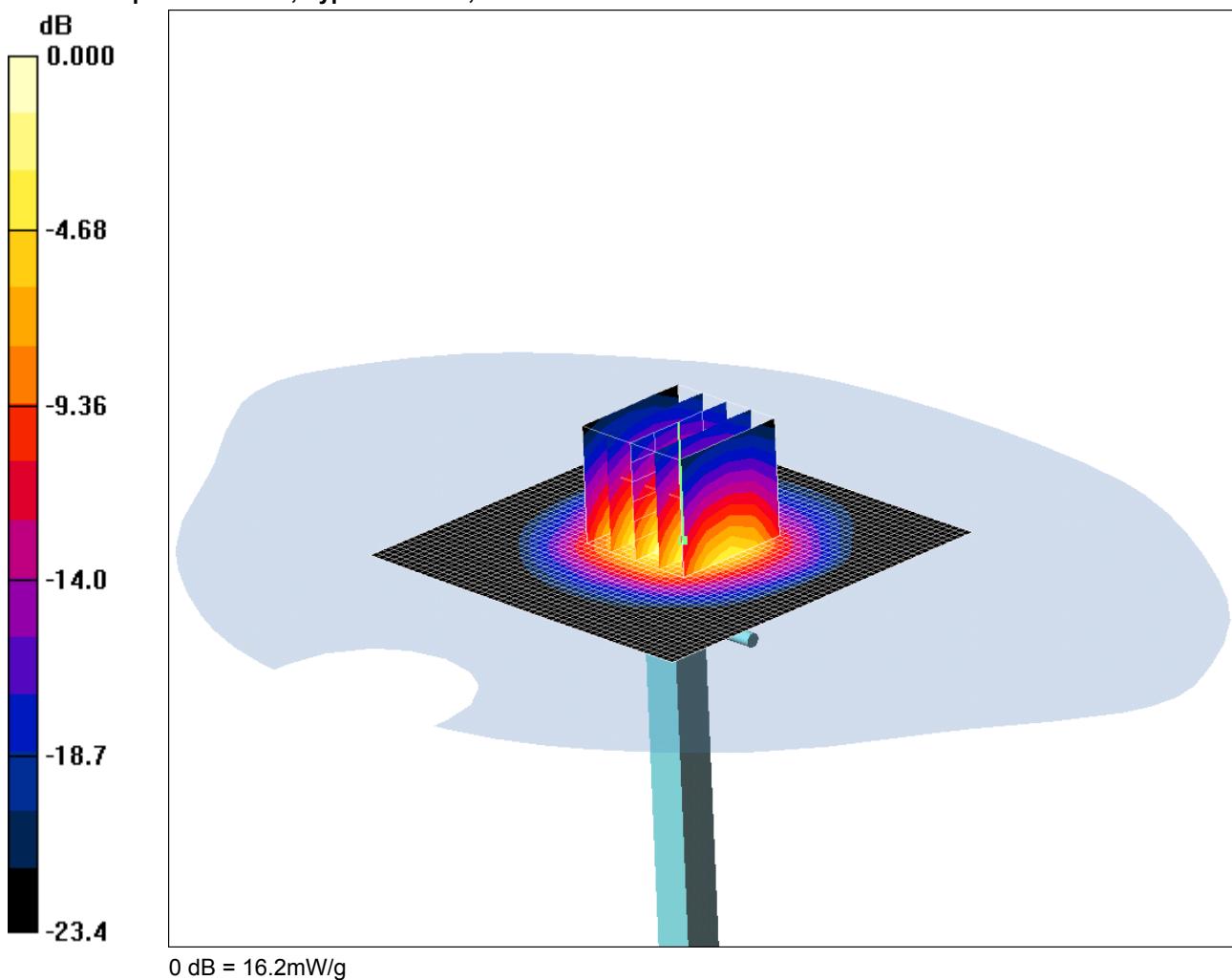
SAR(1 g) = 0.036 mW/g; SAR(10 g) = 0.021 mW/g

Maximum value of SAR (measured) = 0.038 mW/g

SCN/80583JD01/005: System Performance Check 2450MHz Body 03 02 11

Date: 02/02/2011

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN: 702



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

Medium: 2450 MHz MSL Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn394; Calibrated: 19/04/2010

- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

d=10mm, Pin=250mW 1 2/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR (interpolated) = 19.5 mW/g

d=10mm, Pin=250mW 1 2/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 83.5 V/m; Power Drift = 0.315 dB

Peak SAR (extrapolated) = 30.2 W/kg

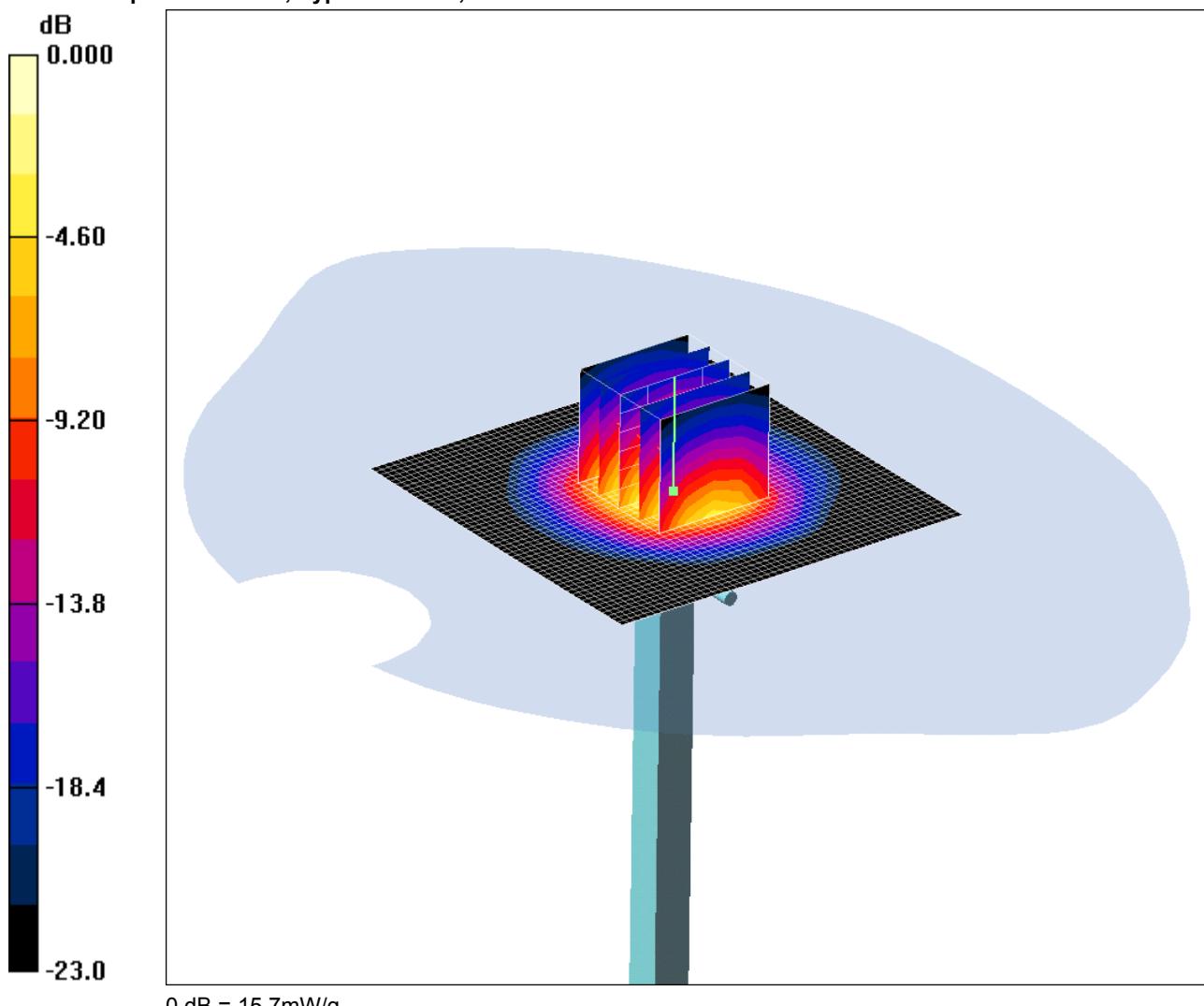
SAR(1 g) = 14.2 mW/g; SAR(10 g) = 6.35 mW/g

Maximum value of SAR (measured) = 16.2 mW/g

SCN/80583JD01/006: System Performance Check 2450MHz Body 04 02 11

Date 04/02/2011

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN: 702



0 dB = 15.7mW/g

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

Medium: 2450 MHz MSL Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3508 (Add. ConvF); ConvF(8.19, 8.19, 8.19); Calibrated: 15/07/2010

- Sensor-Surface: 4mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn394; Calibrated: 19/04/2010

- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193

- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176

d=10mm, Pin=250mW 1 2 2/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm

Maximum value of SAR (interpolated) = 20.2 mW/g

d=10mm, Pin=250mW 1 2 2/Zoom Scan (5x5x7) (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 87.1 V/m; Power Drift = -0.052 dB

Peak SAR (extrapolated) = 29.2 W/kg

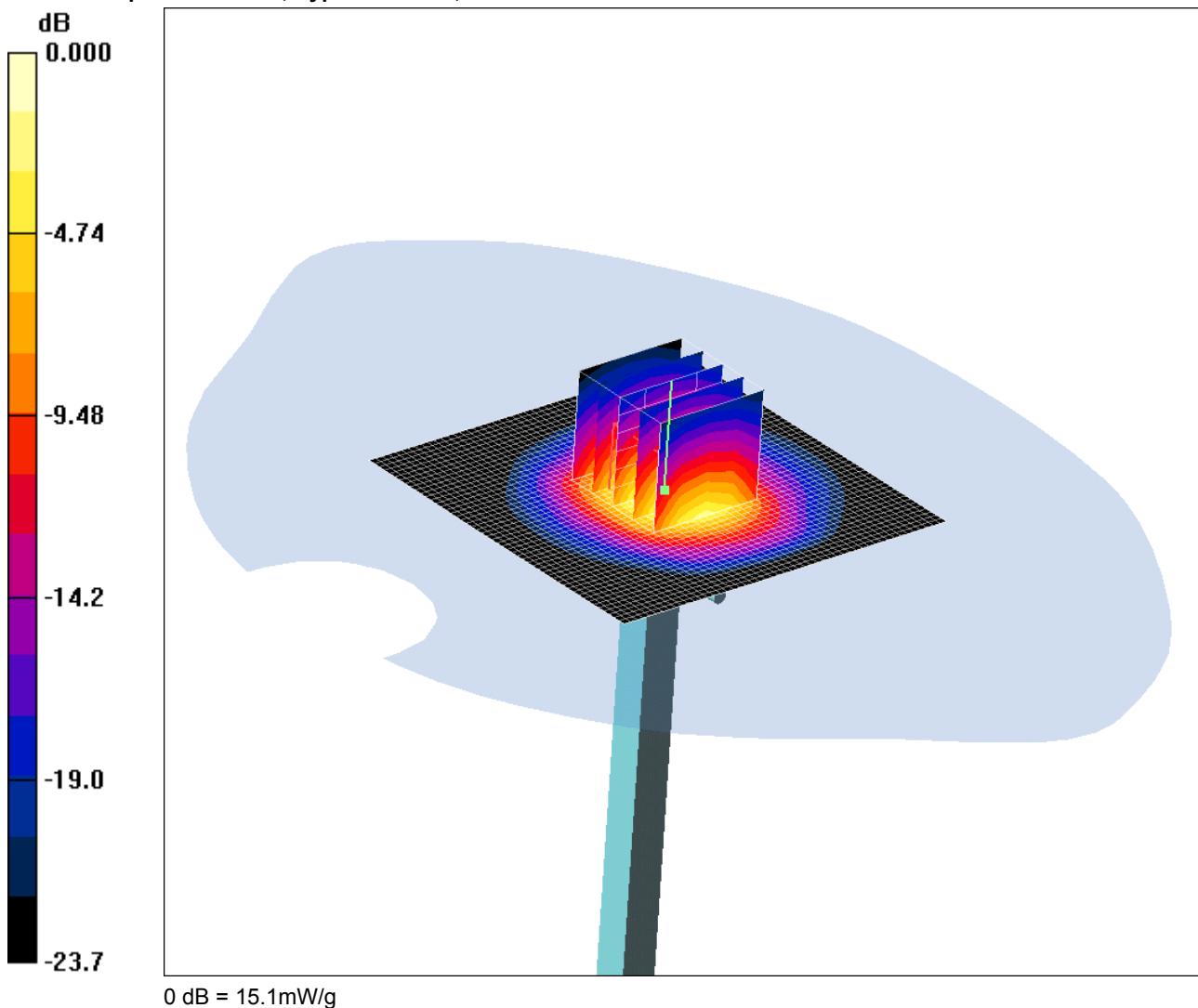
SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.21 mW/g

Maximum value of SAR (measured) = 15.7 mW/g

SCN/80583JD01/007: System Performance Check 2450MHz Body 04 02 11

Date 04/02/2011

DUT: Dipole 2440 MHz; Type: D2440V2; Serial: D2440V2 - SN: 702



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

Medium: 2450 MHz MSL Medium parameters used: $f = 2450$ MHz; $\sigma = 2$ mho/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY4 Configuration:

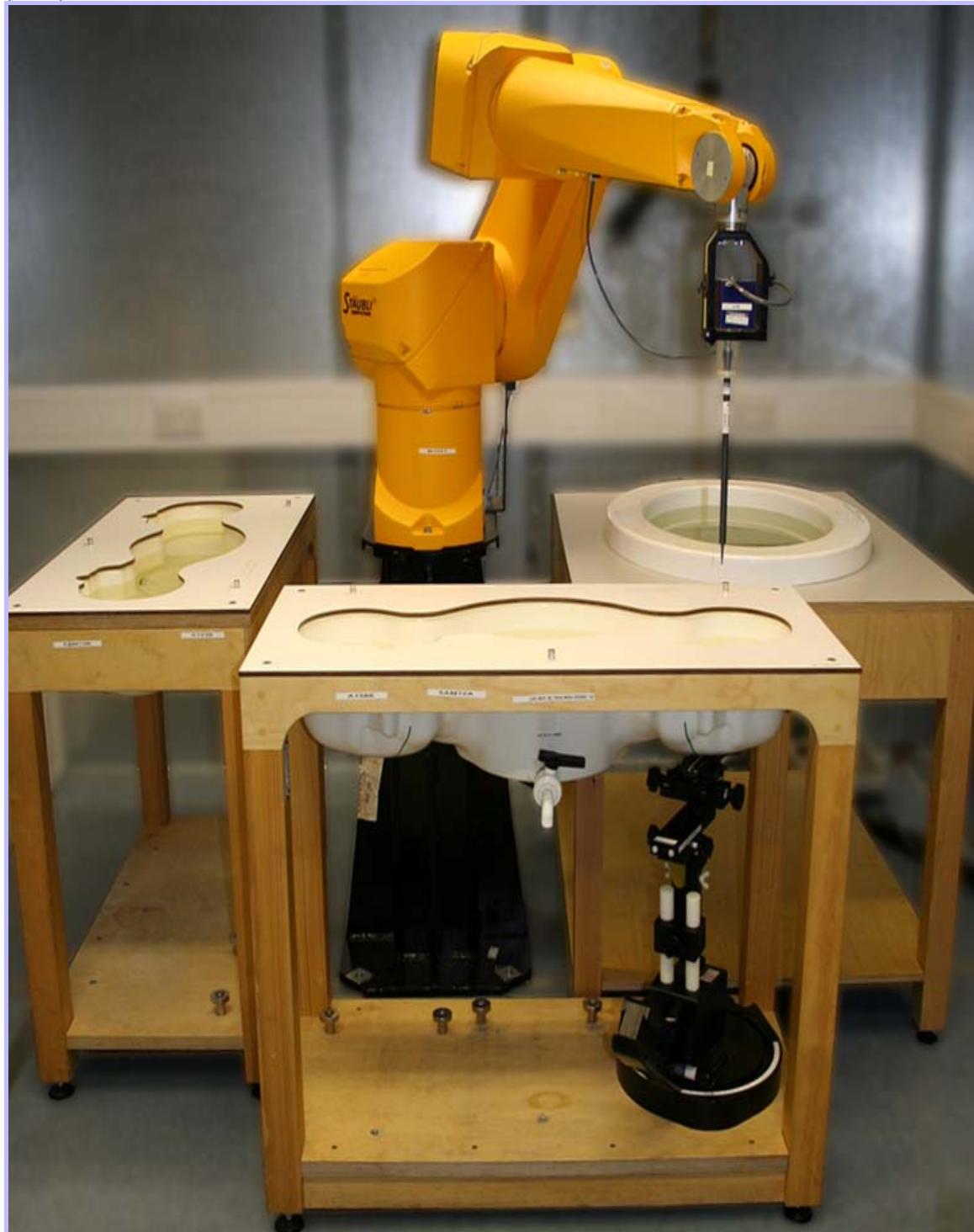
- Probe: ET3DV6 - SN1583; ConvF(4.23, 4.23, 4.23); Calibrated: 16/11/2010
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn394; Calibrated: 19/04/2010
- Phantom: SAM 12a; Type: SAM 4.0; Serial: TP:1193
- Measurement SW: DASY4, V4.7 Build 55; Postprocessing SW: SEMCAD, V1.8 Build 176
- d=10mm, Pin=250mW /Area Scan (51x51x1):** Measurement grid: dx=20mm, dy=20mm
- Maximum value of SAR (interpolated) = 19.6 mW/g
- d=10mm, Pin=250mW /Zoom Scan (5x5x7) (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
- Reference Value = 92.1 V/m; Power Drift = -0.158 dB
- Peak SAR (extrapolated) = 30.5 W/kg
- SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.12 mW/g**
- Maximum value of SAR (measured) = 15.1 mW/g

Appendix 4. Photographs

This appendix contains the following photographs:

Photo Reference Number	Title
PHT/80583JD01/001	Test configuration for the measurement of Specific Absorption Rate (SAR)
PHT/80583JD01/002	Horizontal-Up Facing Phantom
PHT/80583JD01/003	Horizontal-Down Facing Phantom
PHT/80583JD01/004	Vertical-Up Facing Phantom
PHT/80583JD01/005	Vertical-Down Facing Phantom
PHT/80583JD01/006	General Setup EUT in Horizontal-Up Facing Phantom
PHT/80583JD01/007	WLAN Card Plug in Laptop View
PHT/80583JD01/008	WLAN Card View
PHT/80583JD01/009	2450 MHz Body Fluid Level

PHT/80583JD01/001: Test configuration for the measurement of Specific Absorption Rate (SAR)



PHT/80583JD01/002: Horizontal-Up Facing Phantom



PHT/80583JD01/003: Horizontal-Down Facing Phantom



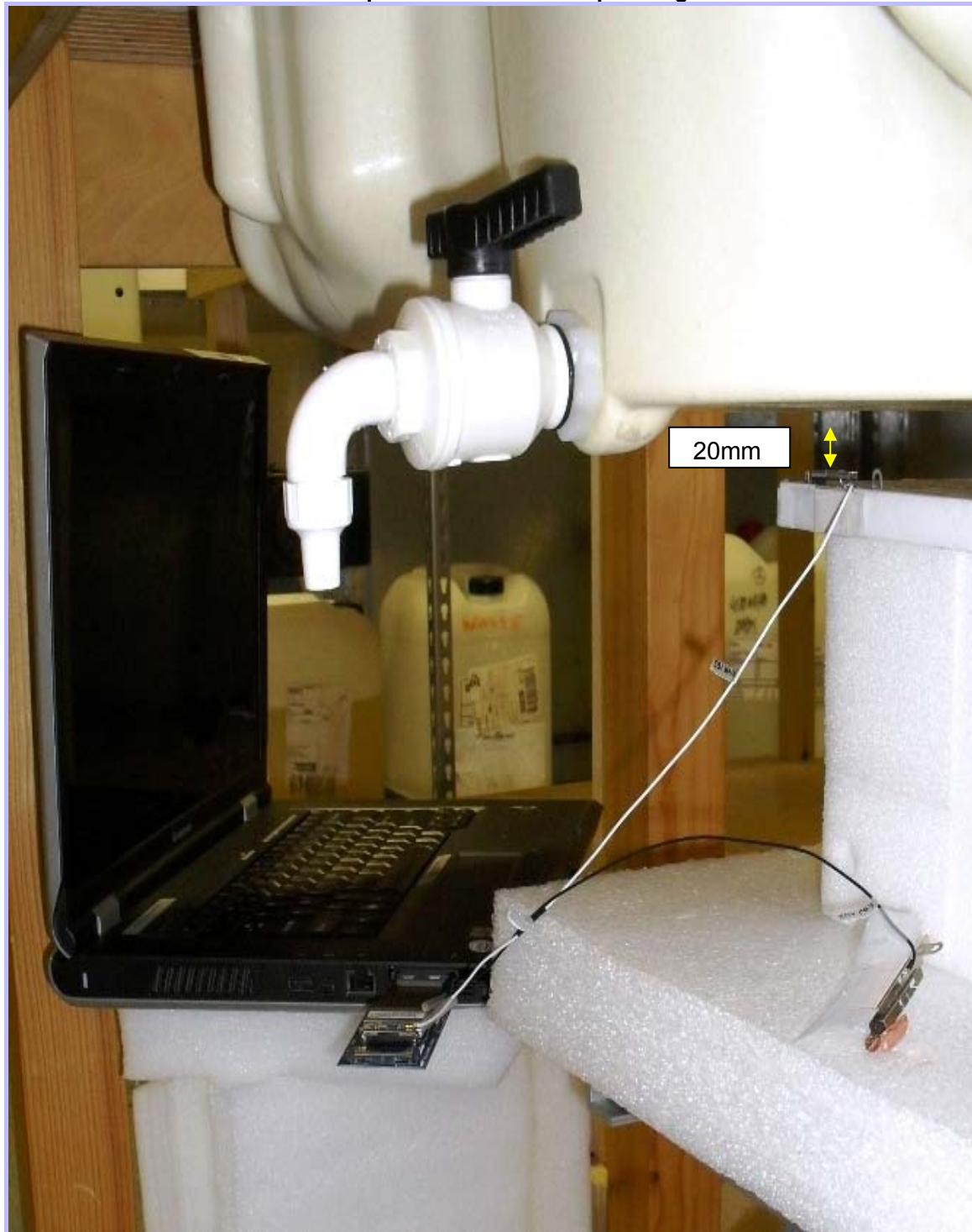
PHT/80583JD01/004: Vertical-Up Facing Phantom



PHT/80583JD01/005: Vertical-Down Facing Phantom



PHT/80583JD01/006: General Setup EUT in Horizontal-Up Facing Phantom



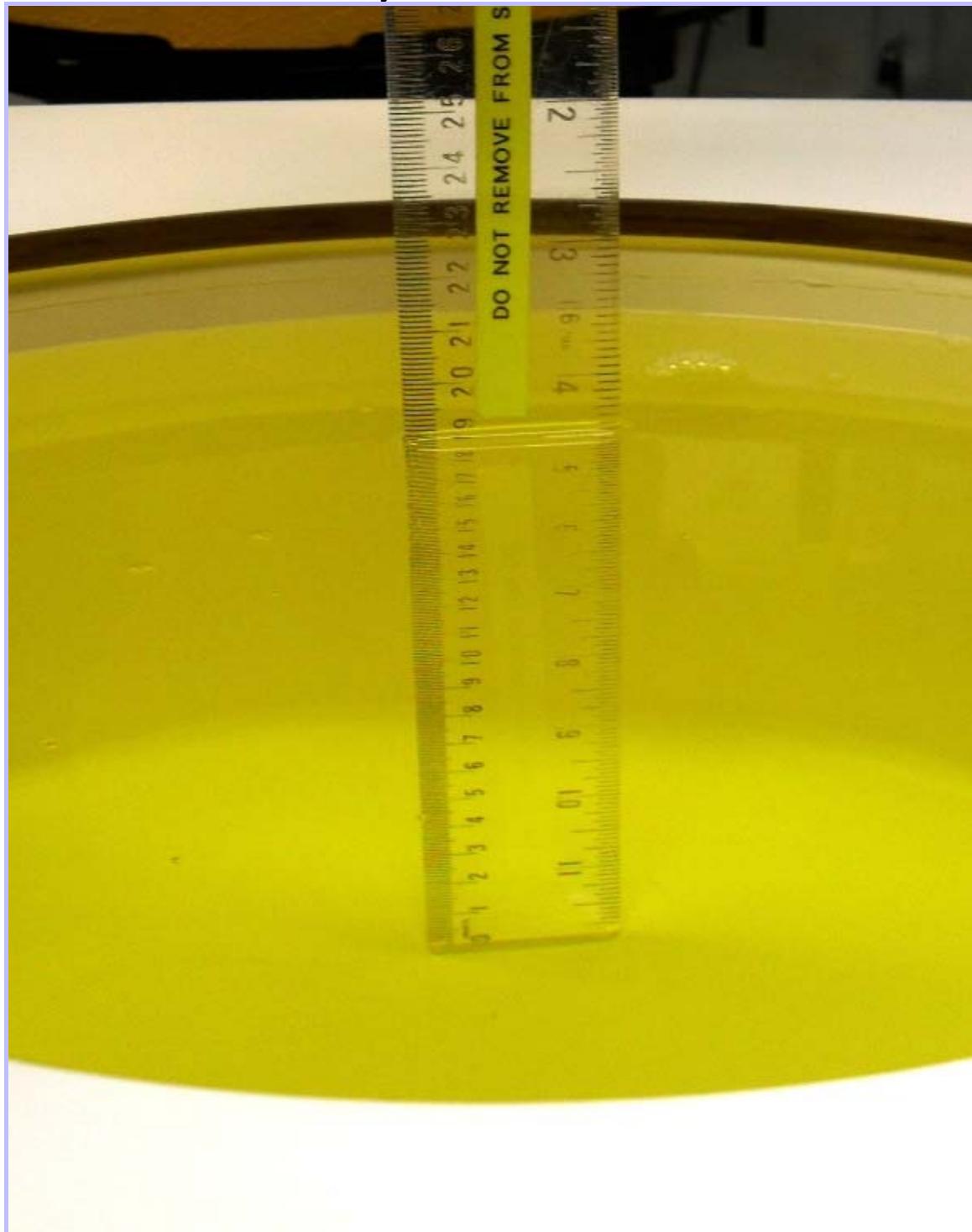
PHT/80583JD01/007: WLAN Card Plug in Laptop View



PHT/80583JD01/008: WLAN Card View



PHT/80583JD01/009: 2450 MHz Body Fluid Level



Appendix 5. Validation of System

Prior to the assessment, the system was verified in the flat region of the phantom. A 2450 MHz dipole was used. A forward power of 250 mW was applied to the dipole and the system was verified to a tolerance of $\pm 5\%$ for the 2450 MHz dipole. The applicable verification (normalised to 1 Watt).

Date: 03/02/2011

Validation Dipole and Serial Number: D2440V2; SN: 702

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 °C	22.1 °C	ϵ_r	52.70	52.39	-0.60	5.00
				σ	1.95	2.00	2.63	5.00
				1g SAR	54.30	56.80	4.60	5.00
				10g SAR	25.50	25.40	-0.39	5.00

Date: 04/02/2011

Validation Dipole and Serial Number: D2440V2; SN: 702 (Probe SN: 3508)

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 °C	22.8 °C	ϵ_r	52.70	52.39	-0.60	5.00
				σ	1.95	2.00	2.63	5.00
				1g SAR	54.30	55.20	1.66	5.00
				10g SAR	25.50	24.84	-2.59	5.00

Date: 04/02/2011

Validation Dipole and Serial Number: D2440V2; SN: 702 (Probe SN: 1583)

Simulant	Frequency (MHz)	Room Temp	Liquid Temp	Parameters	Target Value	Measured Value	Deviation (%)	Limit (%)
Body	2450	24.0 °C	22.8 °C	ϵ_r	52.70	52.39	-0.60	5.00
				σ	1.95	2.00	2.63	5.00
				1g SAR	54.30	54.40	0.18	5.00
				10g SAR	25.50	24.48	-4.00	5.00

Appendix 6. Simulated Tissues

The body mixture consists of Polysorbate 20, Water and salt. Visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

Ingredient	Frequency
	2450 MHz Body
De-Ionized Water	71.70
Polysorbate 20 (Tween 20)	28.00
Salt	0.30

Appendix 7. DASY4 System Details

A.7.1. DASY4 SAR Measurement System

RFI Global Services Ltd, SAR measurement facility utilises the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY4 system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the SAM phantom containing brain or muscle equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller; teach pendant (Joystick), and remote control. This is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. The data acquisition electronics (DAE) performs signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection etc. The DAE 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. The DAE3 utilises 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.

A.7.2. DASY4 SAR System Specifications

Robot System	
Positioner:	Stäubli Unimation Corp. Robot Model: RX90L
Repeatability:	0.025 mm
No. of Axis:	6
Serial Number:	F00/SD89A1/A/01
Reach:	1185 mm
Payload:	3.5 kg
Control Unit:	CS7
Programming Language:	V+
Data Acquisition Electronic (DAE) System	
Serial Number:	DAE3 SN:394
PC Controller	
PC:	Dell Precision 340
Operating System:	Windows 2000
Data Card:	DASY4 Measurement Server
Serial Number:	1080
Data Converter	
Features:	Signal Amplifier, multiplexer, A/D converted and control logic.
Software:	DASY4 Software
Connecting Lines:	Optical downlink for data and status info. Optical uplink for commands and clock.
PC Interface Card	
Function:	24 bit (64 MHz) DSP for real time processing Link to DAE3 16 bit A/D converter for surface detection system serial link to robot direct emergency stop output for robot.

DASY4 SAR System Specifications (Continued)

E-Filed Probe

Model:	EX3DV3
Serial No:	3508
Construction:	Triangular core
Frequency:	10 MHz to >6 GHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	330
Probe Diameter (mm):	12
Tip Length (mm):	20
Tip Diameter (mm):	2.5
Sensor X Offset (mm):	1
Sensor Y Offset (mm):	1
Sensor Z Offset (mm):	1

E-Filed Probe

Model:	ET3DV6
Serial No:	1583
Construction:	Triangular core
Frequency:	10 MHz to >6 GHz
Linearity:	± 0.2 dB (30 MHz to 6 GHz)
Probe Length (mm):	337
Probe Diameter (mm):	10
Tip Length (mm):	10
Tip Diameter (mm):	6.8
Sensor X Offset (mm):	2.7
Sensor Y Offset (mm):	2.7
Sensor Z Offset (mm):	2.7

Phantom

Phantom:	SAM Phantom
Shell Material:	Fibreglass
Thickness:	2.0 ± 0.1 mm