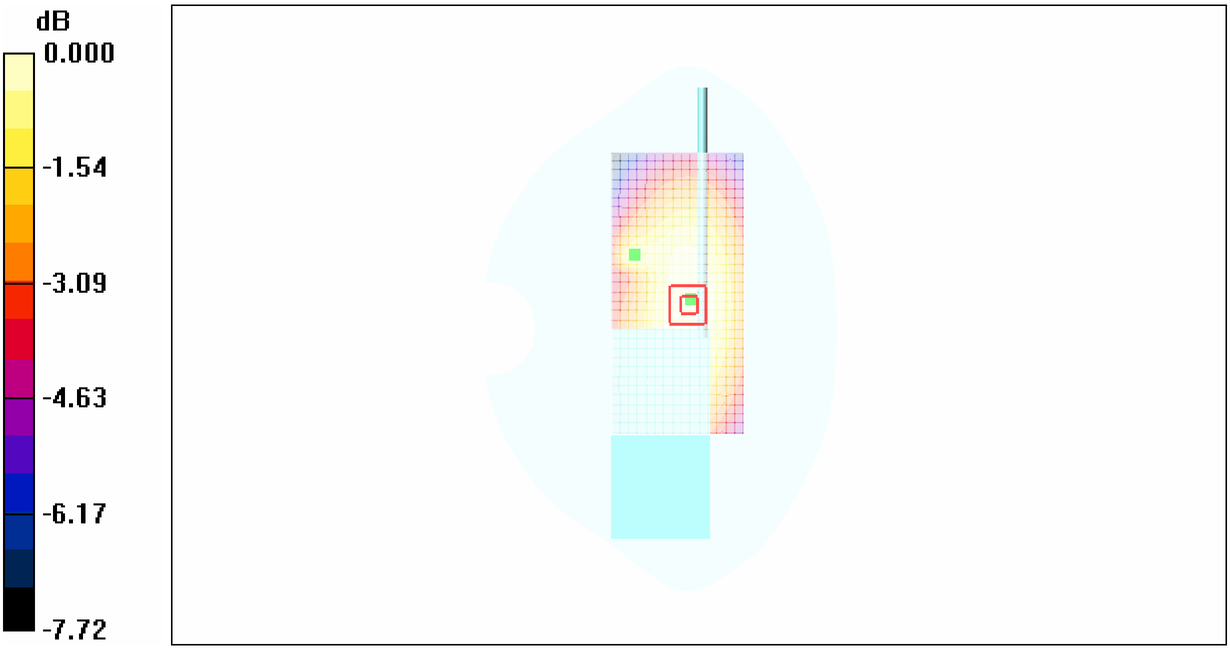
Mode 1 with Ni-mh Battery, Middle Frequency

Date/Time: 2006-10-27 14:02:30
Electronics: DAE3 Sn536
Medium: 450 MHZ Head
Medium parameters used: f = 450 MHz; σ = 0.84 mho/m; ε_r = 45.6; ρ = 1000 kg/m^3
Ambient Temperature:22.9°C Liqiud Temperature: 22.1°C
Communication System: Handy Transceiver Frequency: 455.012 MHz Duty Cycle: 1:1
Probe: ET3DV6 - SN1600 ConvF(7.95, 7.95, 7.95)

Middle Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 2.68 mW/g

Middle Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 52.9 V/m; Power Drift = -0.148 dB
Peak SAR (extrapolated) = 3.65 W/kg
SAR(1 g) = 2.52 mW/g; SAR(10 g) = 1.85 mW/g
Maximum value of SAR (measured) = 2.64 mW/g



0 dB = 2.64mW/g

Fig. 9 Mode 1 with Ni-mh Battery, Channel 2

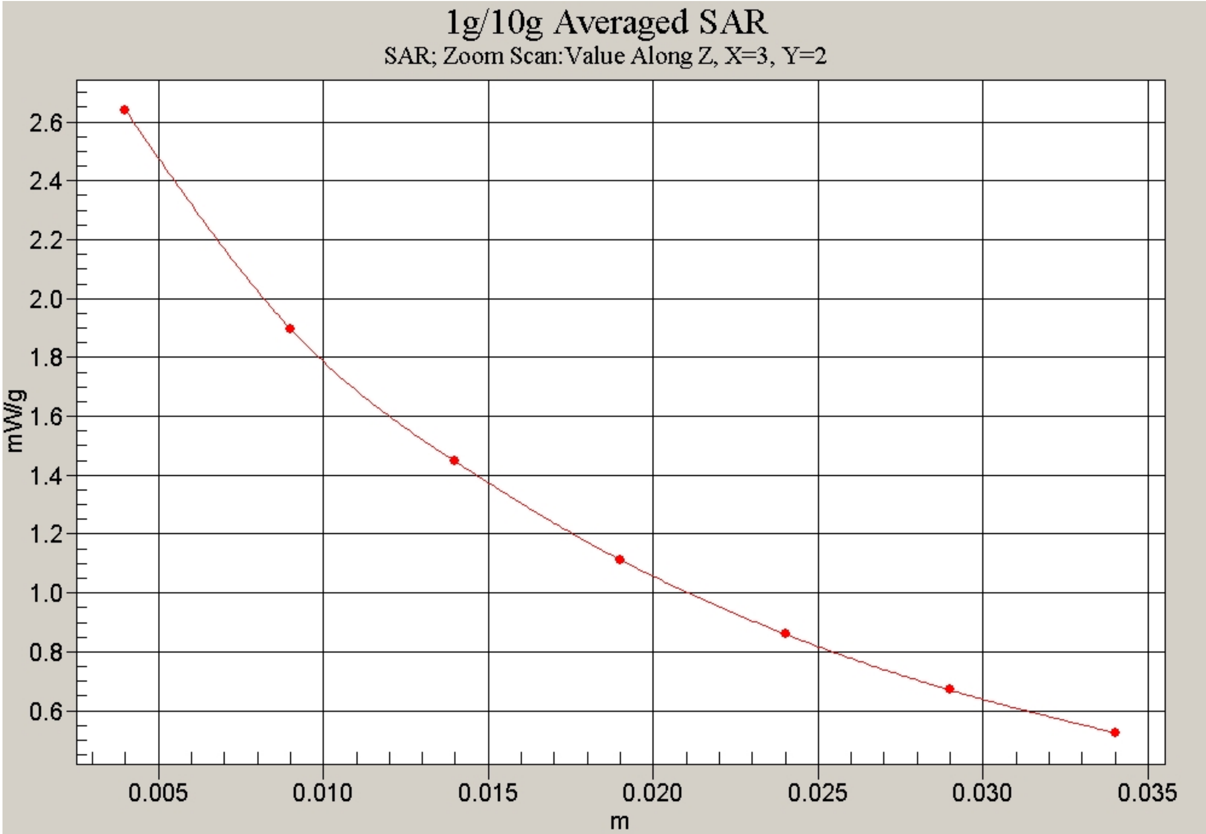


Fig. 10 Z-Scan at power reference point (Mode 1 with Ni-mh Battery, Channel 2)

Mode 1 with Ni-mh Battery, Low Frequency

Date/Time: 2006-10-27 13:36:23

Electronics: DAE3 Sn536

Medium: 450 MHZ Head

Medium parameters used: f = 450 MHz; $\sigma = 0.84$ mho/m; $\varepsilon_r = 45.6$; $\rho = 1000$ kg/m^3

Ambient Temperature:22.9°C Liqiud Temperature: 22.1°C

Communication System: Handy Transceiver Frequency: 440.012 MHz Duty Cycle: 1:1

Probe: ET3DV6 - SN1600 ConvF(7.95, 7.95, 7.95)

Low Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.53 mW/g

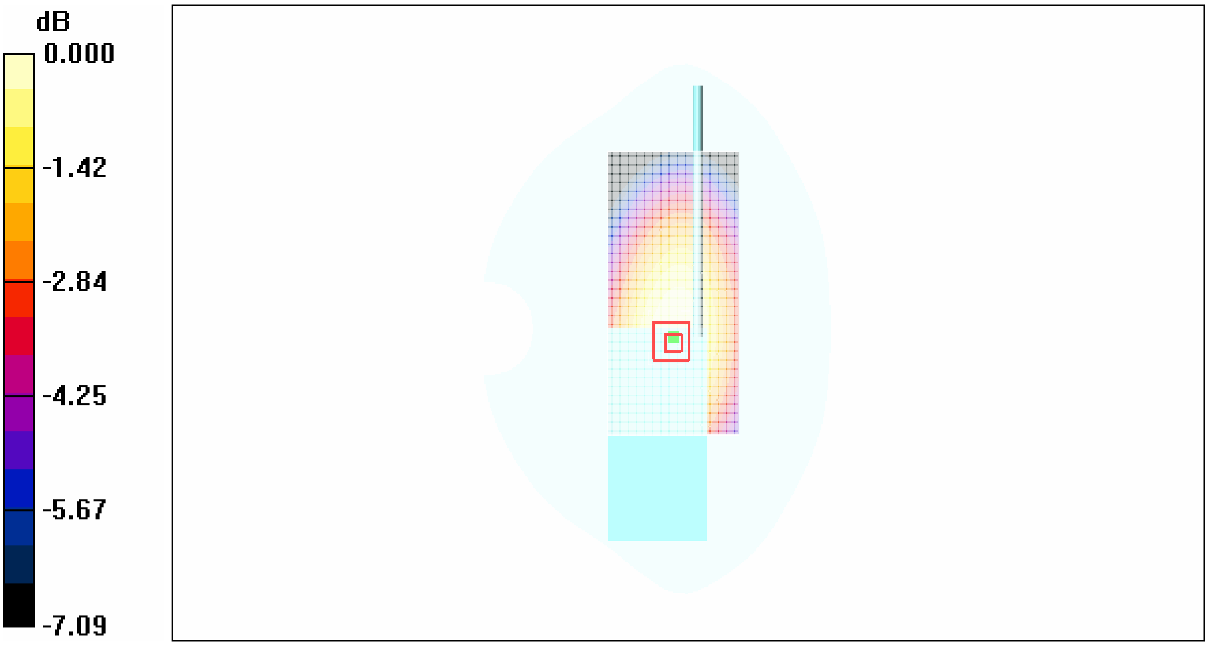
Low Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 54.9 V/m; Power Drift = -0.182dB

Peak SAR (extrapolated) = 3.43 W/kg

SAR(1 g) = 2.42 mW/g; SAR(10 g) = 1.81 mW/g

Maximum value of SAR (measured) = 2.51 mW/g



0 dB = 2.51mW/g

Fig. 11 Mode 1 with Ni-mh Battery, Channel 1

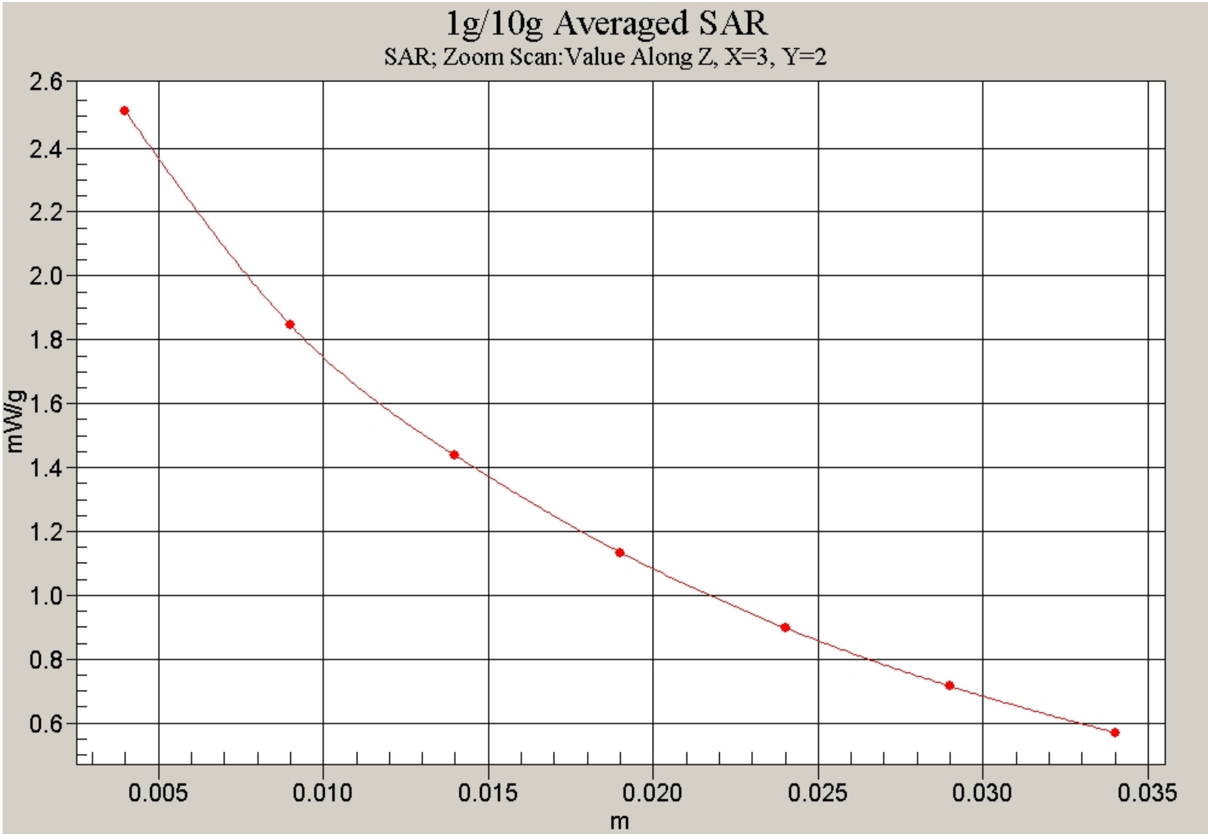


Fig. 12 Z-Scan at power reference point (Mode 1 with Ni-mh Battery, Channel 1)

Mode 2 with Li-ion Battery, High Frequency

Date/Time: 2006-10-27 16:57:43

Electronics: DAE3 Sn536

Medium: 450 MHz Body

Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3

Ambient Temperature:23.0°C Liqiud Temperature: 22.5°C

Communication System: Handy Transceiver Frequency: 469.913 MHz Duty Cycle: 1:1

Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

High Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 4.83 mW/g

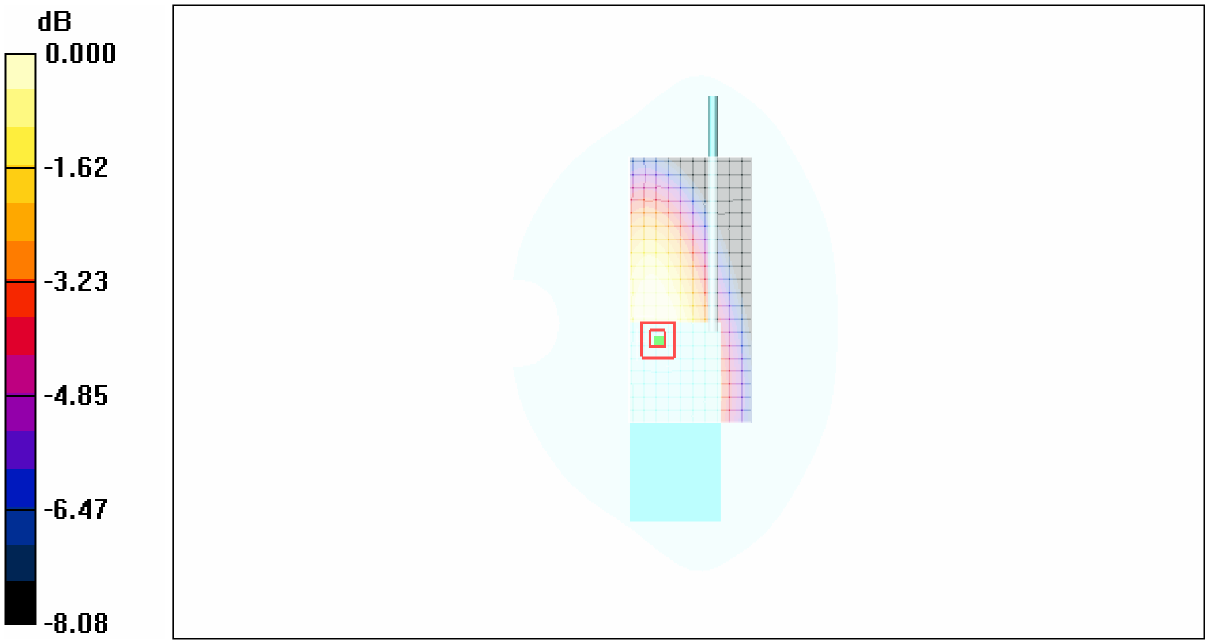
High Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 68.4 V/m; Power Drift = -0.166dB

Peak SAR (extrapolated) = 6.46 W/kg

SAR(1 g) = 4.36 mW/g; SAR(10 g) = 3.14 mW/g

Maximum value of SAR (measured) = 4.57 mW/g



0 dB = 4.57mW/g

Fig.13 Mode 2 with Li-ion Battery, Channel 3

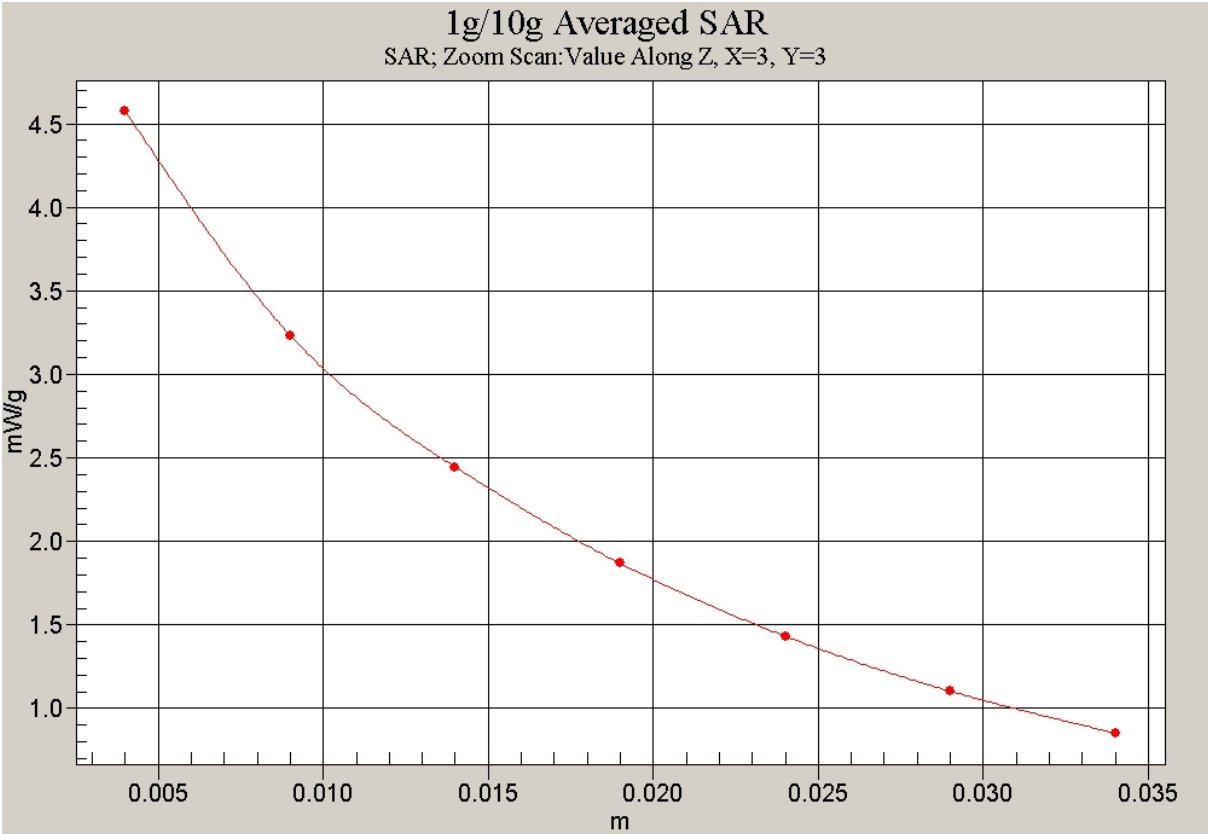


Fig. 14 Z-Scan at power reference point (Mode 2 with Li-ion Battery, Channel 3)

Mode 2 with Li-ion Battery, Middle Frequency

Date/Time: 2006-10-27 18:02:34

Electronics: DAE3 Sn536

Medium: 450 MHz Body

Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3

Ambient Temperature:23.0^{o}C Liqiud Temperature: 22.5^{o}C

Communication System: Handy Transceiver Frequency: 455.012 MHz Duty Cycle: 1:1

Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

Middle Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 4.83 mW/g

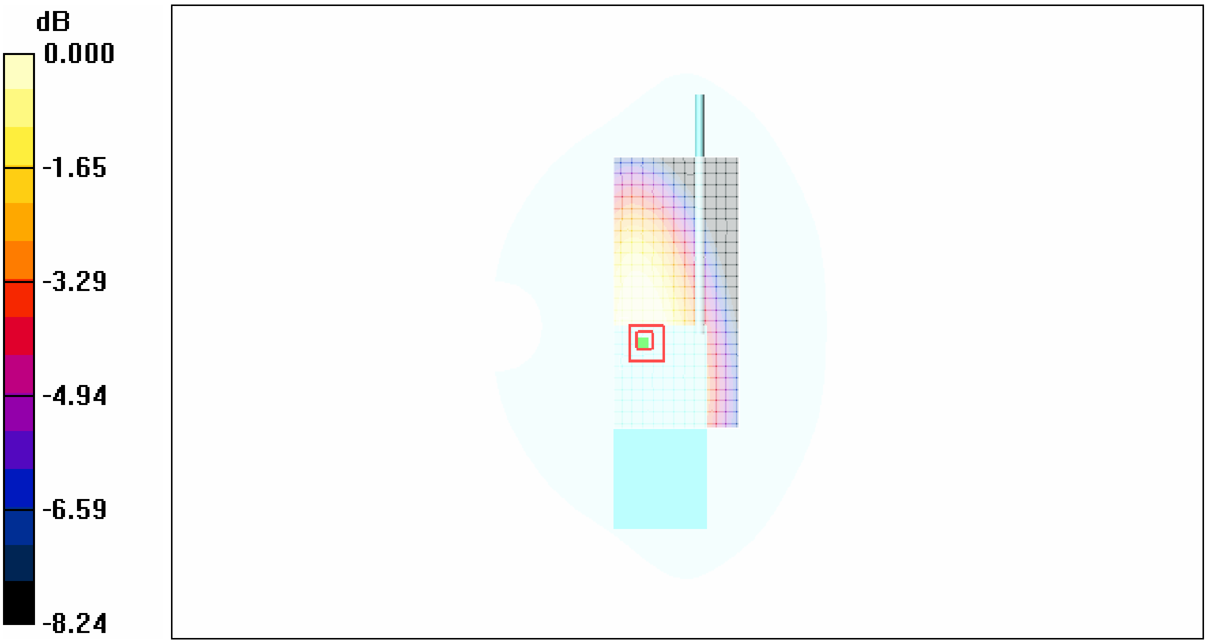
Middle Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 70.7 V/m; Power Drift = -0.152 dB

Peak SAR (extrapolated) = 6.40 W/kg

SAR(1 g) = 4.29 mW/g; SAR(10 g) = 3.1 mW/g

Maximum value of SAR (measured) = 4.51 mW/g



0 dB = 4.51mW/g

Fig.15 Mode 2 with Li-ion Battery, Channel 2

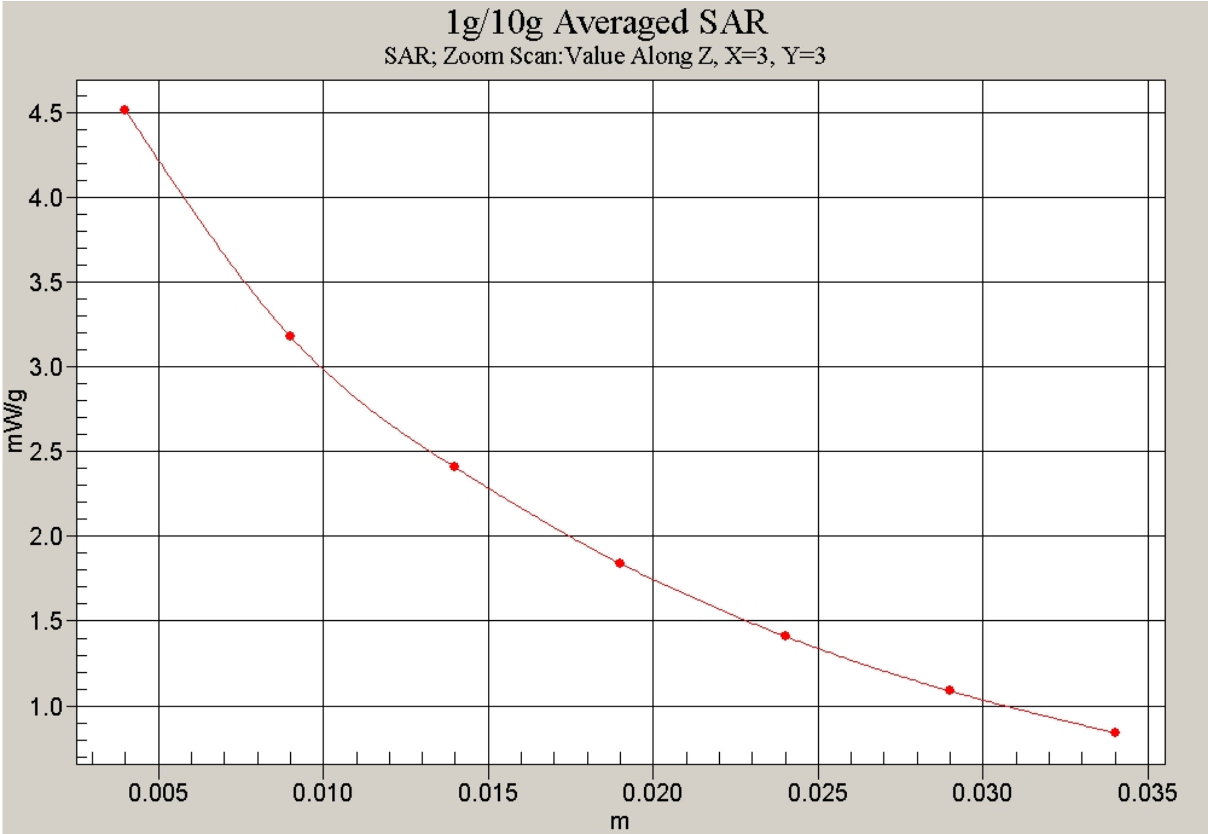


Fig. 16 Z-Scan at power reference point (Mode 2 with Li-ion Battery, Channel 2)

Mode 2 with Li-ion Battery, Low Frequency

Date/Time: 2006-10-27 15:36:14

Electronics: DAE3 Sn536

Medium: 450 MHz Body

Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3

Ambient Temperature:23.0°C Liqiud Temperature: 22.5°C

Communication System: Handy Transceiver Frequency: 440.012 MHz Duty Cycle: 1:1

Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

Low Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 4.39 mW/g

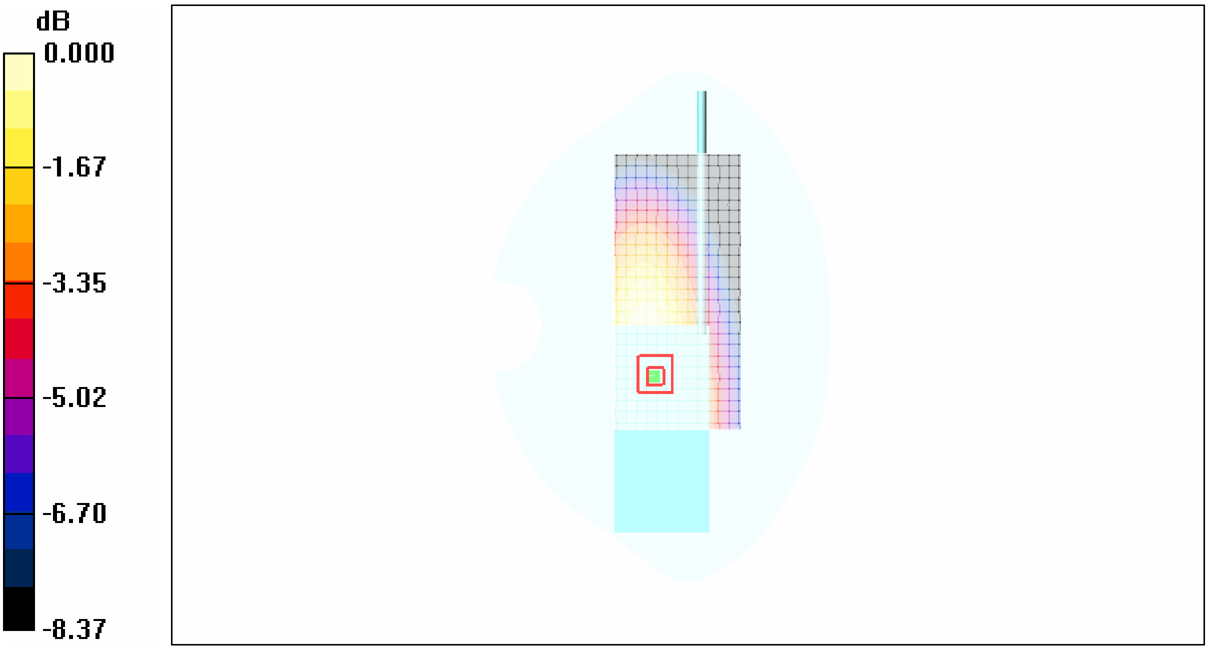
Low Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 65.0 V/m; Power Drift = -0.174 dB

Peak SAR (extrapolated) = 5.98 W/kg

SAR(1 g) = 4.07 mW/g; SAR(10 g) = 2.95 mW/g

Maximum value of SAR (measured) = 4.28 mW/g



0 dB = 4.28mW/g

Fig.17 Mode 2 with Li-ion Battery, Channel 1

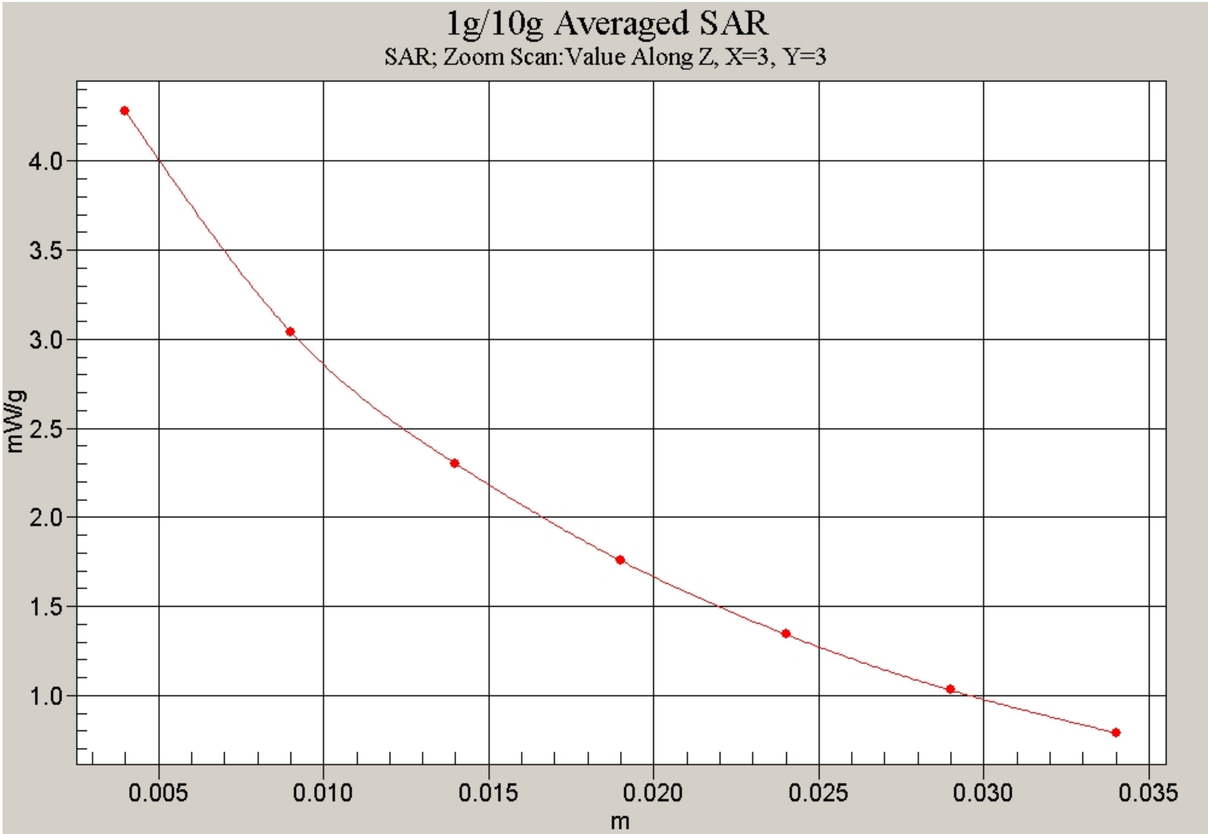


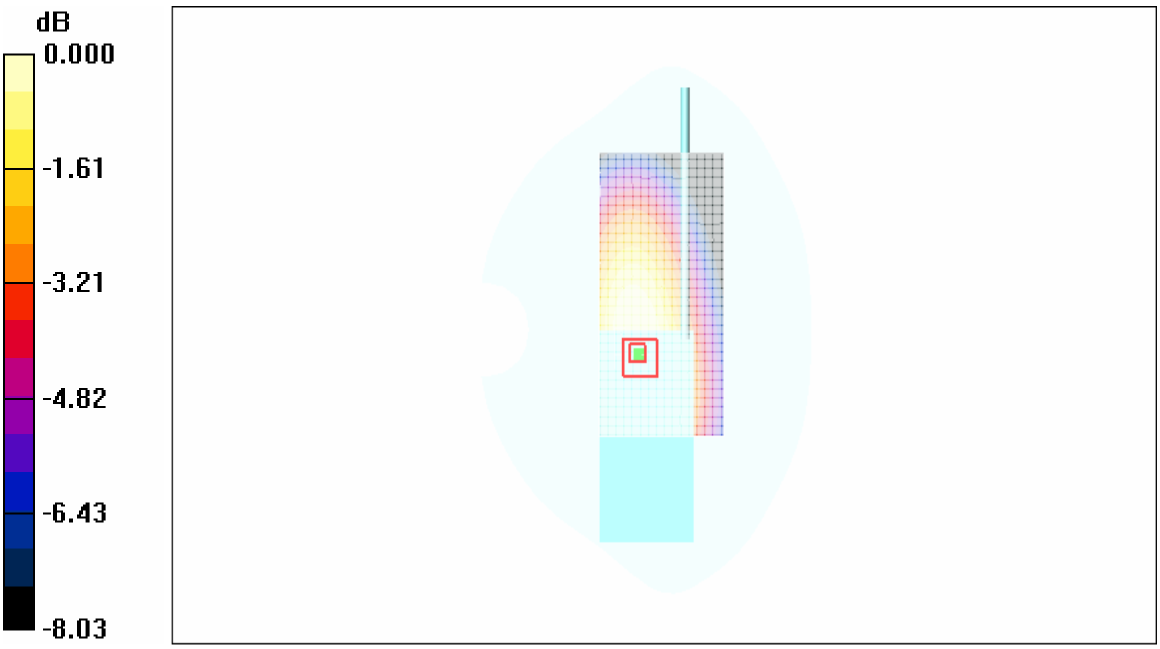
Fig. 18 Z-Scan at power reference point (Mode 2 with Li-ion Battery, Channel 1)

Mode 2 with Ni-mh Battery, High Frequency

Date/Time: 2006-10-27 18:45:37
Electronics: DAE3 Sn536
Medium: 450 MHz Body
Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Ambient Temperature:23.0°C Liqiud Temperature: 22.5°C
Communication System: Handy Transceiver Frequency: 469.913 MHz Duty Cycle: 1:1
Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

High Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 3.66 mW/g

High Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 62.1 V/m; Power Drift = -0.154 dB
Peak SAR (extrapolated) = 4.91 W/kg
SAR(1 g) = 3.32 mW/g; SAR(10 g) = 2.42 mW/g
Maximum value of SAR (measured) = 3.47 mW/g



0 dB = 3.47mW/g

Fig.19 Mode 2 with Ni-mh Battery, Channel 3

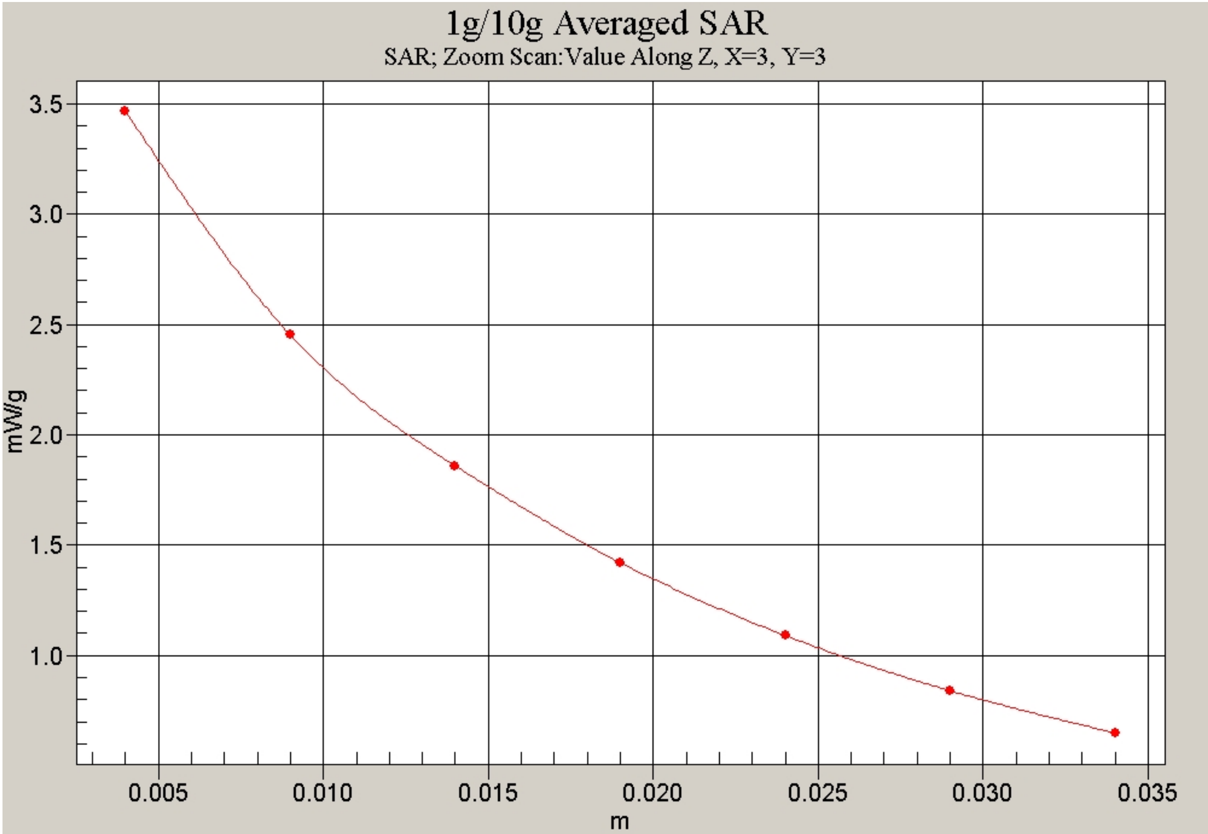


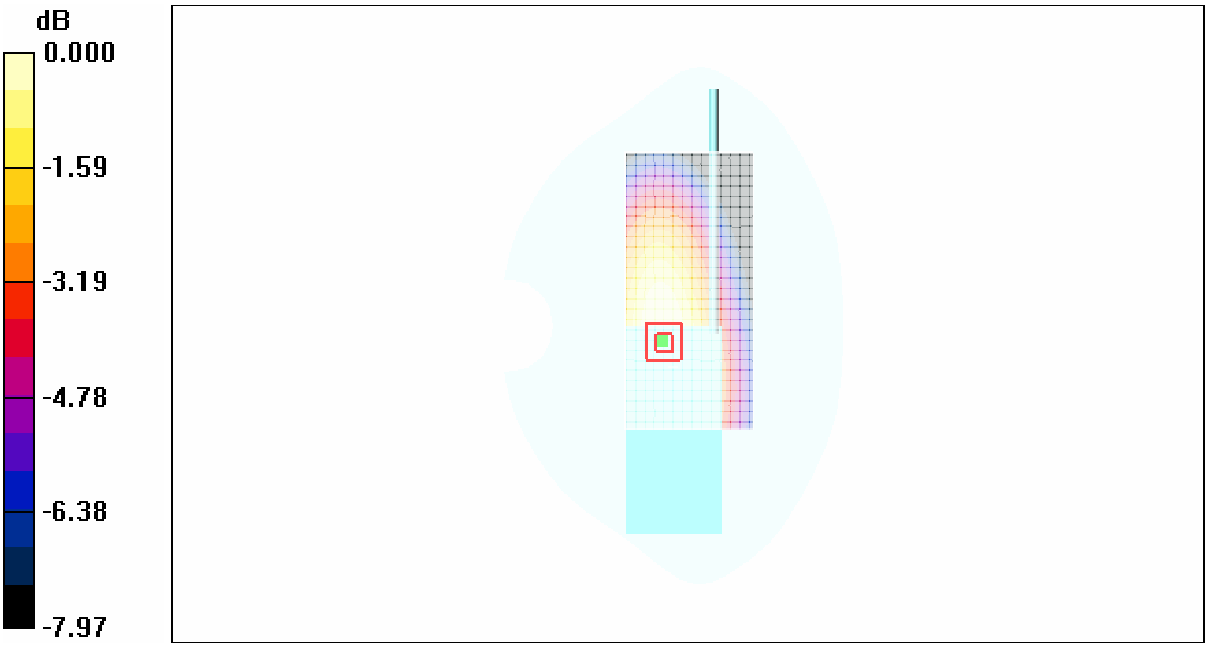
Fig. 20 Z-Scan at power reference point (Mode 2 with Ni-mh Battery, Channel 3)

Mode 2 with Ni-mh Battery, Middle Frequency

Date/Time: 2006-10-27 19:28:18
Electronics: DAE3 Sn536
Medium: 450 MHz Body
Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3
Ambient Temperature:23.0°C Liqiud Temperature: 22.5°C
Communication System: Handy Transceiver Frequency: 455.012 MHz Duty Cycle: 1:1
Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

Middle Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 3.54 mW/g

Middle Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 60.8 V/m; Power Drift = -0.169 dB
Peak SAR (extrapolated) = 4.94 W/kg
SAR(1 g) = 3.35 mW/g; SAR(10 g) = 2.44 mW/g
Maximum value of SAR (measured) = 3.50 mW/g



0 dB = 3.50mW/g

Fig.21 Mode 2 with Ni-mh Battery, Channel 2

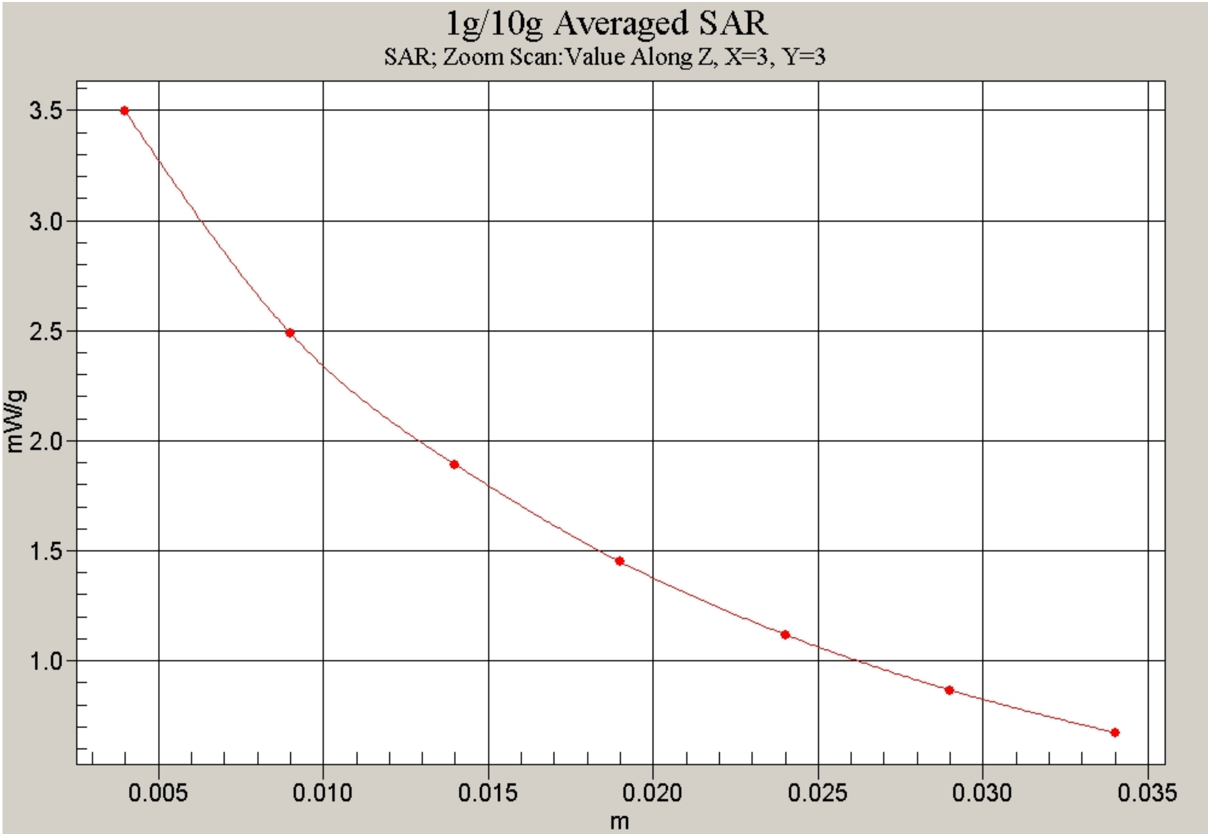


Fig. 22 Z-Scan at power reference point (Mode 2 with Ni-mh Battery, Channel 2)

Mode 2 with Ni-mh Battery, Low Frequency

Date/Time: 2006-10-27 20:23:14

Electronics: DAE3 Sn536

Medium: 450 MHz Body

Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 57.1; ρ = 1000 kg/m^3

Ambient Temperature:23.0°C Liqiud Temperature: 22.5°C

Communication System: Handy Transceiver Frequency: 440.012 MHz Duty Cycle: 1:1

Probe: ET3DV6 - SN1600 ConvF(7.74, 7.74, 7.74)

Low Frequency/Area Scan (81x161x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 3.85 mW/g

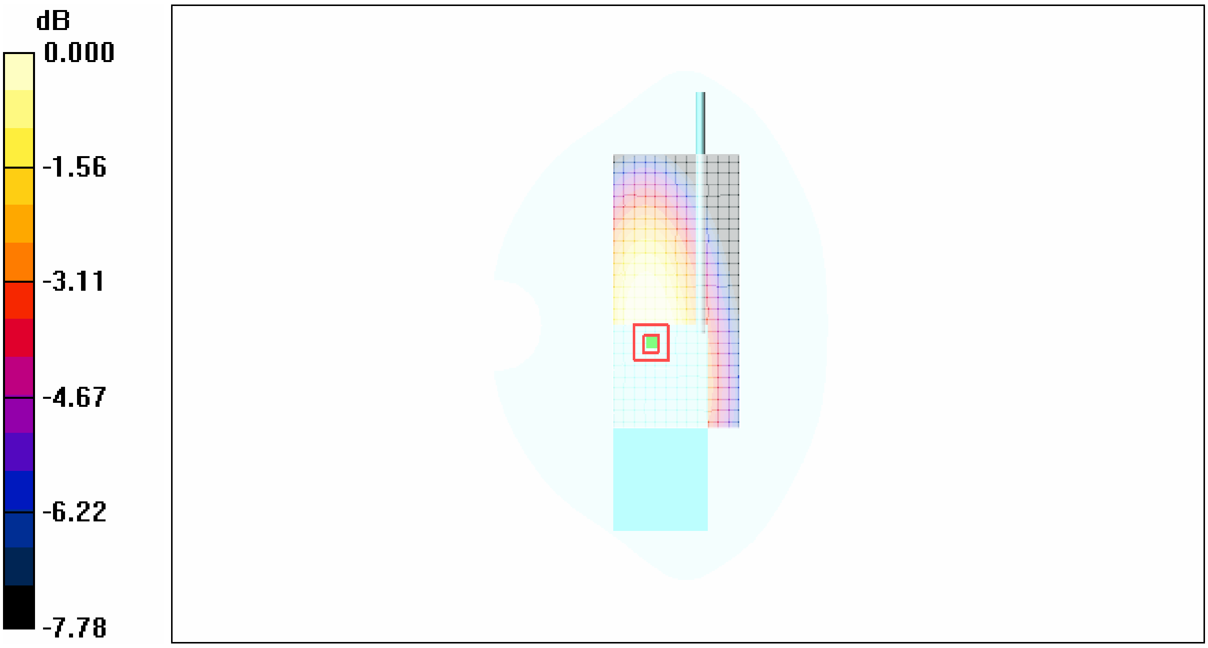
Low Frequency/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 64.5 V/m; Power Drift = -0.121 dB

Peak SAR (extrapolated) = 5.02 W/kg

SAR(1 g) = 3.44 mW/g; SAR(10 g) = 2.51 mW/g

Maximum value of SAR (measured) = 3.59 mW/g



0 dB = 3.59mW/g

Fig.23 Mode 2 Test Position with Ni-mh Battery, Channel 1

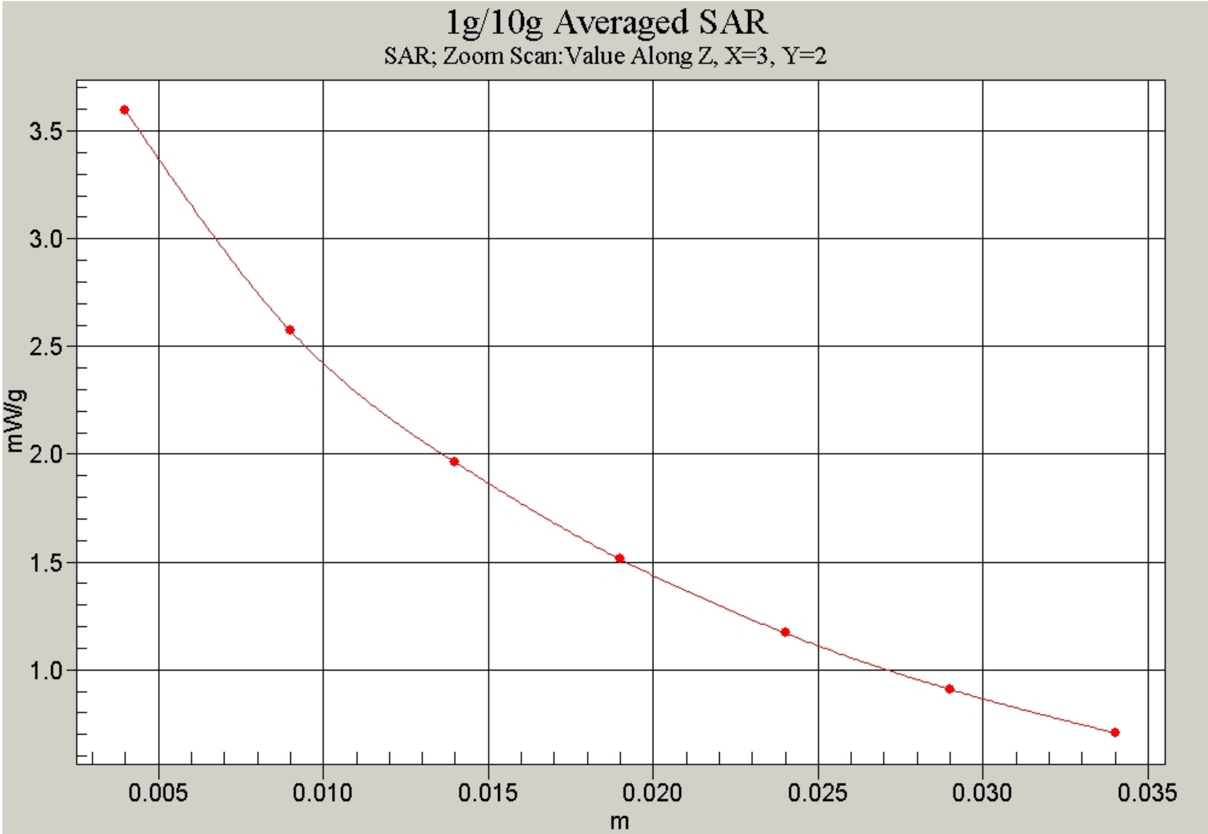


Fig. 24 Z-Scan at power reference point (Mode 2 with Ni-mh Battery, Channel 1

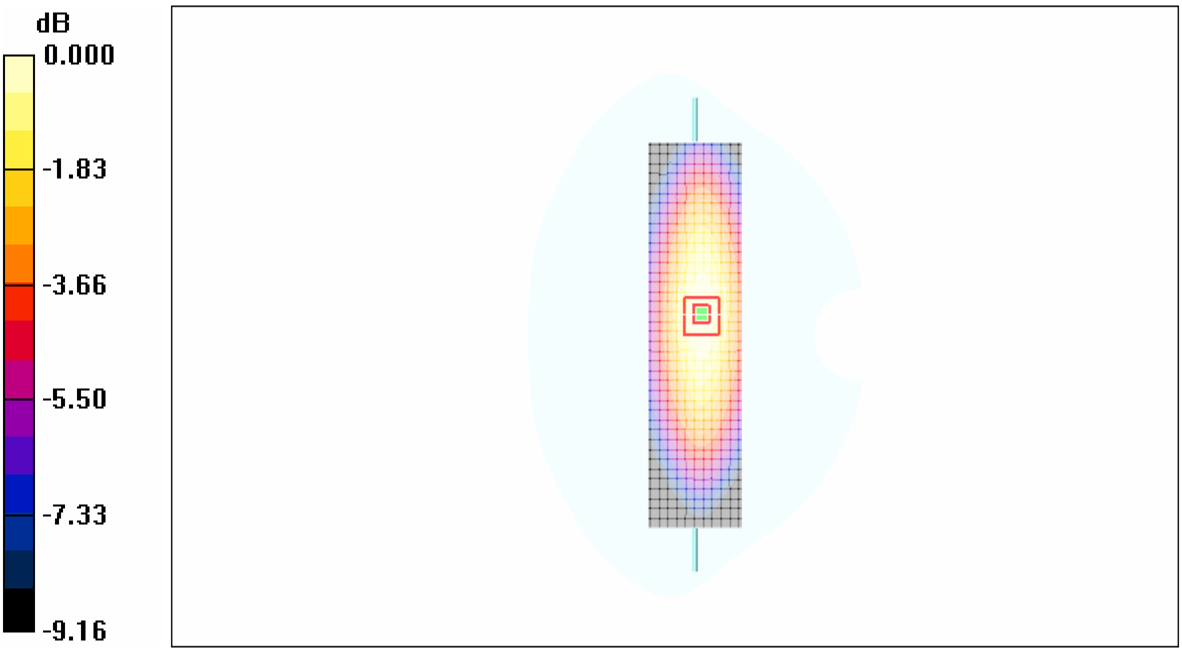
ANNEX D: SYSTEM VALIDATION RESULTS

450MHzDAE536Probe1600

Date/Time: 2006-10-27 09:04:47
Electronics: DAE3 Sn536
Medium: 450MHZ
Medium parameters used: f = 450 MHz; σ = 0.84 mho/m; εr = 45.6; ρ = 1000 kg/m3
Ambient Temperature:22.9°C Liqiud Temperature: 22.1°C
Communication System: CW Frequency: 450 MHz Duty Cycle: 1:1
Probe: ET3DV6 - SN1600 ConvF(7.95, 7.95, 7.95)

System Validation/Area Scan (61x221x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 1.29 mW/g

System Validation/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 38.4 V/m; Power Drift = 0.007 dB
Peak SAR (extrapolated) = 1.97 W/kg
SAR(1 g) = 1.23 mW/g; SAR(10 g) = 0.823 mW/g
Maximum value of SAR (measured) = 1.31 mW/g



0 dB = 1.31mW/g

Fig.25 validation 450MHz 250mW

ANNEX E: PROBE CALIBRATION CERTIFICATE

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

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
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 TMC-Auden **Certificate No:** ET3-1600_Jan06

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1600
Calibration procedure(s)	QA CAL-01.v5 and QA CAL-13.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 20, 2006
Condition of the calibrated item	In Tolerance

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-05 (METAS, No. 251-00388)	May-06
Power sensor E4412A	MY41495277	5-May-05 (METAS, No. 251-00388)	May-06
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-05 (METAS, No. 251-00403)	Aug-06
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-05 (METAS, No. 251-00389)	May-06
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-05 (METAS, No. 251-00404)	Aug-06
Reference Probe ES3DV2	SN: 3013	7-Jan-06 (SPEAG, No. ES3-3013_Jan05)	Jan-07
DAE4	SN: 617	29-Sep-05 (SPEAG, No. DAE4-617_Sep04)	Sep-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-05 (SPEAG, in house check Oct-03)	In house check: Oct 08
RF generator HP 8648C	US3642U01700	4-Aug-05 (SPEAG, in house check Dec-03)	In house check: Dec-11
Network Analyzer HP 8753E	US37390585	18-Oct-05 (SPEAG, in house check Nov-04)	In house check: Nov 09

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	D.Vetter
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 21, 2006

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

Certificate No: ET3-1600_Jan06 Page 1 of 9

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

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ET3DV6

SN:1600

Manufactured:	July 30, 2001
Last calibrated:	January 16, 2005
Recalibrated:	January 20, 2006

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1600

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

NormX	**1.92** ± 10.1%	$\mu V/(V/m)^2$	DCP X	**92** mV
NormY	**1.96** ± 10.1%	$\mu V/(V/m)^2$	DCP Y	**92** mV
NormZ	**1.87** ± 10.1%	$\mu V/(V/m)^2$	DCP Z	**92** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	8.3	4.3
SAR_{be} [%]	With Correction Algorithm	0.1	0.3

TSL **1810 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	12.4	8.5
SAR_{be} [%]	With Correction Algorithm	0.5	0.2

Sensor Offset

Probe Tip to Sensor Center **2.7** mm

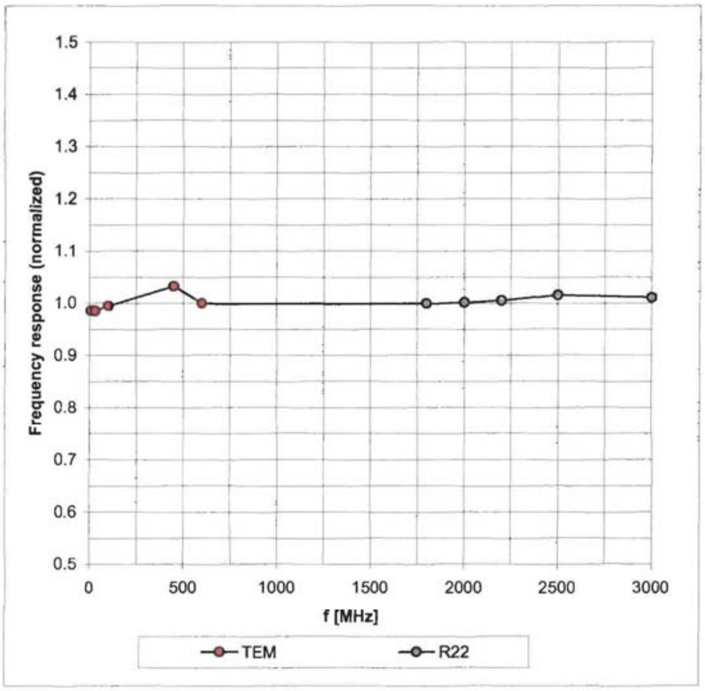
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

ET3DV6 SN:1600 January 20, 2006

Frequency Response of E-Field

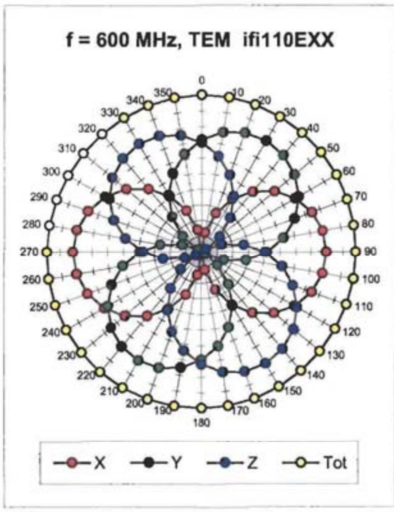
(TEM-Cell:ifi110 EXX, Waveguide: R22)

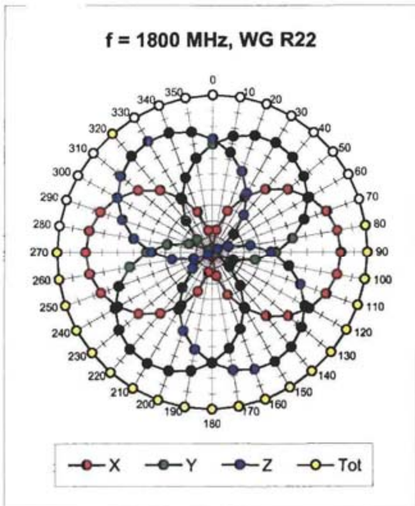


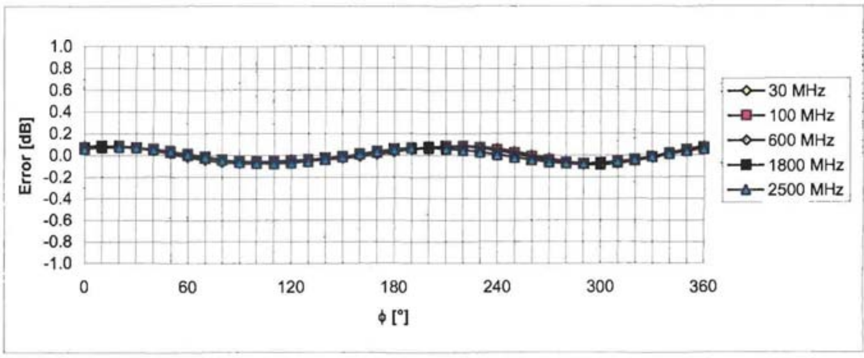
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ET3DV6 SN:1600 January 20, 2006

Receiving Pattern (ϕ), ϑ = 0°





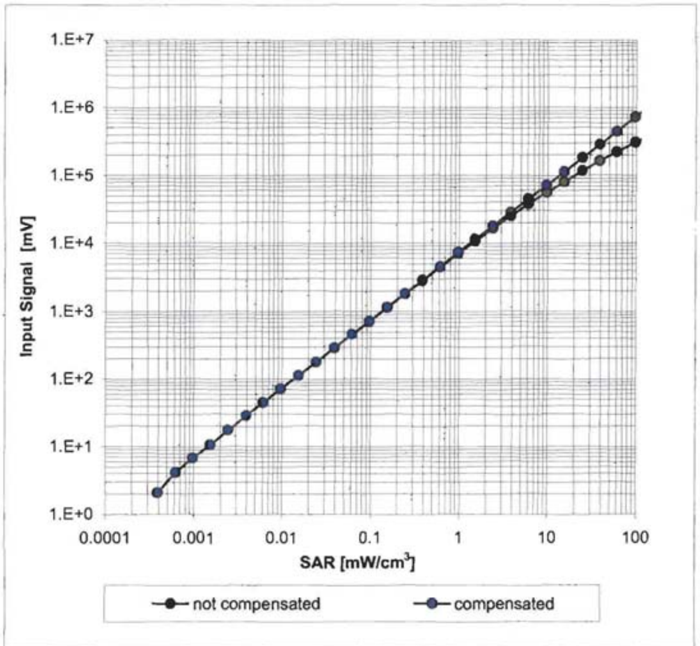


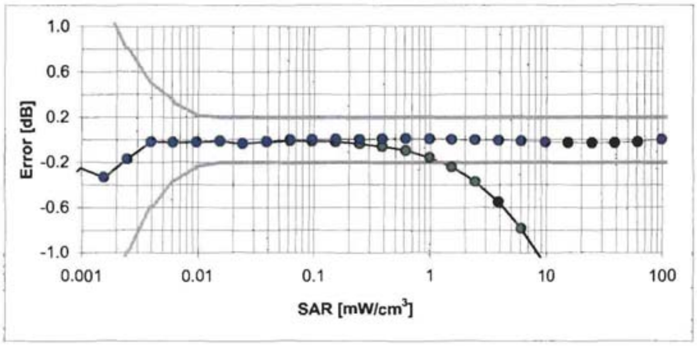
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

ET3DV6 SN:1600 January 20, 2006

Dynamic Range f(SAR$_{head}$)

(Waveguide R22, f = 1800 MHz)

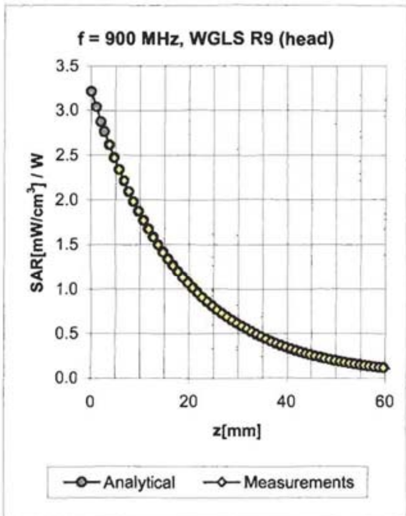


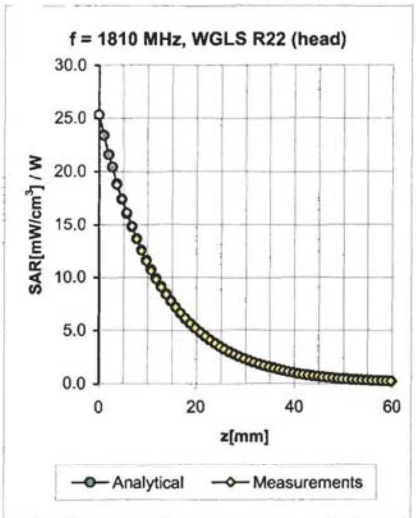


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

ET3DV6 SN:1600 January 20, 2006

Conversion Factor Assessment





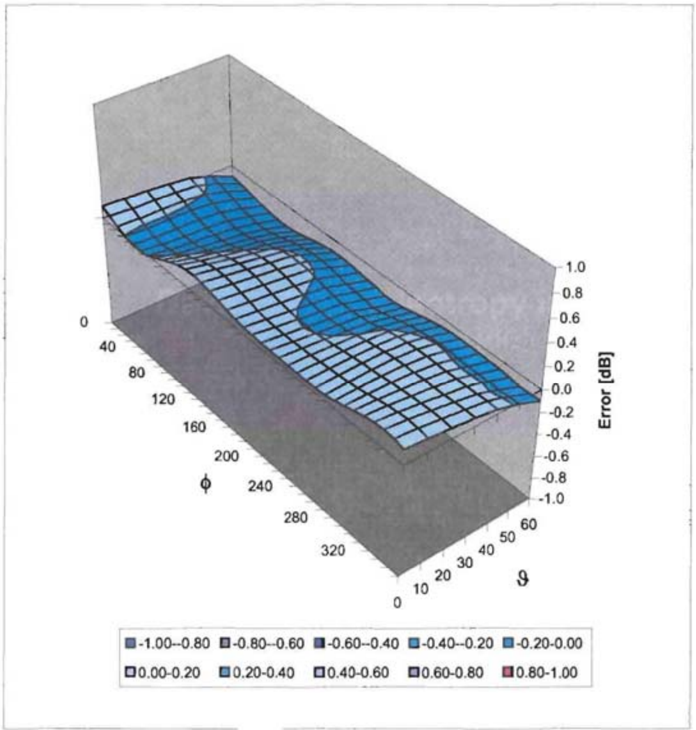
f [MHz]	Validity [MHz][C]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.15	1.83	7.95	± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.57	1.83	6.68	± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.52	2.46	5.44	± 11.0% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.12	1.61	7.74	± 13.3% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.47	2.15	6.45	± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.53	2.78	4.88	± 11.0% (k=2)

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

ET3DV6 SN:1600 January 20, 2006

Deviation from Isotropy in HSL

Error (ϕ, ϑ), f = 900 MHz



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

ANNEX F: DIPOLE CALIBRATION CERTIFICATE

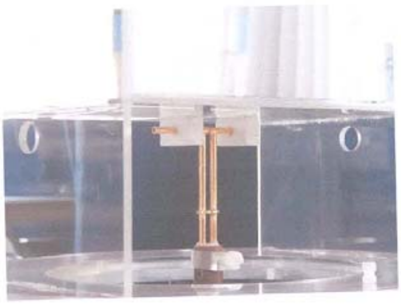
INDEXSAR

Report No. SN0111_450
December 2004

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

Performance measurements

MI Manning



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1. Measurement Conditions

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

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

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

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

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

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

2. Typical SAR Measurement

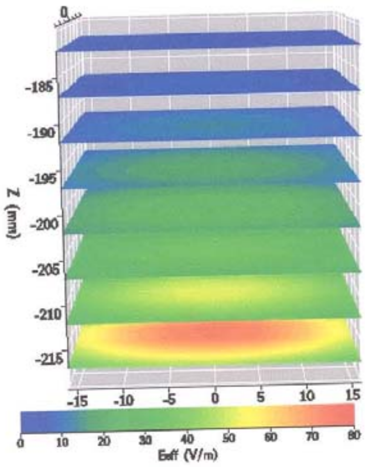
A SAR validation check is performed with the box-phantom located on the SARA2 phantom support base on the SARA2 robot system. Tests are then conducted at a feed power level of approx. 0.25W. The actual power level is recorded and used to normalise the results obtained to the standard input power conditions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

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

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

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

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



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

Averaged over 1 cm3 (1g) of tissue	**49.26 W/kg**
Averaged over 10cm3 (10g) of tissue	**23.65 W/kg**

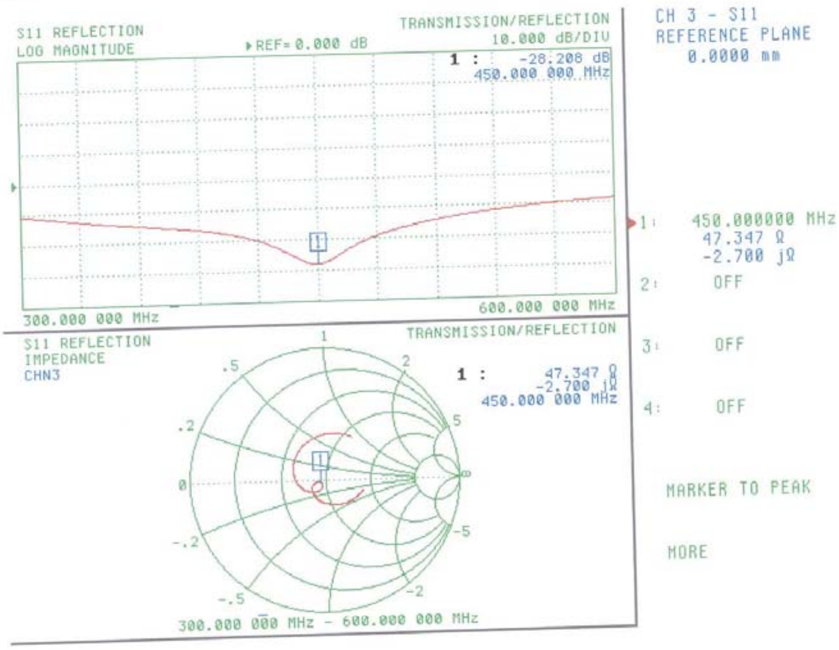
These results can be compared with Table 8.1 in [1]. The agreement is within 10%.

3. Dipole impedance and return loss

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

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

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



4. Dipole handling

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

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

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

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

5. Tuning the dipole

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

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

6. References

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