



A D T

**D3: DAE**

## IMPORTANT NOTICE

### USAGE OF THE DAE 3

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

**Battery Exchange:** The battery cover of the DAE3 unit is connected to a fragile 3-pin battery connector. Customer is responsible to apply utmost caution not to bend or damage the connector when changing batteries.

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

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

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

**Important Note:**

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

**Important Note:**

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

**Important Note:**

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



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Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **DAE3-579\_Jul09**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 579**

Calibration procedure(s) **QA CAL-06.v20  
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **July 17, 2009**

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 ( $22 \pm 3$ )°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	30-Sep-08 (No: 7670)	Sep-09
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	05-Jun-09 (in house check)	In house check: Jun-10

Calibrated by:	Name <b>Daniel Hess</b>	Function Technician	Signature <i>D. Hess</i>
Approved by:	Name <b>Fin Bomholt</b>	Function R&D Director	Signature <i>F. Bomholt</i>

Issued: July 17, 2009

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## Glossary

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

## Methods Applied and Interpretation of Parameters

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

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1 $\mu$ V, full range = -100...+300 mV

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

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

Calibration Factors	X	Y	Z
High Range	404.340 $\pm$ 0.1% (k=2)	404.405 $\pm$ 0.1% (k=2)	404.179 $\pm$ 0.1% (k=2)
Low Range	3.98795 $\pm$ 0.7% (k=2)	3.99425 $\pm$ 0.7% (k=2)	3.94999 $\pm$ 0.7% (k=2)

## Connector Angle

Connector Angle to be used in DASY system	358.5 $^{\circ}$ $\pm$ 1 $^{\circ}$
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## Appendix

### 1. DC Voltage Linearity

High Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	199993.3	-0.13	-0.00
Channel X + Input	20003.43	2.43	0.01
Channel X - Input	-19993.69	5.81	-0.03
Channel Y + Input	200002.8	0.51	0.00
Channel Y + Input	19999.73	-0.07	-0.00
Channel Y - Input	-19996.86	2.44	-0.01
Channel Z + Input	200001.0	-0.52	-0.00
Channel Z + Input	20001.01	0.31	0.00
Channel Z - Input	-19998.70	-0.01	-0.01

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000.0	-0.09	-0.00
Channel X + Input	198.99	-0.91	-0.46
Channel X - Input	-200.88	-0.88	0.44
Channel Y + Input	2000.4	0.38	0.02
Channel Y + Input	198.39	-1.61	-0.80
Channel Y - Input	-202.11	-2.21	1.10
Channel Z + Input	2000.1	0.13	0.01
Channel Z + Input	197.95	-2.05	-1.02
Channel Z - Input	-202.15	-2.15	1.07

### 2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading ( $\mu\text{V}$ )	Low Range Average Reading ( $\mu\text{V}$ )
Channel X	200	8.06	5.79
	-200	-4.78	-6.20
Channel Y	200	7.41	7.20
	-200	-8.12	-8.99
Channel Z	200	8.29	8.32
	-200	-10.02	-10.01

### 3. Channel separation

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

	Input Voltage (mV)	Channel X ( $\mu\text{V}$ )	Channel Y ( $\mu\text{V}$ )	Channel Z ( $\mu\text{V}$ )
Channel X	200	-	-0.14	-0.70
Channel Y	200	2.34	-	3.07
Channel Z	200	1.88	-0.12	-

#### 4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	16340	15896
Channel Y	16193	16225
Channel Z	15813	15945

#### 5. Input Offset Measurement

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

Input 10M $\Omega$

	Average ( $\mu$ V)	min. Offset ( $\mu$ V)	max. Offset ( $\mu$ V)	Std. Deviation ( $\mu$ V)
Channel X	-0.86	-2.24	0.56	0.49
Channel Y	-2.23	-3.31	-1.32	0.34
Channel Z	0.01	-1.37	3.11	0.46

#### 6. Input Offset Current

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

#### 7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2001	200.9
Channel Y	0.2001	203.9
Channel Z	0.2001	204.5

#### 8. Low Battery Alarm Voltage (verified during pre test)

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

#### 9. Power Consumption (verified during pre test)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9



## D4: SYSTEM VALIDATION DIPOLE





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Accreditation No.: **SCS 108**

Client **BV-ADT (Auden)**

Certificate No: **D2450V2-716\_Mar09**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 716**

Calibration procedure(s) **QA CAL-05.v7  
Calibration procedure for dipole validation kits**

Calibration date: **March 17, 2009**

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 EPM-442A	GB37480704	08-Oct-08 (No. 217-00898)	Oct-09
Power sensor HP 8481A	US37292783	08-Oct-08 (No. 217-00898)	Oct-09
Reference 20 dB Attenuator	SN: 5086 (20g)	01-Jul-08 (No. 217-00864)	Jul-09
Type-N mismatch combination	SN: 5047.2 / 06327	01-Jul-08 (No. 217-00867)	Jul-09
Reference Probe ES3DV2	SN: 3025	28-Apr-08 (No. ES3-3025_Apr08)	Apr-09
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-07)	In house check: Oct-09
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: March 18, 2009

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Accreditation No.: **SCS 108**

### Glossary:

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

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

## Measurement Conditions

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

DASY Version	DASY5	V5.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
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	38.0 $\pm$ 6 %	1.82 mho/m $\pm$ 6 %
Head TSL temperature during test	(21.0 $\pm$ 0.2) °C	----	----

## SAR result with Head TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.5 mW / g
SAR normalized	normalized to 1W	54.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>53.3 mW / g <math>\pm</math> 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.24 mW / g
SAR normalized	normalized to 1W	25.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>24.8 mW / g <math>\pm</math> 16.5 % (k=2)</b>

<sup>1</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## 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	54.3 ± 6 %	1.99 mho/m ± 6 %
Body TSL temperature during test	(21.1 ± 0.2) °C	----	----

## SAR result with Body TSL

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	13.3 mW / g
SAR normalized	normalized to 1W	53.2 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>52.9 mW /g ± 17.0 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.24 mW / g
SAR normalized	normalized to 1W	25.0 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>25.0 mW /g ± 16.5 % (k=2)</b>

<sup>2</sup> Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	$54.9 \Omega + 1.4 j\Omega$
Return Loss	- 26.2 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	$50.2 \Omega + 4.3 j\Omega$
Return Loss	- 27.4 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.144 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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

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

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 10, 2002

# DASY5 Validation Report for Head TSL

Date/Time: 17.03.2009 15:42:29

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN716**

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

Medium: HSL U10 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  mho/m;  $\epsilon_r = 38.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

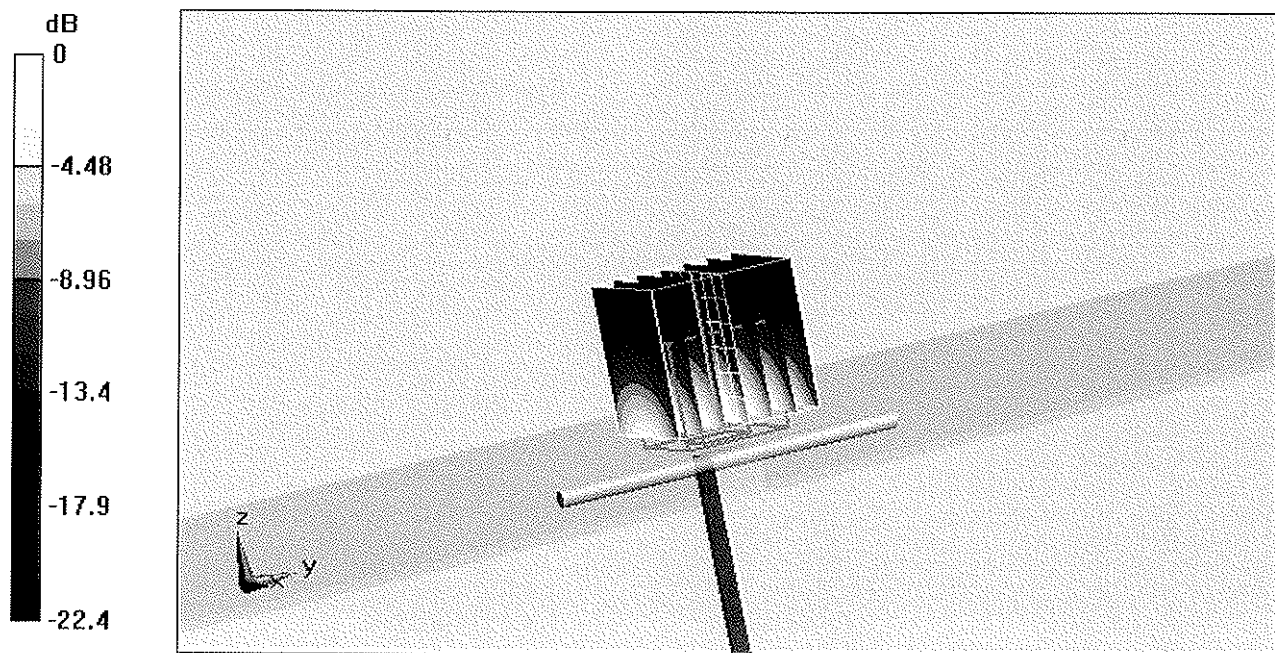
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.5 V/m; Power Drift = 0.040 dB

Peak SAR (extrapolated) = 28.2 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.24 mW/g**

Maximum value of SAR (measured) = 16.1 mW/g



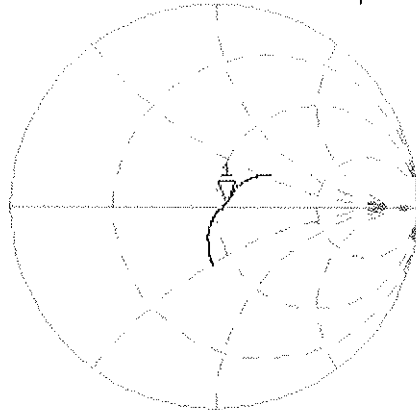
0 dB = 16.1mW/g

# Impedance Measurement Plot for Head TSL

17 Mar 2009 11:42:32

CH1 S11 1 U FS 1: 54.941  $\Omega$  1.4121  $\Omega$  91.732 pF 2 450.000 000 MHz

\*  
De1  
Cor



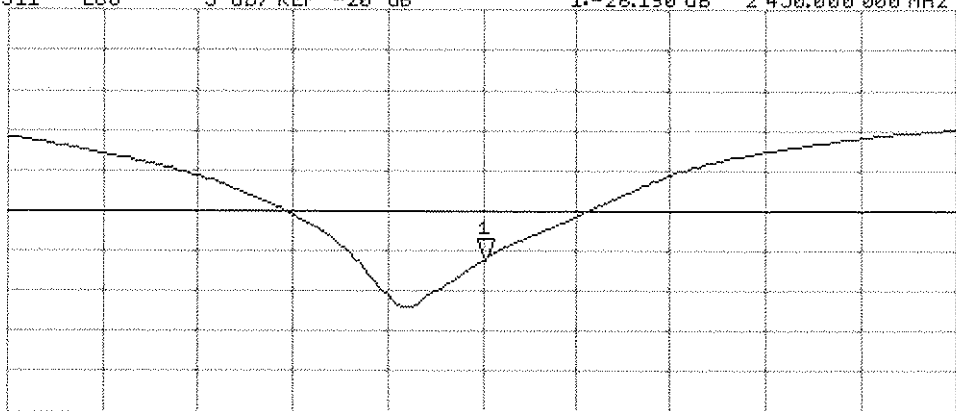
↑

CH2 S11 LOG 5 dB/REF -20 dB 1:-26.190 dB 2 450.000 000 MHz

De1  
Cor

Avg  
16

↑



START 2 250.000 000 MHz

STOP 2 550.000 000 MHz

# DASY5 Validation Report for Body TSL

Date/Time: 10.03.2009 14:20:02

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:716**

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

Medium: MSL U10 BB

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2$  mho/m;  $\epsilon_r = 54.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC)

## DASY5 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.07, 4.07, 4.07); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY5, V5.0 Build 120; SEMCAD X Version 13.4 Build 45

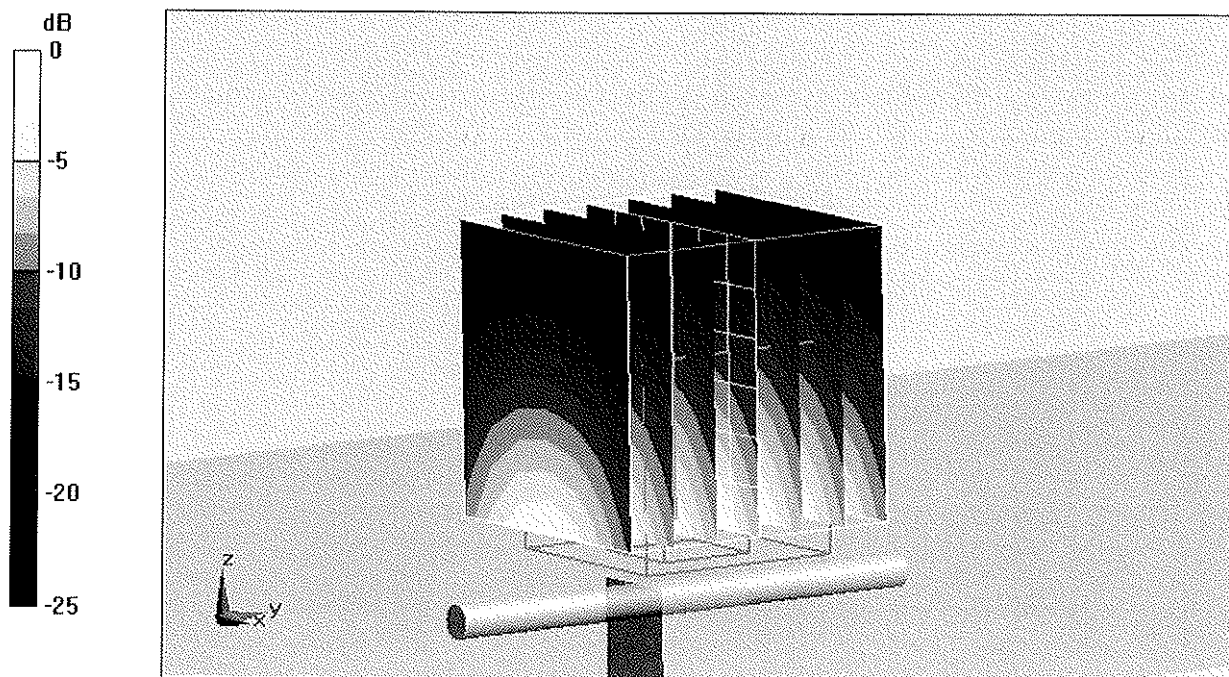
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.7 V/m; Power Drift = -0.00384 dB

Peak SAR (extrapolated) = 26.8 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.24 mW/g**

Maximum value of SAR (measured) = 16.5 mW/g



0 dB = 16.5mW/g

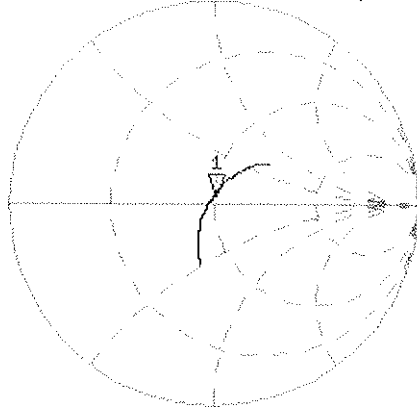


# Impedance Measurement Plot for Body TSL

10 Mar 2009 09:52:25

CH1 S11 1 U FS 1: 50.232  $\Omega$  4.2793  $\Omega$  277.99  $\mu\text{H}$  2 450.000 000 MHz

\*  
De1  
Cor



Avg  
16

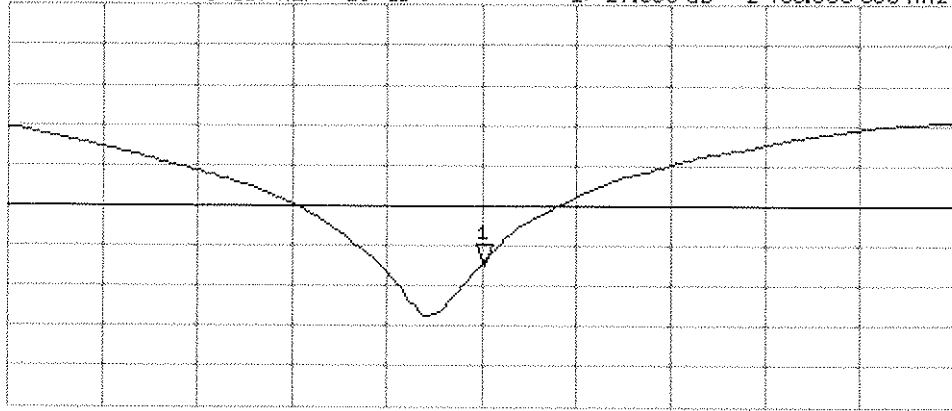
↑

CH2 S11 LOG 5 dB/REF -20 dB 1: -27.386 dB 2 450.000 000 MHz

Cor

Avg  
16

↑



START 2 250.000 000 MHz

STOP 2 550.000 000 MHz