



**D3: DAE**

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



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Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No: **DAE3-510\_Aug05**

## CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 510**

Calibration procedure(s) **QA CAL-06.v12  
Calibration procedure for the data acquisition unit (DAE)**

Calibration date: **August 17, 2005**

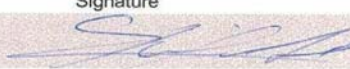

Condition of the calibrated item **In Tolerance**

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	7-Sep-04 (Sintrel, No.E-040073)	Sep-05
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1002	29-Jun-05 (SPEAG, in house check)	In house check Jun-06

Calibrated by:	Name Eric Hainfeld	Function Technician	Signature 
Approved by:	Fin Bomholt	R&D Director	

Issued: August 17, 2005

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## Glossary

DAE digital 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 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	403.415 $\pm$ 0.1% (k=2)	403.485 $\pm$ 0.1% (k=2)	403.851 $\pm$ 0.1% (k=2)
Low Range	3.95575 $\pm$ 0.7% (k=2)	3.93409 $\pm$ 0.7% (k=2)	3.95875 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	44 $^{\circ}$ $\pm$ 1 $^{\circ}$
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## Appendix

### 1. DC Voltage Linearity

High Range	Input ( $\mu\text{V}$ )	Reading ( $\mu\text{V}$ )	Error (%)
Channel X + Input	200000	200000.5	0.00
Channel X + Input	20000	20004.73	0.02
Channel X - Input	20000	-19990.82	-0.05
Channel Y + Input	200000	200000.4	0.00
Channel Y + Input	20000	20002.02	0.01
Channel Y - Input	20000	-19995.68	-0.02
Channel Z + Input	200000	200000.2	0.00
Channel Z + Input	20000	20006.25	0.03
Channel Z - Input	20000	-19996.09	-0.02

Low Range	Input ( $\mu\text{V}$ )	Reading ( $\mu\text{V}$ )	Error (%)
Channel X + Input	2000	2000.1	0.00
Channel X + Input	200	200.36	0.18
Channel X - Input	200	-200.01	0.00
Channel Y + Input	2000	1999.9	0.00
Channel Y + Input	200	199.23	-0.38
Channel Y - Input	200	-200.56	0.28
Channel Z + Input	2000	2000	0.00
Channel Z + Input	200	199.08	-0.46
Channel Z - Input	200	-200.99	0.50

### 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	17.56	16.61
	- 200	-15.84	-17.03
Channel Y	200	14.35	14.26
	- 200	-15.35	-15.86
Channel Z	200	-8.76	-8.81
	- 200	7.41	7.46

### 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	-	3.17	0.64
Channel Y	200	0.23	-	3.72
Channel Z	200	-0.73	-0.05	-

#### 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	15976	16467
Channel Y	16203	16387
Channel Z	16171	16268

#### 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	0.21	-0.66	0.72	0.27
Channel Y	-1.17	-3.01	0.16	0.33
Channel Z	-1.42	-2.98	-0.81	0.29

#### 6. Input Offset Current

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

#### 7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2001	201.1
Channel Y	0.2001	199.6
Channel Z	0.2000	200.5

#### 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 **ADT (Auden)**

Certificate No: **D2450V2-716\_Aug05**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 716**

Calibration procedure(s) **QA CAL-05.v6  
 Calibration procedure for dipole validation kits**

Calibration date: **August 23, 2005**

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 E442	GB37480704	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Power sensor HP 8481A	US37292783	12-Oct-04 (METAS, No. 251-00412)	Oct-05
Reference 20 dB Attenuator	SN: 5086 (20g)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference Probe ES3DV2	SN 3025	29-Oct-04 (SPEAG, No. ES3-3025_Oct04)	Oct-05
DAE4	SN 601	07-Jan-05 (SPEAG, No. DAE4-601_Jan05)	Jan-06
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (SPEAG, in house check Oct-03)	In house check: Oct-05
RF generator R&S SML-03	100698	27-Mar-02 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov-05

	<b>Name</b>	<b>Function</b>	<b>Signature</b>
Calibrated by:	Mike Meili	Laboratory Technician	<i>M. Meili</i>
Approved by:	Katja Pokovic	Technical Manager	<i>Katja Pokovic</i>

Issued: August 25, 2005

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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:**

- 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
- c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

**Additional Documentation:**

- d) DASY4 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.

<b>DASY Version</b>	DASY4	V4.6
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Area Scan resolution</b>	dx, dy = 15 mm	
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2450 MHz $\pm$ 1 MHz	

### Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	38.5 $\pm$ 6 %	1.73 mho/m $\pm$ 6 %
<b>Head TSL temperature during test</b>	(21.0 $\pm$ 0.2) °C	38.4 $\pm$ 6 %	1.77 mho/m $\pm$ 6 %

### SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	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>54.4 mW / g <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.23 mW / g
SAR normalized	normalized to 1W	24.9 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>25.1 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	52.5 ± 6 %	2.03 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	52.5 ± 6 %	2.06 mho/m ± 6 %

### 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	13.6 mW / g
SAR normalized	normalized to 1W	54.4 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>53.1 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	6.28 mW / g
SAR normalized	normalized to 1W	25.1 mW / g
SAR for nominal Body TSL parameters <sup>2</sup>	normalized to 1W	<b>24.5 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	53.7 $\Omega$ + 2.5 j $\Omega$
Return Loss	-27.3 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5 $\Omega$ + 4.0 j $\Omega$
Return Loss	- 27.9 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.147 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

## DASY4 Validation Report for Head TSL

Date/Time: 23.08.2005 17:40:59

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: HSL U10 BB;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.77$  mho/m;  $\epsilon_r = 38.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.4, 4.4, 4.4); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA
- Measurement SW: DASY4, V4.6 Build 9; Postprocessing SW: SEMCAD, V1.8 Build 151

**Pin = 250 mW; d = 10 mm/Area Scan (41x61x1):**

Measurement grid:  $dx=15$ mm,  $dy=15$ mm

Maximum value of SAR (interpolated) = 17.5 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**

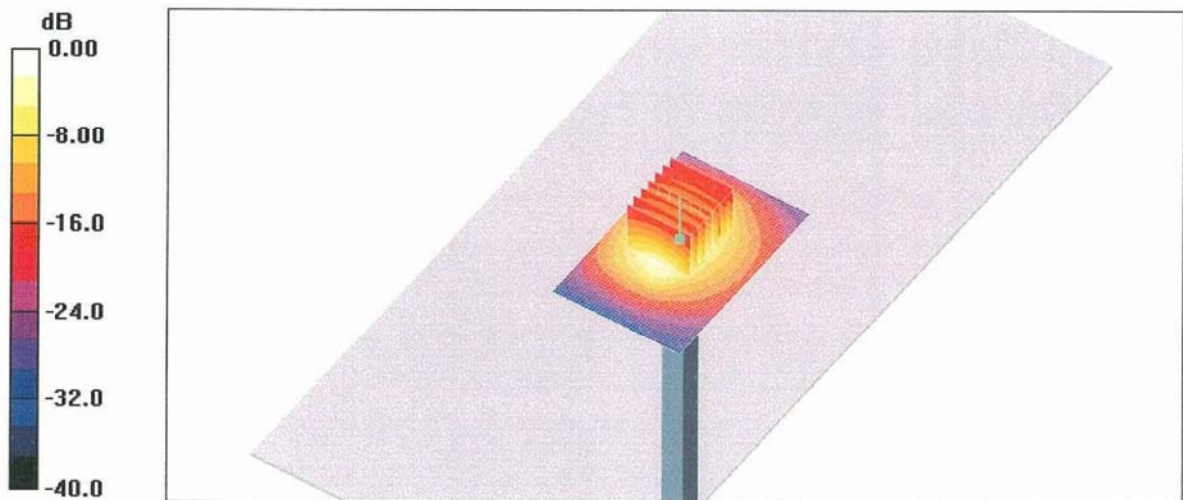
Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm

Reference Value = 87.4 V/m; Power Drift = 0.097 dB

Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.23 mW/g**

Maximum value of SAR (measured) = 15.3 mW/g

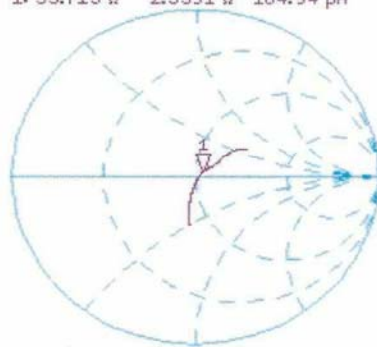


0 dB = 15.3mW/g

### Impedance Measurement Plot for Head TSL

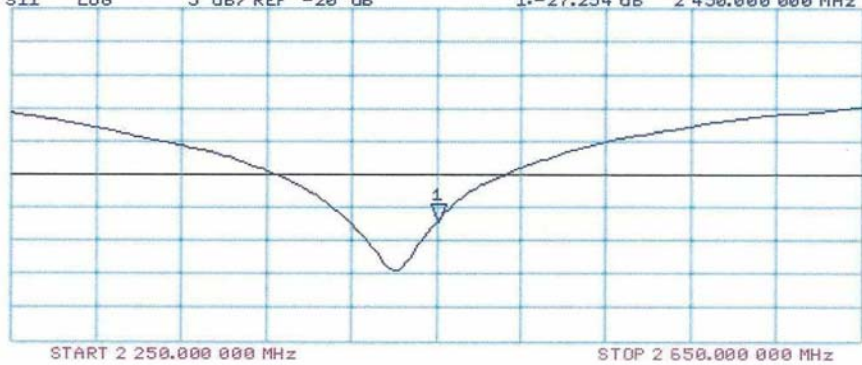
23 Aug 2005 14:39:18  
 CH1 S11 1 U FS 1: 53.715  $\Omega$  2.5391  $\Omega$  164.94 pF 2 450.000 000 MHz

\*  
 De1  
 Cor  
 Avg  
 16



CH2 S11 L06 5 dB/REF -20 dB 1:-27.254 dB 2 450.000 000 MHz

Cor  
 Avg  
 16



## DASY4 Validation Report for Body TSL

Date/Time: 23.08.2005 16:16:42

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium: MSL 2450;

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.05$  mho/m;  $\epsilon_r = 52.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.13, 4.13, 4.13); Calibrated: 29.10.2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 22.07.2004
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA
- Measurement SW: DASY4, V4.6 Build 9; Postprocessing SW: SEMCAD, V1.8 Build 151

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):**

Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 15.4 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**

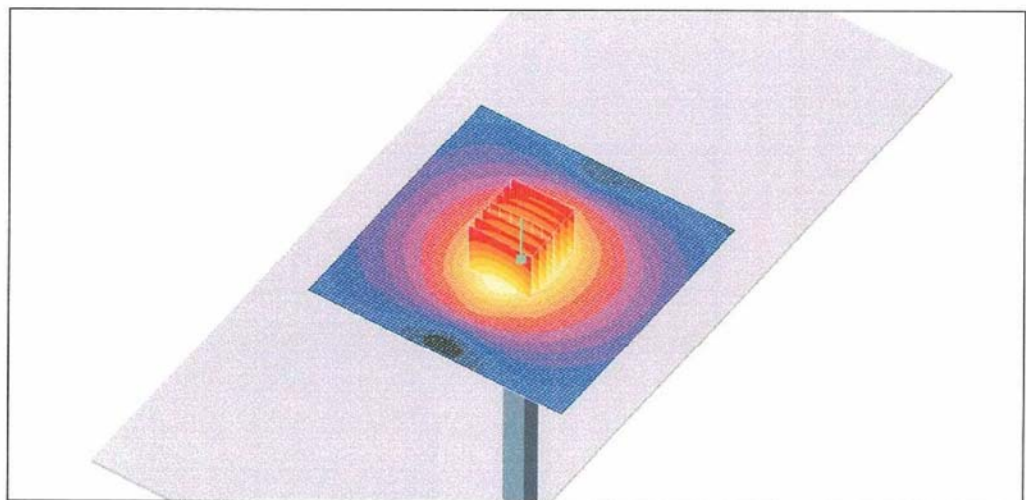
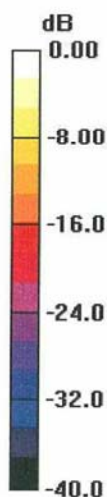
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.2 V/m; Power Drift = -0.055 dB

Peak SAR (extrapolated) = 28.3 W/kg

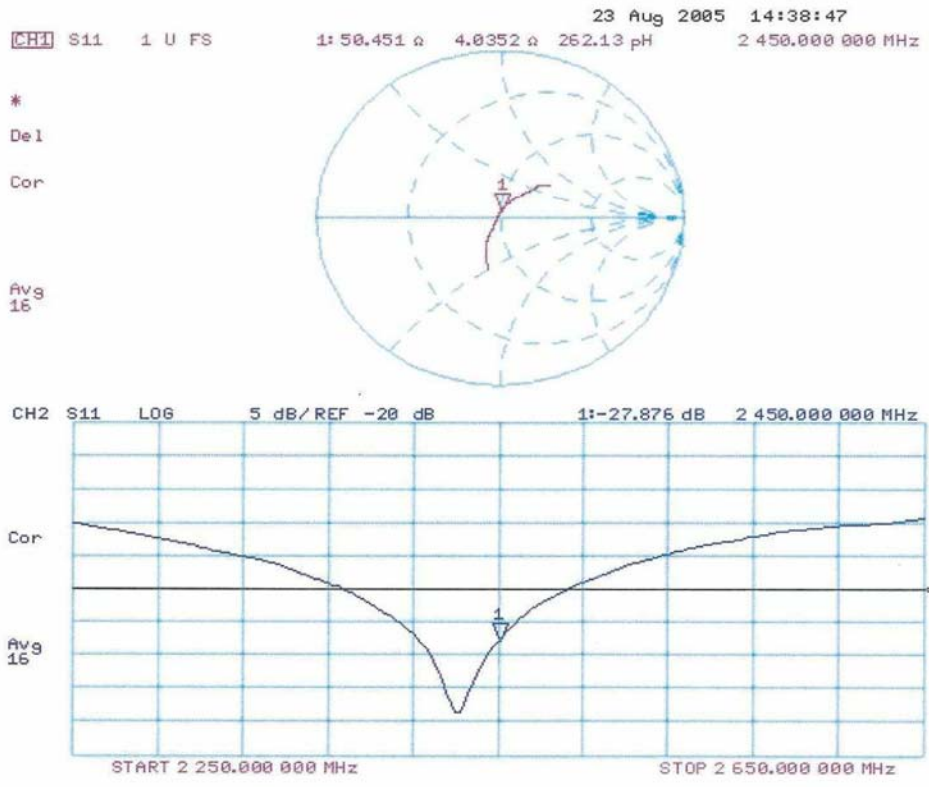
**SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.28 mW/g**

Maximum value of SAR (measured) = 15.6 mW/g



0 dB = 15.6mW/g

### Impedance Measurement Plot for Body TSL







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Accreditation No.: **SCS 108**

Client **ADT (Auden)**

Certificate No. **D5GHzV2-1018\_May06**

**CALIBRATION CERTIFICATE**

Object **D5GHzV2 - SN: 1018**

Calibration procedure(s) **QA CAL-22 v1  
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **May 3, 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-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41495277	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Power sensor E4412A	MY41498087	5-Apr-06 (METAS, No. 251-00557)	Apr-07
Reference 20 dB Attenuator	SN: S5086 (20b)	4-Apr-06 (METAS, No. 251-00558)	Apr-07
Reference 10 dB Attenuator	SN: 5047.2 (10r)	11-Aug-05 (METAS, No 251-00498)	Aug-06
Reference Probe EX3DV4	SN: 3503	19-Mar-05 (SPEAG, No. EX3-3503_Mar06)	Mar-07
DAE4	SN: 601	15-Dec-05 (SPEAG, No. DAE4-601_Dec05)	Dec-06

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	4-Aug-99 (SPEAG, in house check Nov-05)	In house check: Nov-07
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (SPEAG, in house check Nov-05)	In house check: Nov 06

Calibrated by: **Name: Marcel Fehr, Function: Laboratory Technician, Signature: [Signature]**

Approved by: **Name: Katja Pokovic, Function: Technical Manager, Signature: [Signature]**

Issued: May 4, 2006

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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:

- a) IEC Std 62209 Part 2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", Draft Version 0.9, December 2004
- b) 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:

- c) DASY4 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.

<b>DASY Version</b>	DASY4	V4.7
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Area Scan resolution</b>	dx, dy = 10 mm	
<b>Zoom Scan Resolution</b>	dx, dy = 4.3 mm, dz = 3 mm	
<b>Frequency</b>	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

## Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	36.0	4.66 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	35.6 ± 6 %	4.53 mho/m ± 6 %
<b>Head TSL temperature during test</b>	(21.5 ± 0.2) °C	---	---

## SAR result with Head TSL at 5200 MHz

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	21.3 mW / g
SAR normalized	normalized to 1W	82.9 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>82.6 mW / g ± 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	5.94 mW / g
SAR normalized	normalized to 1W	23.1 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>23.0 mW / g ± 19.5 % (k=2)</b>

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

### Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.1 ± 6 %	4.80 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	---	---

### SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	250 mW input power	21.4 mW / g
SAR normalized	normalized to 1W	85.6 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>85.1 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.00 mW / g
SAR normalized	normalized to 1W	24.0 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>23.8 mW / g ± 19.5 % (k=2)</b>

### Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	34.6 ± 6 %	5.09 mho/m ± 6 %
Head TSL temperature during test	(21.5 ± 0.2) °C	---	---

### SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Head TSL	condition	
SAR measured	250 mW input power	20.9 mW / g
SAR normalized	normalized to 1W	83.6 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>83.0 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.83 mW / g
SAR normalized	normalized to 1W	23.3 mW / g
SAR for nominal Head TSL parameters <sup>1</sup>	normalized to 1W	<b>23.1 mW / g ± 19.5 % (k=2)</b>

### Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	49.1 ± 6 %	5.11 mho/m ± 6 %
Body TSL temperature during test	(21.6 ± 0.2) °C	---	---

### SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	250 mW input power	20.3 mW / g
SAR normalized	normalized to 1W	79.0 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>79.1 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.72 mW / g
SAR normalized	normalized to 1W	22.3 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>22.2 mW / g ± 19.5 % (k=2)</b>

### Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.56 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	48.4 ± 6 %	5.50 mho/m ± 6 %
Body TSL temperature during test	(21.6 ± 0.2) °C	---	---

### SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	250 mW input power	20.3 mW / g
SAR normalized	normalized to 1W	81.2 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>81.0 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.69 mW / g
SAR normalized	normalized to 1W	22.8 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>22.7 mW / g ± 19.5 % (k=2)</b>

### Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.8 ± 6 %	5.88 mho/m ± 6 %
Body TSL temperature during test	(21.6 ± 0.2) °C	---	---

### SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm <sup>3</sup> (1 g) of Body TSL	condition	
SAR measured	250 mW input power	18.7 mW / g
SAR normalized	normalized to 1W	74.8 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>74.5 mW / g ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.24 mW / g
SAR normalized	normalized to 1W	21.0 mW / g
SAR for nominal Body TSL parameters <sup>1</sup>	normalized to 1W	<b>20.9 mW / g ± 19.5 % (k=2)</b>

## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.5 $\Omega$ - 10.2 j $\Omega$
Return Loss	-19.8 dB

### Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	49.6 $\Omega$ - 2.4 j $\Omega$
Return Loss	-32.4 dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	55.5 $\Omega$ + 4.7 j $\Omega$
Return Loss	-23.3 dB

### Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.8 $\Omega$ - 8.0 j $\Omega$
Return Loss	-21.9 dB

### Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	49.3 $\Omega$ - 1.2 j $\Omega$
Return Loss	-37.0 dB

### Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.2 $\Omega$ + 6.2 j $\Omega$
Return Loss	-21.7 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns
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After long term use with 40 W 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	February 5, 2004

## DASY4 Validation Report for Head TSL

Date/Time: 02.05.2006 17:04:27

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1018**

Communication System: CW-5GHz; Frequency: 5200 MHz Frequency: 5500 MHz Frequency: 5800 MHz;  
Duty Cycle: 1:1

Medium: HSL 5800 MHz;

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.53$  mho/m;  $\epsilon_r = 35.6$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used:  $f = 5500$  MHz;  $\sigma = 4.8$  mho/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.11$  mho/m;  $\epsilon_r = 34.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

### DASY4 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52)ConvF(5.18, 5.18, 5.18)ConvF(5.02, 5.02, 5.02); Calibrated: 18.03.2006
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 21; Postprocessing SW: SEMCAD, V1.8 Build 165

**d=10mm, Pin=250mW, f=5200 MHz/Area Scan (91x91x1):** Measurement grid: dx=dy=10mm  
Maximum value of SAR (interpolated) = 44.5 mW/g

**d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 78.5 V/m; Power Drift = 0.100 dB  
Peak SAR (extrapolated) = 81.9 W/kg  
**SAR(1 g) = 21.3 mW/g; SAR(10 g) = 5.94 mW/g**  
Maximum value of SAR (measured) = 40.4 mW/g

**d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (8x8x8), dist=2mm 2 (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 77.2 V/m; Power Drift = 0.043 dB  
Peak SAR (extrapolated) = 87.9 W/kg  
**SAR(1 g) = 21.4 mW/g; SAR(10 g) = 6 mW/g**  
Maximum value of SAR (measured) = 46.5 mW/g

**d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 74.6 V/m; Power Drift = 0.046 dB  
Peak SAR (extrapolated) = 87.9 W/kg  
**SAR(1 g) = 20.9 mW/g; SAR(10 g) = 5.83 mW/g**  
Maximum value of SAR (measured) = 44.5 mW/g

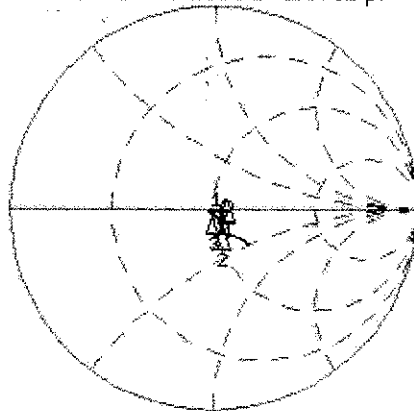


# Impedance Measurement Plot for Head TSL

2 May 2006 11:29:58

CH1 S11 1 U FS 1: 49.691  $\Omega$  -11.898  $\Omega$  2.6752 pF 5 000.000 000 MHz

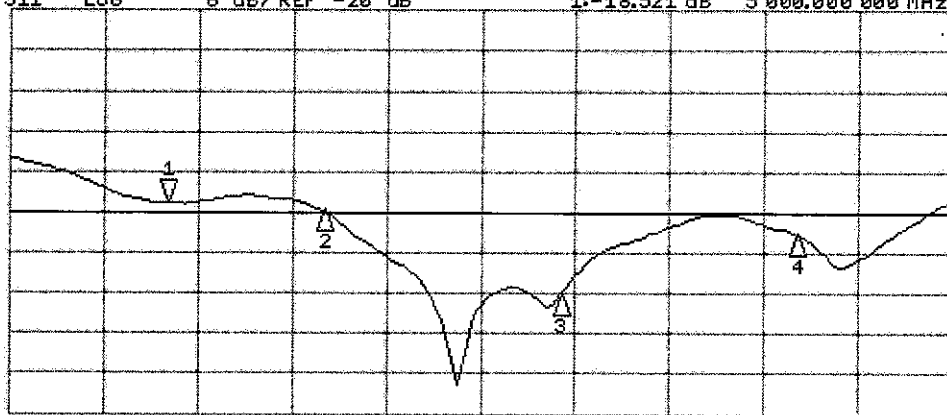
\*  
Del  
Cor  
Avg  
16



CH1 Markers  
2: 52.518  $\Omega$   
-10.199  $\Omega$   
5.20000 GHz  
3: 49.637  $\Omega$   
-2.3535  $\Omega$   
5.50000 GHz  
4: 55.533  $\Omega$   
4.6543  $\Omega$   
5.80000 GHz

CH2 S11 LOG 6 dB/REF -20 dB 1: -18.521 dB 5 000.000 000 MHz

Cor  
Avg  
16



CH2 Markers  
2: -19.830 dB  
5.20000 GHz  
3: -32.415 dB  
5.50000 GHz  
4: -23.296 dB  
5.80000 GHz

## DASY4 Validation Report for Body TSL

Date/Time: 03.05.2006 15:28:08

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1018**

Communication System: CW-5GHz; Frequency: 5200 MHz Frequency: 5500 MHz Frequency: 5800 MHz;  
Duty Cycle: 1:1

Medium: MSL U10 BB;

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.14$  mho/m;  $\epsilon_r = 49.1$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.53$  mho/m;  $\epsilon_r = 48.4$ ;  $\rho = 1000$  kg/m<sup>3</sup> Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.91$  mho/m;  $\epsilon_r = 47.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.98, 4.98, 4.98)ConvF(4.67, 4.67, 4.67)ConvF(4.72, 4.72, 4.72); Calibrated: 18.03.2006
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 15.12.2005
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; ;
- Measurement SW: DASY4, V4.7 Build 21; Postprocessing SW: SEMCAD, V1.8 Build 165

**d=10mm, Pin=250mW, f=5200 MHz/Area Scan (91x91x1):** Measurement grid: dx=dy=10mm  
Maximum value of SAR (interpolated) = 45.0 mW/g

**d=10mm, Pin=250mW, f=5200 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 82.9 V/m; Power Drift = -0.036 dB  
Peak SAR (extrapolated) = 70.7 W/kg  
**SAR(1 g) = 20.3 mW/g; SAR(10 g) = 5.72 mW/g**  
Maximum value of SAR (measured) = 38.2 mW/g

**d=10mm, Pin=250mW, f=5500 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 79.8 V/m; Power Drift = -0.018 dB  
Peak SAR (extrapolated) = 77.4 W/kg  
**SAR(1 g) = 20.3 mW/g; SAR(10 g) = 5.69 mW/g**  
Maximum value of SAR (measured) = 38.6 mW/g

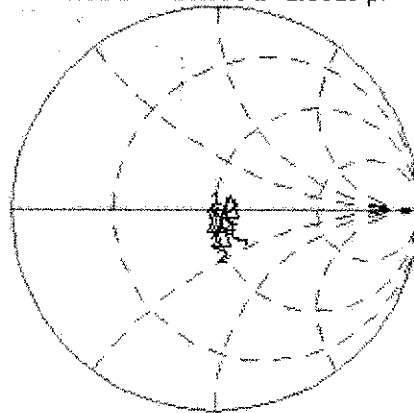
**d=10mm, Pin=250mW, f=5800 MHz/Zoom Scan (8x8x8), dist=2mm (8x8x8)/Cube 0:**  
Measurement grid: dx=4.3mm, dy=4.3mm, dz=3mm  
Reference Value = 72.4 V/m; Power Drift = 0.055 dB  
Peak SAR (extrapolated) = 73.3 W/kg  
**SAR(1 g) = 18.7 mW/g; SAR(10 g) = 5.24 mW/g**  
Maximum value of SAR (measured) = 36.4 mW/g

# Impedance Measurement Plot for Body TSL

2 May 2006 11:31:58

CH1 S11 1 U FS 1: 48.592  $\Omega$  -10.639  $\Omega$  2.9920 pF 5 000.000 000 MHz

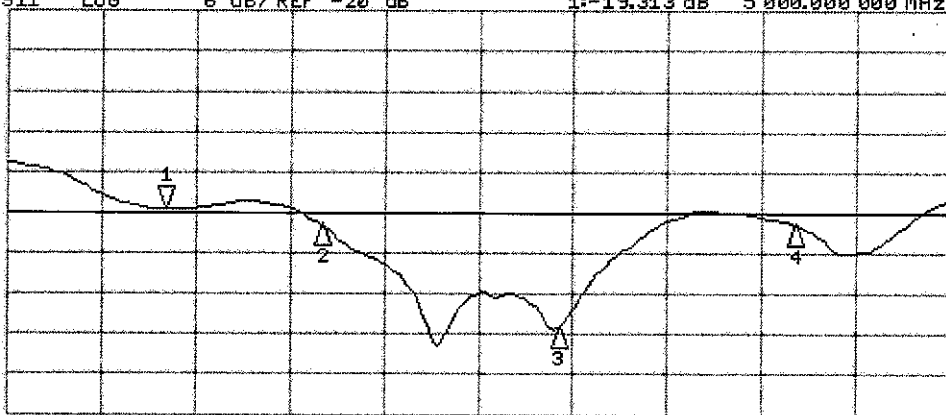
\*  
Del  
Cor  
Avg  
16



CH1 Markers  
2: 51.832  $\Omega$   
-7.9648  $\Omega$   
5.20000 GHz  
3: 49.256  $\Omega$   
-1.1816  $\Omega$   
5.50000 GHz  
4: 56.205  $\Omega$   
6.1895  $\Omega$   
5.80000 GHz

CH2 S11 LOG 6 dB/REF -20 dB 1: -19.313 dB 5 000.000 000 MHz

Cor  
Avg  
16



CH2 Markers  
2: -21.937 dB  
5.20000 GHz  
3: -36.968 dB  
5.50000 GHz  
4: -21.683 dB  
5.80000 GHz

START 4 800.000 000 MHz

STOP 6 000.000 000 MHz