



**1. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating liquid** of the following electrical parameters at 1900 MHz:

Relative Dielectricity	<b>38.8</b>	± 5%
Conductivity	<b>1.47 mho/m</b>	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.96 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

**2. SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm <sup>3</sup> (1 g) of tissue:	<b>41.6 mW/g ± 16.8 % (k=2)<sup>1</sup></b>
averaged over 10 cm <sup>3</sup> (10 g) of tissue:	<b>21.6 mW/g ± 16.2 % (k=2)<sup>1</sup></b>

<sup>1</sup> validation uncertainty



**3. Dipole Impedance and Return Loss**

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay: **1.200 ns** (one direction)  
Transmission factor: **0.993** (voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 1900 MHz:  $Re\{Z\} = 51.2 \Omega$   
 $Im\{Z\} = 4.9\Omega$   
Return Loss at 1900 MHz: **-26.1 dB**

**4. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating tissue** of the following electrical parameters at 1900 MHz:

Relative Dielectricity **52.5**  $\pm 5\%$   
Conductivity **1.58 mho/m**  $\pm 5\%$

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 4.57 at 1900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.  
The dipole input power (forward power) was 250mW  $\pm 3 \%$ . The results are normalized to 1W input power.



### 5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1 W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue: **42.0 mW/g ± 16.8 % (k=2)<sup>2</sup>**

averaged over 10 cm<sup>3</sup> (10 g) of tissue: **22.0 mW/g ± 16.2 % (k=2)<sup>2</sup>**

### 6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 1900 MHz: **Re{Z} = 46.6 Ω**

**Im {Z} = 5.1 Ω**

Return Loss at 1900 MHz **-24.0 dB**

### 7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

### 8. Design

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.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Section 1. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

### 9. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

<sup>2</sup> validation uncertainty



Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d041**

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: HSL 1900 MHz;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.47$  mho/m;  $\epsilon_r = 38.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DAS4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.96, 4.96, 4.96); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DAS4, V4.2 Build 30; Postprocessing SW: SEMCAD, V1.8 Build 98

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 93.8 V/m

Power Drift = 0.002 dB

Maximum value of SAR = 11.8 mW/g

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

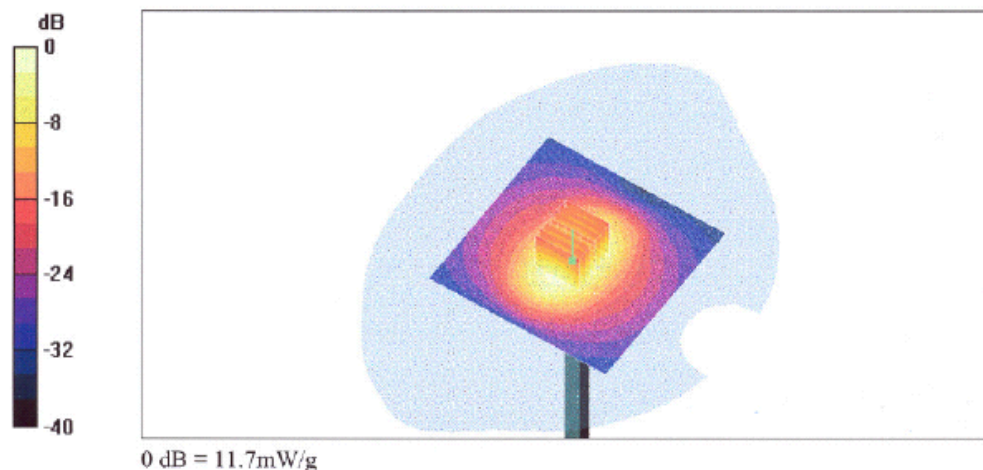
Peak SAR (extrapolated) = 18.7 W/kg

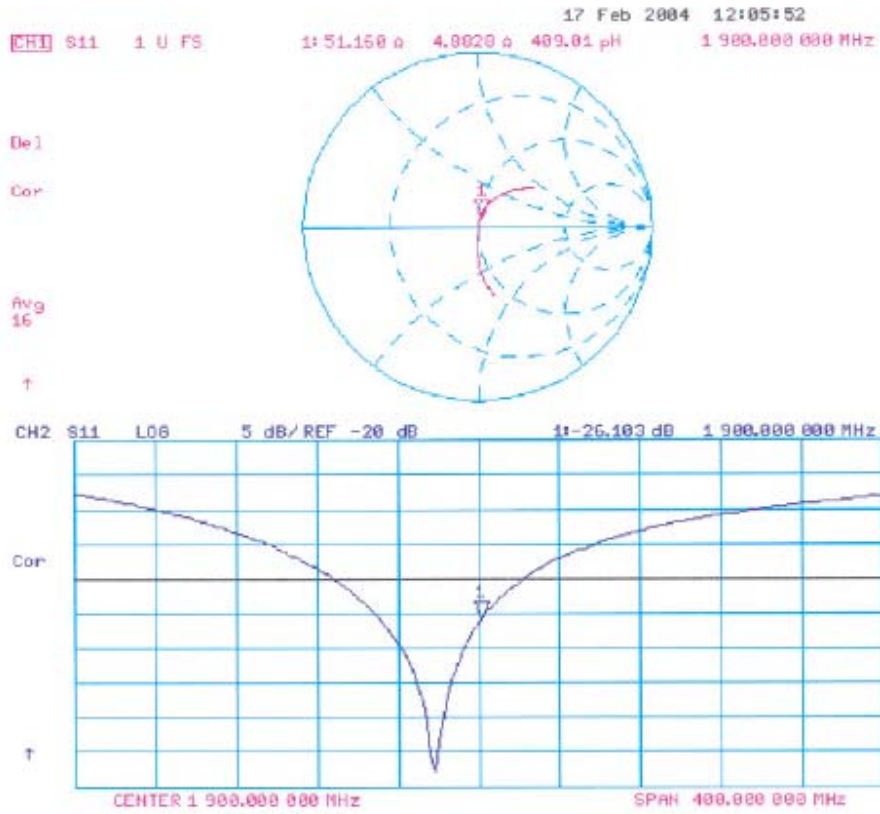
**SAR(1 g) = 10.4 mW/g; SAR(10 g) = 5.39 mW/g**

Reference Value = 93.8 V/m

Power Drift = 0.002 dB

Maximum value of SAR = 11.7 mW/g







Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN5d041**

Communication System: CW-1900; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: Muscle 1900 MHz;

Medium parameters used:  $f = 1900$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 52.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

Measurement Standard: DASYS4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(4.57, 4.57, 4.57); Calibrated: 1/23/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 11/6/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006;
- Measurement SW: DASYS4, V4.2 Build 25; Postprocessing SW: SEMCAD, V1.8 Build 101

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 92.6 V/m; Power Drift = 0.0 dB

Maximum value of SAR (interpolated) = 11.8 mW/g

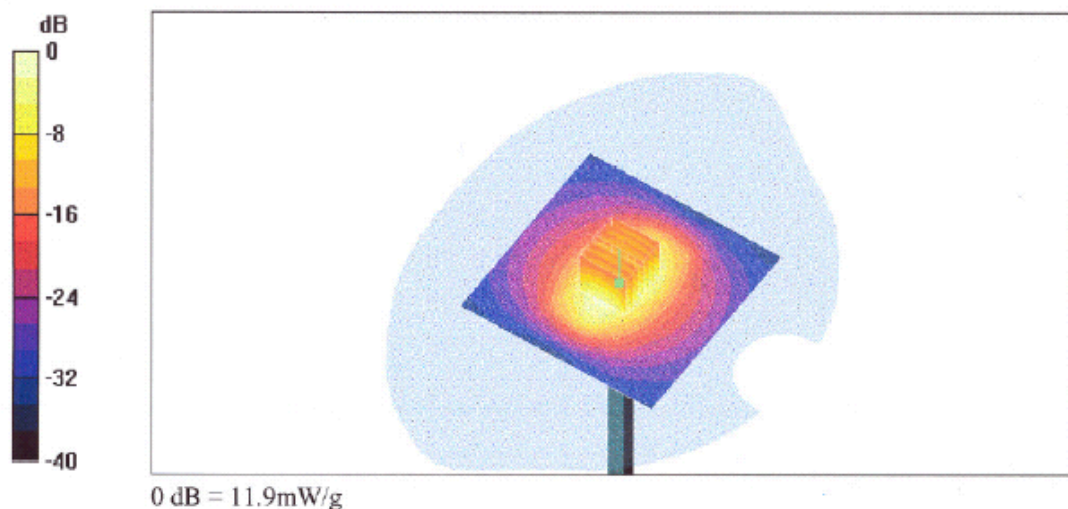
**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

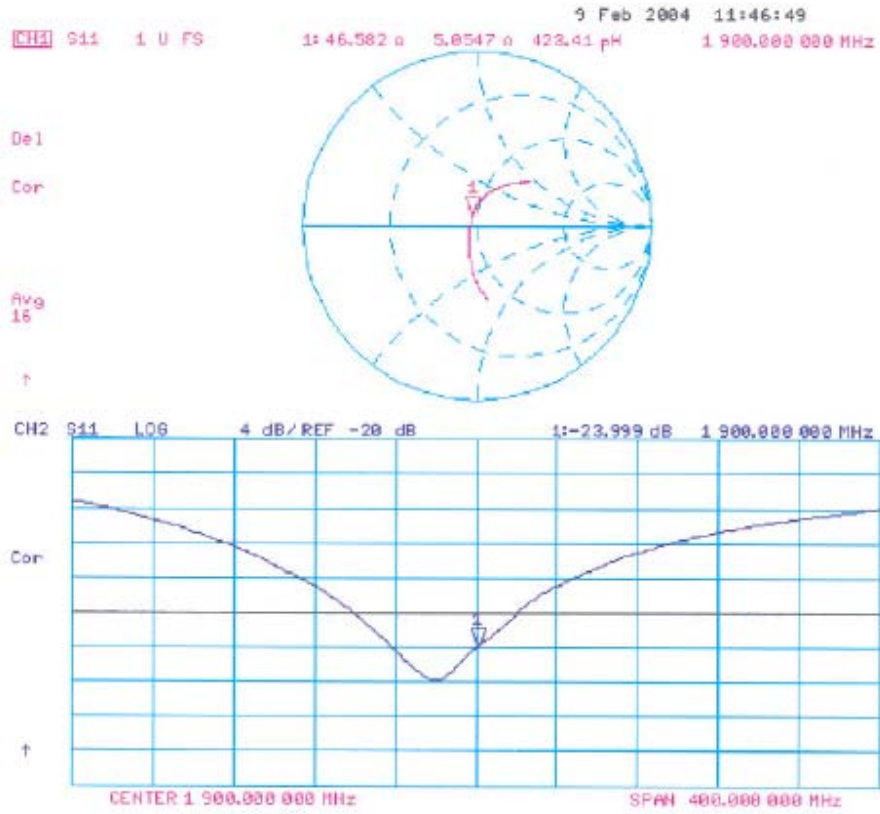
Reference Value = 92.6 V/m; Power Drift = 0.0 dB

Maximum value of SAR (measured) = 11.9 mW/g

Peak SAR (extrapolated) = 18.8 W/kg

SAR(1 g) = 10.5 mW/g; SAR(10 g) = 5.49 mW/g







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

Client Auden > Sporton Int. Inc.

CALIBRATION CERTIFICATE			
Object(s)	ET3DV6 - SN:1788		
Calibration procedure(s)	QA CAL-01 v2 Calibration procedure for dosimetric E-field probes		
Calibration date:	August 29, 2003		
Condition of the calibrated item	In Tolerance (according to the specific calibration document)		
This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.			
All calibrations have been conducted in the closed laboratory facility; environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.			
Calibration Equipment used (M&TE critical for calibration)			
Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03
Calibrated by:	Name Nico Veltens	Function Technician	Signature 
Approved by:	Name Katja Pokovic	Function Laboratory Director	Signature 
Date issued: August 28, 2003			
This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.			





Schmid & Partner Engineering AG

**s p e a g**

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info@speag.com, <http://www.speag.com>

# Probe ET3DV6

## SN:1788

Manufactured: May 28, 2003  
Last calibration: August 29, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)



ET3DV6 SN:1788

August 29, 2003

### DASY - Parameters of Probe: ET3DV6 SN:1788

#### Sensitivity in Free Space

NormX	1.68 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.62 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.71 $\mu\text{V}/(\text{V}/\text{m})^2$

#### Diode Compression

DCP X	95	mV
DCP Y	95	mV
DCP Z	95	mV

#### Sensitivity in Tissue Simulating Liquid

Head 900 MHz  $\epsilon_r = 41.5 \pm 5\%$   $\sigma = 0.97 \pm 5\%$  mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.6 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.6 $\pm 9.5\%$ (k=2)	Alpha 0.34
ConvF Z	6.6 $\pm 9.5\%$ (k=2)	Depth 2.48

Head 1800 MHz  $\epsilon_r = 40.0 \pm 5\%$   $\sigma = 1.40 \pm 5\%$  mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha 0.43
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth 2.80

#### Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR <sub>te</sub> [%] Without Correction Algorithm		8.7	5.0
SAR <sub>te</sub> [%] With Correction Algorithm		0.3	0.5

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR <sub>te</sub> [%] Without Correction Algorithm		12.8	8.9
SAR <sub>te</sub> [%] With Correction Algorithm		0.3	0.1

#### Sensor Offset

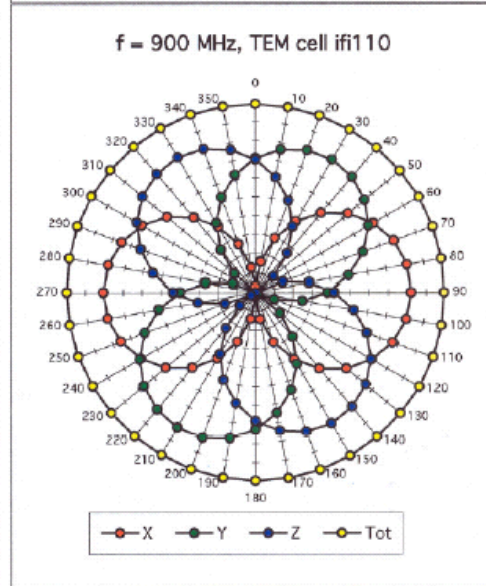
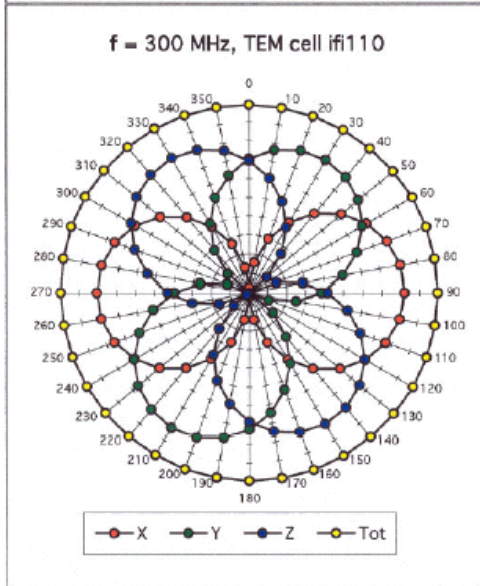
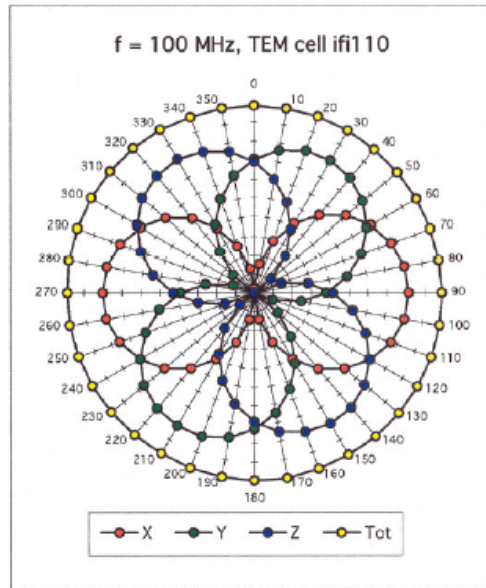
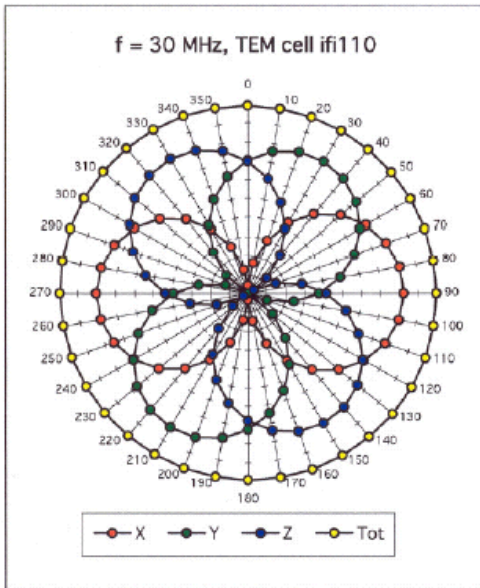
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 $\pm 0.2$	mm



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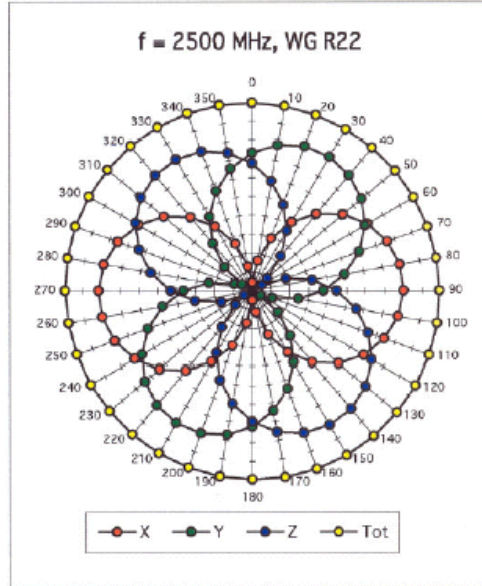
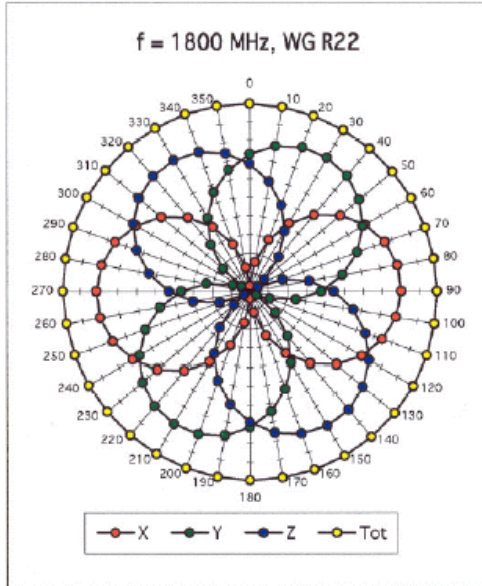
Receiving Pattern ( $\phi$ ),  $\theta = 0^\circ$



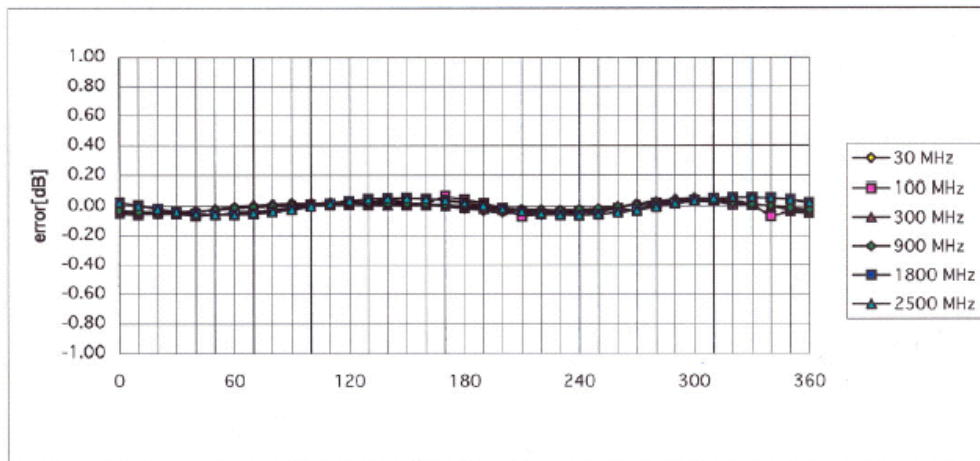


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August 29, 2003



Isotropy Error ( $\phi$ ),  $\theta = 0^\circ$



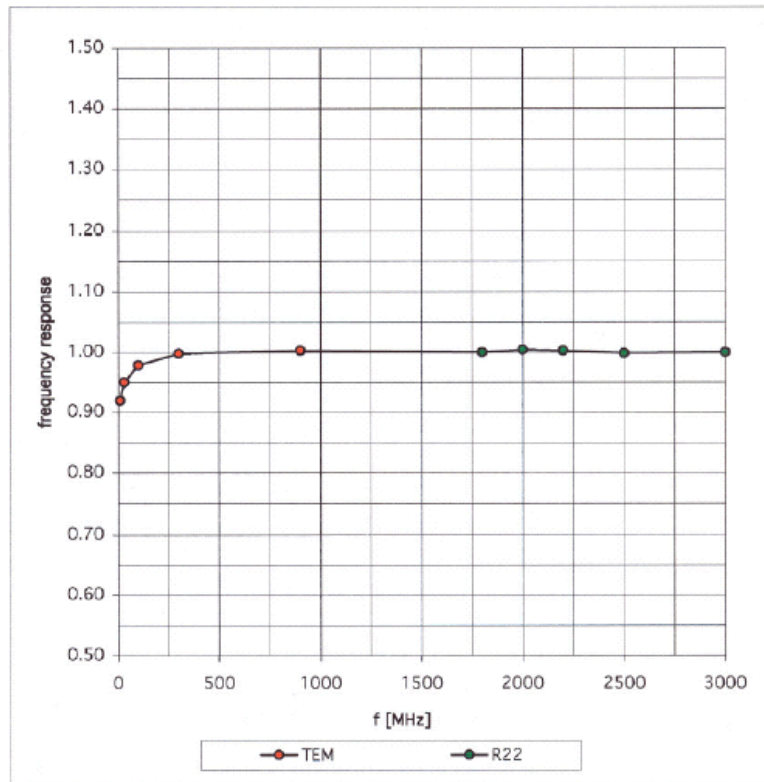


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August 29, 2003

### Frequency Response of E-Field

( TEM-Cell:ifi110, Waveguide R22)



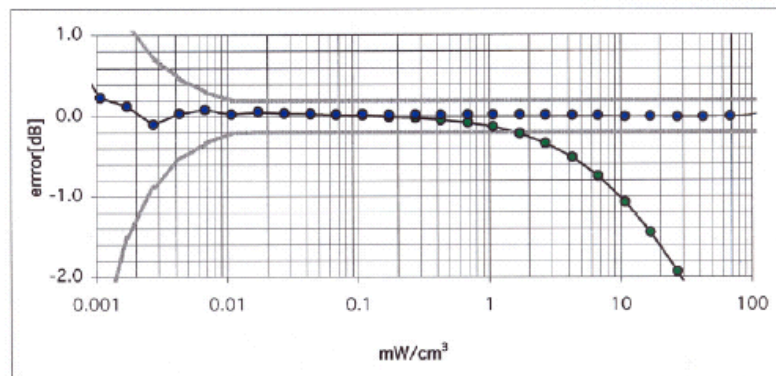
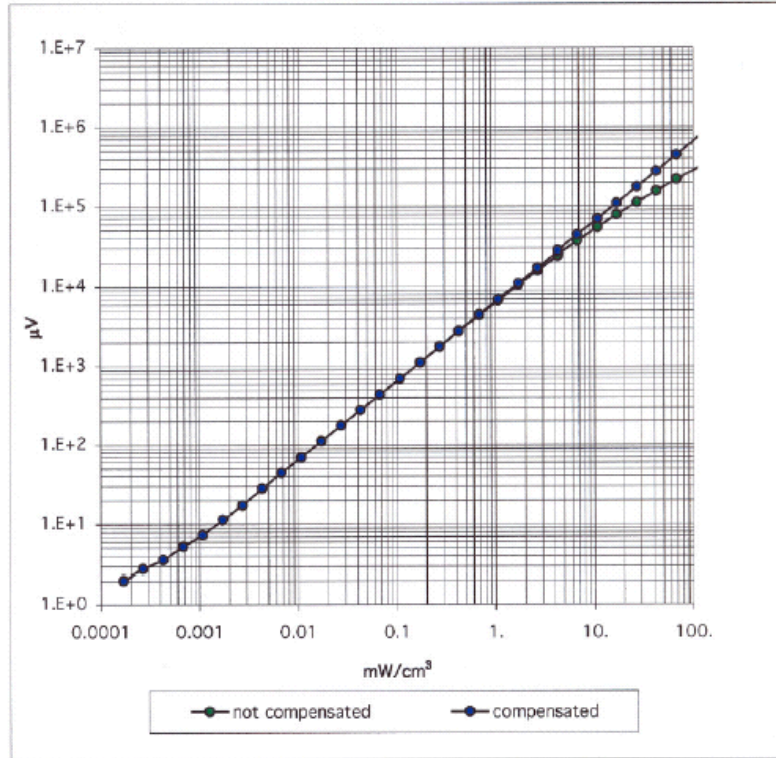


ET3DV6 SN:1788

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### Dynamic Range f(SAR<sub>brain</sub>)

( Waveguide R22 )

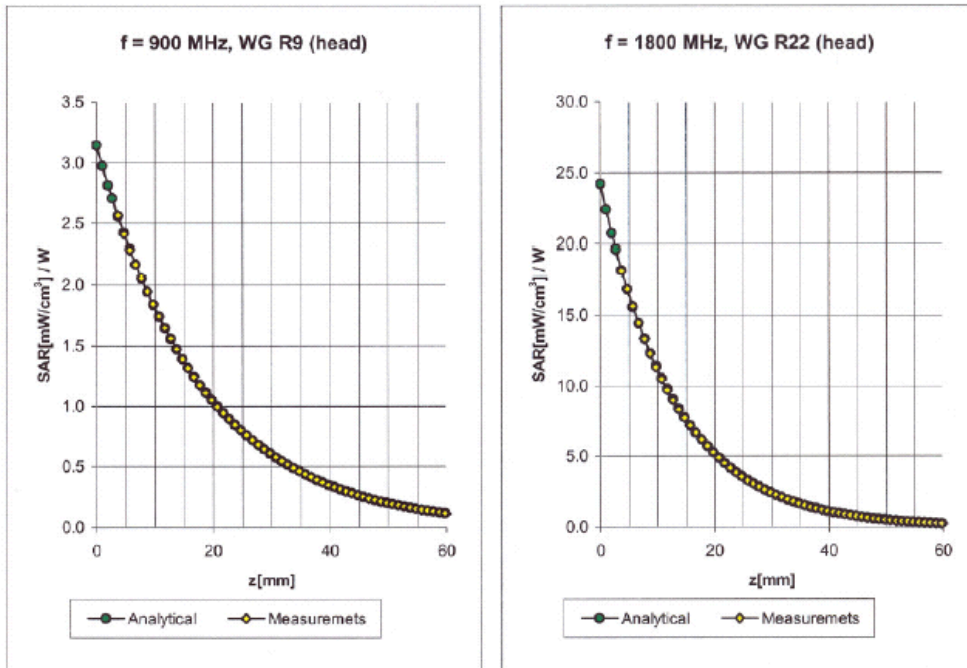




ET3DV6 SN:1788

August 29, 2003

### Conversion Factor Assessment



Head                      900 MHz                       $\epsilon_r = 41.5 \pm 5\%$                        $\sigma = 0.97 \pm 5\%$  mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.6 ± 9.5% (k=2)	Alpha	0.34
ConvF Z	6.6 ± 9.5% (k=2)	Depth	2.48

Head                      1800 MHz                       $\epsilon_r = 40.0 \pm 5\%$                        $\sigma = 1.40 \pm 5\%$  mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

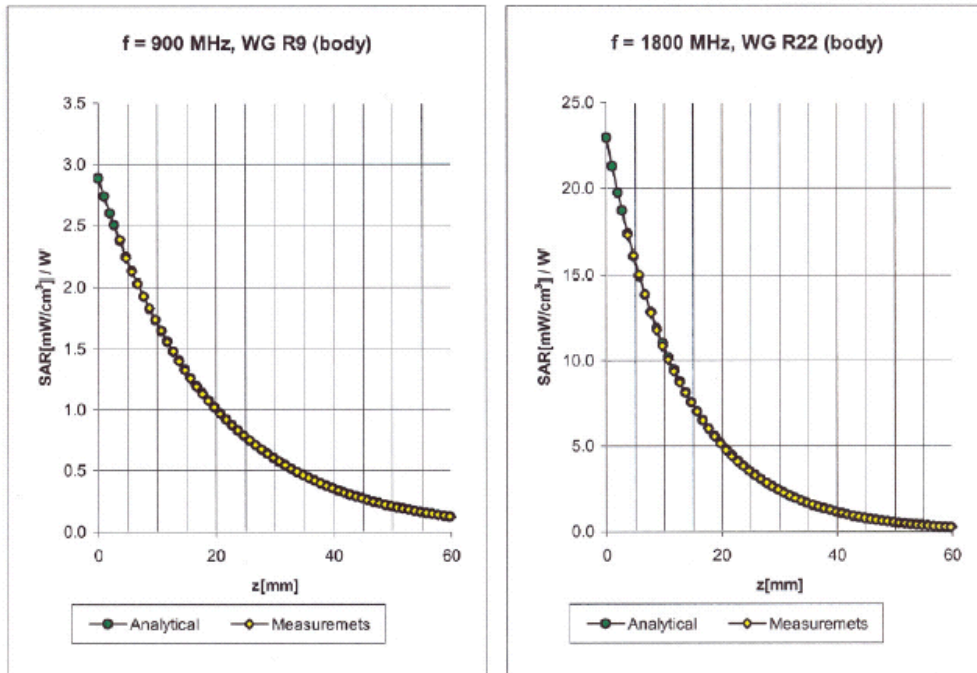
ConvF X	5.3 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.3 ± 9.5% (k=2)	Alpha	0.43
ConvF Z	5.3 ± 9.5% (k=2)	Depth	2.80



ET3DV6 SN:1788

August 29, 2003

### Conversion Factor Assessment



Body                      900 MHz                       $\epsilon_r = 55.0 \pm 5\%$                        $\sigma = 1.05 \pm 5\%$  mho/m

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	$6.5 \pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	$6.5 \pm 9.5\%$ (k=2)	Alpha	<b>0.31</b>
ConvF Z	$6.5 \pm 9.5\%$ (k=2)	Depth	<b>2.92</b>

Body                      1800 MHz                       $\epsilon_r = 53.3 \pm 5\%$                        $\sigma = 1.52 \pm 5\%$  mho/m

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	$5.0 \pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	$5.0 \pm 9.5\%$ (k=2)	Alpha	<b>0.51</b>
ConvF Z	$5.0 \pm 9.5\%$ (k=2)	Depth	<b>2.78</b>

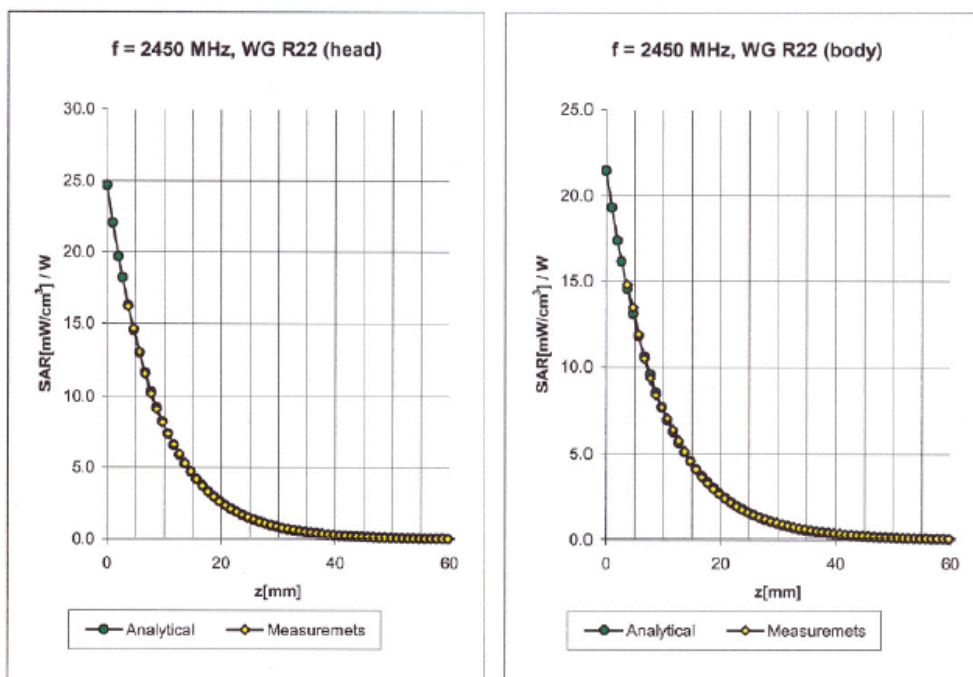




ET3DV6 SN:1788

August 29, 2003

### Conversion Factor Assessment



Head                      2450 MHz                       $\epsilon_r = 39.2 \pm 5\%$                        $\sigma = 1.80 \pm 5\%$  mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.7 ± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.7 ± 8.9% (k=2)	Alpha	<b>0.99</b>
ConvF Z	4.7 ± 8.9% (k=2)	Depth	<b>1.81</b>

Body                      2450 MHz                       $\epsilon_r = 52.7 \pm 5\%$                        $\sigma = 1.95 \pm 5\%$  mho/m

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.5 ± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.5 ± 8.9% (k=2)	Alpha	<b>1.01</b>
ConvF Z	4.5 ± 8.9% (k=2)	Depth	<b>1.74</b>

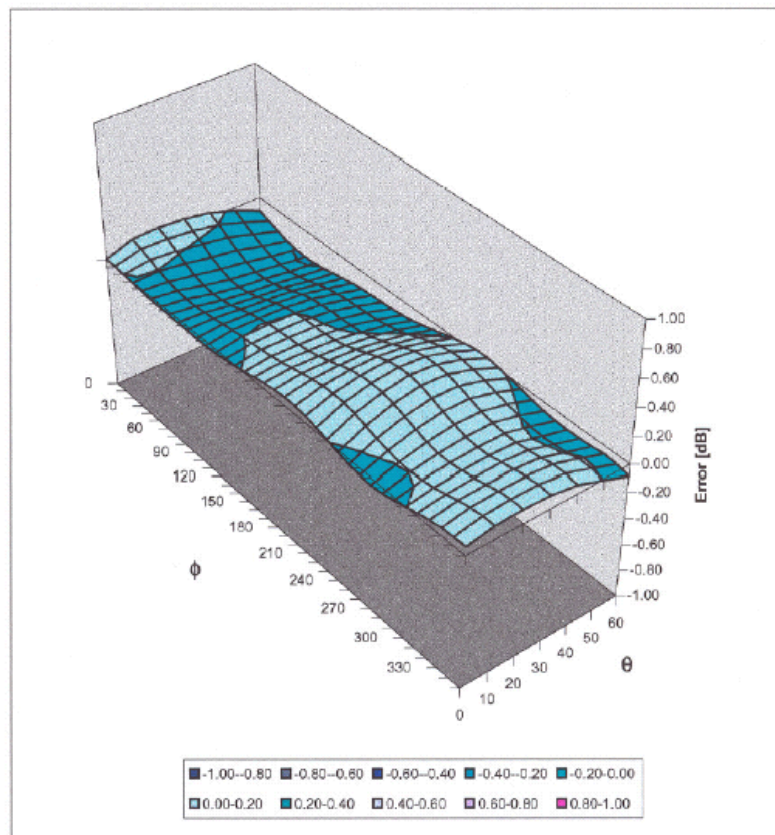


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### Deviation from Isotropy in HSL

Error ( $\theta, \phi$ ),  $f = 900$  MHz





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

Client **Sporton (Auden)**

CALIBRATION CERTIFICATE			
Object(s)	DAE3 – SD 000 D03 AA – SN:577		
Calibration procedure(s)	QA CAL-06.v4 Calibration procedure for the data acquisition unit (DAE)		
Calibration date:	21.11.2003		
Condition of the calibrated item	In Tolerance (according to the specific calibration document)		
This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.			
All calibrations have been conducted in the closed laboratory facility environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.			
Calibration Equipment used (M&TE critical for calibration)			
Model Type	ID #	Cal Date	Scheduled Calibration
Fluke Process Calibrator Type 702	SN. 6295803	8-Sep-03	Sep-05
Calibrated by:	Name Philipp Storchenegger	Function Technician	Signature 
Approved by:	Name Fin Bomholt	Function R&D Director	Signature 
Date issued 21.11.2003			
This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.			



DAE3 SN: 577

DATE: 21.11.2003

**1. Cal Lab. Incoming Inspection & Pre Test**

<b>Modification Status</b>	Note Status here → → → →	BC
<b>Visual Inspection</b>	Note anomalies.....	None
	.....	.....
<b>Pre Test</b>	<b>Indication</b>	<b>Yes/No</b>
<b>Probe Touch</b>	Function	Yes
<b>Probe Collision</b>	Function	Yes
<b>Probe Touch&amp;Collision</b>	Function	Yes

**2. DC Voltage Measurement**

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1µV, full range = 400 mV  
 Low Range: 1LSB = 61nV, full range = 4 mV

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

Calibration Factors	X	Y	Z
High Range	404.434	403.889	404.352
Low Range	3.94303	3.94784	3.9501
Connector Angle to be used in DASY System	127 °		

High Range	Input	Reading in µV	% Error
Channel X + Input	200mV	200000.6	0.00
	20mV	20000.9	0.00
Channel X - Input	20mV	-19992.7	-0.04
Channel Y + Input	200mV	200000.6	0.00
	20mV	19999.1	0.00
Channel Y - Input	20mV	-19994.7	-0.03
Channel Z + Input	200mV	199999.8	0.00
	20mV	19998.1	-0.01
Channel Z - Input	20mV	-19999.2	0.00

Low Range	Input	Reading in µV	% Error
Channel X + Input	2mV	1999.94	0.00
	0.2mV	199.08	-0.46
Channel X - Input	0.2mV	-200.24	0.12
Channel Y + Input	2mV	1999.98	0.00
	0.2mV	199.50	-0.25
Channel Y - Input	0.2mV	-200.80	0.40
Channel Z + Input	2mV	1999.98	0.00
	0.2mV	199.11	-0.44
Channel Z - Input	0.2mV	-201.12	0.56



DAE3 SN: 577

DATE: 21.11.2003

**3. Common mode sensitivity**

DASY measurement parameters:

Auto Zero Time: 3 sec,

Measuring time: 3 sec

High/Low Range

in $\mu\text{V}$	Common mode Input Voltage	High Range Reading	Low Range Reading
Channel X	200mV	12.00	11.9
	- 200mV	-10.76	-12.44
Channel Y	200mV	-8.55	-8.51
	- 200mV	7.58	6.67
Channel Z	200mV	-0.86	-0.58
	- 200mV	-0.85	-0.77

**4. Channel separation**

DASY measurement parameters:

Auto Zero Time: 3 sec,

Measuring time: 3 sec

High Range

in $\mu\text{V}$	Input Voltage	Channel X	Channel Y	Channel Z
Channel X	200mV	-	1.96	0.28
Channel Y	200mV	0.66	-	3.59
Channel Z	200mV	-0.89	-0.11	-

**5.1 AD-Converter Values with Input Voltage set to 2.0 VDC**

in Zero Low	Low Range Max - Min	Max.	Min
Channel X	17	16137	16120
Channel Y	27	16767	16740
Channel Z	8	15103	15077

**5.2 AD-Converter Values with inputs shorted**

in LSB	Low Range	High Range
Channel X	16134	15955
Channel Y	16740	15960
Channel Z	15093	16252

**6. Input Offset Measurement**



DAE3 SN: 577

DATE: 21.11.2003

DASY measurement parameters:

Auto Zero Time: 3 sec, Measuring time: 3 sec  
Number of measurements: 100, Low Range

Input 10MΩ

in μV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	-0.64	-1.84	0.71	0.49
Channel Y	-1.77	-3.93	0.94	0.58
Channel Z	-2.21	-3.14	-0.81	0.34

Input shorted

in μV	Average	min. Offset	max. Offset	Std. Deviation
Channel X	0.12	-1.34	1.45	0.69
Channel Y	-0.69	-1.39	0.30	0.26
Channel Z	-0.94	-1.58	-0.30	0.23

**7. Input Offset Current**

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

**8. Input Resistance**

In MOhm	Calibrating	Measuring
Channel X	0.2000	197.1
Channel Y	0.1999	200.3
Channel Z	0.2001	198.3

**9. Low Battery Alarm Voltage**

in V	Alarm Level
Supply (+ Vcc)	7.58
Supply (- Vcc)	-7.65

**10. Power Consumption**

in mA	Switched off	Stand by	Transmitting
Supply (+ Vcc)	0.00	5.65	13.7
Supply (- Vcc)	-0.01	-7.69	-8.97