

**ANNEX 1: ET3DV6 CALIBRATION CERTIFICATE**

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



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**C** Service suisse d'étalonnage  
**S** Servizio svizzero di taratura  
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client: **EMITECH Le Mans**

Certificate No: **ET3-1544\_Aug09**

**CALIBRATION CERTIFICATE**

Object: **ET3DV6 - SN:1544**

Calibration procedure(s): **QA CAL-01.v6, QA CAL-12.v5, QA CAL-23.v3 and QA CAL-25.v2  
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 24, 2009**

Condition of the calibrated item: **In Tolerance**

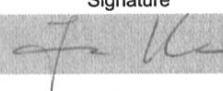

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41495277	1-Apr-09 (No. 217-01030)	Apr-10
Power sensor E4412A	MY41498087	1-Apr-09 (No. 217-01030)	Apr-10
Reference 3 dB Attenuator	SN: S5054 (3c)	31-Mar-09 (No. 217-01026)	Mar-10
Reference 20 dB Attenuator	SN: S5086 (20b)	31-Mar-09 (No. 217-01028)	Mar-10
Reference 30 dB Attenuator	SN: S5129 (30b)	31-Mar-09 (No. 217-01027)	Mar-10
Reference Probe ES3DV2	SN: 3013	2-Jan-09 (No. ES3-3013_Jan09)	Jan-10
DAE4	SN: 660	9-Sep-08 (No. DAE4-660_Sep08)	Sep-09

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-07)	In house check: Oct-09
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-08)	In house check: Oct-09

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

Issued: August 24, 2009

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### Glossary:

TSL	tissue simulating liquid
NORM <sub>x,y,z</sub>	sensitivity in free space
ConvF	sensitivity in TSL / NORM <sub>x,y,z</sub>
DCP	diode compression point
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\vartheta$	$\vartheta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis

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

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

### Methods Applied and Interpretation of Parameters:

- NORM<sub>x,y,z</sub>**: Assessed for E-field polarization  $\vartheta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the E<sup>2</sup>-field uncertainty inside TSL (see below ConvF).
- NORM(f)<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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.
- DCP<sub>x,y,z</sub>**: 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  $f \leq 800$  MHz) and inside waveguide using analytical field distributions based on power measurements for  $f > 800$  MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM<sub>x,y,z</sub> \* 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  $\pm 50$  MHz to  $\pm 100$  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.

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# Probe ET3DV6

## SN:1544

Manufactured:	October 16, 2000
Last calibrated:	May 19, 2008
Recalibrated:	August 24, 2009

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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## DASY - Parameters of Probe: ET3DV6 SN:1544

Sensitivity in Free Space <sup>A</sup>			Diode Compression <sup>B</sup>	
NormX	1.49 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	90 mV
NormY	1.35 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	88 mV
NormZ	1.46 ± 10.1%	$\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	93 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 <sub>be</sub> [%] Without Correction Algorithm	11.6	7.4
	SAR <sub>be</sub> [%] With Correction Algorithm	0.9	0.3
TSL	1810 MHz	Typical SAR gradient: 10 % per mm	
	Sensor Center to Phantom Surface Distance	3.7 mm	4.7 mm
	SAR <sub>be</sub> [%] Without Correction Algorithm	12.9	8.8
	SAR <sub>be</sub> [%] With Correction Algorithm	0.8	0.6

### 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%.**

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).

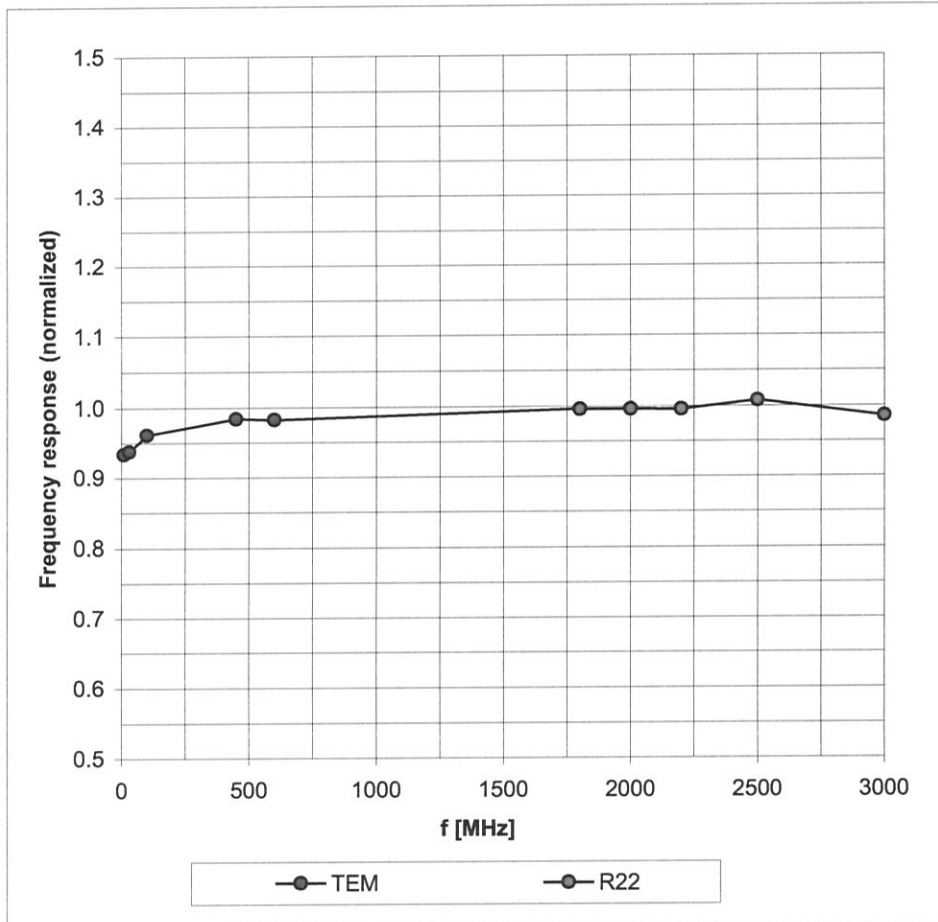
<sup>B</sup> Numerical linearization parameter: uncertainty not required.

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### Frequency Response of E-Field

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

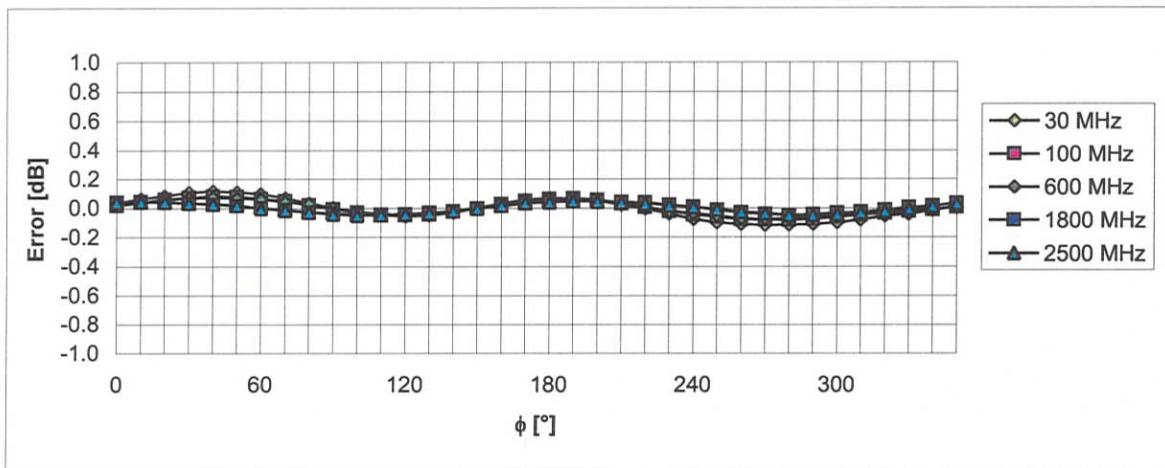
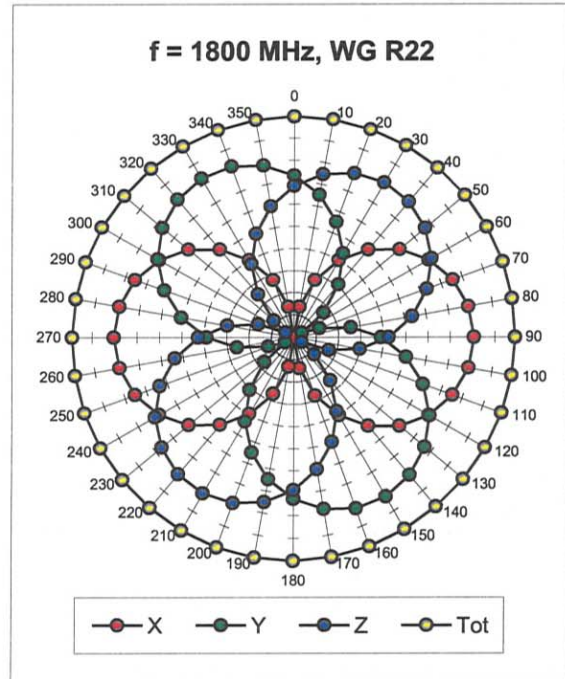
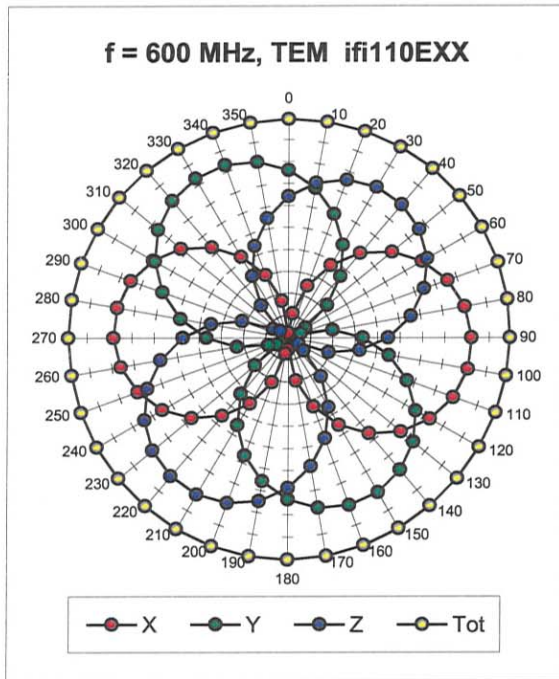


Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  (k=2)

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

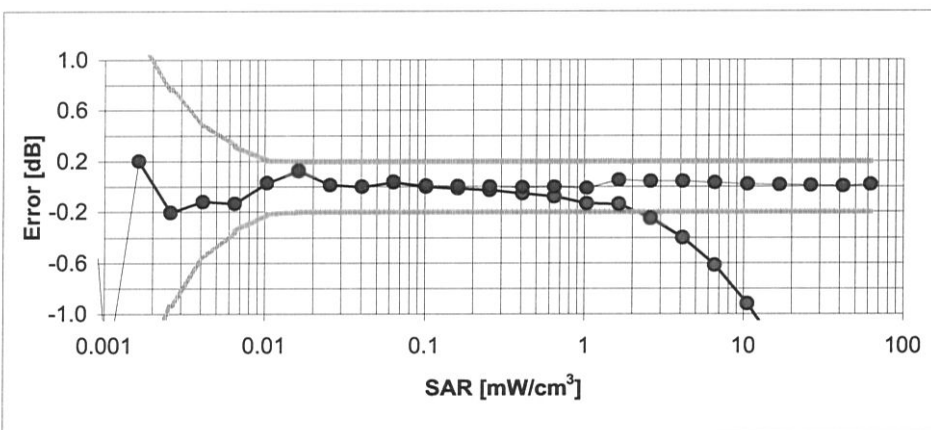
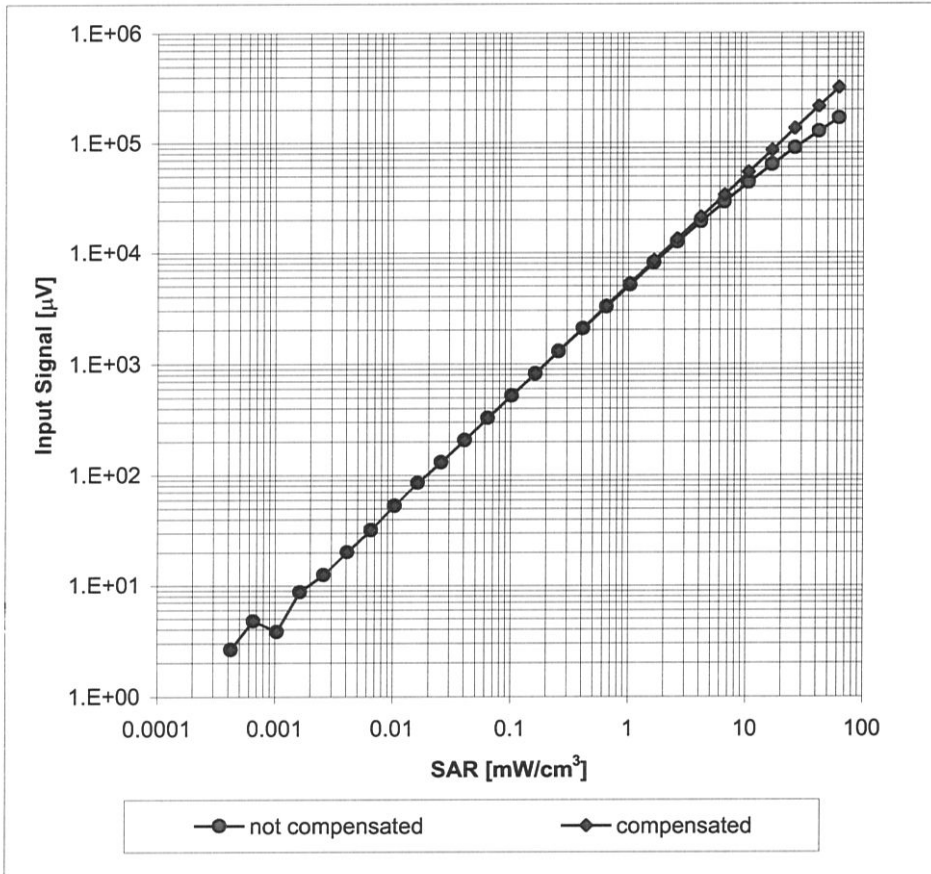


Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  (k=2)

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### Dynamic Range f(SAR<sub>head</sub>) (Waveguide R22, f = 1800 MHz)

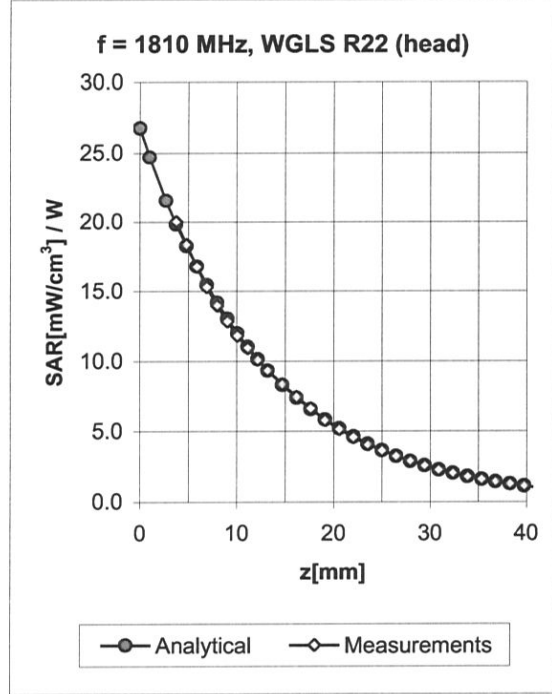
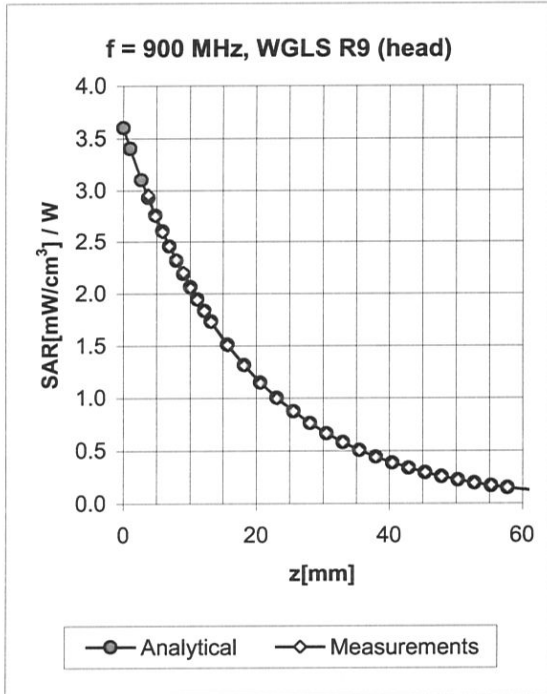


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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### Conversion Factor Assessment



f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.31	1.99	6.81 ± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.26	3.72	6.00 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.72	2.30	5.08 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.96	1.98	4.84 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.99	1.68	4.32 ± 11.0% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.66	2.07	5.76 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.71	2.87	4.59 ± 11.0% (k=2)

<sup>c</sup> 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.

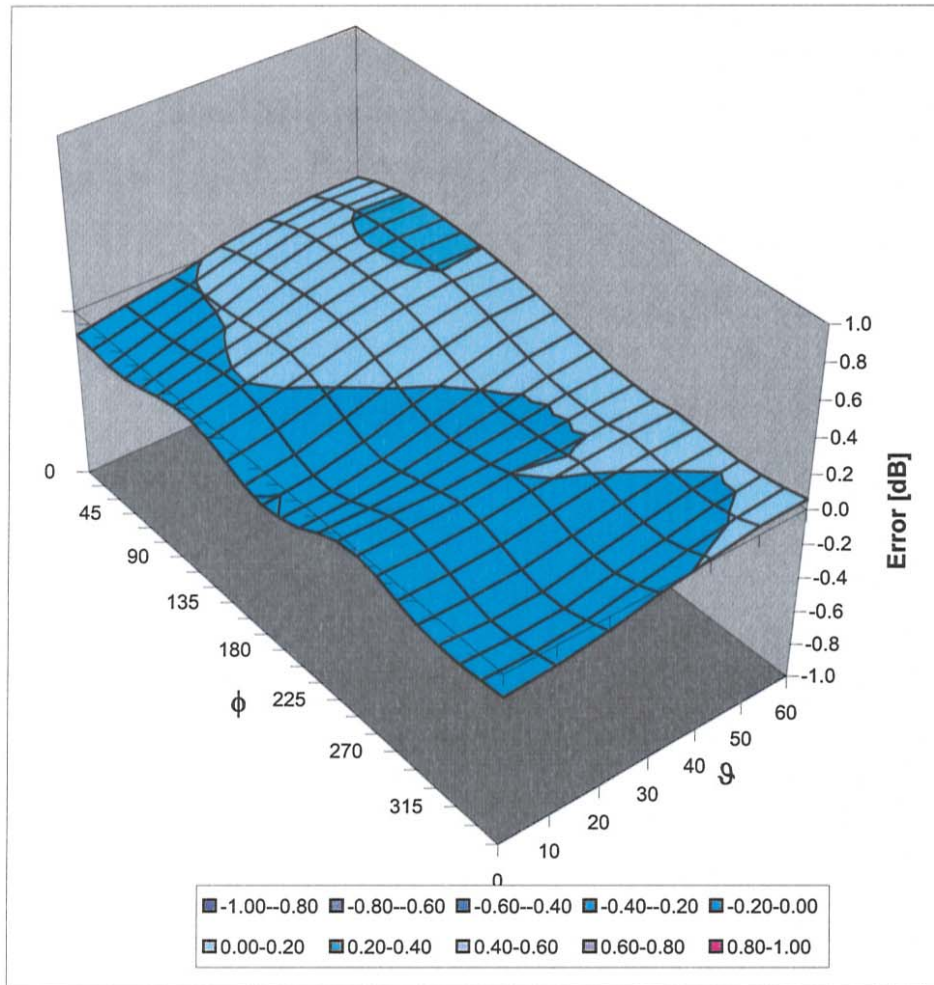


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### Deviation from Isotropy in HSL

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



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

**ANNEX 2: DAE4 CALIBRATION CERTIFICATE**

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Accreditation No.: **SCS 108**

Client **SPEAG (Replacement)**

Certificate No: **DAE4-900\_Jan11**

**CALIBRATION CERTIFICATE**

Object **DAE4 - SD 000 D04 BK - SN: 900**

Calibration procedure(s) **QA CAL-06.v22  
Calibration procedure for the data acquisition electronics (DAE)**



Calibration date: **January 24, 2011**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	28-Sep-10 (No:10376)	Sep-11
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Calibrator Box V1.1	SE UMS 006 AB 1004	07-Jun-10 (in house check)	In house check: Jun-11

Calibrated by:	Name <b>Andrea Guntli</b>	Function <b>Technician</b>	Signature 
Approved by:	Name <b>Fin Bomholt</b>	Function <b>R&amp;D Director</b>	Signature 

Issued: January 25, 2011

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## Glossary

DAE data acquisition electronics  
Connector angle information used in DASYS 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 DASYS 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:* Typical value for information: 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	403.724 $\pm$ 0.1% (k=2)	404.099 $\pm$ 0.1% (k=2)	403.726 $\pm$ 0.1% (k=2)
Low Range	3.94981 $\pm$ 0.7% (k=2)	3.97362 $\pm$ 0.7% (k=2)	3.95119 $\pm$ 0.7% (k=2)

### Connector Angle

Connector Angle to be used in DASY system	89.0 $\pm$ 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	200007.1	-1.62	-0.00
Channel X + Input	20003.21	3.61	0.02
Channel X - Input	-19996.29	3.01	-0.02
Channel Y + Input	200006.4	-1.12	-0.00
Channel Y + Input	19997.94	-1.56	-0.01
Channel Y - Input	-20000.65	-1.35	0.01
Channel Z + Input	200007.2	0.35	0.00
Channel Z + Input	19996.71	-2.79	-0.01
Channel Z - Input	-19995.58	4.52	-0.02

Low Range	Reading ( $\mu\text{V}$ )	Difference ( $\mu\text{V}$ )	Error (%)
Channel X + Input	1999.8	-0.20	-0.01
Channel X + Input	200.92	1.12	0.56
Channel X - Input	-198.84	0.96	-0.48
Channel Y + Input	1999.8	-0.23	-0.01
Channel Y + Input	200.49	0.39	0.19
Channel Y - Input	-199.85	0.25	-0.12
Channel Z + Input	2000.3	0.34	0.02
Channel Z + Input	199.81	-0.19	-0.09
Channel Z - Input	-199.76	0.24	-0.12

### 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	3.74	1.89
	- 200	-0.20	-2.34
Channel Y	200	-0.77	-0.83
	- 200	-0.11	-0.28
Channel Z	200	-2.34	-2.60
	- 200	0.48	0.55

### 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	-	2.27	-0.80
Channel Y	200	2.90	-	3.39
Channel Z	200	1.73	-1.10	-

#### 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	16156	16419
Channel Y	15836	16028
Channel Z	16389	16210

#### 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	0.59	-0.46	1.73	0.40
Channel Y	-0.75	-1.87	0.29	0.39
Channel Z	-0.63	-1.94	1.83	0.42

#### 6. Input Offset Current

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

#### 7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

#### 8. Low Battery Alarm Voltage (Typical values for information)

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

#### 9. Power Consumption (Typical values for information)

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

**ANNEX 3: D900V2 CALIBRATION CERTIFICATE**



**CALIBRATION CERTIFICATE**

Equipment under calibration:

*Designation:* 900MHz dipole  
*Brand:* Schmid & Partner Engineering AG  
*Type:* D900V2  
*Serial number:* 086  
*Emitech number:* 7194

Calibration date: March 02, 2011

Operator: Emmanuel TOUTAIN

Calibration procedure: PRTFIC000MET00050

Environnemental conditions :

*Temperature:* 20.8°C  
*Hygrometry:* 49% HR

Equipment used:

EMITECH N°	DESIGNATION	BRAND	TYPE	CALIBRATION DATE
7216	Network Analyser	Hewlett Packard	8753D	December 04, 2009
7217	Calibration kit	Hewlett Packard	85033D	December 04, 2009

Liquid measurements:

Frequency (MHz)	Liquid : Head		Liquid : Body (1)	
	Sigma	Epsilon	Sigma	Epsilon
900	-	-	54.0	1.04

Note (1): dielectric properties according to Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)

Return loss measurements:

Dipole	Frequency (MHz)	Liquid : Head		Liquid : Body	
		Return loss (dB)	Verdict (2) ≤ -20dB	Return loss (dB)	Verdict (2) ≤ -20dB
D900V2	900	-	-	-22.6	<b>PASS</b>

Note (2): The reference dipole shall have a return loss better than -20 dB.

Conclusion: In Tolerance

(in body tissue at 900MHz according to the Supplement C to OET Bulletin 65)

Visa:

