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## Annex A.2 Photographs of Test Setup



**Photograph of the SAR measurement System**

### Annex A.3 Test Position

(a) Body\_Front\_gap 0 mm



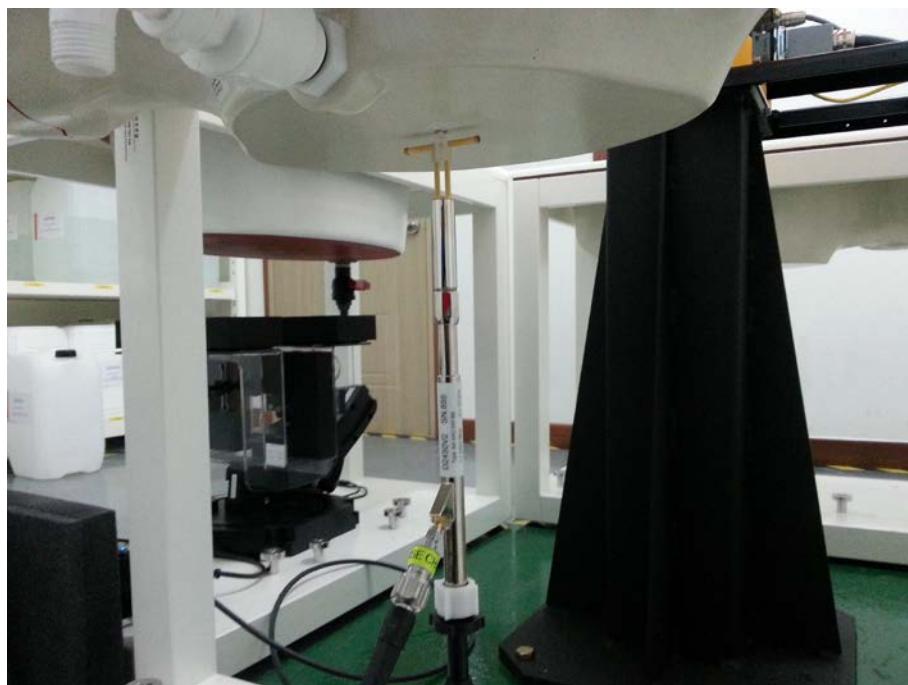
(b) Body\_Back\_gap 0 mm



**(c) Body\_Edge2\_gap 0 mm**

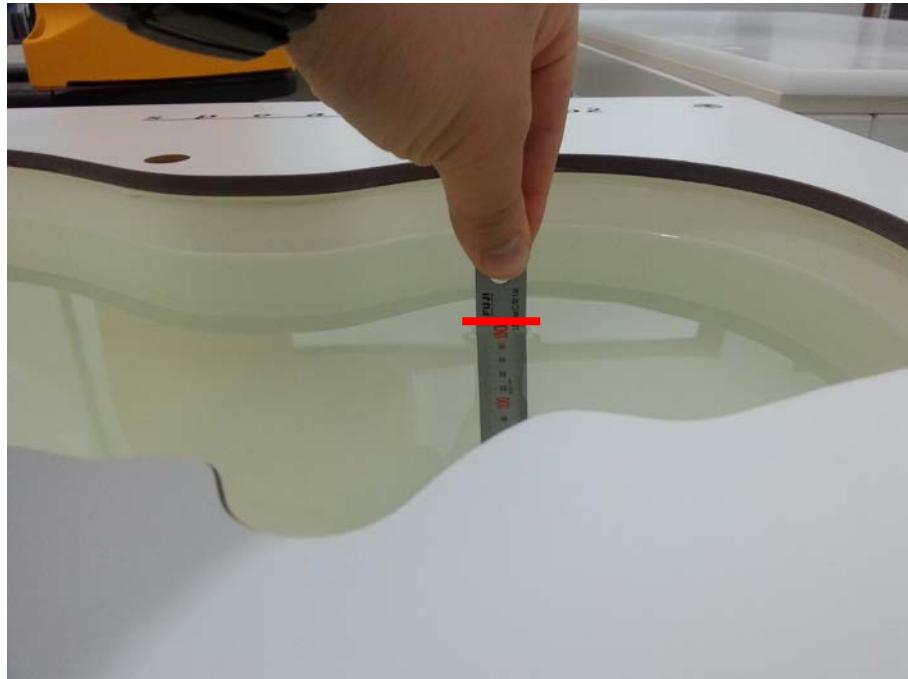


**(d) Validation 2450 MHz**



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#### Annex A.4 Liquid Depth



**Body 2450 MHz**

## Annex B. Calibration certificate

### Annex B.1 Probe Calibration certificate

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



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

Accredited by the Swiss Accreditation Service (SAS)  
The Swiss Accreditation Service is one of the signatories to the EA  
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client EMC Compliance (Dymstec)

Certificate No: EX3-3865\_Aug12

#### CALIBRATION CERTIFICATE

Object EX3DV4 - SN:3865

Calibration procedure(s) QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4,  
QA CAL-25.v4  
Calibration procedure for dosimetric E-field probes

Calibration date: August 6, 2012

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  $(22 \pm 3)^\circ\text{C}$  and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	29-Mar-12 (No. 217-01508)	Apr-13
Power sensor E4412A	MY41498087	29-Mar-12 (No. 217-01508)	Apr-13
Reference 3 dB Attenuator	SN: S5054 (3c)	27-Mar-12 (No. 217-01531)	Apr-13
Reference 20 dB Attenuator	SN: S5086 (20b)	27-Mar-12 (No. 217-01529)	Apr-13
Reference 30 dB Attenuator	SN: S5129 (30b)	27-Mar-12 (No. 217-01532)	Apr-13
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 660	20-Jun-12 (No. DAE4-660_Jun12)	Jun-13
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

Calibrated by:	Name	Function	Signature
	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: August 6, 2012

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



Certificate No: EX3-3865\_Aug12

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**Calibration Laboratory of**  
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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
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization $\varphi$	$\varphi$ rotation around probe axis
Polarization $\theta$	$\theta$ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ 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:**

- $NORM_{x,y,z}$ : Assessed for E-field polarization  $\theta = 0$  ( $f \leq 900$  MHz in TEM-cell;  $f > 1800$  MHz: R22 waveguide).  $NORM_{x,y,z}$  are only intermediate values, i.e., the uncertainties of  $NORM_{x,y,z}$  does not affect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- $NORM(f)x,y,z = NORM_{x,y,z} * frequency\_response$  (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- $DCP_{x,y,z}$ : DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- $PAR$ : PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- $A_{x,y,z}$ ;  $B_{x,y,z}$ ;  $C_{x,y,z}$ ;  $VR_{x,y,z}$ ;  $A$ ,  $B$ ,  $C$  are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- 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  $NORM_{x,y,z} * ConvF$  whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from  $\pm 50$  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.

EX3DV4 – SN:3865

August 6, 2012

# Probe EX3DV4

## SN:3865

Manufactured: February 2, 2012  
Calibrated: August 6, 2012

Calibrated for DASY/EASY Systems  
(Note: non-compatible with DASY2 system!)

EX3DV4- SN:3865

August 6, 2012

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3865

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ( $\mu$ V/(V/m) <sup>2</sup> ) <sup>A</sup>	0.42	0.37	0.41	$\pm$ 10.1 %
DCP (mV) <sup>B</sup>	96.8	100.4	96.9	

### Modulation Calibration Parameters

UID	Communication System Name	PAR	A dB	B dB	C dB	VR mV	Unc <sup>C</sup> (k=2)
0	CW	0.00	X 0.00	0.00	1.00	148.0	$\pm$ 4.4 %
			Y 0.00	0.00	1.00	133.9	
			Z 0.00	0.00	1.00	145.8	

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 Pages 5 and 6).

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

<sup>C</sup> Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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### DASY/EASY - Parameters of Probe: EX3DV4 - SN:3865

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	43.5	0.87	10.58	10.58	10.58	0.11	1.00	± 13.4 %
850	41.5	0.92	9.83	9.83	9.83	0.40	0.81	± 12.0 %
900	41.5	0.97	9.81	9.81	9.81	0.80	0.50	± 12.0 %
1750 <sup>I</sup>	40.1	1.37	8.69	8.69	8.69	0.39	0.79	± 12.0 %
1900	40.0	1.40	8.34	8.34	8.34	0.27	1.00	± 12.0 %
2450	39.2	1.80	7.42	7.42	7.42	0.33	0.83	± 12.0 %
2600	39.0	1.96	7.28	7.28	7.28	0.32	0.89	± 12.0 %
5200	36.0	4.66	4.54	4.54	4.54	0.40	1.80	± 13.1 %
5300	35.9	4.76	4.33	4.33	4.33	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.37	4.37	4.37	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.09	4.09	4.09	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.25	4.25	4.25	0.48	1.80	± 13.1 %

<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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### DASY/EASY - Parameters of Probe: EX3DV4 - SN:3865

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) <sup>c</sup>	Relative Permittivity <sup>f</sup>	Conductivity (S/m) <sup>f</sup>	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
450	56.7	0.94	11.32	11.32	11.32	0.04	1.00	± 13.4 %
850	55.2	0.99	9.84	9.84	9.84	0.24	1.13	± 12.0 %
900	55.0	1.05	10.00	10.00	10.00	0.56	0.73	± 12.0 %
1750	53.4	1.49	8.22	8.22	8.22	0.42	0.79	± 12.0 %
1900	53.3	1.52	7.87	7.87	7.87	0.28	0.93	± 12.0 %
2450	52.7	1.95	7.47	7.47	7.47	0.55	0.63	± 12.0 %
2600	52.5	2.16	7.20	7.20	7.20	0.80	0.50	± 12.0 %
5200	49.0	5.30	4.28	4.28	4.28	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.16	4.16	4.16	0.50	1.80	± 13.1 %
5500	48.6	5.65	3.89	3.89	3.89	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.74	3.74	3.74	0.50	1.90	± 13.1 %
5800	48.2	6.00	3.87	3.87	3.87	0.60	1.90	± 13.1 %

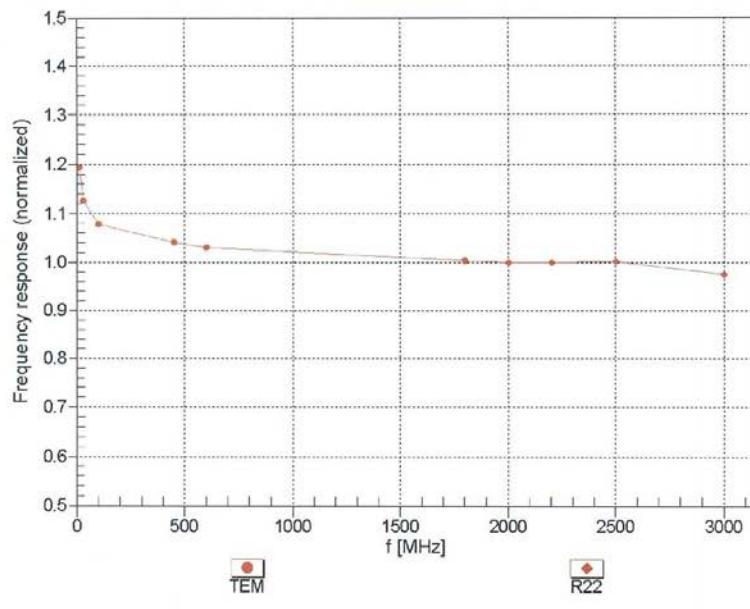
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<sup>f</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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**Frequency Response of E-Field**  
(TEM-Cell:ifi110 EXX, Waveguide: R22)



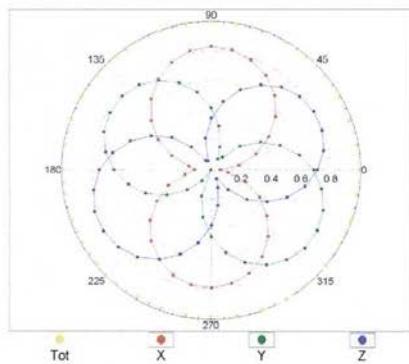
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

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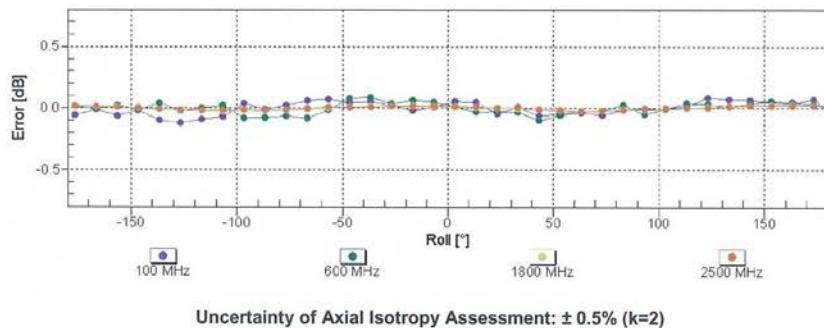
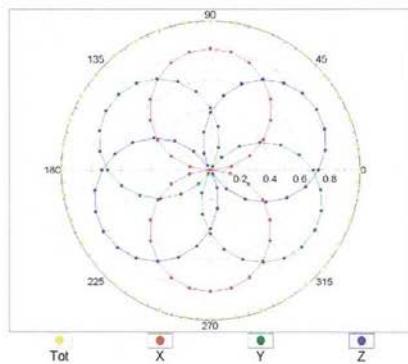
August 6, 2012

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

f=600 MHz, TEM



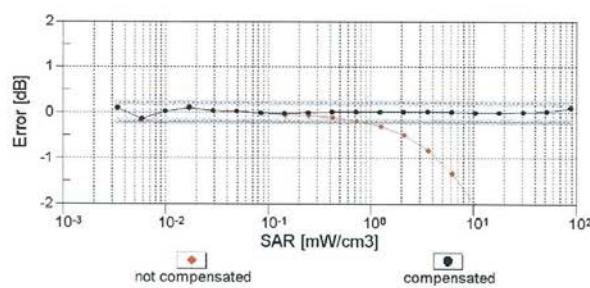
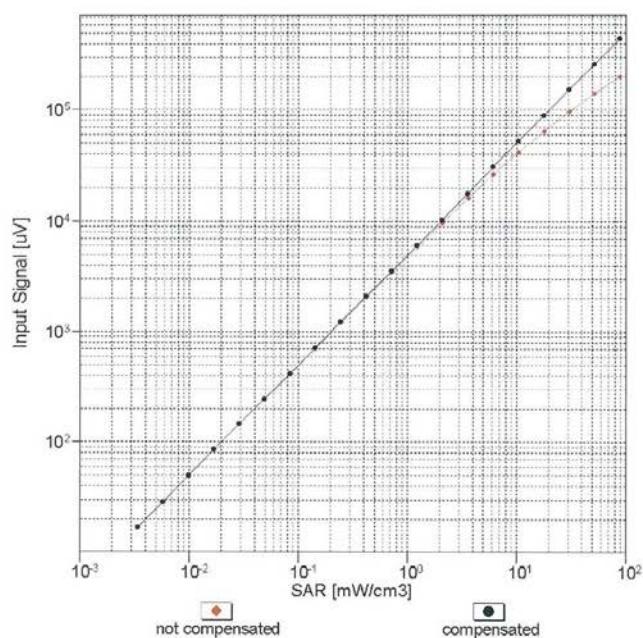
f=1800 MHz, R22



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**Dynamic Range f(SAR<sub>head</sub>)**  
(TEM cell, f = 900 MHz)

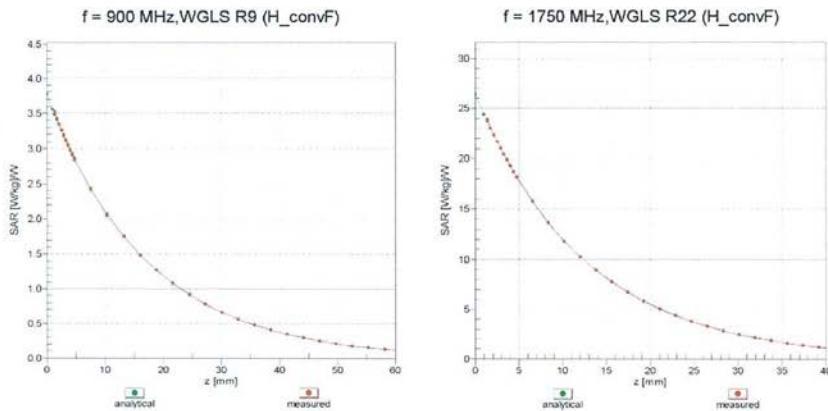


Uncertainty of Linearity Assessment:  $\pm 0.6\%$  (k=2)

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### Conversion Factor Assessment



### Deviation from Isotropy in Liquid Error ( $\phi$ , 9), f = 900 MHz

