

APPENDIX E – PROBE CALIBRATION DATA

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

Accredited by the Swiss Federal Office of Metrology and Accreditation 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 H-CT (Dymstec)

Certificate No: ET3-1609_Aug07

Power meter E4419B GB41283874 29-Mer-07 (METAS, No. 217-00670) Mar-08	Object	ET3DV6 - SN:1	609		
Condition of the calibrated item In Tolerance This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (91). 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 Calibratic Power mater E4419B Power sensor E4419B Power sensor E4412A MY41495277 29-Mer-07 (METAS, No. 217-00670) Mar-08 Power sensor E4412A MY4149607 29-Mer-07 (METAS, No. 217-00670) Mar-08 Reference 30 dB Attenuator SN: 55054 (3c) S-Aug-07 (METAS, No. 217-00671) Mar-08 Reference 20 dB Attenuator SN: 55054 (3c) SN: 55054 (3c) S-Aug-07 (METAS, No. 217-00671) Mar-08 Reference 30 dB Attenuator SN: 55054 (3c) SN: 55054 (3c) SN: 55054 (3c) SN-3013 (4-)3n-07 (METAS, No. 217-00720) Aug-08 Reference Probe E530V2 SN: 3013 4-)3n-07 (SPEAG, No. DAE4-654_Apr07) Apr-08 Secondary Standards ID # Check Date (in house check Nov-05) In house check: Oct- Network Analyzer HP 8753E Name Function Signature Calibrated by: Calibrated by: Name Function Signature	Calibration procedure(s)	The second secon			
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland





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Accredited by the Swiss Federal Office of Metrology and Accreditation The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Glossary:

TSL tissue simulating liquid
NORMx,y,z sensitivity in free space
ConF sensitivity in TSL / NORMx,y,z

DCP diode compression point Polarization φ rotation around probe axis

Polarization 9 9 rotation around an axis that is in the plane normal to probe axis (at

measurement center), i.e., 9 = 0 is normal to probe axis

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
- 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:

- NORMx,y,z: Assessed for E-field polarization 9 = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)x,y,z = NORMx,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.
- DCPx,y,z: 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 ≤ 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 NORMx,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 ± 50 MHz to ± 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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ET3DV6 SN:1609

August 30, 2007

Probe ET3DV6

SN:1609

Manufactured: July 21, 2001 Last calibrated: March 23, 2006 Recalibrated: August 30, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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DASY - Parameters of Probe: ET3DV6 SN:1609

Sensitivity in Fre	e Space ^A	Diode C	compression ^B	
NormX	1.94 ± 10.1%	$\mu V/(V/m)^2$	DCP X	95 mV
NormY	1.78 ± 10.1%	$\mu V/(V/m)^2$	DCP Y	95 mV
Norm7	1 79 + 10 1%	$\mu V/(V/m)^2$	DCP Z	97 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

Boundary Effect

TSL	900 MHz	Typical SAR	gradient: 5 % per mm
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Sensor Cente	er to Phantom Surface Distance	3.7 mm	4.7 mm
SAR _{te} [%]	Without Correction Algorithm	5.3	2.1
SAR _{be} [%]	With Correction Algorithm	0.2	0.2

TSL 1810 MHz Typical SAR gradient: 10 % per mm

Sensor Cente	er to Phantom Surface Distance	3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	13.6	9.0
SAR _{be} [%]	With Correction Algorithm	0.2	0.0

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%.

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A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Page 8).

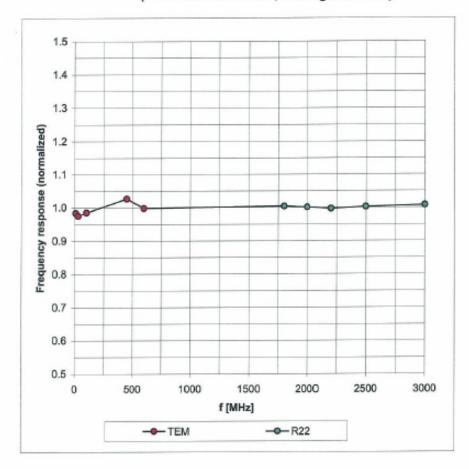
^a Numerical linearization parameter; uncertainty not required.

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Frequency Response of E-Field

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



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

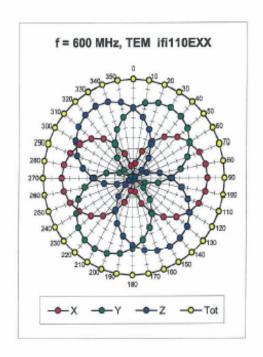
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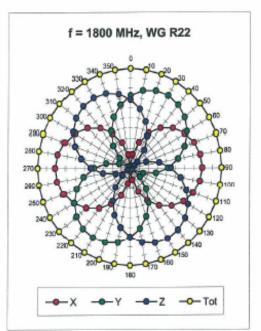
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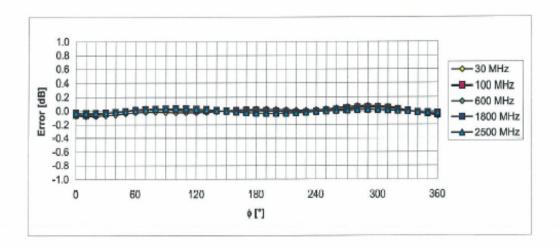
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Receiving Pattern (ϕ), $\vartheta = 0^{\circ}$







Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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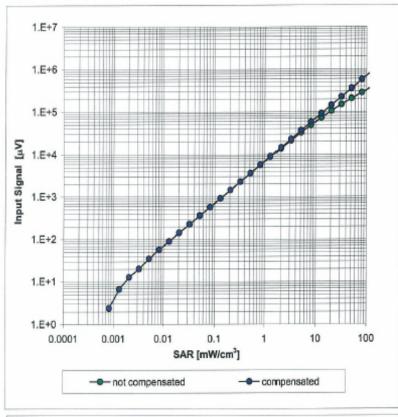
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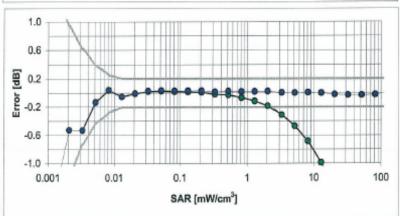
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Dynamic Range f(SAR_{head})

(Waveguide R22, f = 1800 MHz)





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

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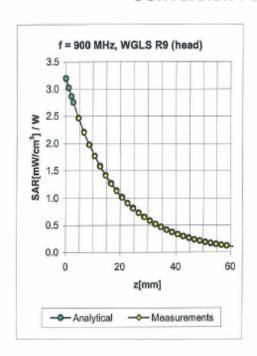
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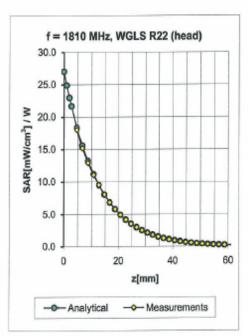
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Conversion Factor Assessment





f [MHz]	Validity [MHz] ^C	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	$0.87 \pm 5\%$	0.37	1.85	7.25 ± 13.3% (k=2)
900	± 50 / ± 100	Head	41.5 ± 5%	$0.97 \pm 5\%$	0.36	2.42	6.81 ± 11.0% (k=2)
1810	± 50 / ± 100	Head	40.0 ± 5%	$1.40 \pm 5\%$	0.52	2.66	5.36 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	$1.40 \pm 5\%$	0.60	2.50	5.12 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	$1.80 \pm 5\%$	0.69	1.89	4.78 ± 11.8% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	$0.94 \pm 5\%$	0.31	1.90	7.76 ± 13.3% (k=2)
835	± 50 / ± 100	Body	55.2 ± 5%	$0.97 \pm 5\%$	0.35	2.55	6.49 ± 11.0% (k=2)
1900	± 50 / ± 100	Body	53.3 ± 5%	$1.52 \pm 5\%$	0.71	2.44	4.74 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.58	2.37	4.17 ± 11.8% (k=2)

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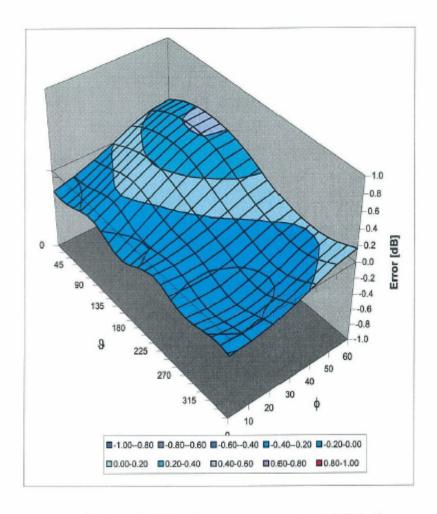
^c The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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Deviation from Isotropy in HSL

Error (♦, ३), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

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