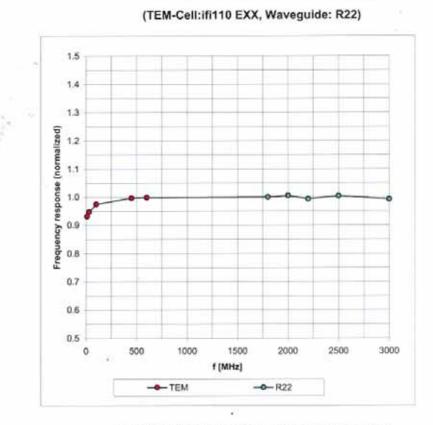




August 26, 2008

## Frequency Response of E-Field



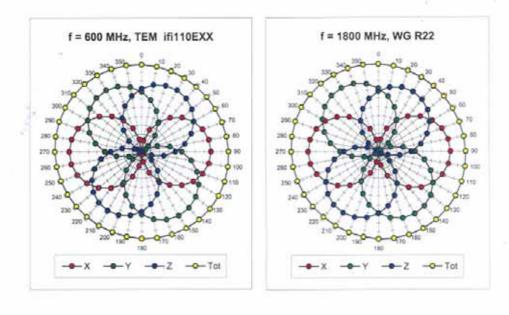
## Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: ET3-1787\_Aug08

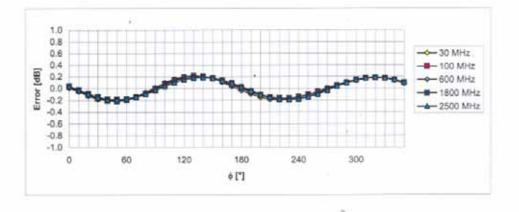
Page 5 of 9



August 26, 2008



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



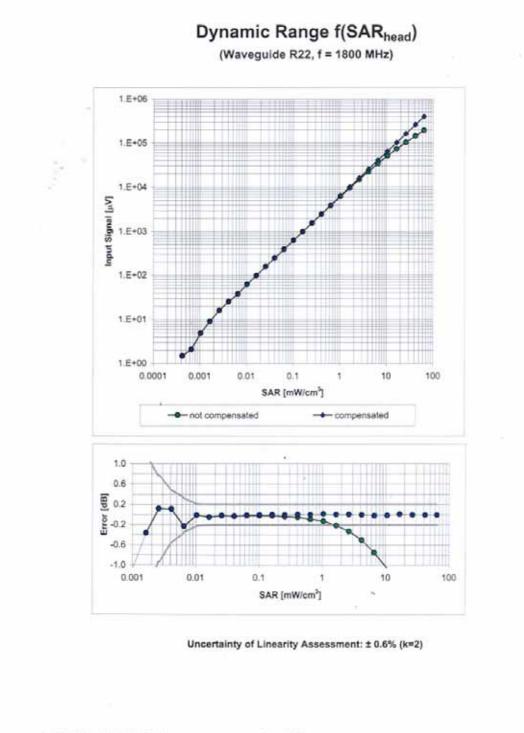
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: ET3-1787\_Aug08

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August 26, 2008

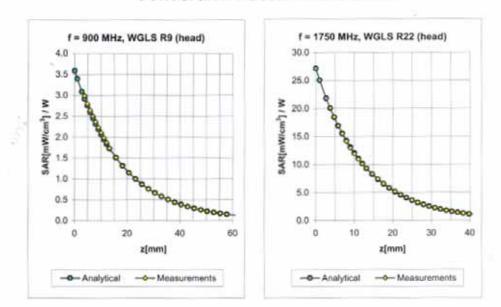


Certificate No: ET3-1787\_Aug08

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August 26, 2008



## **Conversion Factor Assessment**

f [MHz]	Validity [MHz] <sup>c</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5±5%	0.97 ± 5%	0.30	2.80	6.06 ± 11.0% (k#2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.53	2.11	5.36 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	$1.40 \pm 5\%$	0.59	1.96	5.01 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1,80 ± 5%	0.77	1.57	4.49 ± 11.0% (k=2)
				14.1			
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.31	2.98	5.91 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	$53.4\pm5\%$	1.49 ± 5%	0.60	2.20	4.73 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	$1.52 \pm 5\%$	0.68	1.95	4.49 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.90	1.51	3.79 ± 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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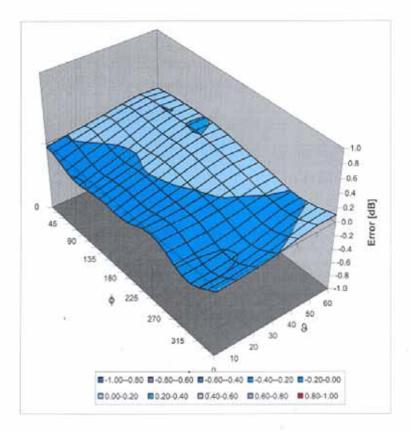




August 26, 2008

## Deviation from Isotropy in HSL

Error (¢, 8), f = 900 MHz



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

Certificate No: ET3-1787\_Aug08

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ccredited by the Swiss Federal O he Swiss Accreditation Servic	e is one of the signatori	correditation Accreditation No	ervizio svizzero di taratura wiss Calibration Service .: SCS 108
Aultilateral Agreement for the model of the formation of			T3-1788_Sep07
CALIBRATION	CERTIFICAT	E Contraction of the second	
Object	ET3DV6 - SN:1	788	
Calibration procedure(s)	QA CAL-01.v6 Calibration proc	edure for dosimetric E-field probes	
Calibration date:	September 26,	2007	
Condition of the calibrated item	In Tolerance		anter anter de la compañía de la com
		probability are given on the following pages and are by facility: environment temperature (22 ± 3)*C are	
The measurements and the unce All calibrations have been condu	cted in the closed laborat	bry facility: environment temperature ( $22 \pm 3$ )*C and	
The moasurements and the unco All calibrations have been condu Calibration Equipment used (M&	cted in the closed laborat TE critical for calibration)	ory facility: environment temperature (22 ± 3)*C and	d humidity < 70%.
The measurements and the unce All calibrations have been condu Calibration Equipment used (M& Primary Standards	cted in the closed laborat	bry facility: environment temperature ( $22 \pm 3$ )*C and	
The measurements and the unce All calibrations have been condu Calibration Equipment used (M& Primary Standards Power meter E44 198	cted in the closed laborat TE critical for calibration)   10 #	bry facility: environment temperature (22 ± 3)*C and Cal Date (Calibrated by, Certificate No.)	d humidity < 70%. Scheduled Calibration
The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A	cted in the closed laborat TE critical for calibration) ID # G841293874 MY41495277 MY41498087	Dry facility: environment temperature (22 ± 3)*C and Cal Date (Calibrated by, Certificate No ) 29-Mar-07 (METAS, No. 217-00670)	d humidity < 70%. Scheduled Calibration Mar-08
The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator	cted in the closed laborat TE critical for calibration) ID # G841293874 MY41495277 MY41498087 SN: S5054 (3c)	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08
The moaourements and the unco All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator	Cted in the closed laborat TE critical for calibration) ID # G841293874 MY41495277 MY41498087 SN: S5054 (3c) SN: S5086 (20b)	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-00671)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Mar-08
The moaourements and the unco All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power neter E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator Reference 30 dB Attenuator Reference 30 dB Attenuator	Cled in the closed laborat TE critical for calibration) ID # G841293874 MY41495277 MY41498067 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b)	Cal Date (Calibrated by, Cartificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00671) 8-Aug-07 (METAS, No. 217-00720)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Aug-08 Aug-08
The moaourements and the unco All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power sensor E44198 Power sensor E44198 Power sensor E4412A Reference 3 dB Attenuator Reference 30 dB Attenuator Reference 30 dB Attenuator Reference Probe ES30V2	Cted in the closed laborat TE critical for calibration) ID # G841293874 MY41495277 MY41498087 SN: S5054 (3c) SN: S5086 (20b)	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-00671)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Mar-08
The moasurements and the unco All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power sansor E4412A Power sansor E4412A Power sansor E4412A Reference 3 dB Attenuator Reference 3 dB Attenuator Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4 Secondary Standards	cted in the closed laborat TE critical for calibration) ID # GB41293874 MY41495277 MY41498067 SN: S5054 (3c) SN: S5056 (20b) SN: S5129 (30b) SN: S5129 (30b) SN: S5129 (30b) SN: 654 ID #	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719] 29-Mar-07 (METAS, No. 217-00719) 8-Aug-07 (METAS, No. 217-00720) 4-Jan-07 (SPEAG, No. ES3-3013_Jan07) 20-Apr-07 (SPEAG, No. DAE4-654_Apr07) Check Date (in house)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Aug-08 Jan-08 Aug-08 Jan-08 Apr-08 Scheduled Check
The moaourements and the unco All calibrations have been conduin Calibration Equipment used (M& Primary Standards Power sensor E44198 Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 20 dB Attenuator Reference Probe ES30V2 DAE4 Secondary Standards RF generator HP 8648C	cted in the closed laborat TE critical for calibration) 10 # GB41293874 MY41493087 SN: \$5054 (3c) SN: \$5054 (3c) SN: \$5054 (3c) SN: \$5129 (30b) SN: \$5129 (30b) SN: \$513 SN: 654	Cal Date (Calibrated by, Cartificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719] 29-Mar-07 (METAS, No. 217-00770) 4-Jan-07 (SPEAG, No. ES3-3013_Jan07) 20-Apr-07 (SPEAG, No. DAE4-854_Apr07)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Aug-08 Jan-08 Aug-08 Jan-08 Apr-08
The mosourements and the unce All calibrations have been conduct Calibration Equipment used (M& Primary Standards Power sensor E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 20 dB Attenuator Reference Probe ES30V2 DAE4 Secondary Standards RF generator HP 8648C	Cted in the closed laborat TE critical for calibration) ID # GB41293874 MY41495277 MY41498087 SN: \$5054 (3c) SN: \$5036 (20b) SN: \$5036 (20b) SN: \$5036 (20b) SN: \$5129 (30b) SN: \$513 SN: 654 ID # U\$3642U01700	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-00719) 8-Aug-07 (METAS, No. 217-00720) 4-Jan-07 (SPEAG, No. ES3-3013_Jan07) 20-Apr-07 (SPEAG, No. DAE4-654_Apr07) Check Date (in house) 4-Aug-99 (SPEAG, in house check Nov-05)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Aug-08 Jan-08 Apr-08 Apr-08 Scheduled Check In house check: Nov-07
The mosourements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards Power meter E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator Reference 20 dB Attenuator Reference 20 dB Attenuator Reference Probe ES30V2 DAE4 Secondary Standards RF generator HP 8648C Network Analyzer HP 8753E	Cted in the closed laborat TE critical for calibration) ID # GB41293874 MY41495277 MY41498087 SN: \$5054 (3c) SN: \$5036 (20b) SN: \$5129 (30b) SN: \$5129 (30b) SN: \$5129 (30b) SN: \$513 ID # U\$3642U01700 U\$37390585	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00671) 8-Aug-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-0071) 8-Aug-07 (METAS, No. 217-00720) 4-Jan-07 (SPEAG, No. DAE4-654_Apr07) 20-Apr-07 (SPEAG, No. DAE4-654_Apr07) Check Date (in house) 4-Aug-99 (SPEAG, in house check Nov-05) 18-Oct-01 (SPEAG, in house check Nov-05)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Aug-08 Aug-08 Mar-08 Jan-08 Jan-08 Jan-08 Scheduled Check In house check: Nov-07 In house check: Oct-07
The measurements and the unce All calibrations have been conduc Calibration Equipment used (M& Primary Standards	cted in the closed laborat TE critical for calibration) ID # GB41293874 MY41495277 MY41498087 SN: \$5054 (3c) SN: \$5036 (20b) SN: \$5129 (30b) SN: \$5129 (30b) SN: \$5129 (30b) SN: \$513 SN: \$654 ID # US3642U01700 US37390585 Name	Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-00671) 8-Aug-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-00719) 29-Mar-07 (METAS, No. 217-00720) 4-Jan-07 (SPEAG, No. ES3-3013_Jan07) 20-Apr-07 (SPEAG, No. DAE4-654_Apr07) Check Date (in house) 4-Aug-99 (SPEAG, in house check Nov-35) 18-Oct-01 (SPEAG, in house check Nov-35) 18-Oct-01 (SPEAG, in house check Nov-35)	d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Aug-08 Aug-08 Mar-08 Jan-08 Jan-08 Apr-08 Scheduled Check In house check: Nov-07 In house check: Oct-07

Certificate No: ET3-1788\_Sep07

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



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

Accreditation No.: SCS 108

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 cartificates

G	ossary	i,
-	SL	

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 8	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
- b) 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 E<sup>2</sup>-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.

Certificate No: ET3-1788\_Sep07

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September 26, 2007

# Probe ET3DV6

## SN:1788

Manufactured: Last calibrated: Modified: Recalibrated: May 28, 2003 September 19, 2006 September 24, 2007 September 26, 2007

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

1.0

Certificate No: ET3-1788\_Sep07

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September 26, 2007

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

ivity in Fre	e Space <sup>A</sup>	Diode C	ompression <sup>B</sup>	
NormX	1.72 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP X	91 mV
NormY	1.66 ± 10.1%	$\mu V/(V/m)^2$	DCP Y	93 mV
NormZ	1.70 ± 10.1%	$\mu V/(V/m)^2$	DCP Z	94 mV
	NormX NormY	NormY 1.66 ± 10.1%	NormX         1.72 ± 10.1% $\mu V/(V/m)^2$ NormY         1.66 ± 10.1% $\mu V/(V/m)^2$	NormX         1.72 ± 10.1% $\mu V/(V/m)^2$ DCP X           NormY         1.66 ± 10.1% $\mu V/(V/m)^2$ DCP Y

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

## Boundary Effect

TSL

900 MHz Typical SAR gradient: 5 % per mm

Sensor Cente	r to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	6.2	3.3
SAR <sub>be</sub> [%]	With Correction Algorithm	0.4	1.0

## TSL 1810 MHz Typical SAR gradient: 10 % per mm

r to Phantom Surface Distance	3.7 mm	4.7 mm
Without Correction Algorithm	12.0	8.1
With Correction Algorithm	0.2	0.1
	<b>N</b>	Without Correction Algorithm 12.0

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%.

\* The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 8).
 \* Numerical linearization parameter: uncertainty not required.

Certificate No: ET3-1788\_Sep07

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September 26, 2007

## (TEM-Cell:ifi110 EXX, Waveguide: R22) 1.5 1.4 1.3 Frequency response (normalized) 1.2 1.1 1.0 0.9 0.8 0.7 0.6 0.5 0 500 1000 1500 2000 2500 3000 f [MHz] -----TEM -0-R22

Frequency Response of E-Field

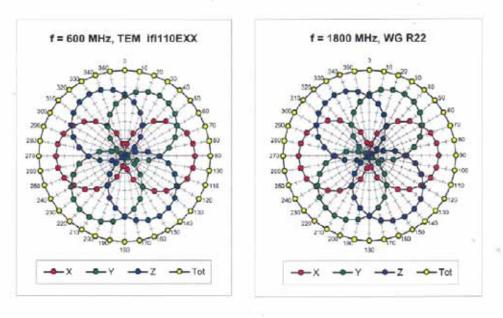
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: ET3-1788\_Sep07

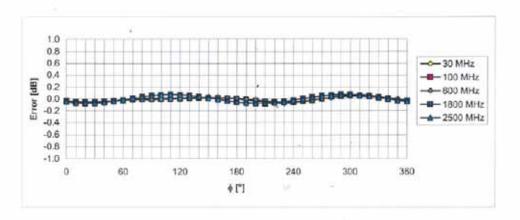
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September 26, 2007



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



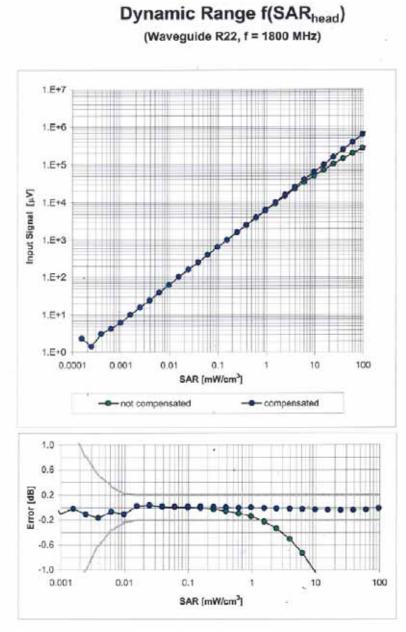
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: ET3-1788\_Sep07

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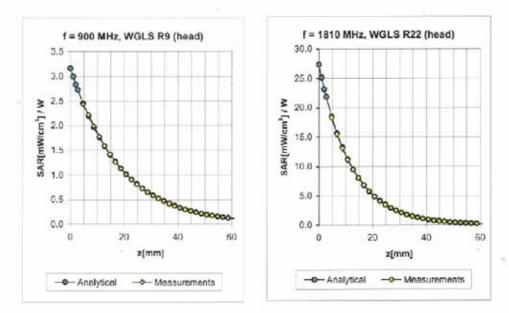
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Certificate No: ET3-1788\_Sep07

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September 26, 2007



## **Conversion Factor Assessment**

f [MHz]	Validity [MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5±5%	0.97 ± 5%	0.22	3.28	6.54 ± 11.0% (k=2)
1810	± 50 / ± 100 °	Head	40.0 ± 5%	1.40 ± 5%	0.59	2.15	5.28 ± 11.0% (k=2)
2000	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.60	2.23	4.87 ± 11.0% (k=2)
2450	$\pm$ 50 / $\pm$ 100	Head	39.2 ± 5%	1.80 ± 5%	0.61	2.39	4.58 ± 11.8% (k=2)
				- ·			
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.28	2.94	6.37 ± 11.0% (k=2)
1810	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.63	2.39	4.75 ± 11.0% (k=2)
2000	$\pm50$ / $\pm100$	Body	53.3 ± 5%	1.52 ± 5%	0.63	2.33	4.36 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.61	2.58	4.17 ± 11.8% (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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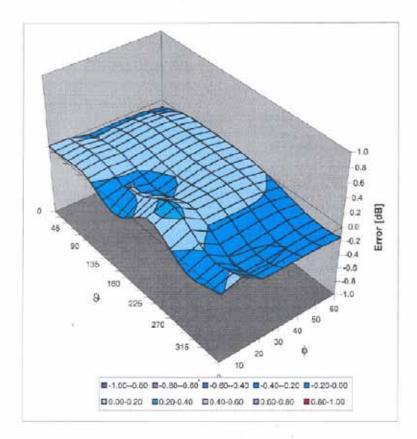
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September 26, 2007

## Deviation from Isotropy in HSL

Error (¢, 3), f = 900 MHz



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

Certificate No: ET3-1788\_Sep07

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### Test Report No : FA880108

#### Calibration Laboratory of

Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



- SNISS CODZO RIBRATOS
  - S Schweizerischer Kalibrierdienst C Service suisse d'étalonnage Servizio svizzero di taratura
  - S Swiss Calibration Service

Accreditation No.: SCS 108

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

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Certificate No: ET3-1788\_Sep08 Client Sporton (Auden) CALIBRATION CERTIFICATE ET3DV6 - SN:1788 Object QA CAL-01.v6 and QA CAL-23.v3 Calibration procedure(s) Calibration procedure for dosimetric E-field probes Calibration date: September 23, 2008 In Tolerance Condition of the calibrated item 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 Cal Date (Certificate No.) Scheduled Calibration ID# GB41293874 1-Apr-08 (No. 217-00788) Apr-09 Power meter E4419B Power sensor E4412A MY41495277 1-Apr-08 (No. 217-00788) Apr-09 Power sensor E4412A MY41498087 1-Apr-08 (No. 217-00788) Apr-09 Jul-09 Reference 3 dB Attenuator SN: S5054 (3c) 1-Jul-08 (No.-217-00865) Reference 20 dB Attenuator SN: S5086 (20b) 31-Mar-08 (No. 217-00787) Apr-09 Jul-09 Reference 30 dB Attenuator SN: S5129 (30b) 1-Jul-08 (No. 217-00866) Reference Probe ES3DV2 SN: 3013 2-Jan-08 (No. ES3-3013\_Jan08) Jan-09 DAE4 SN: 660 9-Sep-08 (No. DAE4-660\_Sep08) Sep-09 Secondary Standards Scheduled Check ID # Check Date (in house) 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-07) In house check: Oct-08 Name Function Signature Technical Manager Calibrated by: Katja Pokovic Fin Bomholt **R&D** Director Approved by:

Issued: September 24, 2008

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

Certificate No: ET3-1788\_Sep08

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





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C Service suisse d'étalonnage

Servizio svizzero di taratura Suiss Calibration Service

Accreditation No.: SCS 108

Swiss Calibration Service

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### Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization $\phi$	φ rotation around probe axis
Polarization 9	$\vartheta$ 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:

- 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) 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 E<sup>2</sup>-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.

Certificate No: ET3-1788\_Sep08

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September 23, 2008

# Probe ET3DV6

## SN:1788

Manufactured: Last calibrated: Recalibrated:

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May 28, 2003 September 26, 2007 September 23, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ET3-1788\_Sep08

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September 23, 2008

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

Sensitivity in Fre	e Space <sup>A</sup>	Diode C	ompression <sup>B</sup>	
NormX	1.73 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP X	<b>95</b> mV
NormY	1.59 ± 10.1%	$\mu$ V/(V/m) <sup>2</sup>	DCP Y	98 mV
NormZ	1.72 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Z	91 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

## **Boundary Effect**

### TSL

900 MHz Typical SAR gradient: 5 % per mm

Sensor Cente	er to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	10.6	6.8
SAR <sub>be</sub> [%]	With Correction Algorithm	0.8	0.3

#### TSL 1750 MHz Typical SAR gradient: 10 % per mm

Sensor Cente	r to Phantom Surface Distance	3.7 mm	4.7 mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	8.8	4.9
SAR <sub>be</sub> [%]	With Correction Algorithm	0.7	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>8</sup> Numerical linearization parameter: uncertainty not required.

Certificate No: ET3-1788\_Sep08

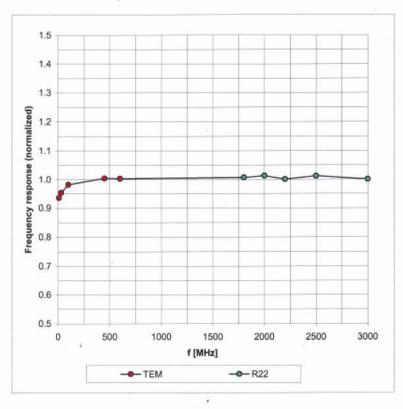
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September 23, 2008

## Frequency Response of E-Field

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



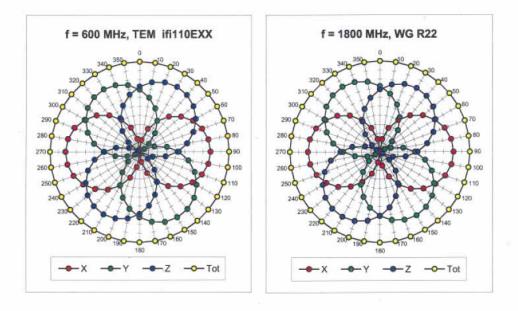
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: ET3-1788\_Sep08

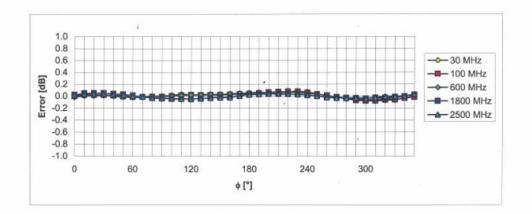
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September 23, 2008



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



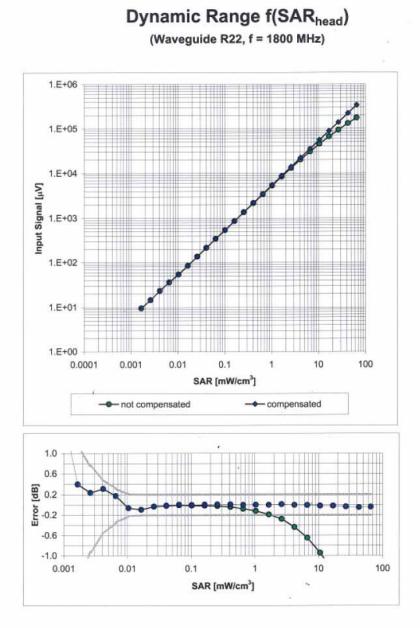
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Certificate No: ET3-1788\_Sep08

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September 23, 2008



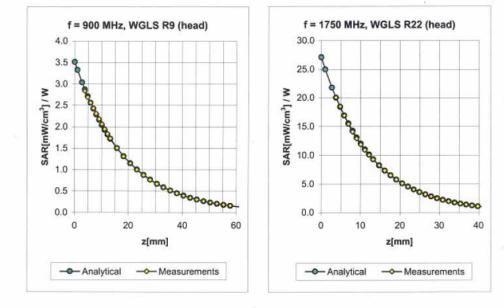


Certificate No: ET3-1788\_Sep08

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September 23, 2008



## **Conversion Factor Assessment**

f [MHz]	Validity [MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.44	2.65	6.55 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.68	1.98	5.59 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.75	1.75	5.13 ± 11.0% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.80	1.45	4.68 ± 11.0% (k=2)
				÷			
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.50	. 2.48	6.34 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	53.4 ± 5%	1.49 ± 5%	0.63	2.33	4.87 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	53.3 ± 5%	1.52 ± 5%	0.74	1.99	4.73 ± 11.0% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.94	1.75	3.98 ± 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.

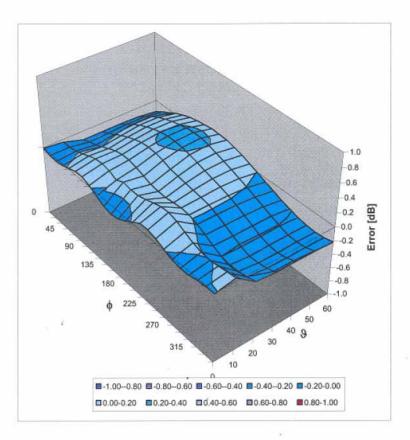
Certificate No: ET3-1788\_Sep08

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September 23, 2008

## Deviation from Isotropy in HSL Error (\(\phi, \vert\)), f = 900 MHz



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

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chmid & Partner Engineering AG ughausstrasse 43, 8004 Zuric	ry of	ILAC MRA	Service suisse d'étalonnage Servizio svizzero di taratura		
credited by the Swiss Accredite e Swiss Accreditation Servic ultilateral Agreement for the r	e is one of the signatori	es to the EA	No.: SCS 108		
Sporton (Aude	in)	Certificate No	o: EX3-3514_May08		
ALIBRATION					
loject	EX3DV3 - SN:3	514			
alibration procedure(s)		QA CAL-14.v3 and QA CAL-23.v3 edure for dosimetric E-field probe			
albration date:	May 16, 2008 (/	Additional Conversion Factors)			
ondition of the calibrated item	In Tolerance				
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e measurements and the unce I calibrations have been condu- albration Equipment used (M& rimary Standards ower meter E44108 ower sensor E4412A ower sensor E4412A eference 3 dB Attenuator	the confidence of the confiden	probability are given on the following pages an ory facility: environment temperature (22 ± 3)*0 Cal Date (Certificate No.) 1-Apr-08 (No. 217-00768) 1-Apr-08 (No. 217-00768) 1-Apr-08 (No. 217-00768) 8-Aug-07 (No. 217-00719)	d are part of the certificate. C and humidity < 70%. Schooled Calibration Apr-09 Apr-09 Apr-09 Aug-08		
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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S Schweizerischer Kalibrierdienst

- C Service suisse d'étalonnage
- Servizio svizzero di taratura Servizio Servizion Service
  - Swiss Calibration Service

Accreditation No.: SCS 108

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

Glossary:	
TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization g	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:

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### Methods Applied and Interpretation of Parameters:

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- 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.

Certificate No: EX3-3514 May08

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EX3DV3 SN:3514

May 16, 2008

# Probe EX3DV3

## Additional Conversion Factors

## SN:3514

Manufactured: Last calibrated: Recalibrated: December 15, 2002 January 31, 2008 May 16, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: EX3-3514\_May08

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### EX3DV3 SN:3514

May 16, 2008

## DASY - Parameters of Probe: EX3DV3 SN:3514

Sensitivity in Free Space<sup>A</sup> Diode Compression<sup>B</sup>  $\mu V/(V/m)^2$ NormX 0.650 ± 10.1% DCP X 95 mV NormY µV/(V/m)2 DCP Y 93 mV 0.690 ± 10.1%  $\mu V/(V/m)^2$ DCP Z 96 mV NormZ 0.580 ± 10.1%

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 5.

## **Boundary Effect**

TSL

5200 MHz Typical SAR gradient: 25 % per mm

Sensor Cente	er to Phantom Surface Distance	2.0 mm	3.0 mm	
SAR [%]	Without Correction Algorithm	2.2	1.2	
SARte [%]	With Correction Algorithm	0.1	0.0	

TSL

5800 MHz Typical SAR gradient: 30 % per mm

Sensor Cente	r to Phantom Surface Distance	2.0 mm	3.0 mm
SAR <sub>be</sub> [%]	Without Correction Algorithm	6.5	4,3
SARte [%]	With Correction Algorithm	0.1	0,1

Sensor Offset

Probe Tip to Sensor Center

1.0 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).

\* Numerical linearization parameter: uncertainty not required.

Certificate No: EX3-3514\_May08

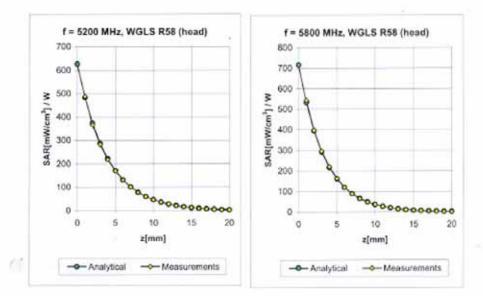
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### EX3DV3 SN:3514

May 16, 2008



## **Conversion Factor Assessment**

f [MHz]	Validity [MHz] <sup>c</sup>	TSL.	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
5200	± 50 / ± 100	Head	36.0 ± 5%	4.66±5%	0.36	1.70	5.01	± 13.1% (k=2)
5500	± 50 / ± 100	Head	35.6 ± 5%	4.96 ± 5%	0.40	1.70	4.62	± 13.1% (k=2)
5800	± 50 / ± 100	Head	$35.3\pm5\%$	5.27 ± 5%	0.48	1.70	4.51	± 13,1% (k=2)

<sup>5</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.

Certificate No: EX3-3514\_May08

Page 5 of 5



Test Report No : FA880108

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



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- Servizio svizzero di taratura
- Swiss Calibration Service

Accreditation No.: SCS 108

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

### Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization $\phi$	or 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
- b) 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, v.z: Assessed for E-field polarization ∂ = 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 E<sup>2</sup>-field uncertainty inside TSL (see below ConVF).
- NORM(f)x,y,z = NORMx,y,z \* frequency\_response (see Frequency Response Chart). This Inearization 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.

Certificate No: EX3-3514\_Jan08

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January 31, 2008

# Probe EX3DV3

## SN:3514

Manufactured: Last calibrated: Recalibrated: December 15, 2002 February 21, 2007 January 31, 2008

## Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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January 31, 2008

## DASY - Parameters of Probe: EX3DV3 SN:3514

Sensitivity in Free Space<sup>A</sup>

Diode Compression<sup>B</sup>

NormX	0.650 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP X	95 mV
NormY	0.690 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Y	93 mV
NormZ	$\textbf{0.580} \pm 10.1\%$	$\mu V/(V/m)^2$	DCP Z	96 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

EX3DV3 SN:3514

Boundary Effect

TSL 2300 MHz Typical SAR gradient: 10 % per mm

Sensor Cente	r to Phantom Surface Distance	2.0 mm	3.0 mm
SARbe [%]	Without Correction Algorithm	5.9	3.3
SARbe [%]	With Correction Algorithm	0.5	0.8

TSL 2600 MHz Typical SAR gradient: 11 % per mm

Sensor Cente	r to Phantom Surface Distance	2.0 mm	3.0 mm
SAR to [%]	Without Correction Algorithm	6.3	3.4
SAR De [%]	With Correction Algorithm	0.1	0.3

Sensor Offset

Probe Tip to Sensor Center

1.0 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).

\* Numerical linearization parameter: uncertainty not required.

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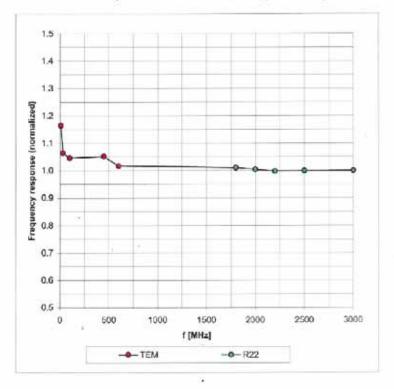
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## Frequency Response of E-Field

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



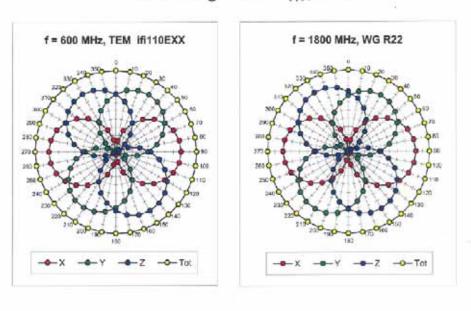
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: EX3-3514\_Jan06

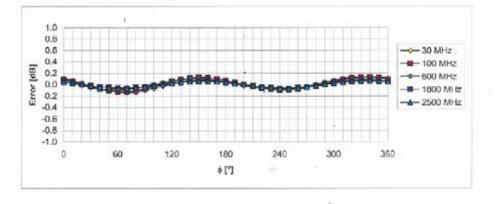
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## Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$



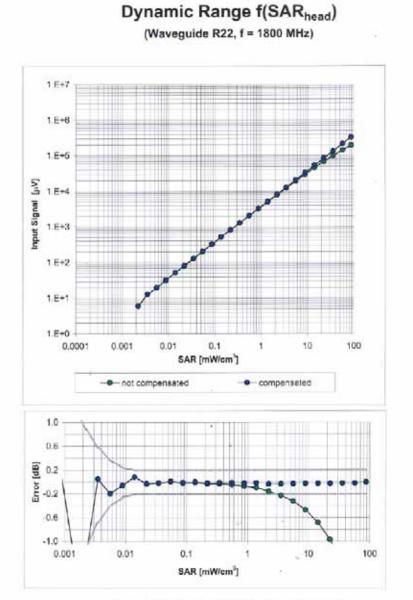
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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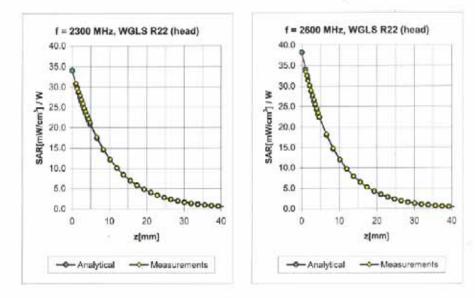
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

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## Conversion Factor Assessment

f [MHz]	Validity [MHz] <sup>C</sup>	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
2300	± 50 / ± 100	Head	39.4 ± 5%	1.71 ± 5%	0.76	0.52	7.73	± 11.8% (k=2)
2600	± 50 / ± 100	Head	39.0 ± 5%	1.96 ± 5%	0.62	0.60	7.31	± 11.8% (k=2)
3500	± 50 / ± 100	Head	$37.9\pm5\%$	2.91 ± 5%	0.36	1.03	7.09	± 13.1% (k=2)
				3				
2300	±50/±100	Body	52.8 ± 5%	1.85 ± 5%	0.63	0.64	7.59	± 11.8% (k=2)
2600	± 50 / ± 100	Body	52.5 ± 5%	2.16 ± 5%	0.52	, 0.76	6.91	± 11.8% (k=2)
3500	±50/±100	Body	51.3 ± 5%	3.31 ± 5%	0.40	1.33	6.32	± 13.1% (k=2)
5200	±50/±100	Body	49.0 ± 5%	5.30 ± 5%	0.35	1.70	4.34	± 13.1% (k=2)
5300	± 50 / ± 100	Body	48.9 ± 5%	5.42 ± 5%	0.38	1.70	4.06	± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	5.65 ± 5%	0.43	1.70	3.98	± 13.1% (k=2)
5600	± 50/± 100	Body	48.5 ± 5%	5.77 ± 5%	0.35	1.70	4.19	± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	6.00 ± 5%	0.30	1.70	4.20	± 13.1% (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.

Certificate No: EX3-3514 Jan08

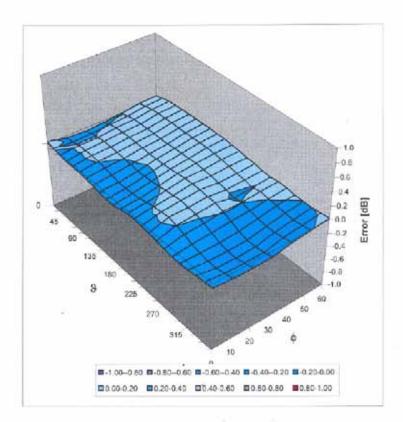
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## Deviation from Isotropy in HSL

Error (\$, 9), f = 900 MHz



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

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Certificate No: EX3-3514\_Jan08



Test Report No : FA880108

Accredited by the Swiss Accredit The Swiss Accreditation Servic Multilateral Agreement for the	e is one of the signator		.: SCS 108
Client ADT (Auden)		Certificate No: E	EX3-3506_Mar08
CALIBRATION	CERTIFICAT	Έ	
Object	EX3DV3 - SN:3	506	
Calibration procedure(s)		and QA CAL-14.v3 redure for dosimetric E-field probes	
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The measurements and the unc All calibrations have been condu Calibration Equipment used (M& Primary Standards Power mater E44198 Power sensor E4412A Power sensor E4412A Reference 3 dB Attenuator Reference 30 dB Attenuator Reference 30 dB Attenuator Reference Probe ES3DV2 DAE4	ettainties with confidence cted in the closed laborat TE critical for calibration) ID # GB41293874 MY41495277 MY41495087 SN: S5054 (3c) SN: S5054 (3c) SN: S5056 (20b) SN: S5129 (30b) SN: 3013	probability are given on the following pages and an ory facility: environment temperature (22 ± 3)*C an Cal Date (Calibrated by, Certificate No.) 29-Mar-07 (METAS, No. 217-00670) 29-Mar-07 (METAS, No. 217-00670) 8-Aug-07 (METAS, No. 217-0070) 29-Mar-07 (METAS, No. 217-0071) 8-Aug-07 (METAS, No. 217-0071) 8-Aug-07 (METAS, No. 217-00720) 2-Jan-08 (SPEAG, No. ES3-3013_Jan08)	e part of the certificate. d humidity < 70%. Scheduled Calibration Mar-08 Mar-08 Mar-08 Aug-08 Mar-08 Aug-08 Aug-08 Jan-09
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Calibration Laboratory of Schmid & Partner Engineering AG Zeughausstrasse 43, 8004 Zurich, Switzerland



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- Servizio svizzero di taratura
- Swiss Calibration Service

Accreditation No.: SCS 108

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

Glossary:	
TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
Polarization $\phi$	φ rotation around probe axis
Polarization 9	$\vartheta$ 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:

- 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) 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 8 = 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 E<sup>2</sup>-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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# Probe EX3DV3

## SN:3506

Manufactured: Last calibrated: Recalibrated: February 18, 2004 March 20, 2007 March 21, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

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## DASY - Parameters of Probe: EX3DV3 SN:3506

Sensitivity in Free Space<sup>A</sup>

Diode Compression<sup>B</sup>

NormX	0.780 ± 10.1%	$\mu V/(V/m)^2$	DCP X	85 mV
NormY	0.830 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Y	85 mV
NormZ	0.760 ± 10.1%	μV/(V/m) <sup>2</sup>	DCP Z	85 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

## Boundary Effect

## TSL

900 MHz Typical SAR gradient: 5 % per mm

Sensor Cente	r to Phantom Surface Distance	2.0 mm	3.0 mm	
SAR <sub>be</sub> [%]	Without Correction Algorithm	15.4	11.5	
SAR <sub>be</sub> [%]	With Correction Algorithm	0.8	0.6	

TŜL

1750 MHz Typical SAR gradient: 10 % per mm

Sensor Cente	r to Phantom Surface Distance	2.0 mm	3.0 mm	
SAR <sub>be</sub> [%]	Without Correction Algorithm	10.2	6.5	
SAR <sub>be</sub> [%]	With Correction Algorithm	0.9	0.8	

### Sensor Offset

Probe Tip to Sensor Center

1.0 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).

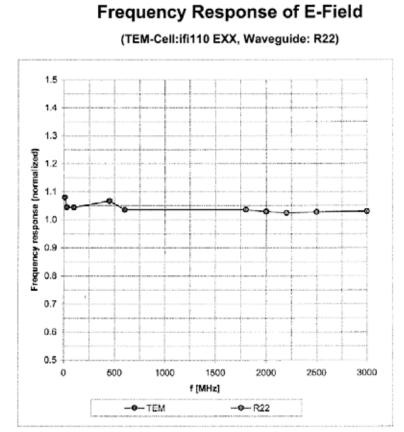
<sup>8</sup> Numerical linearization parameter: uncertainty not required.

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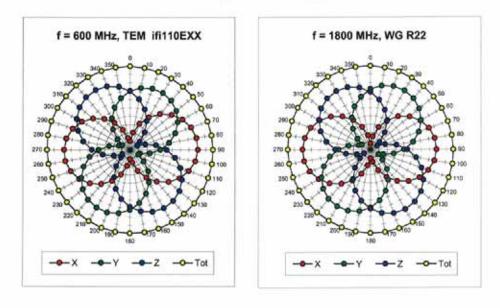
## Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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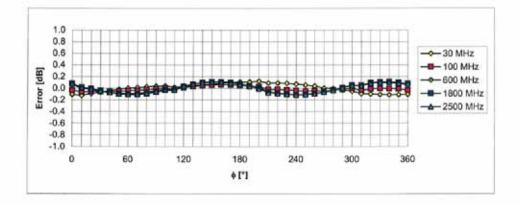
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## Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$



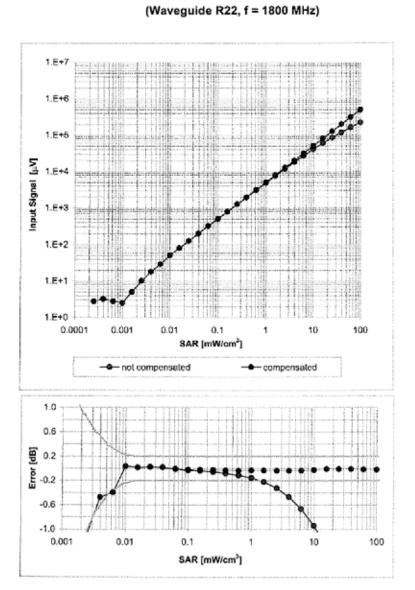
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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Dynamic Range f(SAR<sub>head</sub>)

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
900	± 50 / ± 100	Head	41.5 ± 5%	0.97 ± 5%	0.28	2.16	10.72 ± 11.0% (k=2)
1750	± 50 / ± 100	Head	40.1 ± 5%	1.37 ± 5%	0.53	0.68	9.42 ± 11.0% (k=2)
1950	± 50 / ± 100	Head	40.0 ± 5%	1.40 ± 5%	0.61	0.55	9.42 ± 11.0% (k=2)
2300	± 50 / ± 100	Head	39.4 ± 5%	1.71 ± 5%	0.55	0.57	8.35 ± 11.8% (k=2)
2450	± 50 / ± 100	Head	39.2 ± 5%	1.80 ± 5%	0.52	0.62	7.87 ± 11.8% (k=2)
2600	± 50 / ± 100	Head	$39.0\pm5\%$	1.96 ± 5%	0.43	0.75	7.48 ± 11.8% (k=2)
3500	± 50 / ± 100	Head	37.9 ± 5%	2.91 ± 5%	0.40	0.92	7.71 ± 13.1% (k=2)
4950	± 50 / ± 100	Head	$36.3\pm5\%$	4.40 ± 5%	0.25	1.75	5.42 ± 13.1% (k=2)
5200	± 50 / ± 100	Head	$36.0\pm5\%$	4.66 ± 5%	0.30	1.75	5.12 ± 13.1% (k=2)
5300	± 50 / ± 100	Head	$35.9 \pm 5\%$	4.76 ± 5%	0.34	1.75	4.64 ± 13.1% (k=2)
5500	± 50 / ± 100	Head	$35.6 \pm 5\%$	4.96 ± 5%	0.35	1.75	4.45 ± 13.1% (k=2)
5600	± 50 / ± 100	Head	$35.5 \pm 5\%$	5.07 ± 5%	0.50	1.75	4.18 ± 13.1% (k=2)
5800	± 50 / ± 100	Head	35.3 ± 5%	5.27 ± 5%	0.42	1.75	4.50 ± 13.1% (k=2)
900	± 50 / ± 100	Body	55.0 ± 5%	1.05 ± 5%	0.37	1.50	10.18 ± 11.0% (k=2)
1750	± 50 / ± 100	Body	$53.4 \pm 5\%$	1.49 ± 5%	0.71	0.63	9.32 ± 11.0% (k=2)
1950	± 50 / ± 100	Body	$53.3 \pm 5\%$	1.52 ± 5%	0.32	0.94	9.34 ± 11.0% (k=2)
2300	± 50 / ± 100	Body	52.8 ± 5%	1.85 ± 5%	0.50	0.69	8.27 ± 11.8% (k=2)
2450	± 50 / ± 100	Body	52.7 ± 5%	1.95 ± 5%	0.33	1.11	7.77 ± 11.8% (k=2)
2600	± 50 / ± 100	Body	52.5 ± 5%	2.16 ± 5%	0.32	1.12	7.34 ±11.8% (k=2)
3500	± 50 / ± 100	Body	51.3 ± 5%	3.31 ± 5%	0.48	1.10	6.92 ± 13.1% (k=2)
4950	± 50 / ± 100	Body	49.4 ± 5%	5.01 ± 5%	0.32	1.80	4.19 ± 13.1% (k=2)
5200	± 50 / ± 100	Body	49.0 ± 5%	5.30 ± 5%	0.30	1.80	4.17 ± 13.1% (k=2)
5300	± 50 / ± 100	Body	48.5 ± 5%	5.42 ± 5%	0.35	1.80	3.87 ± 13.1% (k=2)
5500	± 50 / ± 100	Body	48.6 ± 5%	$5.65 \pm 5\%$	0.45	1.80	3.72 ± 13.1% (k=2)
5600	± 50 / ± 100	Body	48.5 ± 5%	5.77 ± 5%	0.40	1.80	3.83 ± 13.1% (k=2)
5800	± 50 / ± 100	Body	48.2 ± 5%	$6.00 \pm 5\%$	0.48	1.80	3.75 ± 13.1% (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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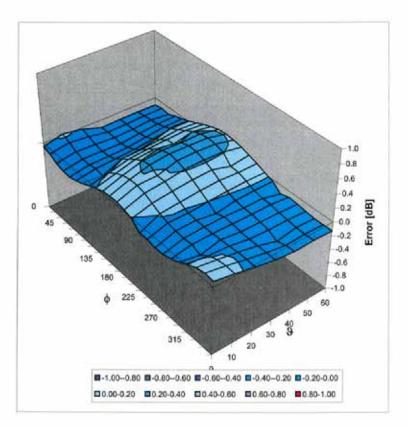
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## Deviation from Isotropy in HSL

Error (¢, 3), f = 900 MHz



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

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