

| Applicant: | Kyocera           |
|------------|-------------------|
| FCC ID:    | V65SCP-3810       |
| Report #:  | CT-V65-9C-0609-R0 |

### EXHIBIT 9 APPENDIX C: SAR PROBE CALIBRATION CERTIFICATE

Total pages including cover page = 37

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





S Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
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

Client

Kyocera USA

Certificate No: ES3-3035 Aug08

Accreditation No.: SCS 108

Object ES3DV3-SN:3035

Calibration procedure(s) QA CAL-01.v6 and QA CAL-23:v3

Calibration procedure for dosimetric E-field probes

Calibration date: August 25, 2008

Condition of the calibrated item In lolerance

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)

| ID#             | Cal Date (Certificate No.)   | Scheduled Calibration  |
|-----------------|--|--|
| GB41293874      | 1-Apr-08 (No. 217-00788)   | Apr-09   |
| MY41495277      | 1-Apr-08 (No. 217-00788)   | Apr-09   |
| MY41498087      | 1-Apr-08 (No. 217-00788)   | Арг-09   |
| SN: S5054 (3c)  | 1-Jul-08 (No. 217-00865)   | Jul-09   |
| SN: S5086 (20b) | 31-Mar-08 (No. 217-00787)  | Apr-09   |
| SN: S5129 (30b) | 1-Jul-08 (No. 217-00866)   | Jul-09   |
| SN: 3013        | 2-Jan-08 (No. ES3-3013_Jan08)  | Jan-09   |
| SN: 660         | 3-Sep-07 (No. DAE4-660_Sep07)  | Sep-08   |
| ID#             | Check Date (in house)  | Scheduled Check  |
| US3642U01700    | 4-Aug-99 (in house check Oct-07)   | In house check: Oct-09   |
| US37390585      | 18-Oct-01 (in house check Oct-07)  | in house check: Oct-08   |
| Name            | Function   | Signature  |
| Katja Poković   | Technical Manager  | 28 1164  |
| Niels Kuster    | Quality Manager  |  |
|                 | GB41293874 MY41495277 MY41498087 SN: S5054 (3c) SN: S5086 (20b) SN: S5129 (30b) SN: 3013 SN: 660  ID # US3642U01700 US37390585  Name Katja Pokovic | GB41293874 1-Apr-08 (No. 217-00788) MY41495277 1-Apr-08 (No. 217-00788) MY41498087 1-Apr-08 (No. 217-00788) SN: S5054 (3c) 1-Jul-08 (No. 217-00865) SN: S5086 (20b) 31-Mar-08 (No. 217-00787) SN: S5129 (30b) 1-Jul-08 (No. 217-00866) SN: 3013 2-Jan-08 (No. ES3-3013_Jan08) SN: 660 3-Sep-07 (No. DAE4-660_Sep07)  ID # Check Date (in house) US3642U01700 4-Aug-99 (in house check Oct-07) US37390585 18-Oct-01 (in house check Oct-07) Name Function Katja Pokovic Technical Manager |

Issued: August 25, 2008

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Certificate No: ES3-3035 Aug08 9

#### Calibration Laboratory of

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**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 sensitivity in free space NORMx,y,z

ConvF sensitivity in TSL / NORMx,y,z diode compression point **DCP** Polarization o 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.,  $\vartheta = 0$  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 ( $f \le 900$  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,v,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, v, 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.

ES3DV3 SN:3035 August 25, 2008

# Probe ES3DV3

SN:3035

Manufactured: August 21, 2003

Last calibrated: September 19, 2007

Recalibrated: August 25, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ES3-3035\_Aug08 Page 3 of 9

#### DASY - Parameters of Probe: ES3DV3 SN:3035

| Sensitivity in Free Space <sup>A</sup> Diod |
|---|
|---|

| NormX | <b>1.11</b> ± 10.1% | μV/(V/m)² | DCP X | <b>97</b> mV |
|-------|---------------------|-----------|-------|--------------|
| NormY | <b>0.93</b> ± 10.1% | μV/(V/m)² | DCP Y | <b>95</b> mV |
| NormZ | <b>1.15</b> ± 10.1% | μV/(V/m)² | DCP Z | <b>96</b> mV |

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

#### **Boundary Effect**

TSL 835 MHz Typical SAR gradient: 5 % per mm

| Sensor Center t       | o Phantom Surface Distance   | 3.0 mm | 4.0 mm |
|-----------------------|------------------------------|--------|--------|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 9.1    | 5.0    |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 8.0    | 0.3    |

TSL 1900 MHz Typical SAR gradient: 10 % per mm

| Sensor Center to      | o Phantom Surface Distance   | 3.0 mm | 4.0 mm |
|-----------------------|------------------------------|--------|--------|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 8.5    | 4.8    |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.4    | 0.2    |

#### Sensor Offset

Probe Tip to Sensor Center 2.0 mm

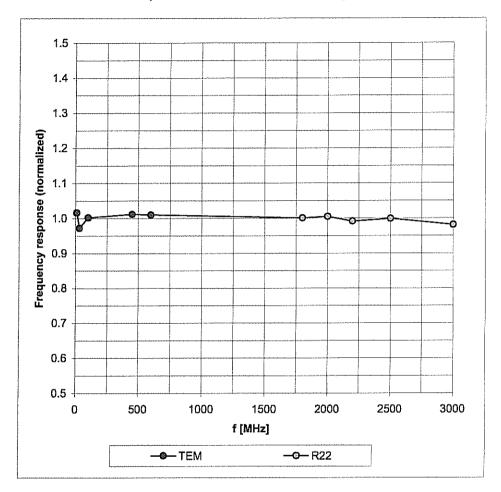
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

<sup>&</sup>lt;sup>a</sup> Numerical linearization parameter: uncertainty not required.

### Frequency Response of E-Field

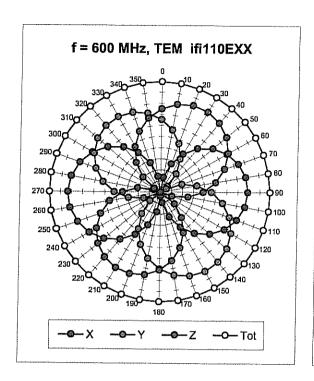
(TEM-Cell:ifi110 EXX, Waveguide: R22)

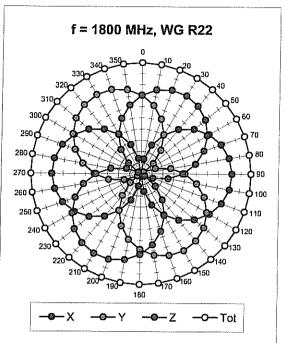


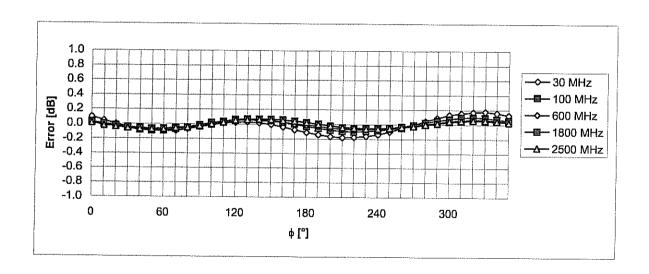
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

ES3DV3 SN:3035 August 25, 2008

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







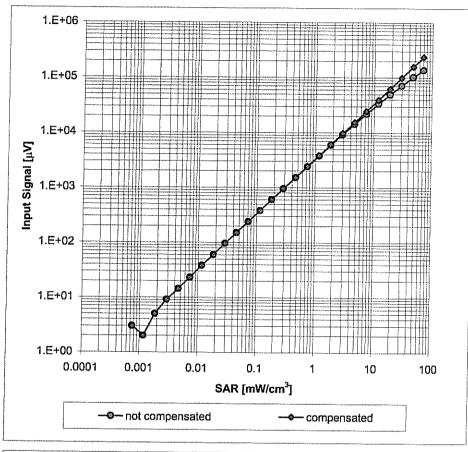
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

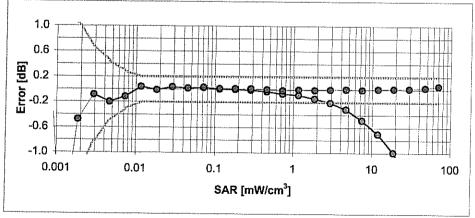
Certificate No: ES3-3035\_Aug08 Page 6 of 9

ES3DV3 SN:3035 August 25, 2008

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

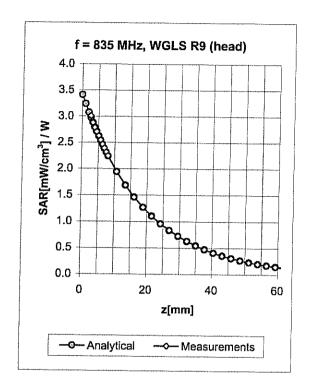
(Waveguide R22, f = 1800 MHz)

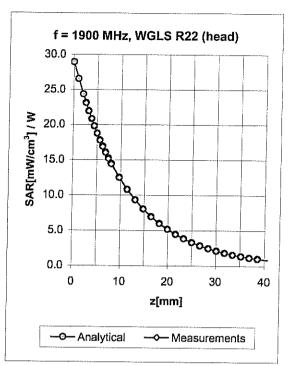




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

## **Conversion Factor Assessment**





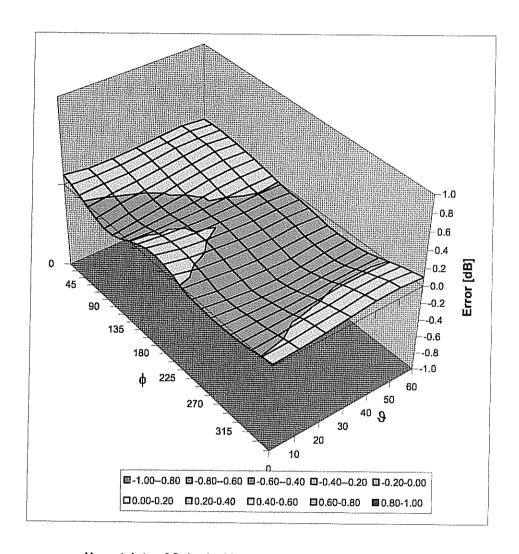
| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity   | Alpha | Depth | ConvF | Uncertainty   |
|---------|-----------------------------|------|--------------|----------------|-------|-------|-------|---------------|
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%      | 0.43  | 1.49  | 6.20  | ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%      | 0.66  | 1.27  | 5.01  | ± 11.0% (k=2) |
|         |                             |      |              |                |       |       |       |               |
|         |                             |      |              |                |       |       |       |               |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | $0.97 \pm 5\%$ | 0.60  | 1.28  | 6.06  | ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%      | 0.45  | 1.77  | 4.65  | ± 11.0% (k=2) |

 $<sup>^{\</sup>rm c}$  The validity of  $\pm$  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.

ES3DV3 SN:3035 August 25, 2008

# **Deviation from Isotropy in HSL**

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



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

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Client

Kyocera USA

Certificate No: ES3-3036 Sep08

#### Object ES3DV3 - SN:3036 QA CAL-01 v6 and QA CAL-23 v3 Calibration procedure(s) Calibration procedure for dosimetric E-field probes September 18, 2008 Calibration date: 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) Scheduled Calibration Primary Standards Cal Date (Certificate No.) Apr-09 GB41293874 1-Apr-08 (No. 217-00788) Power meter E4419B Apr-09 Power sensor E4412A MY41495277 1-Apr-08 (No. 217-00788) Арг-09 Power sensor E4412A MY41498087 1-Apr-08 (No. 217-00788) Jul-09 Reference 3 dB Attenuator SN: S5054 (3c) 1-Jul-08 (No. 217-00865) Арг-09 Reference 20 dB Attenuator SN: S5086 (20b) 31-Mar-08 (No. 217-00787) 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 ID# Check Date (in house) Scheduled Check US3642U01700 4-Aug-99 (in house check Oct-07) In house check: Oct-09 RF generator HP 8648C US37390585 In house check: Oct-08 Network Analyzer HP 8753E 18-Oct-01 (in house check Oct-07) Name Function Signature Calibrated by: Katja Pokovic Technical Manager Quality Manager Niels Kuster Approved by: Issued: September 19, 2008 This calibration certificate shall not be reproduced except in full without written approval of the laboratory.

Certificate No: ES3-3036 Sep08 Page 1 of 9

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Multilateral Agreement for the recognition of calibration certificates

#### Glossary:

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

ConvF sensitivity in TSL / NORMx,y,z diode compression point DCP φ rotation around probe axis Polarization o

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,y,z:* Assessed for E-field polarization 9 = 0 ( $f \le 900$  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,v,z = NORMx,v,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.v.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.

Certificate No: ES3-3036 Sep08

ES3DV3 SN:3036 September 18, 2008

# Probe ES3DV3

SN:3036

Manufactured:

August 21, 2003

Last calibrated:

October 22, 2007

Recalibrated:

September 18, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

### DASY - Parameters of Probe: ES3DV3 SN:3036

|  | Sensitivity in | Free Space <sup>A</sup> | Diode Compression <sup>B</sup> |
|--|----------------|-------------------------|--------------------------------|
|--|----------------|-------------------------|--------------------------------|

| NormX | <b>1.22</b> ± 10.1% | μV/(V/m) <sup>2</sup> | DCP X | <b>91</b> mV |
|-------|---------------------|-----------------------|-------|--------------|
| NormY | <b>1.40</b> ± 10.1% | μV/(V/m)²             | DCP Y | <b>94</b> mV |
| NormZ | 1.43 ± 10.1%        | $\mu V/(V/m)^2$       | DCP Z | <b>93</b> mV |

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

#### **Boundary Effect**

TSL 835 MHz Typical SAR gradient: 5 % per mm

| Sensor Center to      | o Phantom Surface Distance   | 3.0 mm | 4.0 mm |
|-----------------------|------------------------------|--------|--------|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 12.1   | 8.1    |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.7    | 0.4    |

TSL 1900 MHz Typical SAR gradient: 10 % per mm

| Sensor Center t       | o Phantom Surface Distance   | 3.0 mm | 4.0 mm |
|-----------------------|------------------------------|--------|--------|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 11.7   | 7.9    |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.4    | 0.2    |

#### Sensor Offset

Probe Tip to Sensor Center 2.0 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%.

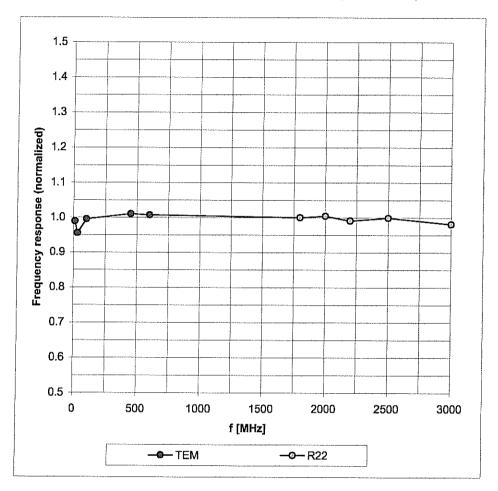
Certificate No: ES3-3036\_Sep08

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

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

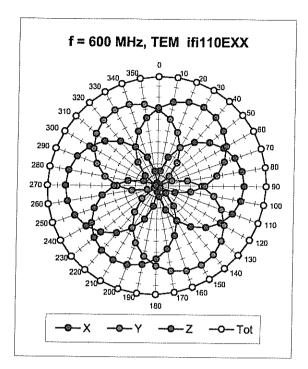
### Frequency Response of E-Field

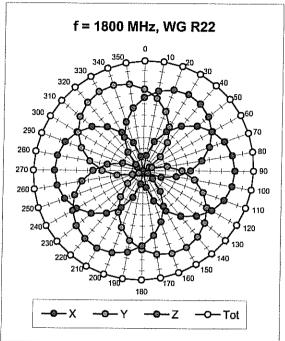
(TEM-Cell:ifi110 EXX, Waveguide: R22)

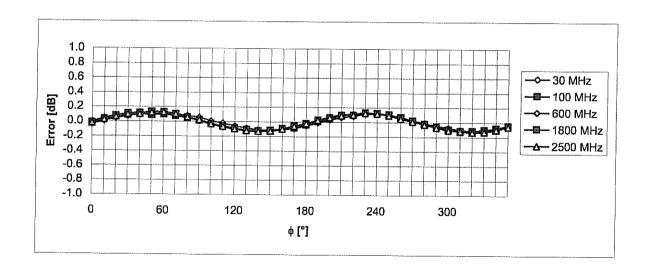


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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



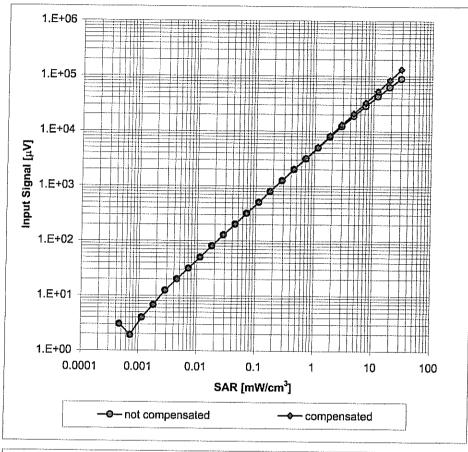


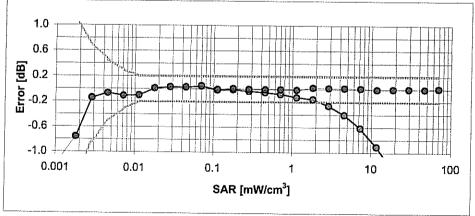


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

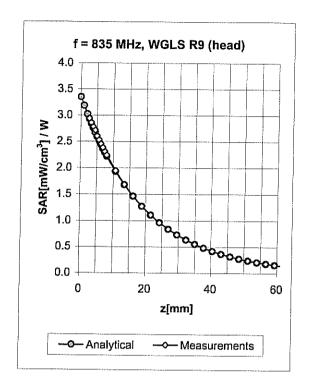
(Waveguide R22, f = 1800 MHz)

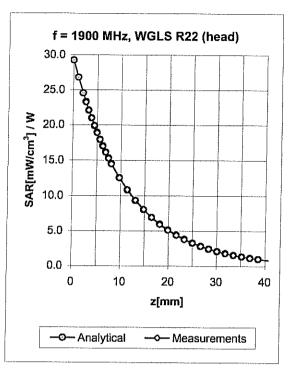




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

### **Conversion Factor Assessment**



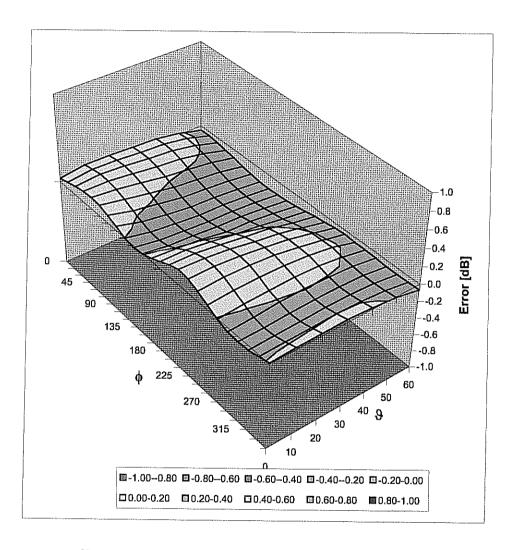


| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|------|--------------|--------------|-------|-------|--------------------|
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%    | 0.62  | 1.46  | 6.09 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.40  | 1.98  | 5.02 ± 11.0% (k=2) |
|         |                             |      |              |              |       |       |                    |
|         |                             |      |              |              |       |       |                    |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 0.99  | 1.09  | 5.97 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.40  | 2.02  | 4.56 ± 11.0% (k=2) |

 $<sup>^{\</sup>rm c}$  The validity of  $\pm$  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.

# **Deviation from Isotropy in HSL**

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



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

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





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Accreditation No.: SCS 108

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Client

Kyocera USA

Certificate No. ET3-1618 Aug08

#### GALIBRATION GERTIE GATE ET3DV6-SN:1618 Object QA GAL-01 v6 and QA GAL-23 v3 Calibration procedure(s) Calibration procedure for dosimetric E-field probes Calibration date: August 25, 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) Scheduled Calibration Cal Date (Certificate No.) **Primary Standards** 1-Apr-08 (No. 217-00788) Арг-09 GB41293874 Power meter E4419B MY41495277 1-Apr-08 (No. 217-00788) Apr-09 Power sensor E4412A Арг-09 Power sensor E4412A MY41498087 1-Apr-08 (No. 217-00788) Jul-09 Reference 3 dB Attenuator 1-Jul-08 (No. 217-00865) SN: S5054 (3c) Арг-09 Reference 20 dB Attenuator 31-Mar-08 (No. 217-00787) SN: S5086 (20b) Jul-09 Reference 30 dB Attenuator SN: S5129 (30b) 1-Jul-08 (No. 217-00866) SN: 3013 2-Jan-08 (No. ES3-3013 Jan08) Jan-09 Reference Probe ES3DV2 SN: 660 3-Sep-07 (No. DAE4-660 Sep07) Sep-08 DAE4 Scheduled Check ID# Check Date (in house) Secondary Standards In house check: Oct-09 US3642U01700 4-Aug-99 (in house check Oct-07) RF generator HP 8648C In house check: Oct-08 18-Oct-01 (in house check Oct-07) Network Analyzer HP 8753E US37390585 Signature Name Function Katia Pokovio Technical Manager Calibrated by: Niels Kuster Quality Manager Approved by:

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Accreditation No.: SCS 108

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#### Glossary:

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

ConvF sensitivity in TSL / NORMx,y,z

 $\begin{array}{ll} \text{DCP} & \text{diode compression point} \\ \text{Polarization } \phi & \text{$\phi$ rotation around probe axis} \end{array}$ 

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,y,z:* Assessed for E-field polarization  $\vartheta = 0$  (f  $\le 900$  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  $E^2$ -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.

# Probe ET3DV6

SN:1618

Manufactured: January 25, 2002 Last calibrated: September 19, 2007 Recalibrated: August 25, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

#### DASY - Parameters of Probe: ET3DV6 SN:1618

| Sensitivity in Free Space <sup>A</sup> Diode Compression <sup>B</sup> |
|---|
|---|

| NormX | <b>2.04</b> ± 10.1% | μV/(V/m) <sup>2</sup> | DCP X | <b>93</b> mV |
|-------|---------------------|-----------------------|-------|--------------|
| NormY | <b>2.01</b> ± 10.1% | $\mu V/(V/m)^2$       | DCP Y | <b>92</b> mV |
| NormZ | <b>2.17</b> ± 10.1% | μV/(V/m) <sup>2</sup> | DCP Z | <b>96</b> mV |

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

#### **Boundary Effect**

TSL 835 MHz Typical SAR gradient: 5 % per mm

| Sensor Center to      | 3.7 mm                       | 4.7 mm |     |
|-----------------------|------------------------------|--------|-----|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 10.0   | 6.1 |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.8    | 0.5 |

TSL 1750 MHz Typical SAR gradient: 10 % per mm

| Sensor Center t       | 3.7 mm                       | 4.7 mm |     |
|-----------------------|------------------------------|--------|-----|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 11.0   | 6.9 |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.6    | 0.3 |

#### Sensor Offset

Probe Tip to Sensor Center 2.7 mm

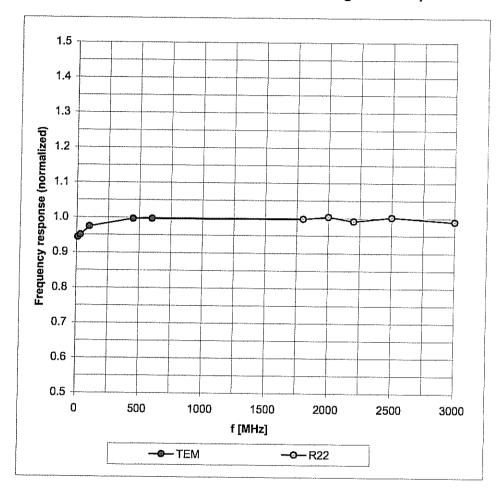
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

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

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

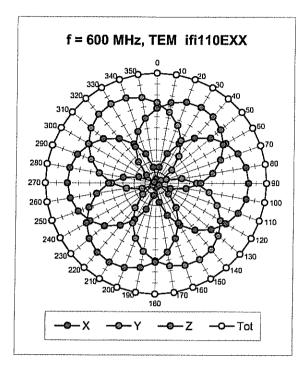
### Frequency Response of E-Field

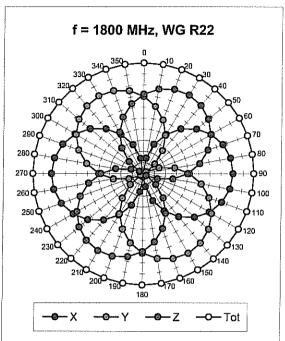
(TEM-Cell:ifi110 EXX, Waveguide: R22)

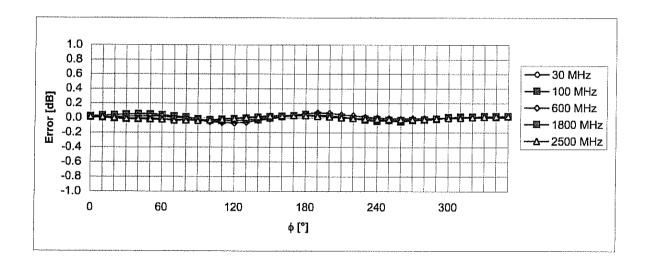


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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



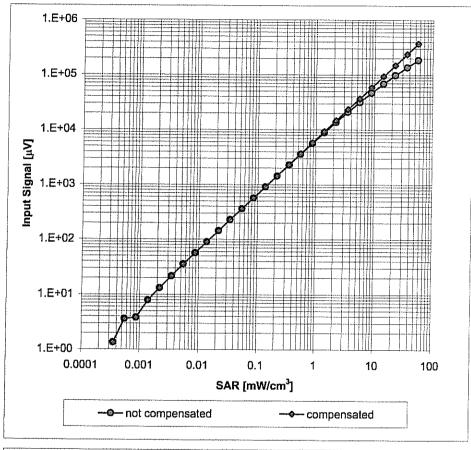


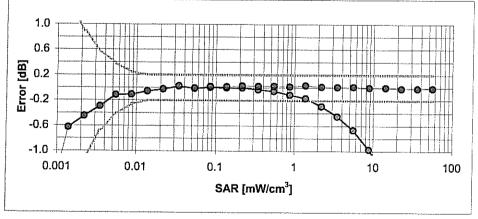


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

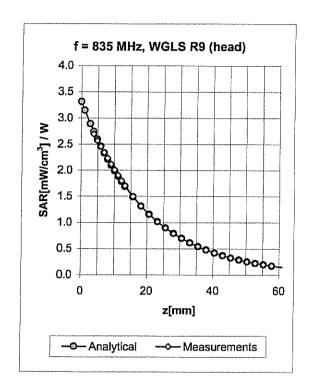
(Waveguide R22, f = 1800 MHz)

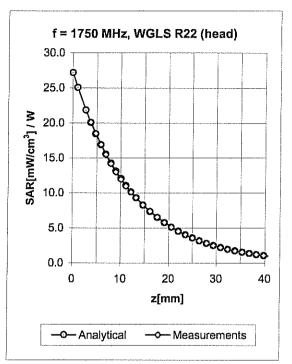




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

### **Conversion Factor Assessment**



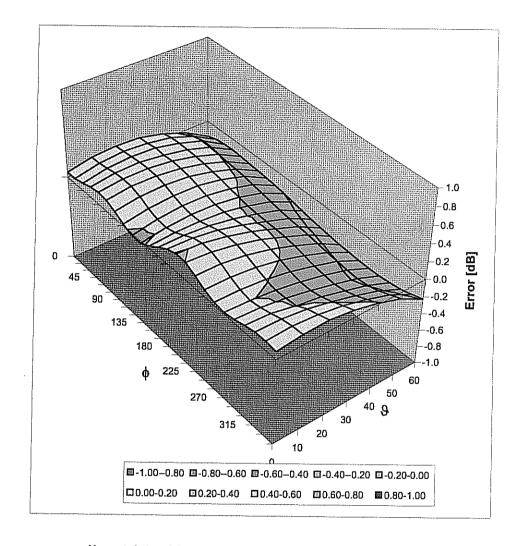


| f [MHz] | Validity [MHz] <sup>c</sup> | TSL  | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|------|--------------|--------------|-------|-------|--------------------|
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%    | 0.50  | 2.40  | 6.64 ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Head | 40.1 ± 5%    | 1.37 ± 5%    | 0.58  | 2.21  | 5.57 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.65  | 1.90  | 5.29 ± 11.0% (k=2) |
|         |                             |      |              |              |       |       |                    |
|         |                             |      |              |              |       |       |                    |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 0.54  | 2.36  | 6.41 ± 11.0% (k=2) |
| 1750    | ± 50 / ± 100                | Body | 53.4 ± 5%    | 1.49 ± 5%    | 0.59  | 2.19  | 4.89 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.63  | 2.00  | 4.57 ± 11.0% (k=2) |

<sup>&</sup>lt;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.

# **Deviation from Isotropy in HSL**

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



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

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





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Client

Kyocera USA

Accreditation No.: SCS 108

Certificate No: ES3-3078 Jun08

#### (O) NEO ERTE CONTRACTOR OF A THE ES3DV3 - SN:3078 Object QA CAL-01 v6 and QA CAL-23 v3 Calibration procedure(s) Calibration procedure for dosimetric E-field probes Calibration date: 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 Scheduled Calibration ID# Cal Date (Certificate No.) 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) Арг-09 Aug-08 Reference 3 dB Attenuator SN: S5054 (3c) 8-Aug-07 (No. 217-00719) Reference 20 dB Attenuator SN: S5086 (20b) 31-Mar-08 (No. 217-00787) Apr-09 Reference 30 dB Attenuator SN: S5129 (30b) 8-Aug-07 (No. 217-00720) Aug-08 Jan-09 Reference Probe ES3DV2 SN: 3013 2-Jan-08 (No. ES3-3013\_Jaп08) SN: 660 Sep-08 DAE4 3-Sep-07 (No. DAE4-660\_Sep07) 1D # Scheduled Check Secondary Standards Check Date (in house) 4-Aug-99 (in house check Oct-07) RF generator HP 8648C US3642U01700 In house check: Oct-09 Network Analyzer HP 8753E US37390585 18-Oct-01 (in house check Oct-07) In house check: Oct-08 Signature Name Function Calibrated by: Katja Pokovic Technical Manager Approved by: Niels Kuster Quality Manager

Issued: June 25, 2008

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

Certificate No: ES3-3078\_Jun08

#### **Calibration Laboratory of**

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





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The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

#### Glossary:

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

ConvF sensitivity in TSL / NORMx,y,z DCP diode compression point

Polarization  $\varphi$   $\phi$  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.,  $\vartheta = 0$  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 θ = 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.

Certificate No: ES3-3078\_Jun08 Page 2 of 9

# Probe ES3DV3

SN:3078

Manufactured: March 14, 2005 Last calibrated: July 16, 2007 Recalibrated: June 23, 2008

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ES3-3078\_Jun08 Page 3 of 9

#### DASY - Parameters of Probe: ES3DV3 SN:3078

| Sensitivity in Free |                     | Diode C            | ompression <sup>B</sup> |              |  |
|---------------------|---------------------|--------------------|-------------------------|--------------|--|
| NormX               | <b>1.26</b> ± 10.1% | $\mu$ V/(V/m) $^2$ | DCP X                   | <b>91</b> mV |  |

NormY 1.27 ± 10.1%  $\mu V/(V/m)^2$  DCP Y 95 mV NormZ 1.20 ± 10.1%  $\mu V/(V/m)^2$  DCP Z 94 mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 8.

#### **Boundary Effect**

TSL 835 MHz Typical SAR gradient: 5 % per mm

| Sensor Center t       | 3.0 mm                       | 4.0 mm |     |
|-----------------------|------------------------------|--------|-----|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 9.4    | 5.7 |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.7    | 0.2 |

TSL 1900 MHz Typical SAR gradient: 10 % per mm

| Sensor Center to      | 3.0 mm                       | 4.0 mm |     |
|-----------------------|------------------------------|--------|-----|
| SAR <sub>be</sub> [%] | Without Correction Algorithm | 7.4    | 4.5 |
| SAR <sub>be</sub> [%] | With Correction Algorithm    | 0.5    | 0.1 |

#### Sensor Offset

Probe Tip to Sensor Center 2.0 mm

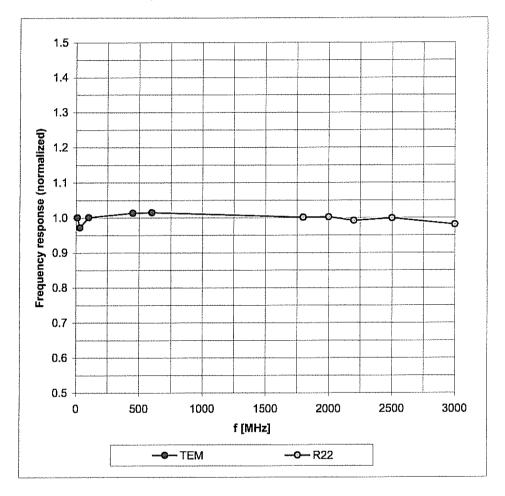
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

<sup>&</sup>lt;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>&</sup>lt;sup>a</sup> Numerical linearization parameter: uncertainty not required.

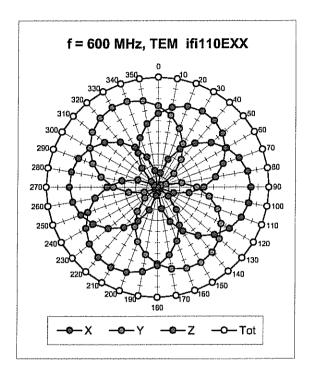
### Frequency Response of E-Field

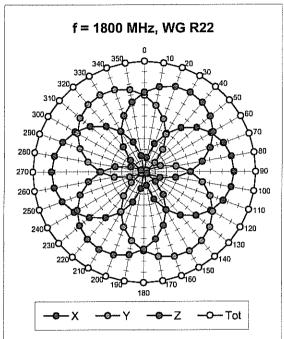
(TEM-Cell:ifi110 EXX, Waveguide: R22)

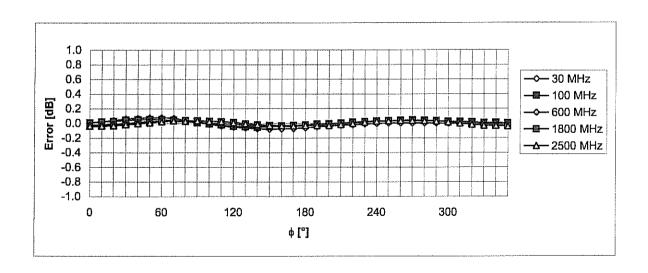


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

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



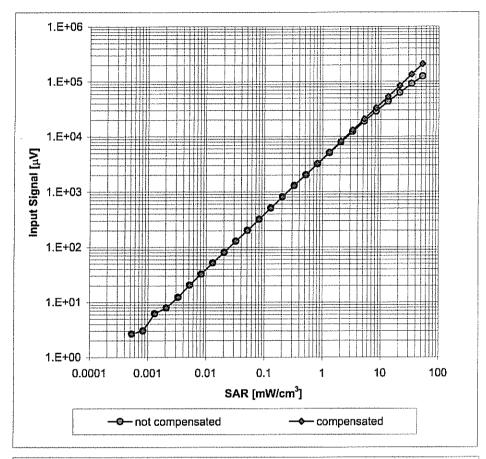


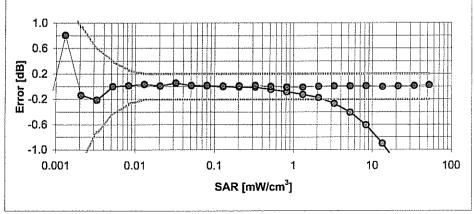


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

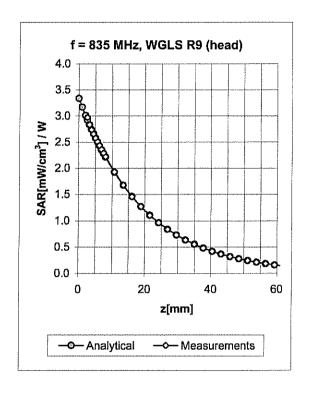
(Waveguide R22, f = 1800 MHz)

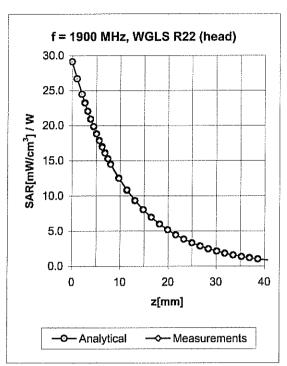




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

#### **Conversion Factor Assessment**



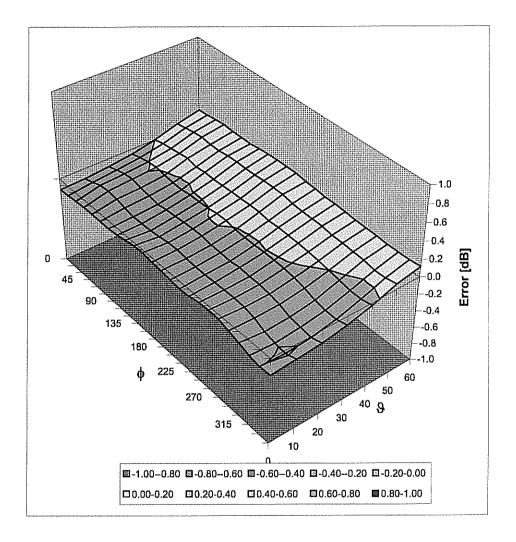


| f [MHz] | Validity [MHz] <sup>c</sup> | TSL. | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|------|--------------|--------------|-------|-------|--------------------|
| 835     | ± 50 / ± 100                | Head | 41.5 ± 5%    | 0.90 ± 5%    | 0.20  | 2.39  | 5.90 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Head | 40.0 ± 5%    | 1.40 ± 5%    | 0.85  | 1.13  | 4.97 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Head | 39.2 ± 5%    | 1.80 ± 5%    | 0.94  | 1.14  | 4.46 ± 11.0% (k=2) |
|         |                             |      |              |              |       |       |                    |
|         |                             |      |              |              |       |       |                    |
| 835     | ± 50 / ± 100                | Body | 55.2 ± 5%    | 0.97 ± 5%    | 0.33  | 1.85  | 5.86 ± 11.0% (k=2) |
| 1900    | ± 50 / ± 100                | Body | 53.3 ± 5%    | 1.52 ± 5%    | 0.79  | 1.33  | 4.58 ± 11.0% (k=2) |
| 2450    | ± 50 / ± 100                | Body | 52.7 ± 5%    | 1.95 ± 5%    | 0.96  | 1.12  | 4.20 ± 11.0% (k=2) |

<sup>&</sup>lt;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.

### **Deviation from Isotropy in HSL**

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



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