



EX3DV4- SN:3932

September 16, 2013

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3932

### Basic Calibration Parameters

|                                                           | Sensor X | Sensor Y | Sensor Z | Unc (k=2)     |
|-----------------------------------------------------------|----------|----------|----------|---------------|
| Norm ( $\mu\text{V}/(\text{V}/\text{m})^2$ ) <sup>A</sup> | 0.52     | 0.55     | 0.46     | $\pm 10.1 \%$ |
| DCP (mV) <sup>B</sup>                                     | 102.3    | 102.8    | 101.8    |               |

### Modulation Calibration Parameters

| UID | Communication System Name |   | A<br>dB | B<br>dB/ $\mu\text{V}$ | C   | D<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-----|---------------------------|---|---------|------------------------|-----|---------|----------|---------------------------|
| 0   | CW                        | X | 0.0     | 0.0                    | 1.0 | 0.00    | 167.8    | $\pm 3.0 \%$              |
|     |                           | Y | 0.0     | 0.0                    | 1.0 |         | 179.9    |                           |
|     |                           | Z | 0.0     | 0.0                    | 1.0 |         | 157.1    |                           |

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

<sup>A</sup> The uncertainties of NormX,Y,Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Pages 5 and 6).

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

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



EX3DV4- SN:3932

September 16, 2013

## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3932

### Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750                  | 41.9                               | 0.89                            | 10.36   | 10.36   | 10.36   | 0.20  | 1.35       | ± 12.0 %    |
| 835                  | 41.5                               | 0.90                            | 9.89    | 9.89    | 9.89    | 0.29  | 1.02       | ± 12.0 %    |
| 900                  | 41.5                               | 0.97                            | 9.67    | 9.67    | 9.67    | 0.21  | 1.33       | ± 12.0 %    |
| 1750                 | 40.1                               | 1.37                            | 8.47    | 8.47    | 8.47    | 0.33  | 0.89       | ± 12.0 %    |
| 1900                 | 40.0                               | 1.40                            | 8.21    | 8.21    | 8.21    | 0.12  | 1.47       | ± 12.0 %    |
| 2100                 | 39.8                               | 1.49                            | 8.31    | 8.31    | 8.31    | 0.80  | 0.50       | ± 12.0 %    |
| 2300                 | 39.5                               | 1.67                            | 7.75    | 7.75    | 7.75    | 0.43  | 0.70       | ± 12.0 %    |
| 2450                 | 39.2                               | 1.80                            | 7.40    | 7.40    | 7.40    | 0.36  | 0.81       | ± 12.0 %    |
| 2600                 | 39.0                               | 1.96                            | 7.16    | 7.16    | 7.16    | 0.44  | 0.78       | ± 12.0 %    |

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

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



## DASY/EASY - Parameters of Probe: EX3DV4 - SN:3932

### Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) <sup>C</sup> | Relative Permittivity <sup>F</sup> | Conductivity (S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750                  | 55.5                               | 0.96                            | 9.92    | 9.92    | 9.92    | 0.21  | 1.47       | ± 12.0 %    |
| 835                  | 55.2                               | 0.97                            | 9.92    | 9.92    | 9.92    | 0.30  | 1.12       | ± 12.0 %    |
| 900                  | 55.0                               | 1.05                            | 9.67    | 9.67    | 9.67    | 0.51  | 0.79       | ± 12.0 %    |
| 1750                 | 53.4                               | 1.49                            | 8.14    | 8.14    | 8.14    | 0.56  | 0.73       | ± 12.0 %    |
| 1900                 | 53.3                               | 1.52                            | 7.80    | 7.80    | 7.80    | 0.42  | 0.80       | ± 12.0 %    |
| 2100                 | 53.2                               | 1.62                            | 8.12    | 8.12    | 8.12    | 0.29  | 1.01       | ± 12.0 %    |
| 2300                 | 52.9                               | 1.81                            | 7.57    | 7.57    | 7.57    | 0.59  | 0.68       | ± 12.0 %    |
| 2450                 | 52.7                               | 1.95                            | 7.34    | 7.34    | 7.34    | 0.80  | 0.50       | ± 12.0 %    |
| 2600                 | 52.5                               | 2.16                            | 7.08    | 7.08    | 7.08    | 0.80  | 0.50       | ± 12.0 %    |
| 5200                 | 49.0                               | 5.30                            | 4.69    | 4.69    | 4.69    | 0.45  | 1.90       | ± 13.1 %    |
| 5300                 | 48.9                               | 5.42                            | 4.48    | 4.48    | 4.48    | 0.45  | 1.90       | ± 13.1 %    |
| 5500                 | 48.6                               | 5.65                            | 4.15    | 4.15    | 4.15    | 0.50  | 1.90       | ± 13.1 %    |
| 5600                 | 48.5                               | 5.77                            | 4.07    | 4.07    | 4.07    | 0.45  | 1.90       | ± 13.1 %    |
| 5800                 | 48.2                               | 6.00                            | 4.19    | 4.19    | 4.19    | 0.55  | 1.90       | ± 13.1 %    |

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

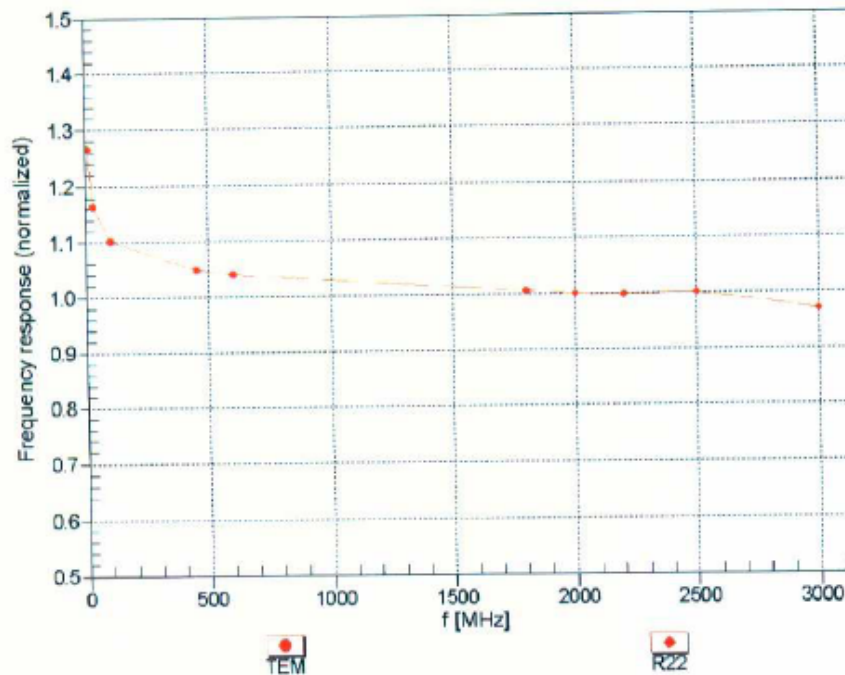
<sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted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



EX3DV4- SN:3932

September 16, 2013

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



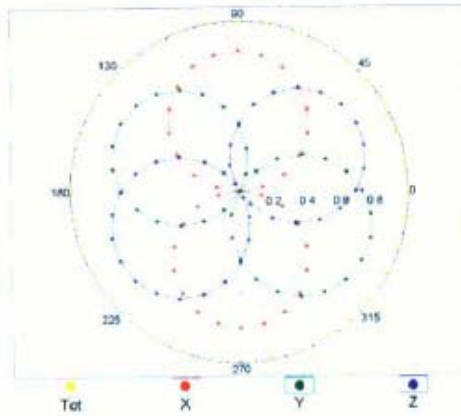
Uncertainty of Frequency Response of E-field:  $\pm 6.3\%$  ( $k=2$ )

EX3DV4- SN:3932

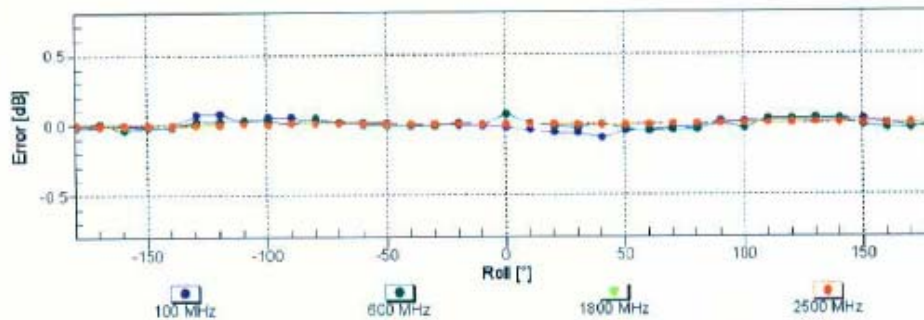
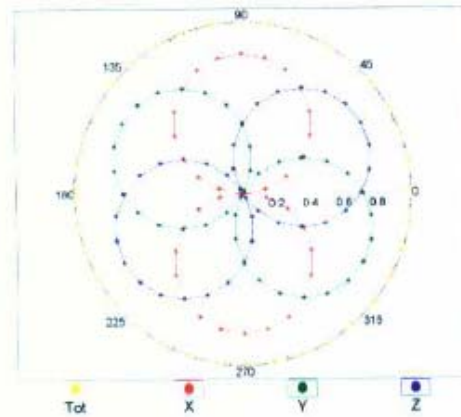
September 16, 2013

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

f=600 MHz,TEM



f=1800 MHz,R22



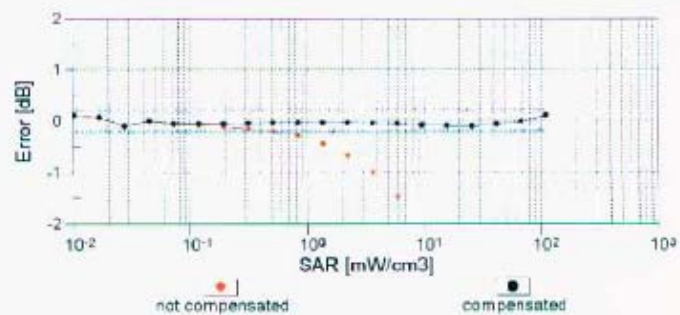
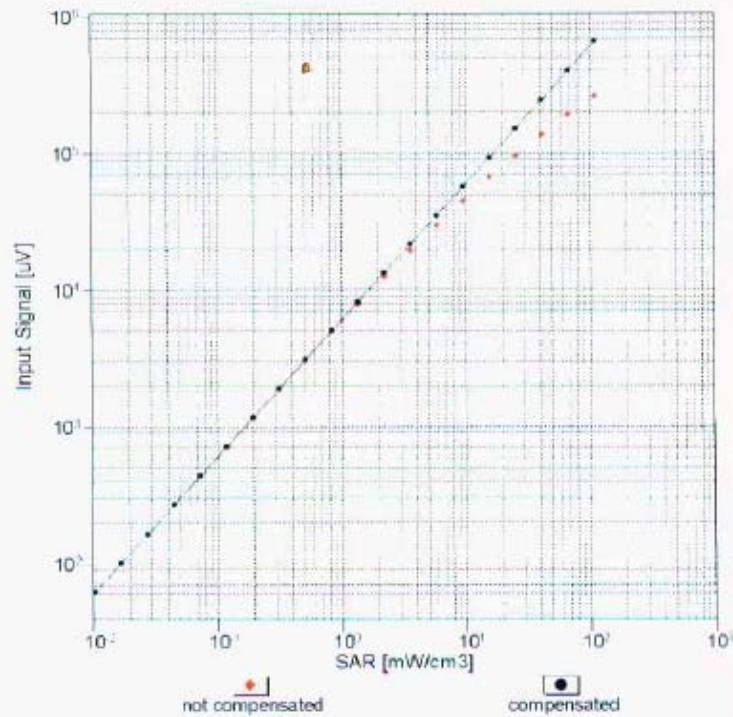
Uncertainty of Axial Isotropy Assessment:  $\pm 0.5\%$  ( $k=2$ )



EX3DV4- SN:3932

September 16, 2013

### Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f = 900 \text{ MHz}$ )



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

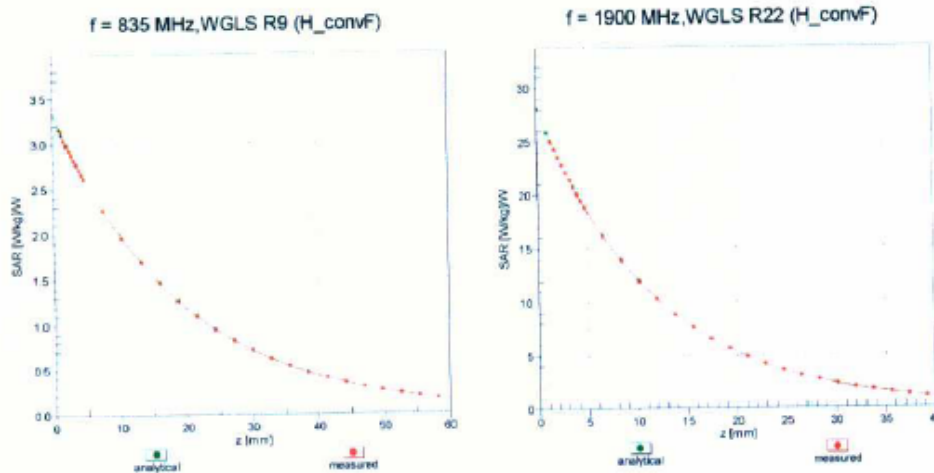
Certificate No: EX3-3932\_Sep13

Page 9 of 11

EX3DV4- SN:3932

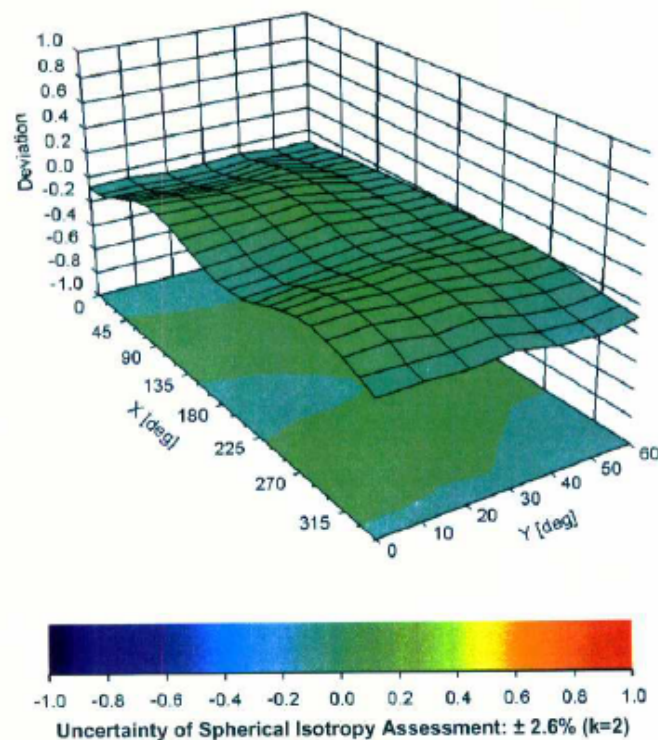
September 16, 2013

## Conversion Factor Assessment



## Deviation from Isotropy in Liquid

Error ( $\phi, \theta$ ),  $f = 900 \text{ MHz}$





EX3DV4- SN:3932

September 16, 2013

## **DASY/EASY - Parameters of Probe: EX3DV4 - SN:3932**

### **Other Probe Parameters**

|                                               |            |
|-----------------------------------------------|------------|
| Sensor Arrangement                            | Triangular |
| Connector Angle (°)                           | -109.5     |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 9 mm       |
| Tip Diameter                                  | 2.5 mm     |
| Probe Tip to Sensor X Calibration Point       | 1 mm       |
| Probe Tip to Sensor Y Calibration Point       | 1 mm       |
| Probe Tip to Sensor Z Calibration Point       | 1 mm       |
| Recommended Measurement Distance from Surface | 2 mm       |





## 5. (1) D2450V2 Dipole Calibration Certificate

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



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

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

Accreditation No.: **SCS 108**

Client **Neutron Engineering (Auden)**

Certificate No: **D2450V2-919\_Sep13**

### CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 919**

Calibration procedure(s) **QA CAL-05.v9**  
**Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **September 10, 2013**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards           | ID #               | Cal Date (Certificate No.)     | Scheduled Calibration |
|-----------------------------|--------------------|--------------------------------|-----------------------|
| Power meter EPM-442A        | GB37480704         | 01-Nov-12 (No. 217-01640)      | Oct-13                |
| Power sensor HP 8481A       | US37292783         | 01-Nov-12 (No. 217-01640)      | Oct-13                |
| Reference 20 dB Attenuator  | SN: 5058 (20k)     | 04-Apr-13 (No. 217-01736)      | Apr-14                |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 04-Apr-13 (No. 217-01739)      | Apr-14                |
| Reference Probe ES3DV3      | SN: 3205           | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13                |
| DAE4                        | SN: 601            | 25-Apr-13 (No. DAE4-601_Apr13) | Apr-14                |

| Secondary Standards       | ID #             | Check Date (in house)             | Scheduled Check        |
|---------------------------|------------------|-----------------------------------|------------------------|
| Power sensor HP 8481A     | MY41092317       | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06   | 100005           | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

|                |                               |                                          |               |
|----------------|-------------------------------|------------------------------------------|---------------|
| Calibrated by: | Name<br><b>Israe El-Naouq</b> | Function<br><b>Laboratory Technician</b> | Signature<br> |
| Approved by:   | <b>Katja Pokovic</b>          | <b>Technical Manager</b>                 |               |

Issued: September 10, 2013

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



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**S** Schweizerischer Kalibrierdienst  
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**S** Servizio svizzero di taratura  
**S** Swiss Calibration Service

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Accreditation No.: **SCS 108**

**Glossary:**

|       |                                 |
|-------|---------------------------------|
| TSL   | tissue simulating liquid        |
| ConvF | sensitivity in TSL / NORM x,y,z |
| N/A   | not applicable or not measured  |

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Additional Documentation:**

- DASY4/5 System Handbook

**Methods Applied and Interpretation of Parameters:**

- Measurement Conditions:** Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- Antenna Parameters with TSL:** The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- Feed Point Impedance and Return Loss:** These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- Electrical Delay:** One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- SAR measured:** SAR measured at the stated antenna input power.
- SAR normalized:** SAR as measured, normalized to an input power of 1 W at the antenna connector.
- SAR for nominal TSL parameters:** The measured TSL parameters are used to calculate the nominal SAR result.

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%.