## **APPENDIX C CALIBRATION DOCUMENTS**

- 1. SN: 1380 Probe Calibration Certificate
- 2. SN: 047 D900V2 Dipole Calibration Certificate
- 3. SN: 1051 D750V2 Dipole Calibration Certificate
- 4. SN: 442 DAE3 Data Acquisition Electronics Calibration Certificate



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

Client



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

Accreditation No.: SCS 108

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EMC Technologies

| Certificate No: | ET3-1380 | Dec11 |
|-----------------|----------|-------|
|-----------------|----------|-------|

| CALIBRATION                          | CERTIFICATI   |   |                              |
|--------------------------------------|---|---|------------------------------|
| Object                               | ET3DV6 - SN:13  | 80  |                              |
| Calibration procedure(s)             |   | QA CAL-12.v7, QA CAL-23.v4, QA dure for dosimetric E-field probes   | CAL-25.v4                    |
| Calibration date:                    | December 12, 20   | 011   |                              |
| The measurements and the unc         | ertainties with confidence p<br>ucted in the closed laborator | onal standards, which realize the physical units robability are given on the following pages and y facility: environment temperature $(22 \pm 3)^{\circ}C$ is | are part of the certificate. |
| Primary Standards                    | ID  | Cal Date (Certificate No.)  | Scheduled Calibration        |
| Power meter E4419B                   | GB41293874  | 31-Mar-11 (No. 217-01372)   | Apr-12                       |
| Power sensor E4412A                  | MY41498087  | 31-Mar-11 (No. 217-01372)   | Apr-12                       |
| Reference 3 dB Attenuator            | SN: S5054 (3c)  | 29-Mar-11 (No. 217-01369)   | Apr-12                       |
| Reference 20 dB Attenuator           | SN: S5086 (20b)   | 29-Mar-11 (No. 217-01367)   | Apr-12                       |
| Reference 30 dB Attenuator           | SN: S5129 (30b)   | 29-Mar-11 (No. 217-01370)   | Apr-12                       |
| Reference Probe ES3DV2               | SN: 3013  | 29-Dec-10 (No. ES3-3013_Dec10)  | Dec-11                       |
| DAE4                                 | SN: 654   | 3-May-11 (No. DAE4-654_May11)   | May-12                       |
| Secondary Standards                  | ID  | Check Date (in house)   | Scheduled Check              |
| RF generator HP 8648C                | US3642U01700  | 4-Aug-99 (in house check Apr-11)  | In house check: Apr-13       |
| Network Analyzer HP 8753E            | US37390585  | 18-Oct-01 (in house check Oct-11)   | In house check: Oct-12       |
|                                      | Name  | Function  | Signature .                  |
| Calibrated by:                       | Jeton Kastrati  | Laboratory Technician   |                              |
| Approved by:                         | Katja Pokovic   | Technical Manager   | 2ekg2                        |
| This calibration certificate shall r | not be reproduced except in                                   | full without written approval of the laboratory.  | Issued: December 12, 2011    |

Certificate No: ET3-1380\_Dec11

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Swiss Calibration Service

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Glossary: TSL tissue simulating liquid

| ISL            | ussue simulating liquid  |
|----------------|--|
| NORMx,y,z      | sensitivity in free space  |
| ConvF          | sensitivity in TSL / NORMx,y,z   |
| DCP            | diode compression point  |
| CF             | crest factor (1/duty_cycle) of the RF signal   |
| A, B, C        | modulation dependent linearization parameters  |
| Polarization φ | 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:

- 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 affect 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C are numerical linearization parameters assessed based on the data of
  power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the
  maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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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December 12, 2011

# Probe ET3DV6

# SN:1380

Manufactured: Calibrated: August 16, 1999 December 12, 2011

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

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## DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

#### **Basic Calibration Parameters**

|                          | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|--------------------------|----------|----------|----------|-----------|
| Norm $(\mu V/(V/m)^2)^A$ | 1.68     | 1.60     | 1.72     | ± 10.1 %  |
| DCP (mV) <sup>B</sup>    | 93.1     | 92.7     | 94.2     |           |

#### **Modulation Calibration Parameters**

| UID   | Communication System Name | PAR  |   | A<br>dB | B<br>dB | C<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW                        | 0.00 | X | 0.00    | 0.00    | 1.00    | 137.2    | ±3.0 %                    |
|       |                           |      | Y | 0.00    | 0.00    | 1.00    | 129.6    |                           |
|       |                           |      | Z | 0.00    | 0.00    | 1.00    | 103.8    |                           |

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

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 <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 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. field value.

#### December 12, 2011

## DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

| f (MHz) <sup>C</sup> | Relative<br>Permittivity <sup>F</sup> | Conductivity<br>(S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth<br>(mm) | Unct.<br>(k=2) |
|----------------------|---------------------------------------|------------------------------------|---------|---------|---------|-------|---------------|----------------|
| 300                  | 45.3                                  | 0.87                               | 7.79    | 7.79    | 7.79    | 0.30  | 1.56          | ± 13.4 %       |
| 450                  | 43.5                                  | 0.87                               | 7.00    | 7.00    | 7.00    | 0.23  | 2.37          | ± 13.4 %       |
| 900                  | 41.5                                  | 0.97                               | 5.88    | 5.88    | 5.88    | 0.80  | 1.92          | ± 12.0 %       |
| 1640                 | 40.3                                  | 1.29                               | 5.35    | 5.35    | 5.35    | 0.68  | 2.22          | ± 12.0 %       |
| 1810                 | 40.0                                  | 1.40                               | 5.05    | 5.05    | 5.05    | 0.72  | 2.09          | ± 12.0 %       |
| 1950                 | 40.0                                  | 1.40                               | 4.80    | 4.80    | 4.80    | 0.71  | 2.17          | ± 12.0 %       |
| 2450                 | 39.2                                  | 1.80                               | 4.35    | 4.35    | 4.35    | 1.00  | 1.61          | ± 12.0 %       |

| Calibration Paramete | r Determined in Hea | d Tissue Simulating Media |
|----------------------|---------------------|---------------------------|
|----------------------|---------------------|---------------------------|

<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 (ε and σ) 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 (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Certificate No: ET3-1380\_Dec11

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#### December 12, 2011

## DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

| f (MHz) <sup>C</sup> | Relative<br>Permittivity <sup>F</sup> | Conductivity<br>(S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth<br>(mm) | Unct.<br>(k=2) |
|----------------------|---------------------------------------|------------------------------------|---------|---------|---------|-------|---------------|----------------|
| 450                  | 56.7                                  | 0.94                               | 7.41    | 7.41    | 7.41    | 0.16  | 2.29          | ± 13.4 %       |
| 900                  | 55.0                                  | 1.05                               | 5.94    | 5.94    | 5.94    | 1.00  | 1.63          | ± 12.0 %       |
| 1810                 | 53.3                                  | 1.52                               | 4.66    | 4.66    | 4.66    | 0.69  | 2.50          | ± 12.0 %       |
| 1950                 | 53.3                                  | 1.52                               | 4.68    | 4.68    | 4.68    | 0.72  | 2.35          | ± 12.0 %       |
| 2450                 | 52.7                                  | 1.95                               | 4.15    | 4.15    | 4.15    | 1.00  | 1.29          | ± 12.0 %       |

Calibration Parameter Determined in Body Tissue Simulating Media

<sup>C</sup> Frequency validity of  $\pm$  100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to  $\pm$  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  $\pm$  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  $\pm$  5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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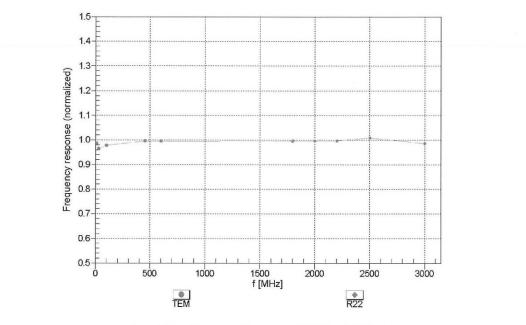
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#### Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

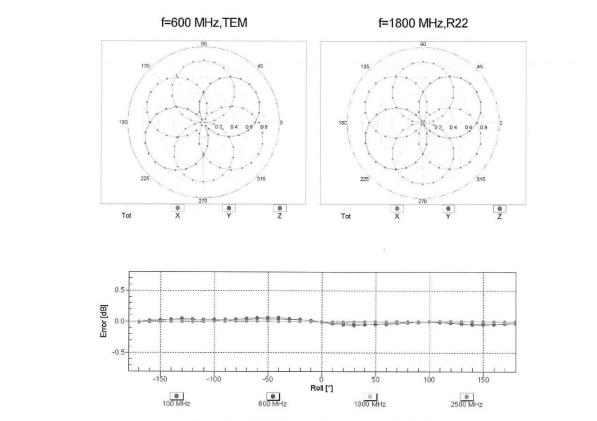
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# Receiving Pattern ( $\phi$ ), $\vartheta = 0^{\circ}$

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

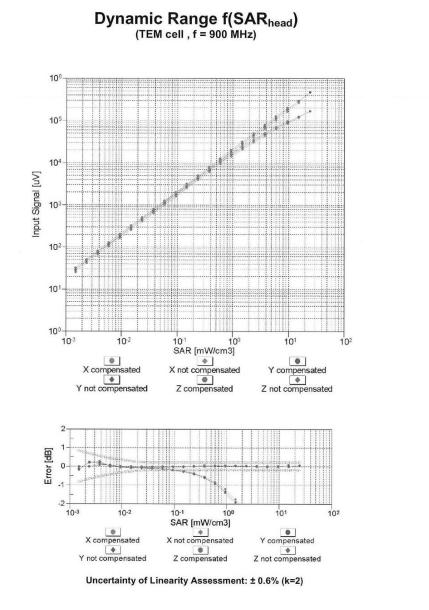
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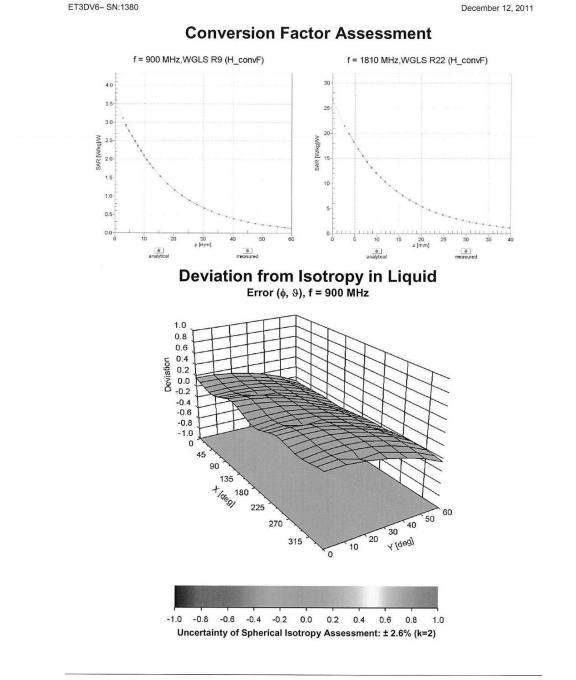


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December 12, 2011

# DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

#### **Other Probe Parameters**

| Sensor Arrangement                            | Triangular     |
|---|----------------|
| Connector Angle (°)                           | Not applicable |
| Mechanical Surface Detection Mode             | enabled        |
| Optical Surface Detection Mode                | disabled       |
| Probe Overall Length                          | 337 mm         |
| Probe Body Diameter                           | 10 mm          |
| Tip Length                                    | 10 mm          |
| Tip Diameter                                  | 6.8 mm         |
| Probe Tip to Sensor X Calibration Point       | 2.7 mm         |
| Probe Tip to Sensor Y Calibration Point       | 2.7 mm         |
| Probe Tip to Sensor Z Calibration Point       | 2.7 mm         |
| Recommended Measurement Distance from Surface | 4 mm           |

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|--|---|
| Additional Con   | version Factors<br>ric E-Field Probe              |
| Туре:  | ET3DV6  |
| Serial Number:   | 1380  |
| Place of Assessment:   | Zurich  |
| Date of Assessment:  | October 4, 2012                                   |
| Probe Calibration Date:  | December 12, 2011                                 |
| have been evaluated on the date indicated a<br>FDTD numerical code SEMCAD of Schm<br>evaluation is coupled with measured conve<br>following the re-calibration schedule of the | ersion factors, it has to be recalculated yearly, |

Assessed by:

done they

ET3DV6-SN:1380

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October 4, 2012



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| Conversion factor (± standard deviation)<br>750 ± 50 MHz ConvF 6.14 ± 7% | 380  |  |
|--|--|--|
|  | 380  |  |
|  |  |  |
| <u>K-</u>  | $\epsilon_r = 41.9 \pm 59$<br>$\sigma = 0.89 \pm 59$<br>ad tissue) |  |
| Important Note:  | $\sigma = 0.89 \pm 5\%$  |  |

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October 4, 2012



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|---|---|--------------|
|   |   |              |
|   |   |              |
|   | version Factors   |              |
| Туре:   | ET3DV6  |              |
| Serial Number:  | 1380  |              |
| Place of Assessment:  | Zurich  |              |
| Date of Assessment:   | June 14, 2012   |              |
| Probe Calibration Date:   | December 12, 2011   |              |
| have been evaluated on the date indicated<br>the FDTD numerical code SEMCAD of S<br>evaluation is coupled with measured conv<br>i.e., following the re-calibration schedule   | y certifies that conversion factor(s) of this pro<br>above. The assessment was performed using<br>chmid & Partner Engineering AG. Since the<br>ersion factors, it has to be recalculated yearly<br>of the probe. The uncertainty of the numerica<br>rom measured value at 450, 900 MHz or at 18 | r,<br>al     |
| have been evaluated on the date indicated<br>the FDTD numerical code SEMCAD of S<br>evaluation is coupled with measured conv<br>i.e., following the re-calibration schedule<br>assessment is based on the extrapolation f | above. The assessment was performed using<br>chmid & Partner Engineering AG. Since the<br>ersion factors, it has to be recalculated yearly<br>of the probe. The uncertainty of the numerica   | s<br>,<br>al |
| Assessed by:  | Jal 15-   |              |

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June 14, 2012



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|--|--------------------|--|-------|----|----------------------|-------------|-----------|
| Dosimetric   |                    | <b>robe ET3DV6</b><br>deviation)         | SN:13 | 80 |                      |             |           |
| 750 ± 50 MHz   | ConvF              | 6.13 ± 7%                                | (body |    | 55.5 ± 5<br>0.96 ± 5 | %<br>% mho/ | m         |
|  | assessed pro       | be conversion fac<br>e following entrie: |       |    |                      |             | ta in the |

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June 14, 2012



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| ccredited by the Swiss Accredit<br>he Swiss Accreditation Servio<br>ultilateral Agreement for the  | ce is one of the signatories   | to the EA  | lo.: SCS 108   |
| lient EMC Technol  | ogies  | Certificate No:  | ET3-1380_Dec12   |
| CALIBRATION  | CERTIFICATE  |  |  |
| Dbject   | ET3DV6 - SN:138  | 30   |  |
| Calibration procedure(s)   |  | A CAL-12.v7, QA CAL-23.v4, QA<br>dure for dosimetric E-field probes  | CAL-25.v4  |
| Calibration date:  | December 10, 20  | 12   |  |
| The measurements and the unc   | certainties with confidence pr<br>ucted in the closed laboratory   | onal standards, which realize the physical units obability are given on the following pages and a<br>y facility: environment temperature (22 ± 3)°C a  | are part of the certificate.   |
| The measurements and the unc<br>All calibrations have been condu-<br>Calibration Equipment used (MA  | certainties with confidence pr<br>ucted in the closed laboratory<br>&TE critical for calibration)  | obability are given on the following pages and a<br>y facility: environment temperature $(22 \pm 3)^{\circ}$ C a   | are part of the certificate.<br>Ind humidity < 70%.  |
| The measurements and the unc<br>All calibrations have been condi-<br>Calibration Equipment used (Ma<br>Primary Standards   | ertainties with confidence pr<br>ucted in the closed laboratory<br>&TE critical for calibration)   | obability are given on the following pages and a<br>y facility: environment temperature (22 ± 3)°C a<br>Cat Date (Certificate No.)   | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration   |
| he measurements and the unc<br>Il calibrations have been cond<br>Calibration Equipment used (Ma<br>Primary Standards<br>Power meter E4419B   | ertainties with confidence pr<br>ucted in the closed laborator<br>&TE critical for calibration)<br>ID<br>GB41293874  | obability are given on the following pages and a<br>y facility: environment temperature (22 ± 3)°C a<br>Cal Date (Certificate No.)<br>29-Mar-12 (No. 217-01508)  | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13   |
| he measurements and the unc<br>Il calibrations have been cond<br>Calibration Equipment used (Ma<br>Primary Standards<br>Power meter E4419B<br>Power sensor E4412A  | Exertainties with confidence pr<br>ucted in the closed laborator<br>&TE critical for calibration)<br>ID<br>GB41293874<br>MY41498087  | obability are given on the following pages and a<br>y facility: environment temperature (22 ± 3)°C a<br>Cal Date (Certificate No.)<br>29-Mar-12 (No. 217-01508)<br>29-Mar-12 (No. 217-01508)   | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration   |
| The measurements and the unc<br>All calibrations have been cond<br>Calibration Equipment used (MA<br>Primary Standards<br>Power meter E4419B<br>Power sensor E4412A<br>Reference 3 dB Attenuator   | ertainties with confidence pr<br>ucted in the closed laborator<br>&TE critical for calibration)<br>ID<br>GB41293874  | obability are given on the following pages and a<br>y facility: environment temperature (22 ± 3)°C a<br>Cal Date (Certificate No.)<br>29-Mar-12 (No. 217-01508)  | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13<br>Apr-13   |
| The measurements and the unc<br>All calibrations have been cond<br>Calibration Equipment used (Ma<br>Primary Standards<br>Power sensor E4419B<br>Power sensor E4412A<br>Reference 3 dB Attenuator<br>Reference 3 dB Attenuator   | Errainties with confidence pr<br>ucted in the closed laboratory<br>&TE critical for calibration)<br>ID<br>GB41293874<br>MY41498087<br>SN: S5054 (3c)   | obability are given on the following pages and it         y facility: environment temperature (22 ± 3)°C a         Cal Date (Certificate No.)         29-Mar-12 (No. 217-01508)         29-Mar-12 (No. 217-01508)         27-Mar-12 (No. 217-01531)  | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13<br>Apr-13<br>Apr-13   |
| The measurements and the unconstructions have been condi-<br>Calibration Equipment used (Material<br>Primary Standards<br>Power meter E4419B<br>Power sensor E4412A<br>Reference 3 dB Attenuator<br>Reference 20 dB Attenuator   | ertainties with confidence pr<br>ucted in the closed laboratory<br>&TE critical for calibration)<br>ID<br>GB41293874<br>MY41498087<br>SN: S5054 (3c)<br>SN: S5086 (20b)  | Obability are given on the following pages and it           y facility: environment temperature (22 ± 3)°C a           Cal Date (Certificate No.)           29-Mar-12 (No. 217-01508)           29-Mar-12 (No. 217-01508)           27-Mar-12 (No. 217-01531)           27-Mar-12 (No. 217-01529)  | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13   |
| The measurements and the unc<br>All calibrations have been condi-<br>Calibration Equipment used (Ma<br>Primary Standards<br>Power meter E44198<br>Power sensor E4412A<br>Reference 3 dB Attenuator<br>Reference 20 dB Attenuator<br>Reference 20 dB Attenuator<br>Reference Probe ES3DV2   | ertainties with confidence pr<br>ucted in the closed laboratory<br>&TE critical for calibration)<br>ID<br>GB41293874<br>MY41498087<br>SN: \$5054 (3c)<br>SN: \$5056 (20b)<br>SN: \$5129 (30b)  | Cal Date (Certificate No.)           29-Mar-12 (No. 217-01508)           27-Mar-12 (No. 217-01508)           27-Mar-12 (No. 217-01529)           27-Mar-12 (No. 217-01522)   | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13   |
| The measurements and the unconstruction of the second construction of the s | Exertainties with confidence pr<br>ucted in the closed laboratory<br>BTE critical for calibration)<br>ID<br>GB41293874<br>MY41498087<br>SN: S5054 (3c)<br>SN: S5086 (20b)<br>SN: S5129 (30b)<br>SN: S5129 (30b)<br>SN: 660   | Cal Date (Certificate No.)           29-Mar-12 (No. 217-01508)           29-Mar-12 (No. 217-01508)           27-Mar-12 (No. 217-01531)           27-Mar-12 (No. 217-01529)           29-Dec-11 (No. ES3-3013_Dec11)           20-Jun-12 (No. DAE4-660_Jun12)   | are part of the certificate.<br>and humidity < 70%.<br>Scheduled Calibration<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13<br>Apr-13<br>Dec-12<br>Jun-13   |
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#### Calibration Laboratory of Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland



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#### Glossary:

| Glossary:           |  |
|---------------------|--|
| TSL                 | tissue simulating liquid   |
| NORMx,y,z           | sensitivity in free space  |
| ConvF               | sensitivity in TSL / NORMx,y,z   |
| DCP                 | diode compression point  |
| CF                  | crest factor (1/duty_cycle) of the RF signal   |
| A, B, C             | modulation dependent linearization parameters  |
| 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:

- 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 affect 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C are numerical linearization parameters assessed based on the data of
  power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the
  maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters: Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 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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December 10, 2012

# Probe ET3DV6

# SN:1380

Manufactured: Calibrated: August 16, 1999 December 10, 2012

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

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December 10, 2012

# DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

#### **Basic Calibration Parameters**

|                          | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|--------------------------|----------|----------|----------|-----------|
| Norm $(\mu V/(V/m)^2)^A$ | 1.68     | 1.60     | 1.71     | ± 10.1 %  |
| DCP (mV) <sup>8</sup>    | 94.6     | 94.2     | 95.9     | =         |

#### **Modulation Calibration Parameters**

| UID | Communication System Name | PAR  |   | A<br>dB | B<br>dB | C<br>dB | VR<br>mV | Unc <sup>E</sup><br>(k=2) |
|-----|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 0   | CW                        | 0.00 | X | 0.0     | 0.0     | 1.0     | 185.0    | ±3.3 %                    |
|     |                           |      | Y | 0.0     | 0.0     | 1.0     | 174.8    |                           |
|     |                           |      | Z | 0.0     | 0.0     | 1.0     | 192.3    |                           |

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. field value.

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#### December 10, 2012

# DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

| f (MHz) <sup>C</sup> | Relative<br>Permittivity <sup>F</sup> | Conductivity<br>(S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth<br>(mm) | Unct.<br>(k=2) |
|----------------------|---------------------------------------|------------------------------------|---------|---------|---------|-------|---------------|----------------|
| 300                  | 45.3                                  | 0.87                               | 8.20    | 8.20    | 8.20    | 0.33  | 1.69          | ± 13.4 %       |
| 450                  | 43.5                                  | 0.87                               | 7.21    | 7.21    | 7.21    | 0.27  | 2.49          | ± 13.4 %       |
| 900                  | 41.5                                  | 0.97                               | 6.09    | 6.09    | 6.09    | 0.40  | 2.62          | ± 12.0 %       |
| 1640                 | 40.3                                  | 1.29                               | 5.42    | 5.42    | 5.42    | 0.76  | 2.16          | ± 12.0 %       |
| 1810                 | 40.0                                  | 1.40                               | 5.11    | 5.11    | 5.11    | 0.80  | 2.46          | ± 12.0 %       |
| 1950                 | 40.0                                  | 1.40                               | 4.87    | 4.87    | 4.87    | 0.80  | 2.39          | ± 12.0 %       |
| 2450                 | 39.2                                  | 1.80                               | 4.50    | 4.50    | 4.50    | 0.80  | 2.20          | ± 12.0 %       |

# Calibration Parameter Determined in Head Tissue Simulating Media

<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 (c and σ) 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 (c and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Certificate No: ET3-1380\_Dec12

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#### December 10, 2012

# DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

| f (MHz) <sup>c</sup> | Relative<br>Permittivity <sup>F</sup> | Conductivity<br>(S/m) <sup>F</sup> | ConvF X | ConvF Y | ConvF Z | Alpha | Depth<br>(mm) | Unct.<br>(k=2) |
|----------------------|---------------------------------------|------------------------------------|---------|---------|---------|-------|---------------|----------------|
| 450                  | 56.7                                  | 0.94                               | 7.57    | 7.57    | 7.57    | 0.19  | 2.46          | ± 13.4 %       |
| 750                  | 55.5                                  | 0.96                               | 6.19    | 6.19    | 6.19    | 0.53  | 2.12          | ± 12.0 %       |
| 900                  | 55.0                                  | 1.05                               | 6.00    | 6.00    | 6.00    | 0.38  | 2.75          | ± 12.0 %       |
| 1810                 | 53.3                                  | 1.52                               | 4.70    | 4.70    | 4.70    | 0.80  | 2.52          | ± 12.0 %       |
| 1950                 | 53.3                                  | 1.52                               | 4.69    | 4.69    | 4.69    | 0.80  | 2.30          | ± 12.0 %       |
| 2450                 | 52.7                                  | 1.95                               | 4.12    | 4.12    | 4.12    | 0.60  | 2.20          | ± 12.0 %       |

# Calibration Parameter Determined in Body Tissue Simulating Media

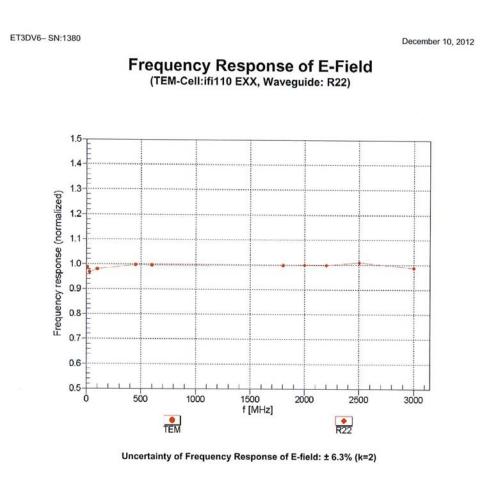
<sup>C</sup> Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. <sup>F</sup> At frequencies below 3 GHz, the validity of tissue parameters (t and σ) 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 (t and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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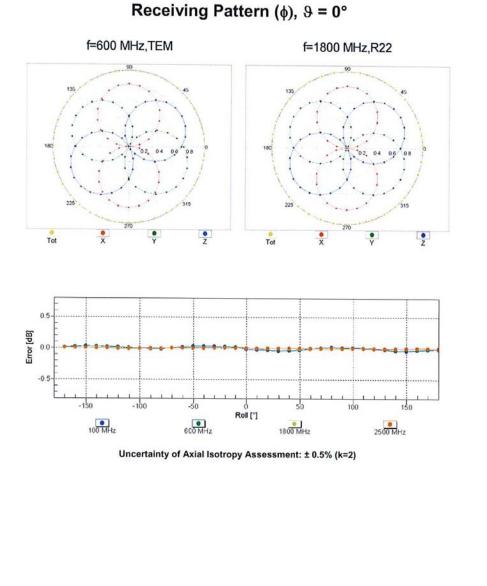
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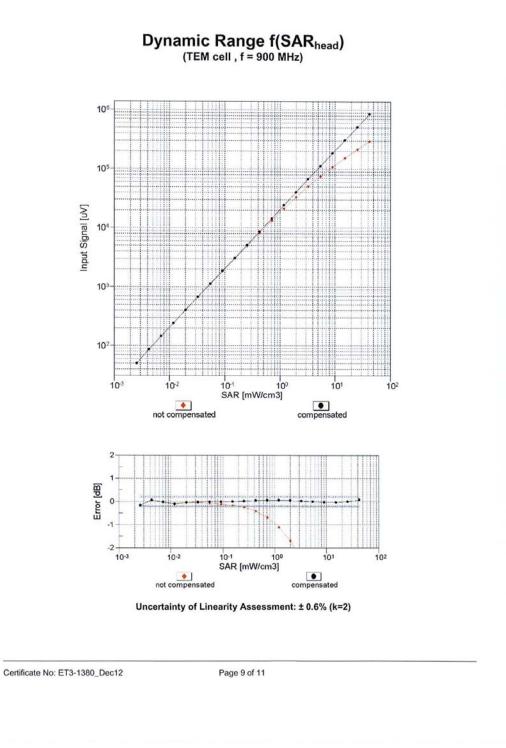
Certificate No: ET3-1380\_Dec12

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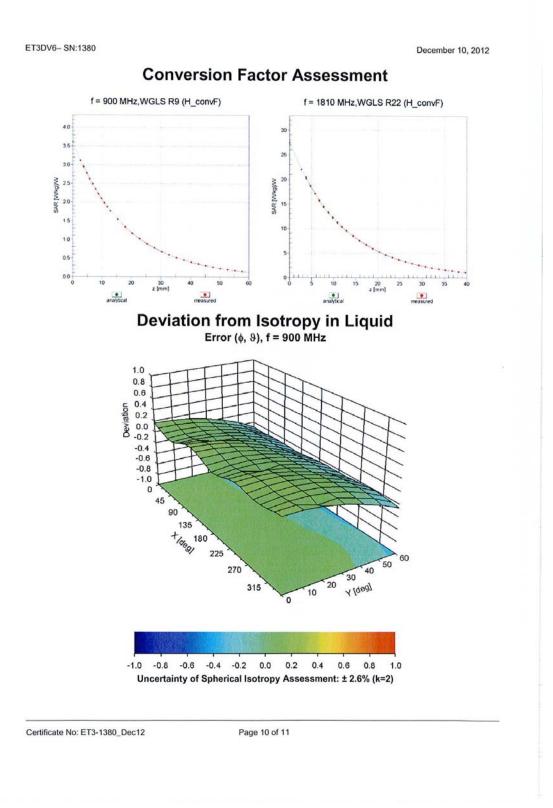
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December 10, 2012





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# DASY/EASY - Parameters of Probe: ET3DV6 - SN:1380

#### **Other Probe Parameters**

| Sensor Arrangement                            | Triangular |
|---|------------|
| Connector Angle (°)                           | -20.4      |
| Mechanical Surface Detection Mode             | enabled    |
| Optical Surface Detection Mode                | disabled   |
| Probe Overall Length                          | 337 mm     |
| Probe Body Diameter                           | 10 mm      |
| Tip Length                                    | 10 mm      |
| Tip Diameter                                  | 6.8 mm     |
| Probe Tip to Sensor X Calibration Point       | 2.7 mm     |
| Probe Tip to Sensor Y Calibration Point       | 2.7 mm     |
| Probe Tip to Sensor Z Calibration Point       | 2.7 mm     |
| Recommended Measurement Distance from Surface | 4 mm       |

Certificate No: ET3-1380\_Dec12

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| Schmid & Partner<br>Engineering AG<br>eughausstrasse 43, 8004 Zurict   | y of   | ACC MEA<br>ACC ME | Service suisse d'étalonnage<br>Servizio svizzero di taratura  |
|--|--|---|---|
| Accredited by the Swiss Accreditat<br>The Swiss Accreditation Service<br>Multilateral Agreement for the re   | is one of the signatories  | s to the EA   | on No.: SCS 108   |
| Client EMC Technolog   |  |   | to: D900V2-047_Jun12  |
| CALIBRATION C  | ERTIFICATE   |   |   |
| Object   | D900V2 - SN: 04  | timis Med Sta   | , 1948 , (g. 1945)  |
| Calibration procedure(s)   | QA CAL-05.v8<br>Calibration proce  | dure for dipole validation kits at  | oove 700 MHz  |
|  |  |   | 그는 사람은 것에 봐.  |
| Calibration date:  | June 22, 2012  |   | 「学校で、「美いすいです  |
| The measurements and the unce  | ertainties with confidence p   | onal standards, which realize the physical u<br>robability are given on the following pages of<br>ry facility: environment temperature (22 ± 3)   | and are part of the certificate.  |
| The measurements and the unce  | ertainties with confidence p   | robability are given on the following pages a   | and are part of the certificate.  |
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| The measurements and the unce<br>All calibrations have been conduc<br>Calibration Equipment used (M&1<br>Primary Standards<br>Power meter EPM-442A<br>Power sensor HP 8481A  | Artainties with confidence p<br>cted in the closed laborator<br>TE critical for calibration)<br>ID #<br>GB37480704<br>US37292783   | robability are given on the following pages or<br>ry facility: environment temperature (22 ± 3)<br>Cal Date (Certificate No.)<br>05-Oct-11 (No. 217-01451)<br>05-Oct-11 (No. 217-01451)   | and are part of the certificate.<br>)°C and humidity < 70%.<br>Scheduled Calibration<br>Oct-12<br>Oct-12  |
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