

## **ATTACHMENT R – PROBE CALIBRATION DATA**

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

**Client**      **Hyundai CT (Dymstec)**

**CALIBRATION CERTIFICATE**

**Object(s)**      **ET3DV6 - SN:1609**

**Calibration procedure(s)**      **QA CAL-01.v2**  
**Calibration procedure for dosimetric E-field probes**

**Calibration date:**      **January 22, 2004**

**Condition of the calibrated item**      **In Tolerance (according to the specific calibration document)**

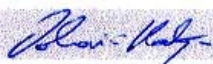
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).  
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

| Model Type                         | ID #           | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration  |
|------------------------------------|----------------|-------------------------------------------|------------------------|
| Power meter EPM E4419B             | GB41293874     | 2-Apr-03 (METAS, No 252-0250)             | Apr-04                 |
| Power sensor E4412A                | MY41495277     | 2-Apr-03 (METAS, No 252-0250)             | Apr-04                 |
| Reference 20 dB Attenuator         | SN: 5086 (20b) | 3-Apr-03 (METAS, No. 251-0340)            | Apr-04                 |
| Fluke Process Callibrator Type 702 | SN: 6295803    | 8-Sep-03 (Sintrel SCS No. E-030020)       | Sep-04                 |
| Power sensor HP 8481A              | MY41092180     | 18-Sep-02 (SPEAG, in house check Oct-03)  | In house check: Oct 05 |
| RF generator HP 8684C              | US3642U01700   | 4-Aug-99 (SPEAG, in house check Aug-02)   | In house check: Aug-05 |
| Network Analyzer HP 8753E          | US37390585     | 18-Oct-01 (SPEAG, in house check Oct-03)  | In house check: Oct 05 |

**Calibrated by:**      **Name**      **Function**      **Signature**  
Nico Vetterl      Technician      

**Approved by:**      **Name**      **Function**  
Katja Pokovic      Laboratory Director      

Date issued: January 23, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

# Probe ET3DV6

## SN:1609

|                  |                  |
|------------------|------------------|
| Manufactured:    | July 27, 2001    |
| Last calibrated: | June 20, 2002    |
| Recalibrated:    | January 22, 2004 |

**Calibrated for DASY Systems**

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1609

January 22, 2004

**DASY - Parameters of Probe: ET3DV6 SN:1609****Sensitivity in Free Space****Diode Compression<sup>A</sup>**

|       |                                          |
|-------|------------------------------------------|
| NormX | $1.72 \mu\text{V}/(\text{V}/\text{m})^2$ |
| NormY | $1.72 \mu\text{V}/(\text{V}/\text{m})^2$ |
| NormZ | $1.72 \mu\text{V}/(\text{V}/\text{m})^2$ |

|       |    |    |
|-------|----|----|
| DCP X | 96 | mV |
| DCP Y | 96 | mV |
| DCP Z | 96 | mV |

**Sensitivity in Tissue Simulating Liquid (Conversion Factors)**

Please see Page 7.

**Boundary Effect****Head                      900 MHz      Typical SAR gradient: 5 % per mm**

|                                                         |        |        |
|---------------------------------------------------------|--------|--------|
| Sensor Center to Phantom Surface Distance               | 3.7 mm | 4.7 mm |
| SAR <sub>pe</sub> [%]      Without Correction Algorithm | 9.2    | 5.0    |
| SAR <sub>pe</sub> [%]      With Correction Algorithm    | 0.1    | 0.2    |

**Head                      1800 MHz      Typical SAR gradient: 10 % per mm**

|                                                         |        |        |
|---------------------------------------------------------|--------|--------|
| Sensor to Surface Distance                              | 3.7 mm | 4.7 mm |
| SAR <sub>pe</sub> [%]      Without Correction Algorithm | 13.5   | 9.3    |
| SAR <sub>pe</sub> [%]      With Correction Algorithm    | 0.2    | 0.2    |

**Sensor Offset**

|                            |              |
|----------------------------|--------------|
| Probe Tip to Sensor Center | 2.7 mm       |
| Optical Surface Detection  | in tolerance |

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%.

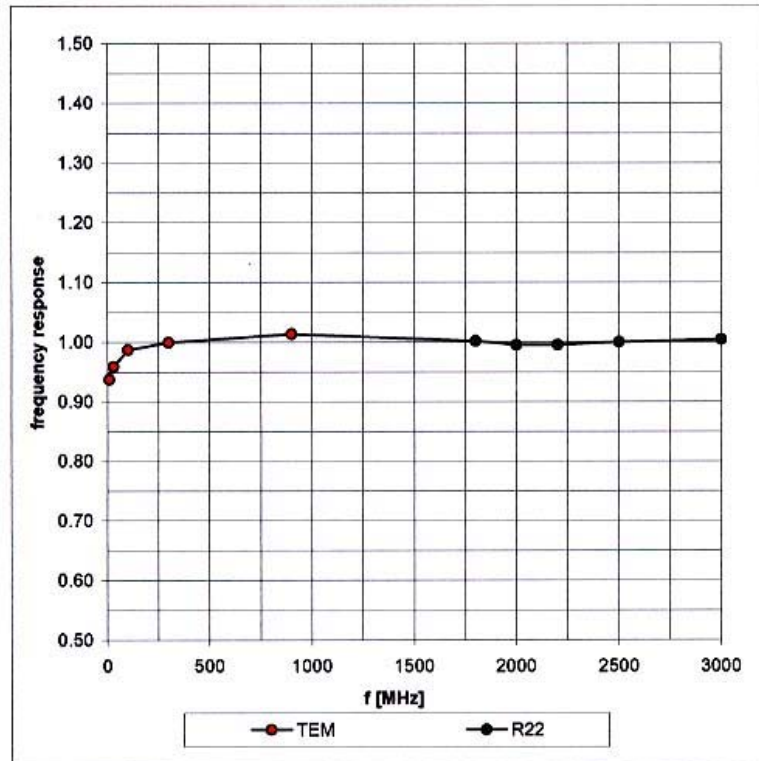
<sup>A</sup> numerical linearization parameter: uncertainty not required

ET3DV6 SN:1609

January 22, 2004

## Frequency Response of E-Field

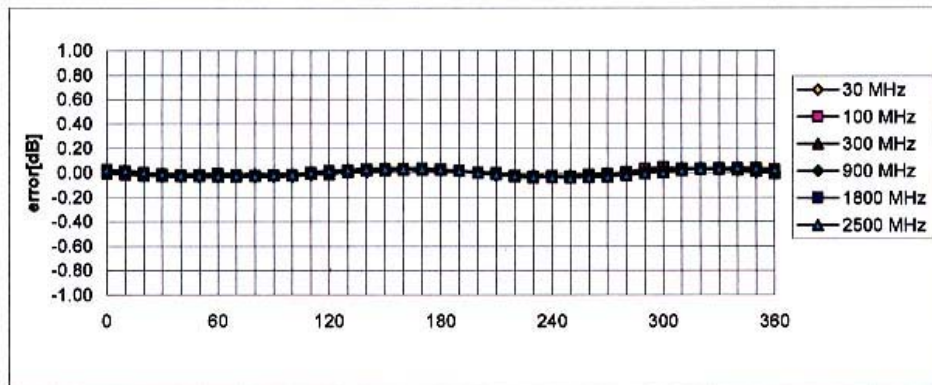
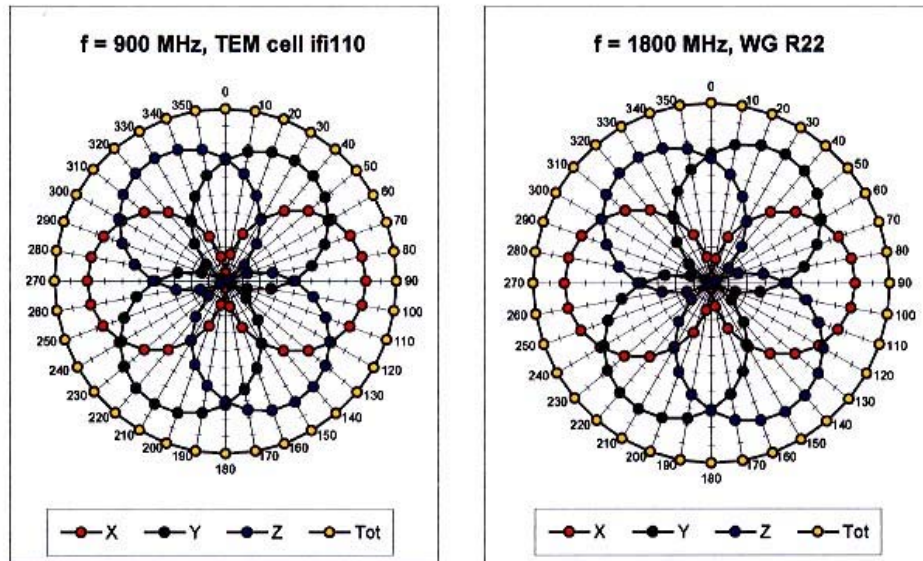
( TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1609

January 22, 2004

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

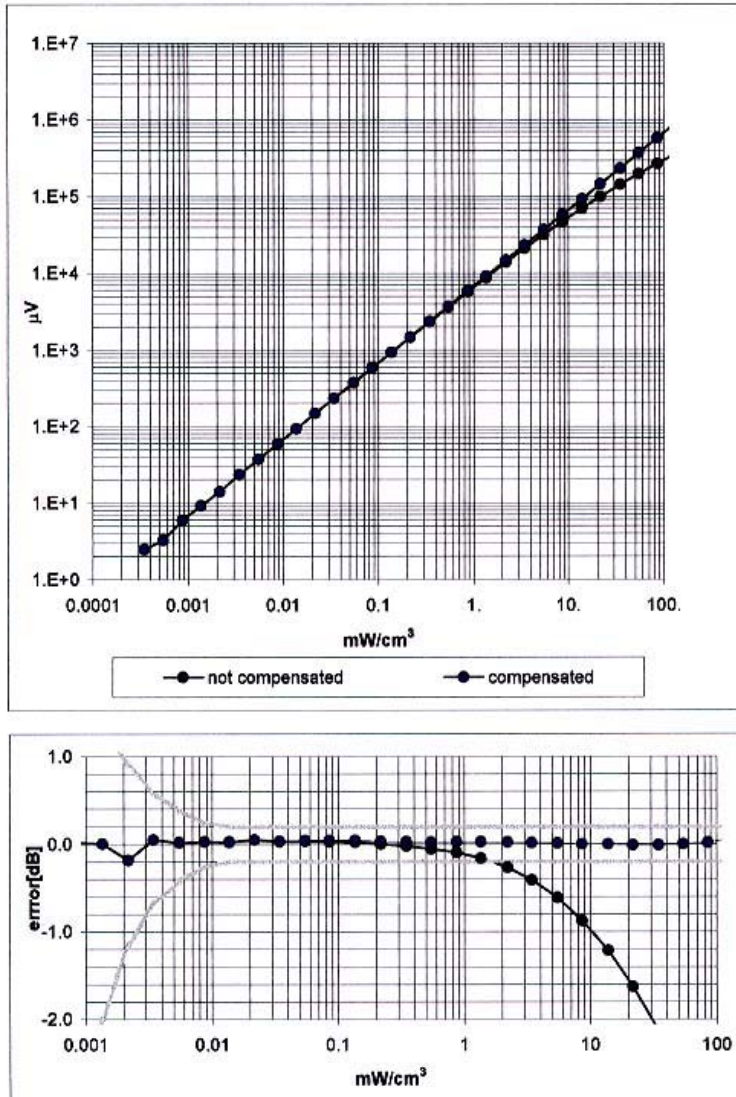


**Axial Isotropy Error <  $\pm 0.2$  dB**

ET3DV6 SN:1609

January 22, 2004

## Dynamic Range f(SAR<sub>head</sub>) ( Waveguide R22 )

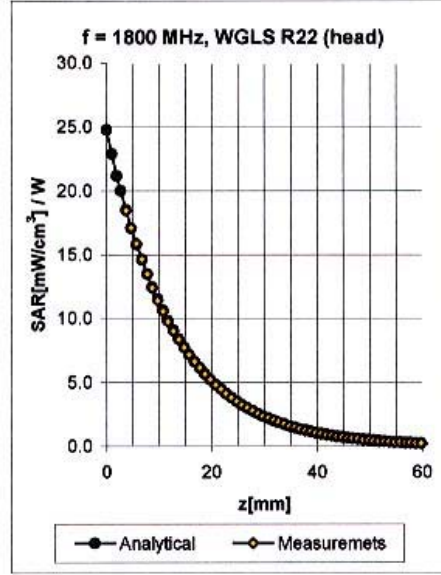
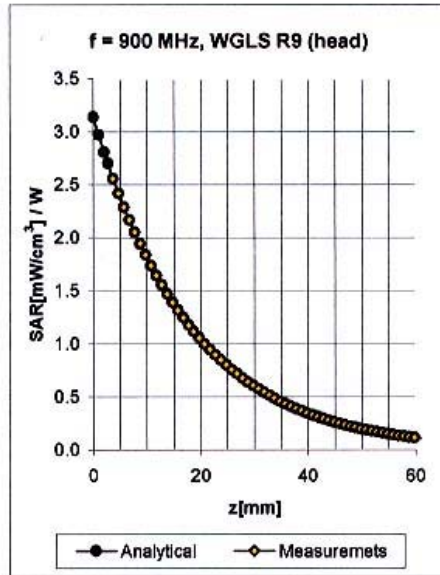


Probe Linearity  $< \pm 0.2$  dB

ET3DV6 SN:1609

January 22, 2004

## Conversion Factor Assessment



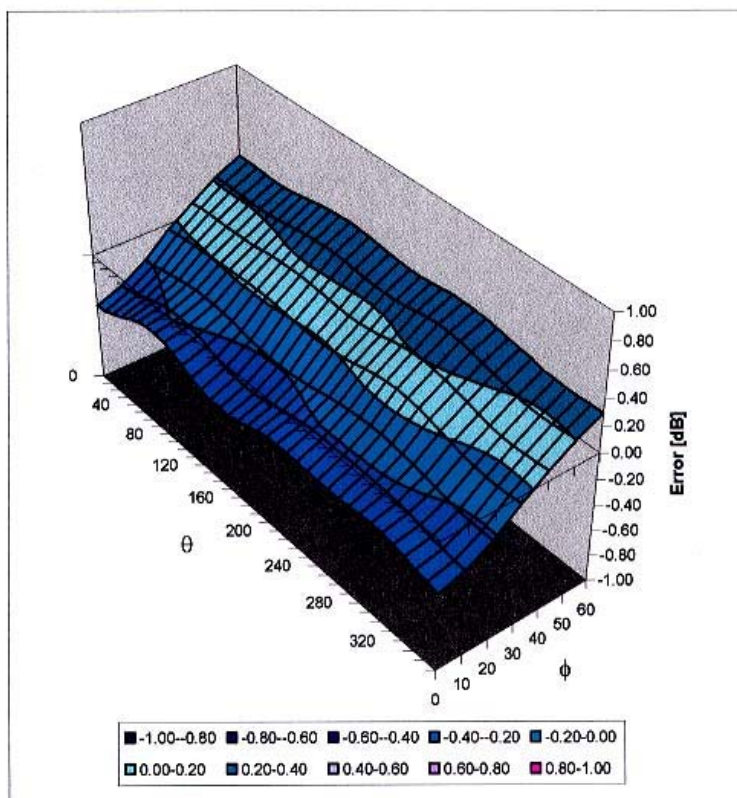
| f [MHz] | Validity [MHz] <sup>B</sup> | Tissue | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty  |
|---------|-----------------------------|--------|--------------|--------------|-------|-------|--------------------|
| 450     | 400-500                     | Head   | 43.5 ± 5%    | 0.87 ± 5%    | 0.73  | 1.68  | 6.88 ± 15.9% (k=2) |
| 900     | 800-1000                    | Head   | 41.5 ± 5%    | 0.97 ± 5%    | 0.58  | 1.90  | 6.62 ± 11.3% (k=2) |
| 1800    | 1710-1910                   | Head   | 40.0 ± 5%    | 1.40 ± 5%    | 0.48  | 2.67  | 5.29 ± 11.7% (k=2) |
| 2450    | 2400-2500                   | Head   | 39.2 ± 5%    | 1.80 ± 5%    | 1.06  | 1.82  | 4.83 ± 9.7% (k=2)  |
| 450     | 400-500                     | Body   | 56.7 ± 5%    | 0.94 ± 5%    | 0.96  | 1.50  | 6.73 ± 15.9% (k=2) |
| 835     | 750-950                     | Body   | 55.2 ± 5%    | 0.97 ± 5%    | 0.47  | 2.20  | 6.57 ± 11.9% (k=2) |
| 1900    | 1800-2000                   | Body   | 53.3 ± 5%    | 1.52 ± 5%    | 0.60  | 2.78  | 4.69 ± 11.3% (k=2) |
| 2450    | 2400-2500                   | Body   | 52.7 ± 5%    | 1.95 ± 5%    | 1.48  | 1.47  | 4.62 ± 9.7% (k=2)  |

<sup>B</sup> The total standard uncertainty is calculated as root-sum-square of standard uncertainty of the Conversion Factor at calibration frequency and the standard uncertainty for the indicated frequency band.

ET3DV6 SN:1609

January 22, 2004

## Deviation from Isotropy in HSL

Error ( $\theta, \phi$ ),  $f = 900$  MHz**Spherical Isotropy Error  $< \pm 0.4$  dB**