ET3DV6 SN:1788 September 30, 2004

# DASY - Parameters of Probe: ET3DV6 SN:1788

## Sensitivity in Free Space[A] Diode Compression[B]

| | | | | |
|---|---|---|---|---|
| NormX | **1.68** ± 9.9% | $\mu V/(V/m)^2$ | DCP X | **94** mV |
| NormY | **1.70** ± 9.9% | $\mu V/(V/m)^2$ | DCP Y | **94** mV |
| NormZ | **1.74** ± 9.9% | $\mu V/(V/m)^2$ | DCP Z | **94** mV |

## Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Please see Page 8.**

## Boundary Effect

**TSL** **900 MHz** **Typical SAR gradient: 5 % per mm**

| Sensor Center to Phantom Surface Distance | | **3.7 mm** | **4.7 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 8.1 | 4.4 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.7 | 0.1 |

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

| Sensor Center to Phantom Surface Distance | | **3.7 mm** | **4.7 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 12.0 | 8.2 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.9 | 0.1 |

## 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 $E^2$-field uncertainty inside TSL (see Page 8).

[B] Numerical linearization parameter: uncertainty not required.

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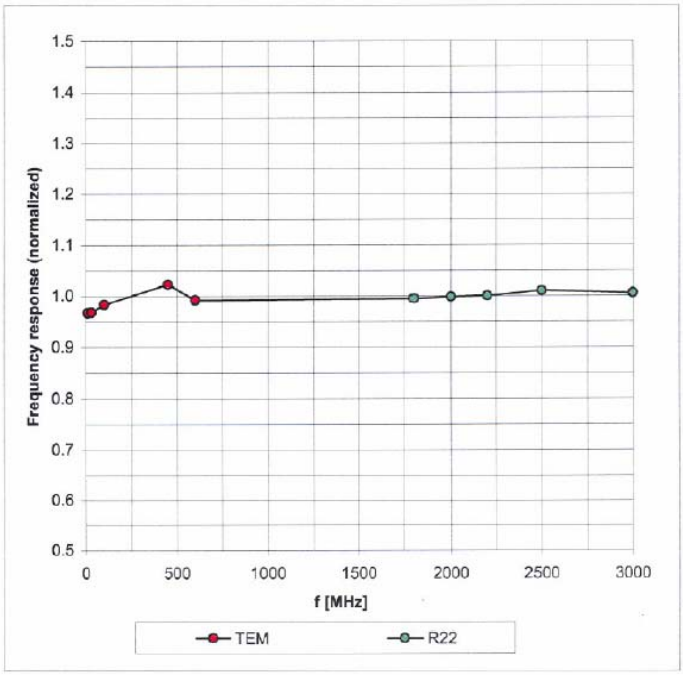
## Frequency Response of E-Field

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




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

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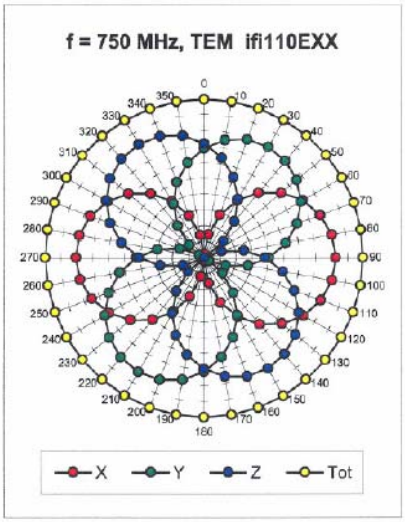
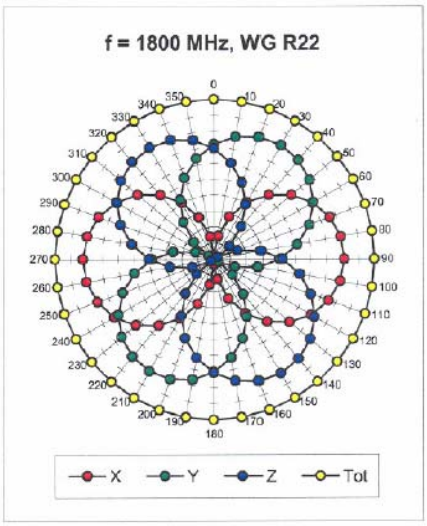
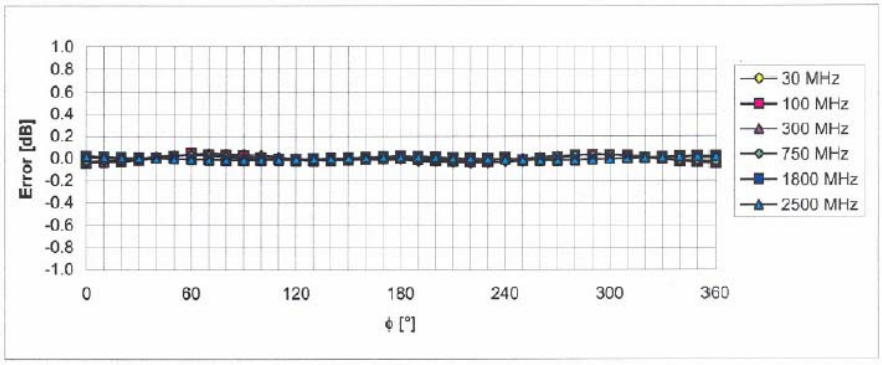
## Receiving Pattern ($\phi$), $\vartheta$ = 0°




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

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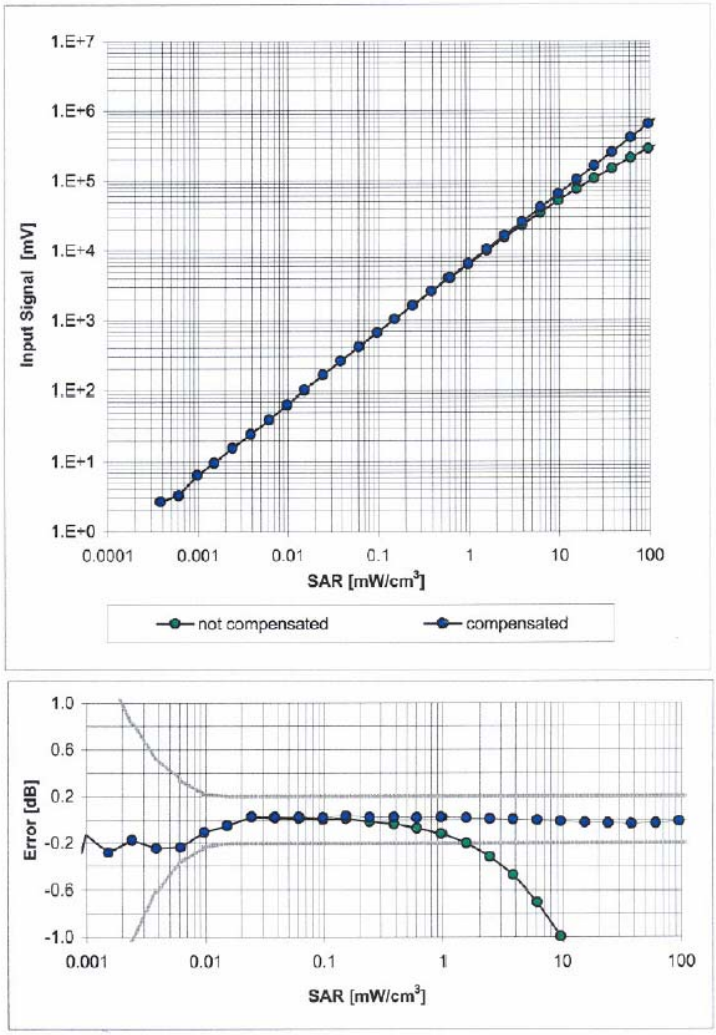
## Dynamic Range f($SAR_{head}$)

(Waveguide R22, f = 1800 MHz)




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

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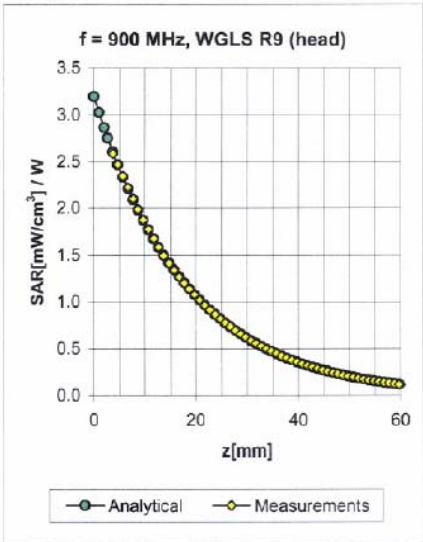
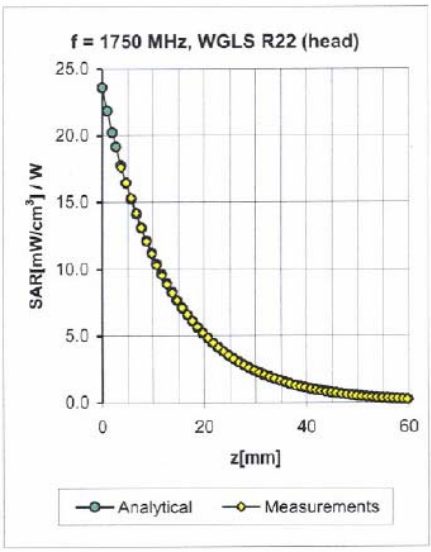
# Conversion Factor Assessment




| f [MHz] | Validity [MHz][c] | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF Uncertainty |
|---|---|---|---|---|---|---|---|
| 835 | ± 50 / ± 100 | Head | 41.5 ± 5% | 0.90 ± 5% | 1.12 | 1.42 | 6.74 ± 11.0% (k=2) |
| 900 | ± 50 / ± 100 | Head | 41.5 ± 5% | 0.97 ± 5% | 1.07 | 1.44 | 6.63 ± 11.0% (k=2) |
| 1750 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.56 | 2.31 | 5.37 ± 11.0% (k=2) |
| 1900 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.55 | 2.42 | 5.16 ± 11.0% (k=2) |
| 2000 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.54 | 2.59 | 4.88 ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.65 | 2.22 | 4.56 ± 11.8% (k=2) |
| 835 | ± 50 / ± 100 | Body | 55.2 ± 5% | 0.97 ± 5% | 1.04 | 1.52 | 6.53 ± 11.0% (k=2) |
| 900 | ± 50 / ± 100 | Body | 55.0 ± 5% | 1.05 ± 5% | 0.99 | 1.56 | 6.17 ± 11.0% (k=2) |
| 1750 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.53 | 2.74 | 4.73 ± 11.0% (k=2) |
| 1900 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.55 | 2.82 | 4.56 ± 11.0% (k=2) |
| 2000 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.54 | 2.98 | 4.43 ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Body | 52.7 ± 5% | 1.95 ± 5% | 0.72 | 2.00 | 4.26 ± 11.8% (k=2) |

[c] The validity of ± 100 MHz only applies for DASY 4.3 B17 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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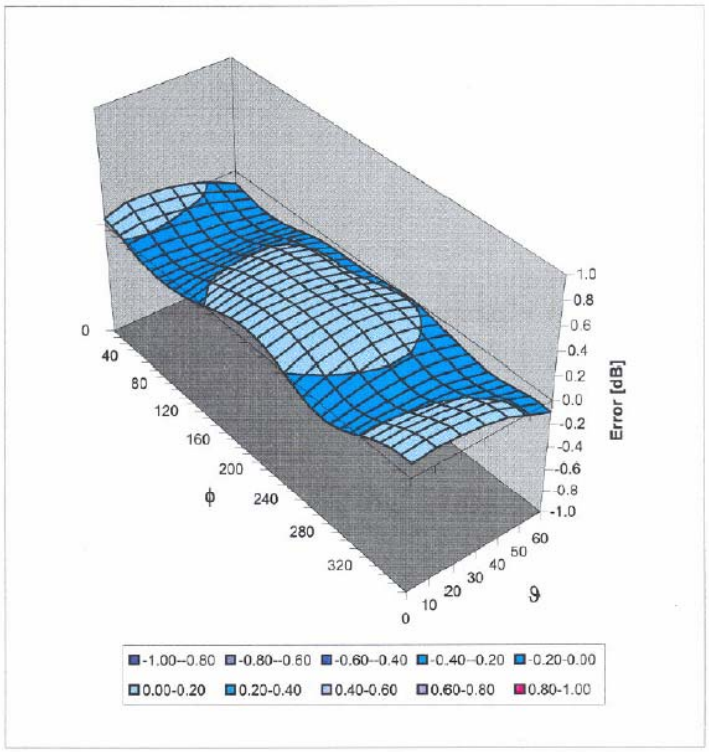
## Deviation from Isotropy in HSL

Error (ϕ, ϑ), 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**

Client **Sporton (Auden)**

**Certificate No: DAE3-577_Nov04**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE3 - SD 000 D03 AA - SN: 577 |
| Calibration procedure(s) | QA CAL-06.v10<br>Calibration procedure for the data acquisition unit (DAE) |
| Calibration date: | November 17, 2004 |
| 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 | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Fluke Process Calibrator Type 702 | SN: 6295803 | 7-Sep-04 (Sintrel, No.E-040073) | Sep-05 |
| **Secondary Standards** | **ID #** | **Check Date (in house)** | **Scheduled Check** |
| Calibrator Box V1.1 | SE UMS 006 AB 1002 | 16-Jul-04 (SPEAG, in house check) | In house check Jul-05 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Eric Hainfeld | Technician | |
| Approved by: | Fin Bomholt | R&D Director | i.V. |

Issued: November 17, 2004

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

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**Accreditation No.: SCS 108**

**Glossary**

| | |
|---|---|
| DAE | digital acquisition electronics |
| Connector angle | information used in DASY system to align probe sensor X to the robot coordinate system. |

**Methods Applied and Interpretation of Parameters**

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters contain technical information as a result from the performance test and require no uncertainty.
- *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
- *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
- *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
- *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
- *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
- *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
- *Input resistance:* DAE input resistance at the connector, during internal auto-zeroing and during measurement.
- *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
- *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

| | | | | |
|---|---|---|---|---|
| High Range: | 1LSB = | 6.1μV , | full range = | -100...+300 mV |
| Low Range: | 1LSB = | 61nV , | full range = | -1.....+3mV |

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 404.437 ± 0.1% (k=2) | 403.891 ± 0.1% (k=2) | 404.359 ± 0.1% (k=2) |
| Low Range | 3.94121 ± 0.7% (k=2) | 3.89867 ± 0.7% (k=2) | 3.95408 ± 0.7% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 127 ° ± 1 ° |

## Appendix

### 1. DC Voltage Linearity

| High Range | | Input (μV) | Reading (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 200000 | 200000.6 | 0.00 |
| Channel X | + Input | 20000 | 20001.77 | 0.01 |
| Channel X | - Input | 20000 | -19991.81 | -0.04 |
| Channel Y | + Input | 200000 | 199999.7 | 0.00 |
| Channel Y | + Input | 20000 | 19999.20 | 0.00 |
| Channel Y | - Input | 20000 | -19994.82 | -0.03 |
| Channel Z | + Input | 200000 | 200000.2 | 0.00 |
| Channel Z | + Input | 20000 | 19996.22 | -0.02 |
| Channel Z | - Input | 20000 | -19996.74 | -0.02 |

| Low Range | | Input (μV) | Reading (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2000 | 2000 | 0.00 |
| Channel X | + Input | 200 | 200.05 | 0.03 |
| Channel X | - Input | 200 | -200.88 | 0.44 |
| Channel Y | + Input | 2000 | 1999.9 | 0.00 |
| Channel Y | + Input | 200 | 199.73 | -0.13 |
| Channel Y | - Input | 200 | -200.53 | 0.27 |
| Channel Z | + Input | 2000 | 2000.1 | 0.00 |
| Channel Z | + Input | 200 | 199.25 | -0.38 |
| Channel Z | - Input | 200 | -201.42 | 0.71 |

### 2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | 13.15 | 12.30 |
| | - 200 | -12.61 | -12.86 |
| Channel Y | 200 | -7.43 | -7.53 |
| | - 200 | 6.30 | 6.52 |
| Channel Z | 200 | -0.16 | 0.31 |
| | - 200 | -1.51 | -1.48 |

### 3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 1.90 | -0.22 |
| Channel Y | 200 | 1.47 | - | 4.60 |
| Channel Z | 200 | -1.40 | -0.08 | - |

## 4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| Channel X | 15948 | 15814 |
| Channel Y | 15960 | 16073 |
| Channel Z | 16236 | 16172 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

| | Average (μV) | min. Offset (μV) | max. Offset (μV) | Std. Deviation (μV) |
|---|---|---|---|---|
| Channel X | 0.03 | -3.07 | 1.24 | 0.58 |
| Channel Y | -0.66 | -2.19 | 1.96 | 0.55 |
| Channel Z | -0.91 | -2.82 | 0.42 | 0.39 |

## 6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

## 7. Input Resistance

| | Zeroing (MOhm) | Measuring (MOhm) |
|---|---|---|
| Channel X | 0.2000 | 199.3 |
| Channel Y | 0.2000 | 200.4 |
| Channel Z | 0.2001 | 199.5 |

## 8. Low Battery Alarm Voltage (verified during pre test)

| Typical values | Alarm Level (VDC) |
|---|---|
| Supply (+ Vcc) | +7.9 |
| Supply (- Vcc) | -7.6 |

## 9. Power Consumption (verified during pre test)

| Typical values | Switched off (mA) | Stand by (mA) | Transmitting (mA) |
|---|---|---|---|
| Supply (+ Vcc) | +0.0 | +6 | +14 |
| Supply (- Vcc) | -0.01 | -8 | -9 |

## 10. Common Mode Bit Generation (verified during pre test)

| Typical values | Bit set to High at Common Mode Error ($V_{DC}$) |
|---|---|
| Channel X, Y, Z | +1.25 |