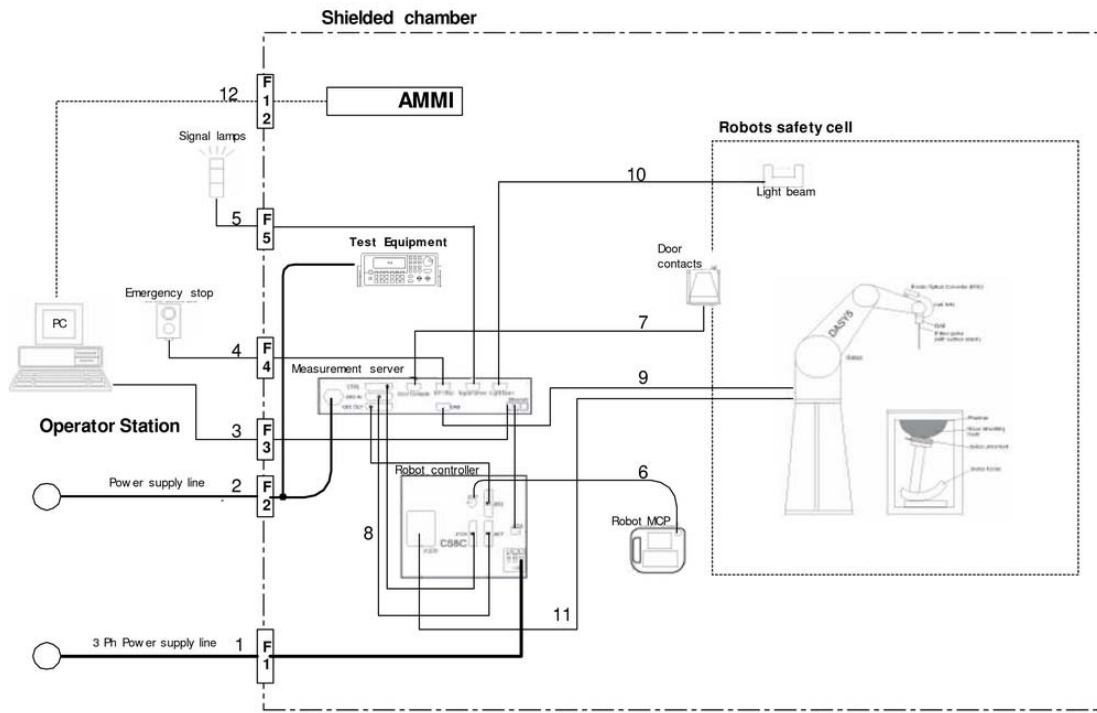


APPENDIX 3 : System specifications

1. Configuration and peripherals



The DASYS5 system for performing compliance tests consist of the following items:

- a) A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
An arm extension for accommodating the data acquisition electronics (DAE).
- b) An isotropic field probe optimized and calibrated for the targeted measurement.
- c) A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- d) The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection.
The EOC is connected to the measurement server.
- e) The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- f) The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- g) A computer running WinXP and the DASYS5 software.
- h) Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
- i) The phantom, the device holder and other accessories according to the targeted measurement.

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2. Specifications

a) Robot TX60L

| | | |
|----------------------|---|------------------|
| Number of Axes | : | 6 |
| Nominal Load | : | 2 kg |
| Maximum Load | : | 5kg |
| Reach | : | 920mm |
| Repeatability | : | +/-0.03mm |
| Control Unit | : | CS8c |
| Programming Language | : | VAL3 |
| Weight | : | 52.2kg |
| Manufacture | : | Stäubli Robotics |

b) E-Field Probe

| | | |
|---------------|---|--|
| Model | : | EX3DV3 / EX3DV4 |
| Serial No. | : | 3507 / 3679 |
| Construction | : | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycol ether) |
| Frequency | : | 10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz) |
| Directivity | : | +/-0.3 dB in HSL (rotation around probe axis) +/-0.5 dB in tissue material (rotation normal probe axis) |
| Dynamic Range | : | 10uW/g to > 100 mW/g; Linearity +/-0.2 dB (noise: typically < 1uW/g) |
| Dimensions | : | Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm |
| Application | : | High precision dosimetric measurement in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6GHz with precision of better 30%. |
| Manufacture | : | Schimid & Partner Engineering AG |



EX3DV3 E-field Probe

c) Data Acquisition Electronic (DAE4)

| | | |
|----------------------|---|---|
| Features | : | Signal amplifier, multiplexer, A/D converter and control logic Serial optical link for communication with DASY5 embedded system (fully remote controlled) Two step probe touch detector for mechanical surface detection and emergency robot stop |
| Measurement Range | : | -100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV) |
| Input Offset voltage | : | < 5 μ V (with auto zero) |
| Input Resistance | : | 200 M Ω |
| Input Bias Current | : | < 50 fA |
| Battery Power | : | > 10 h of operation (with two 9.6 V NiMH accus) |
| Dimension | : | 60 x 60 x 68 mm |
| Manufacture | : | Schimid & Partner Engineering AG |

d) Electro-Optic Converter (EOC)

| | | |
|-------------|---|--|
| Version | : | EOC 61 |
| Description | : | for TX60 robot arm, including proximity sensor |
| Manufacture | : | Schimid & Partner Engineering AG |

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e)DASY5 Measurement server

| | | |
|-------------------------------|---|--|
| Features | : | Intel ULV Celeron 400MHz 128MB chip disk and 128MB RAM 16 Bit A/D converter for surface detection system Vacuum Fluorescent Display Robot Interface Serial link to DAE (with watchdog supervision) Door contact port (Possibility to connect a light curtain) Emergency stop port (to connect the remote control) Signal lamps port Light beam port Three Ethernet connection ports Two USB 2.0 Ports Two serial links Expansion port for future applications |
| Dimensions (L x W x H) | : | 440 x 241 x 89 mm |
| Manufacture | : | Schimid & Partner Engineering AG |

f) Light Beam Switches

| | | |
|---------------------------|---|----------------------------------|
| Version | : | LB5 |
| Dimensions (L x H) | : | 110 x 80 mm |
| Thickness | : | 12 mm |
| Beam-length | : | 80 mm |
| Manufacture | : | Schimid & Partner Engineering AG |

g)Software

| | | |
|-----------------------------|---|-----------------------------------|
| Item | : | Dosimetric Assesment System DASY5 |
| Type No. | : | SD 000 401A, SD 000 402A |
| Software version No. | : | DASY52, Version 52.6 (1) |
| Manufacture / Origin | : | Schimid & Partner Engineering AG |

h)Robot Controll Unit

| | | |
|-------------------------|---|------------------|
| Weight | : | 70 Kg |
| AC Input Voltage | : | selectable |
| Manufacturer | : | Stäubli Robotics |

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i) Phantom and Device Holder

Phantom

| | | |
|-----------------------|---|---|
| Type | : | SAM Twin Phantom V4.0 |
| Description | : | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. |
| Material | : | Vinylester, glass fiber reinforced (VE-GF) |
| Shell Material | : | Fiberglass |
| Thickness | : | 2.0 +/-0.2 mm |
| Dimensions | : | Length: 1000 mm Width: 500 mm Height: adjustable feet |
| Volume | : | Approx. 25 liters |
| Manufacture | : | Schimid & Partner Engineering AG |

| | | |
|------------------------|---|---|
| Type | : | 2mm Flat phantom ERI4.0 |
| Description | : | Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with the latest draft of the standard IEC 62209 Part II and all known tissue simulating liquids. ELI4 has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is supported by software version DASY4.5 and higher and is compatible with all SPEAG dosimetric probes and dipoles. |
| Material | : | Vinylester, glass fiber reinforced (VE-GF) |
| Shell Thickness | : | 2.0 ± 0.2 mm (sagging: <1%) |
| Filling Volume | : | approx. 30 liters |
| Dimensions | : | Major ellipse axis: 600 mm Minor axis: 400 mm |
| Manufacture | : | Schimid & Partner Engineering AG |

Device Holder

In combination with the Twin SAM Phantom V4.0/V4.0c or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).

Material : POM

Laptio Extensions kit

Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM, ELI4 Phantoms.

Material : POM, Acrylic glass, Foam

Urethane

For this measurement, the urethane foam was used as device holder.

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j) Simulated Tissues (Liquid)

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

| Mixture (%) | Frequency (MHz) | | | | | | | | | |
|---------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|------|-------|
| | 450 | | 900 | | 1800 | | 1950 | | 2450 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.91 | 46.21 | 40.29 | 50.75 | 55.24 | 70.17 | 55.41 | 69.79 | 55.0 | 68.64 |
| Sugar | 56.93 | 51.17 | 57.90 | 48.21 | - | - | - | - | - | - |
| Cellulose | 0.25 | 0.18 | 0.24 | 0.00 | - | - | - | - | - | - |
| Salt (NaCl) | 3.79 | 2.34 | 1.38 | 0.94 | 0.31 | 0.39 | 0.08 | 0.2 | - | - |
| Preventol | 0.12 | 0.08 | 0.18 | 0.10 | - | - | - | - | - | - |
| DGMBE | - | - | - | - | 44.45 | 29.44 | 44.51 | 30.0 | 45.0 | 31.37 |
| Dielectric Constant | 43.42 | 58.0 | 42.54 | 56.1 | 42.0 | 56.8 | 39.9 | 54.0 | 39.8 | 52.5 |
| Conductivity (S/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.0 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

Note: DGMBE (Diethyleneglycol-monobutyl ether)

| Mixture (%) | Frequency (MHz) | |
|--------------------|-----------------|------|
| | 3-6GHz | |
| Tissue Type | Head | Body |
| Water | 64.0 | 78.0 |
| Mineral Oil | 18.0 | 11.0 |
| Emulsifiers | 15.0 | 9.0 |
| Additives and salt | 3.0 | 2.0 |

Decision on Simulated Tissues of 5GHz band

In the current standards (e.g., IEC62209-2, IEEE P1528, OET 65 Supplement C), the dielectric parameters suggested for head and body tissue simulating liquid are given at 3000MHz and 5800MHz. As an intermediate solution, dielectric parameters for the frequencies between 5000 to 5800 MHz were obtained using linear interpolation.

Therefore the dielectric parameters of 5200MHz, 5300MHz, 5600MHz and 5500MHz (The frequency for the validation) were decided as following.

| f (MHz) | Head Tissue | | Body Tissue | | Reference |
|---------|--------------|---------------------|--------------|---------------------|--------------|
| | ϵ_r | σ [mho/m] | ϵ_r | σ [mho/m] | |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 | Standard |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 | Standard |
| 5000 | 36.2 | 4.45 | 49.3 | 5.07 | Interpolated |
| 5100 | 36.1 | 4.55 | 49.1 | 5.18 | Interpolated |
| 5200 | 36.0 | 4.66 | 49.0 | 5.30 | Interpolated |
| 5300 | 35.9 | 4.76 | 48.9 | 5.42 | Interpolated |
| 5400 | 35.8 | 4.86 | 48.7 | 5.53 | Interpolated |
| 5500 | 35.6 | 4.96 | 48.6 | 5.65 | Interpolated |
| 5600 | 35.5 | 5.07 | 48.5 | 5.77 | Interpolated |
| 5700 | 35.4 | 5.17 | 48.3 | 5.88 | Interpolated |

Standard and interpolated dielectric parameters for head and body tissue simulating liquid in the frequency range 3000 to 5800MHz.

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3. Dosimetric E-Field Probe Calibration (EX3DV3,S/N: 3507)

**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
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 **UL Japan (PTT)**

Certificate No: **EX3-3507_Mar11**

CALIBRATION CERTIFICATE

| | |
|--------------------------|---|
| Object | EX3DV3 - SN:3507 |
| Calibration procedure(s) | QA CAL-01.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v3 Calibration procedure for dosimetric E-field probes |
| Calibration date: | March 16, 2011 |

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 (Certificate No.) | Scheduled Calibration |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B | GB41293874 | 01-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41495277 | 01-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41498087 | 01-Apr-10 (No. 217-01136) | Apr-11 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 30-Mar-10 (No. 217-01159) | Mar-11 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161) | Mar-11 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 30-Mar-10 (No. 217-01160) | Mar-11 |
| Reference Probe ES3DV2 | SN: 3013 | 29-Dec-10 (No. ES3-3013_Dec10) | Dec-11 |
| DAE4 | SN: 654 | 23-Apr-10 (No. DAE4-654_Apr10) | Apr-11 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

| | | | |
|----------------|-----------------------|-------------------------------|---------------|
| Calibrated by: | Name Katja Pokovic | Function Technical Manager | Signature |
| Approved by: | Name Fin Bomholt | Function R&D Director | Signature |

Issued: March 16, 2011

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

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



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Accreditation No.: **SCS 108**

Glossary:

| | |
|-----------------------|---|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,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 θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., θ = 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:

- **NORM_{x,y,z}**: Assessed for E-field polarization θ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- **NORM(f)_{x,y,z} = NORM_{x,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.
- **DCP_{x,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
- **A_{x,y,z}; B_{x,y,z}; C_{x,y,z}** are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.
- **VR**: VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.
- **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 NORM_{x,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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EX3DV3 – SN:3507

March 16, 2011

Probe EX3DV3

SN:3507

Manufactured: December 15, 2003
Calibrated: March 16, 2011

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

EX3DV3-SN:3507

March 16, 2011

DASY/EASY - Parameters of Probe: EX3DV3 - SN:3507

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-----------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.68 | 0.76 | 0.68 | ± 10.1 % |
| DCP (mV) ^B | 101.3 | 100.9 | 100.1 | |

Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc ^E (k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 106.0 | ±1.7 % |
| | | | Y | 0.00 | 0.00 | 1.00 | 135.2 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 107.9 | |

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 Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

EX3DV3- SN:3507

March 16, 2011

DASY/EASY - Parameters of Probe: EX3DV3 - SN:3507**Calibration Parameter Determined in Head Tissue Simulating Media**

| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 835 | 41.5 | 0.90 | 10.35 | 10.35 | 10.35 | 0.50 | 0.79 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 10.15 | 10.15 | 10.15 | 0.59 | 0.76 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 9.14 | 9.14 | 9.14 | 0.80 | 0.50 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 8.87 | 8.87 | 8.87 | 0.80 | 0.50 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.78 | 8.78 | 8.78 | 0.80 | 0.50 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.71 | 8.71 | 8.71 | 0.80 | 0.54 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.88 | 7.88 | 7.88 | 0.60 | 0.64 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.67 | 7.67 | 7.67 | 0.50 | 0.75 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 4.95 | 4.95 | 4.95 | 0.35 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.59 | 4.59 | 4.59 | 0.40 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.34 | 4.34 | 4.34 | 0.42 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.07 | 4.07 | 4.07 | 0.42 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.29 | 4.29 | 4.29 | 0.42 | 1.80 | ± 13.1 % |

^C 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.

^F 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.

EX3DV3- SN:3507

March 16, 2011

DASY/EASY - Parameters of Probe: EX3DV3- SN:3507

Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 835 | 55.2 | 0.97 | 10.49 | 10.49 | 10.49 | 0.77 | 0.60 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 10.18 | 10.18 | 10.18 | 0.69 | 0.65 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.56 | 8.56 | 8.56 | 0.63 | 0.66 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 8.25 | 8.25 | 8.25 | 0.61 | 0.67 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 8.09 | 8.09 | 8.09 | 0.70 | 0.63 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 8.21 | 8.21 | 8.21 | 0.56 | 0.68 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.61 | 7.61 | 7.61 | 0.73 | 0.55 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.44 | 7.44 | 7.44 | 0.80 | 0.50 | ± 12.0 % |
| 5200 | 49.0 | 5.30 | 4.36 | 4.36 | 4.36 | 0.50 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.17 | 4.17 | 4.17 | 0.50 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 3.70 | 3.70 | 3.70 | 0.55 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.50 | 3.50 | 3.50 | 0.60 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 3.69 | 3.69 | 3.69 | 0.60 | 1.90 | ± 13.1 % |

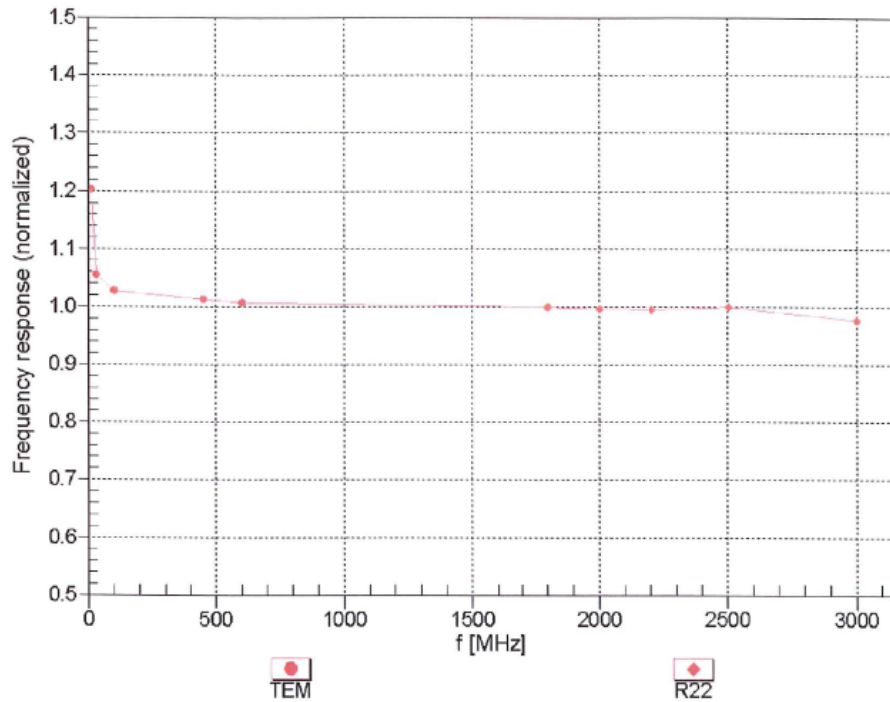
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^F 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.

EX3DV3- SN:3507

March 16, 2011

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

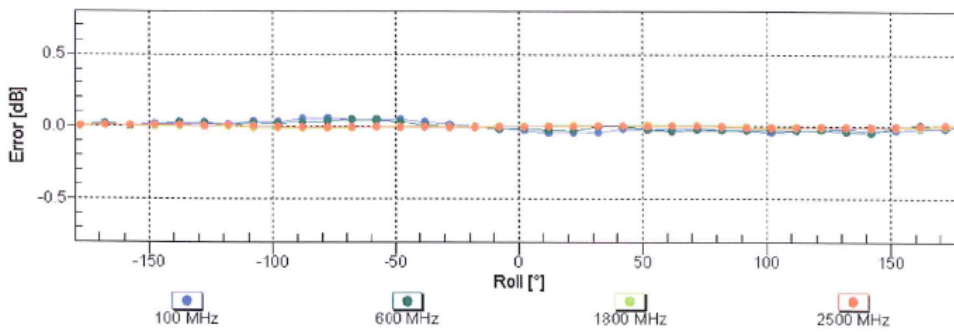
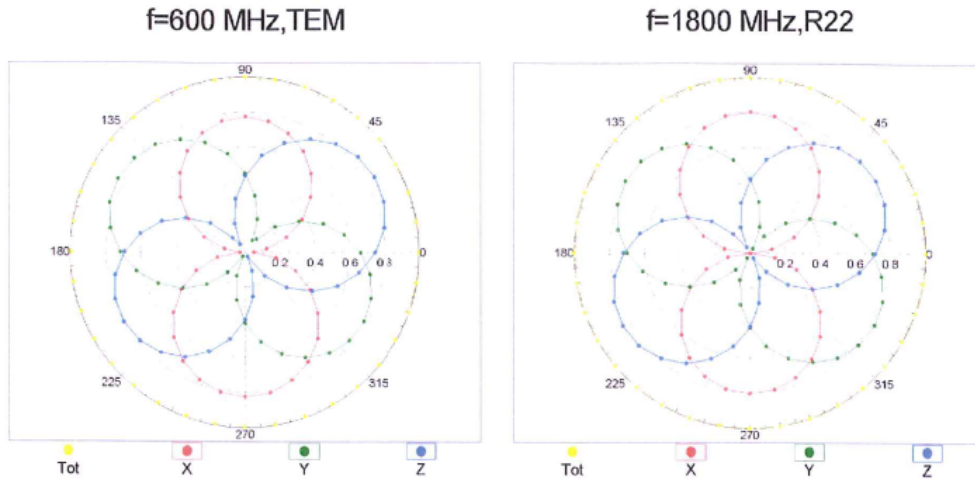


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

EX3DV3- SN:3507

March 16, 2011

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

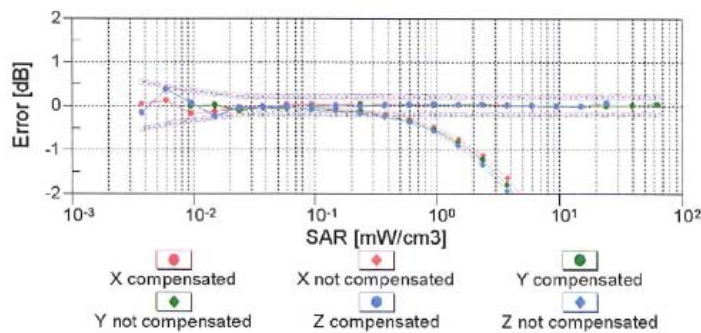
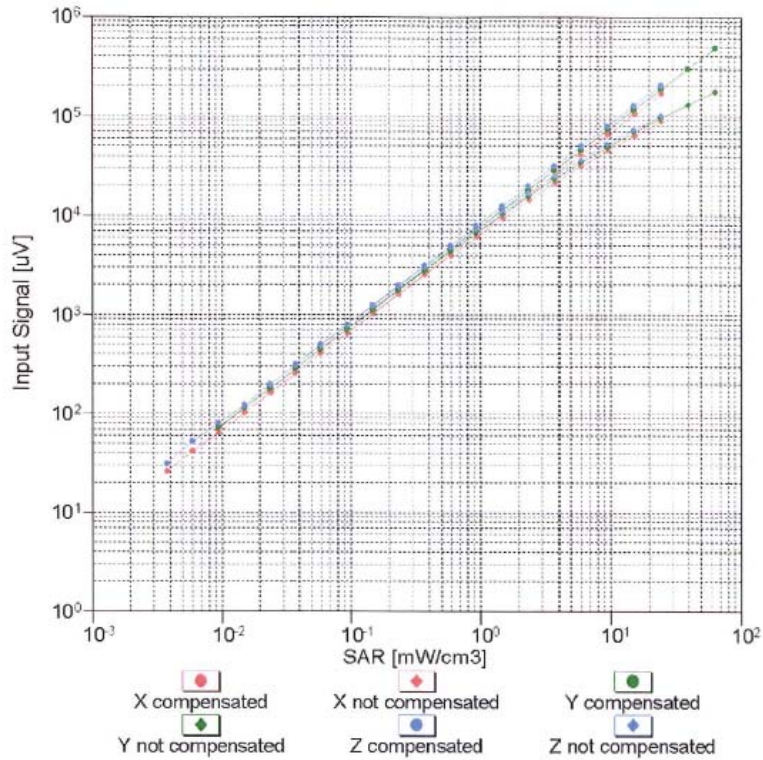


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

EX3DV3- SN:3507

March 16, 2011

Dynamic Range $f(SAR_{head})$ (TEM cell , $f = 900$ MHz)

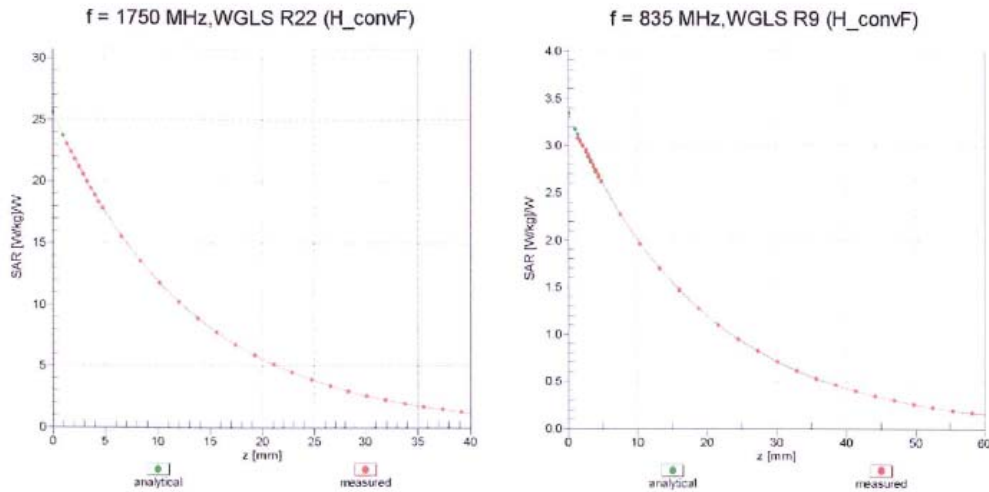


Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

EX3DV3-SN:3507

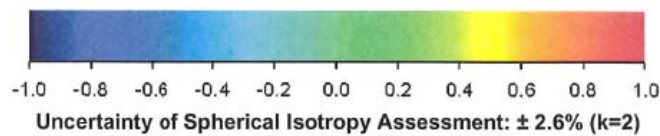
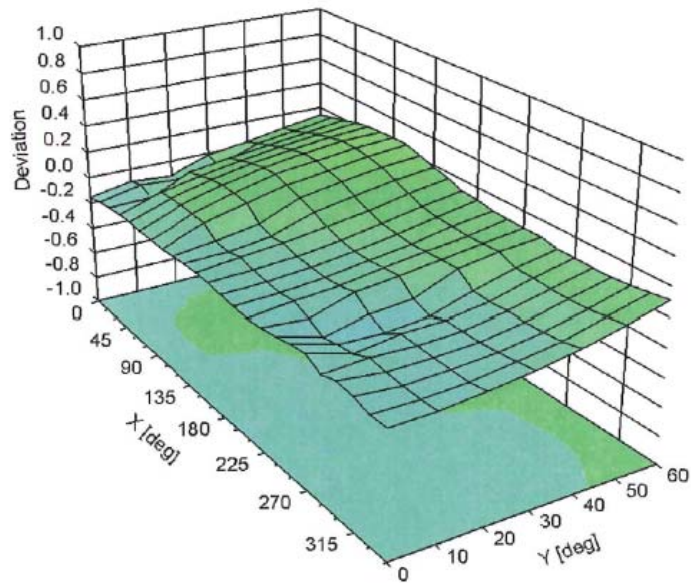
March 16, 2011

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ (k=2)

EX3DV3- SN:3507

March 16, 2011

DASY/EASY - Parameters of Probe: EX3DV3 - SN:3507

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 | 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 |

4, Dosimetric E-Field Probe Calibration (EX3DV4, S/N: 3540)

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



SCS
Schweizerischer Kalibrierdienst
Service suisse d'étalonnage
Servizio svizzero di taratura
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client PTT

Certificate No: EX3-3540_Ju11

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3540

Calibration procedure(s): QA CAL-01.v8, QA CAL-12.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes

Calibration date: July 21, 2011

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 (Certificate No.) | Scheduled Calibration |
|----------------------------|-----------------|-----------------------------------|------------------------|
| Power meter E4419B | GB41293874 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Power sensor E4412A | MY41498097 | 31-Mar-11 (No. 217-01372) | Apr-12 |
| Reference 3 dB Attenuator | SN: S6054 (3c) | 29-Mar-11 (No. 217-01369) | Apr-12 |
| Reference 20 dB Attenuator | SN: S6055 (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 | US3842U01700 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

| | | | |
|----------------|---------------------|-----------------------------|------------|
| Calibrated by: | Name: Katja Pokovic | Function: Technical Manager | Signature: |
| Approved by: | Name: Niels Kuster | Function: Quality Manager | Signature: |

Issued: July 21, 2011

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

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Glossary:

| | |
|-----------------------|---|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,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 θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\theta = 0$ 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:

- NORM_{x,y,z}: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(*i*)_{x,y,z} = NORM_{x,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.
- DCP_{x,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 $f \leq 800$ 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 NORM_{x,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.

UL Japan, Inc.

Head Office EMC Lab.

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EX3DV4 – SN:3540

July 21, 2011

Probe EX3DV4

SN:3540

Manufactured: August 23, 2005
Calibrated: July 21, 2011

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

EX3DV4- SN:3540

July 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3540**Basic Calibration Parameters**

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|--------------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.45 | 0.53 | 0.54 | $\pm 10.1\%$ |
| DCP (mV) ^B | 100.9 | 101.2 | 99.2 | |

Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc ^E (k=2) |
|-------|---------------------------|------|---|---------|---------|---------|----------|---------------------------|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 139.8 | $\pm 2.2\%$ |
| | | | Y | 0.00 | 0.00 | 1.00 | 119.0 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 112.5 | |

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 Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E 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:3540

July 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3540

Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 300 | 45.3 | 0.87 | 11.39 | 11.39 | 11.39 | 0.20 | 0.71 | ± 13.4 % |
| 450 | 43.5 | 0.87 | 10.47 | 10.47 | 10.47 | 0.12 | 1.87 | ± 13.4 % |
| 835 | 41.5 | 0.90 | 10.02 | 10.02 | 10.02 | 0.60 | 0.73 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.82 | 9.82 | 9.82 | 0.57 | 0.77 | ± 12.0 % |
| 1450 | 40.5 | 1.20 | 9.81 | 9.81 | 9.81 | 0.36 | 1.13 | ± 12.0 % |
| 1640 | 40.3 | 1.29 | 9.35 | 9.35 | 9.35 | 0.69 | 0.60 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 9.13 | 9.13 | 9.13 | 0.77 | 0.55 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 8.81 | 8.81 | 8.81 | 0.76 | 0.55 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.65 | 8.65 | 8.65 | 0.64 | 0.62 | ± 12.0 % |
| 1950 | 40.0 | 1.40 | 8.46 | 8.46 | 8.46 | 0.74 | 0.56 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.59 | 8.59 | 8.59 | 0.72 | 0.56 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.65 | 7.65 | 7.65 | 0.61 | 0.62 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.52 | 7.52 | 7.52 | 0.51 | 0.72 | ± 12.0 % |
| 3500 | 37.9 | 2.91 | 7.24 | 7.24 | 7.24 | 0.25 | 1.20 | ± 13.1 % |
| 5200 | 36.0 | 4.66 | 4.71 | 4.71 | 4.71 | 0.35 | 1.85 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.39 | 4.39 | 4.39 | 0.35 | 1.85 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.30 | 4.30 | 4.30 | 0.45 | 1.85 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.00 | 4.00 | 4.00 | 0.50 | 1.85 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.16 | 4.16 | 4.16 | 0.45 | 1.85 | ± 13.1 % |

^C 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.

^F 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.

EX3DV4-SN:3540

July 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4- SN:3540

Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) ^c | Relative Permittivity ^f | Conductivity (S/m) ^f | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 300 | 58.2 | 0.92 | 11.11 | 11.11 | 11.11 | 0.17 | 1.15 | ± 13.4 % |
| 450 | 56.7 | 0.94 | 11.61 | 11.61 | 11.61 | 0.03 | 1.00 | ± 13.4 % |
| 835 | 55.2 | 0.97 | 10.29 | 10.29 | 10.29 | 0.79 | 0.64 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 10.05 | 10.05 | 10.05 | 0.67 | 0.74 | ± 12.0 % |
| 1450 | 54.0 | 1.30 | 9.02 | 9.02 | 9.02 | 0.56 | 0.78 | ± 12.0 % |
| 1640 | 53.8 | 1.40 | 9.11 | 9.11 | 9.11 | 0.68 | 0.65 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.21 | 8.21 | 8.21 | 0.76 | 0.60 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 8.00 | 8.00 | 8.00 | 0.70 | 0.63 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.95 | 7.95 | 7.95 | 0.58 | 0.69 | ± 12.0 % |
| 1950 | 53.3 | 1.52 | 8.27 | 8.27 | 8.27 | 0.70 | 0.62 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 8.19 | 8.19 | 8.19 | 0.60 | 0.68 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.64 | 7.64 | 7.64 | 0.80 | 0.54 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.51 | 7.51 | 7.51 | 0.80 | 0.50 | ± 12.0 % |
| 3500 | 51.3 | 3.31 | 6.56 | 6.56 | 6.56 | 0.20 | 1.60 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 3.94 | 3.94 | 3.94 | 0.55 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 3.59 | 3.59 | 3.59 | 0.55 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 3.56 | 3.56 | 3.56 | 0.58 | 1.90 | ± 13.1 % |
| 5800 | 48.5 | 5.77 | 3.25 | 3.25 | 3.25 | 0.60 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 3.40 | 3.40 | 3.40 | 0.60 | 1.90 | ± 13.1 % |

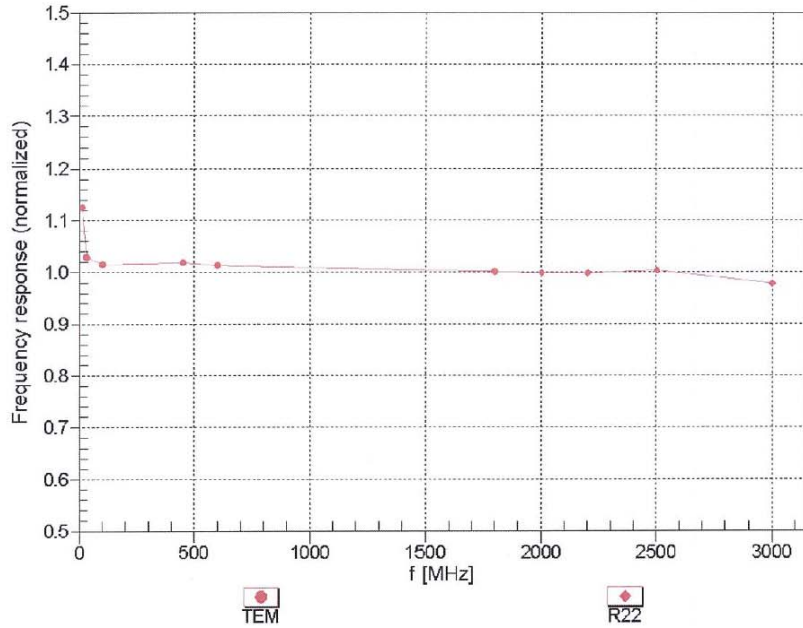
^c Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^f 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.

EX3DV4- SN:3540

July 21, 2011

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

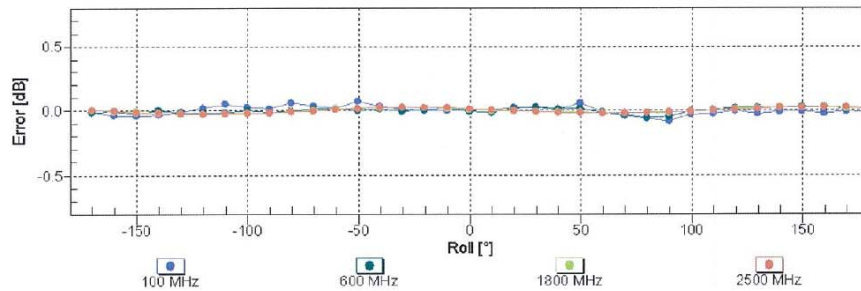
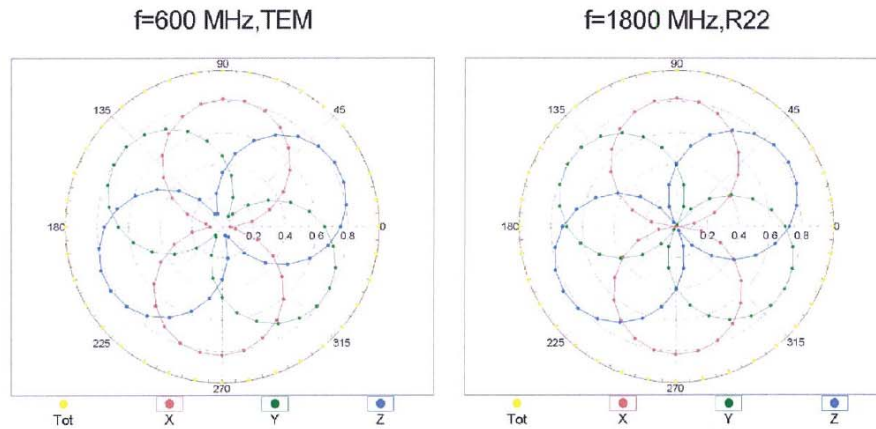


Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

EX3DV4- SN:3540

July 21, 2011

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

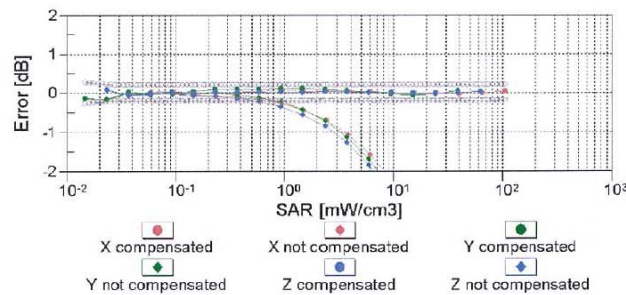
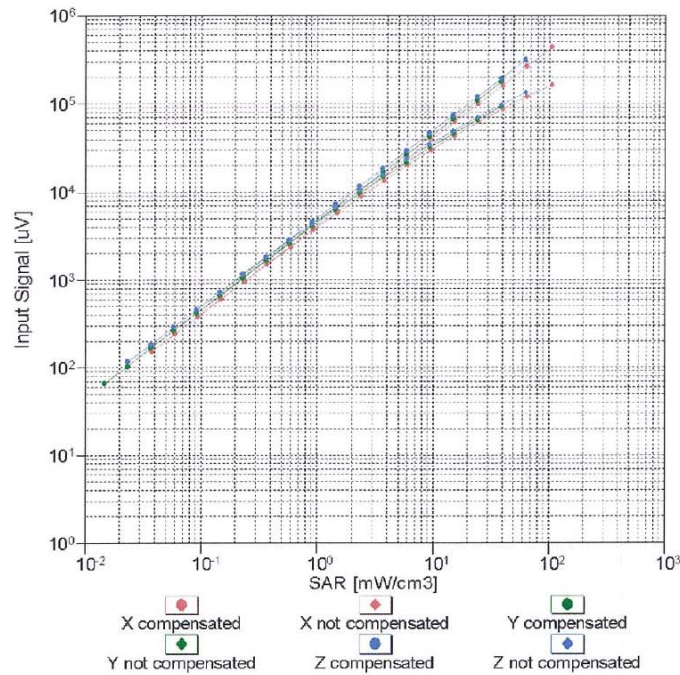


Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

EX3DV4- SN:3540

July 21, 2011

Dynamic Range f(SAR_{head}) (TEM cell, f = 900 MHz)

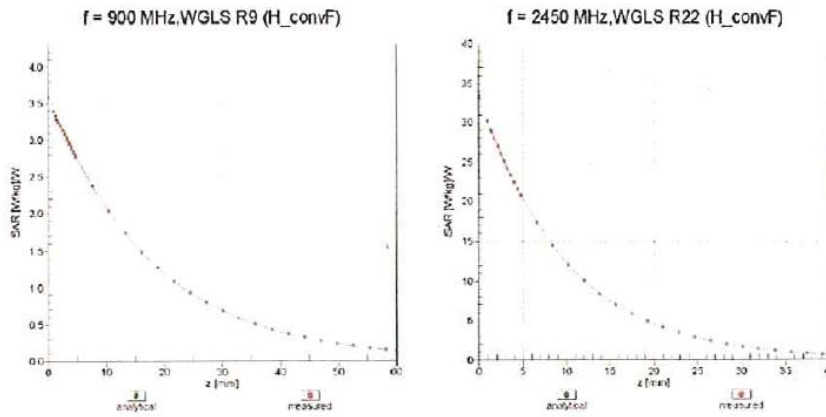


Uncertainty of Linearity Assessment: ± 0.6% (k=2)

EX3DV4-SN:3540

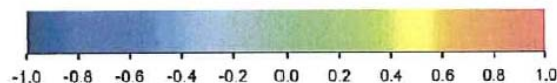
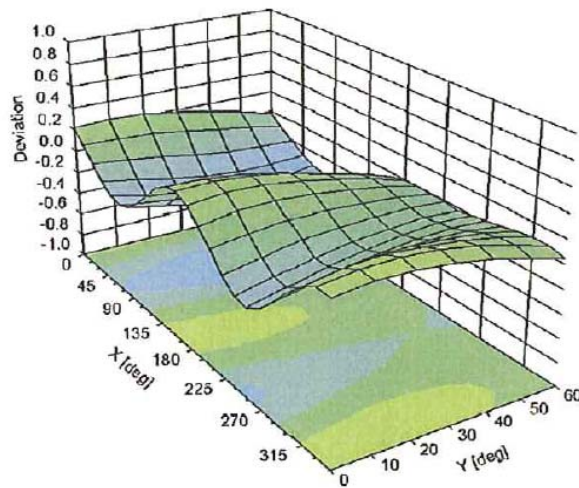
July 21, 2011

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ (k=2)

EX3DV4- SN:3540

July 21, 2011

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3540**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 | 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 |