



FCC SAR TEST REPORT

REPORT NO.: SA110722E07A
MODEL NO.: W121A, NW546
FCC ID: NOI-W121A
RECEIVED: Aug. 17, 2011
TESTED: Aug. 24 ~ Oct. 04, 2011
ISSUED: Oct. 04, 2011

APPLICANT: NETRONIX , INC.

ADDRESS: No. 945, Boai St., Jubei City, Hsin-Chu,
302, Taiwan, R.O.C.

ISSUED BY: Bureau Veritas Consumer Products Services
(H.K.) Ltd., Taoyuan Branch

LAB ADDRESS: No. 47, 14th Ling, Chia Pau Tsuen, Lin Kou
Hsiang, Taipei Hsien 244, Taiwan, R.O.C.

TEST LOCATION: No. 19, Hwa Ya 2nd Rd, Wen Hwa Tsuen, Kwei
Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.

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RELEASE CONTROL RECORD

| ISSUE NO. | REASON FOR CHANGE | DATE ISSUED |
|------------------|-------------------|---------------|
| Original release | N/A | Oct. 04, 2011 |



1. CERTIFICATION

PRODUCT: IEEE 802.11n Wireless USB adapter
MODEL NO.: W121A, NW546
FCC ID: NOI-W121A
BRAND: NETRONIX, 2L
APPLICANT: NETRONIX, INC.
TESTED: Aug. 24 ~ Oct. 04, 2011
STANDARDS: **FCC Part 2 (Section 2.1093)**
FCC OET Bulletin 65, Supplement C (01-01)
IEEE 1528-2003
RSS-102 Issue 4 (2010-03)

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report.

PREPARED BY : Andrea Hsia , DATE : Oct. 04, 2011
Andrea Hsia / Specialist

APPROVED BY : Gary Chang , DATE : Oct. 04, 2011
Gary Chang / Technical Manager

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

| | |
|------------------------------|---|
| EUT | IEEE 802.11n Wireless USB adapter |
| MODEL NO. | W121A, NW546 |
| FCC ID | NOI-W121A |
| MODULATION TYPE | CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM |
| MODULATION TECHNOLOGY | 802.11b / DSSS, 802.11g / OFDM, 802.11n / OFDM |
| TRANSFER RATE | 802.11b: 11 / 5.5 / 2 / 1Mbps 802.11g: 54 / 48 / 36 / 24 / 18 / 12 / 9 / 6Mbps 802.11n (20MHz, 800ns GI): 65 / 58.5 / 52 / 39 / 26 / 19.5 / 13 / 6.5Mbps 802.11n (40MHz, 800ns GI): 135 / 121.5 / 108 / 81 / 54 / 40.5 / 27 / 13.5Mbps |
| OPERATING FREQUENCY | 2412 ~ 2462MHz |
| MAX. SAR (1g) | 0.641 W/kg |
| ANTENNA TYPE | Printed antenna, Soldering with 0dBi antenna gain |

NOTE:

1. All models are electrically identical, different model names and brand names are for marketing purpose.
2. The EUT provides one completed transmitter and one receiver.

| MODULATION MODE | TX FUNCTION |
|-----------------|-------------|
| 802.11b | 1TX |
| 802.11g | 1TX |
| 802.11n (20MHz) | 1TX |
| 802.11n (40MHz) | 1TX |

3. The EUT Conducted average power(dBm) listed as below:

| CH | 802.11b | 802.11g | 802.11n (20MHz) | 802.11n (40MHz) |
|----|---------|---------|-----------------|-----------------|
| L | 12.30 | 14.10 | 13.40 | 13.20 |
| M | 15.30 | 14.10 | 13.20 | 13.10 |
| H | 12.80 | 14.10 | 13.50 | 13.20 |

4. The above EUT information is declared by manufacturer and for more detailed feature description, please refer to the manufacturer's specifications or User's Manual.

2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

FCC Part 2 (2.1093)

FCC OET Bulletin 65, Supplement C (01- 01)

RSS-102 Issue 4 (2010-03)

IEEE 1528-2003

All test items have been performed and recorded as per the above standards.

2.3 GENERAL INFORMATION OF THE SAR SYSTEM

DASY5 consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY5 software defined. The DASY5 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC.

EX3DV4 ISOTROPIC E-FIELD PROBE

| | |
|----------------------|--|
| CONSTRUCTION | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| 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 to probe axis) |
| DYNAMIC RANGE | 10 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g) |
| DIMENSIONS | Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm |
| APPLICATION | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |

NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.
2. For frequencies above 800MHz, calibration in a rectangular wave-guide is used, because wave-guide size is manageable.
3. For frequencies below 800MHz, temperature transfer calibration is used because the wave-guide size becomes relatively large.

TWIN SAM V4.0

| | |
|------------------------|---|
| CONSTRUCTION | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 62209-1 and IEC 62209. 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 manually teaching three points with the robot. |
| SHELL THICKNESS | 2 ± 0.2 mm |
| FILLING VOLUME | 15 cm deep from the ERP |
| DIMENSIONS | Height: 810mm; Length: 1000mm; Width: 500mm |

SYSTEM VALIDATION KITS:

| | |
|-------------------------|--|
| CONSTRUCTION | Symmetrical dipole with 1/4 balun enables measurement of feedpoint impedance with NWA matched for use near flat phantoms filled with brain simulating solutions. Includes distance holder and tripod adaptor |
| CALIBRATION | Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions |
| FREQUENCY | 2450MHz |
| RETURN LOSS | > 20dB at specified validation position |
| POWER CAPABILITY | > 100W (f < 1GHz); > 40W (f > 1GHz) |
| OPTIONS | Dipoles for other frequencies or solutions and other calibration conditions upon request |

DEVICE HOLDER FOR SAM TWIN PHANTOM

| | |
|---------------------|--|
| CONSTRUCTION | The device holder for the mobile phone device is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity $\epsilon = 3$ and loss tangent $\delta = 0.02$. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air. |
|---------------------|--|

DATA ACQUISITION ELECTRONICS

CONSTRUCTION

The data acquisition electronics (DAE3) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe is mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200M Ω ; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

2.4 TEST EQUIPMENT

FOR SAR MEASUREMENT

| ITEM | NAME | BRAND | TYPE | SERIES NO. | DATE OF CALIBRATION | DUE DATE OF CALIBRATION |
|------|-------------------|----------------------|--------------|------------|---------------------|-------------------------|
| 1 | SAM Phantom | S & P | QD000 P40 CA | TP-1485 | NA | NA |
| 2 | Signal Generator | Agilent | E8257C | MY43320668 | Dec. 27, 2010 | Dec. 26, 2011 |
| 3 | E-Field Probe | S & P | EX3DV4 | 3590 | Feb. 25, 2011 | Feb. 24, 2012 |
| 4 | E-Field Probe | S & P | EX3DV4 | 3800 | Aug. 05, 2011 | Aug. 04, 2012 |
| 5 | DAE | S & P | DAE3 | 579 | Sep. 20, 2010 | Sep. 19, 2011 |
| 6 | DAE | S & P | DAE4 | 861 | Aug. 29, 2011 | Aug. 28, 2012 |
| 7 | Robot Positioner | Staubli Unimation | NA | NA | NA | NA |
| 8 | Validation Dipole | S & P | D2450V2 | 716 | Jan. 26, 2011 | Jan. 25, 2013 |

NOTE: Before starting the measurement, all test equipment shall be warmed up for 30min.

FOR TISSUE PROPERTY

| ITEM | NAME | BRAND | TYPE | SERIES NO. | DATE OF CALIBRATION | DUE DATE OF CALIBRATION |
|------|------------------|---------|--------|------------|---------------------|-------------------------|
| 1 | Network Analyzer | Agilent | E8358A | US41480538 | Dec. 30, 2010 | Dec. 29, 2011 |
| 2 | Dielectric Probe | Agilent | 85070D | NA | NA | NA |

NOTE:

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance (k=1) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually $\pm 2.5\%$ and $\pm 5\%$ for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than $\pm 2.5\%$ (k=1). It can be substantially smaller if more accurate methods are applied

2.5 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY52 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|--------------------|---------------------------|---|
| Probe parameters: | - Sensitivity | Norm _i , a _{i0} , a _{i1} , a _{i2} |
| | - Conversion factor | ConvF _i |
| | - Diode compression point | dcp _i |
| Device parameters: | - Frequency | F |
| | - Crest factor | Cf |
| Media parameters: | - Conductivity | σ |
| | - Density | ρ |

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

| | | |
|------------------|----------------------------------|------------------|
| V _i | =compensated signal of channel i | (i = x, y, z) |
| U _i | =input signal of channel i | (i = x, y, z) |
| Cf | =crest factor of exciting field | (DASY parameter) |
| dcp _i | =diode compression point | (DASY parameter) |

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E-field probes: } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}}$$

$$\text{H-field probes: } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

| | | |
|-----------------|--|---------------|
| V_i | =compensated signal of channel I | (i = x, y, z) |
| Norm_i | =sensor sensitivity of channel i $\mu\text{V}/(\text{V/m})^2$ for E-field Probes | (i = x, y, z) |
| ConvF | = sensitivity enhancement in solution | |
| a_{ij} | = sensor sensitivity factors for H-field probes | |
| f | = carrier frequency [GHz] | |
| E_i | = electric field strength of channel i in V/m | |
| H_i | = magnetic field strength of channel i in A/m | |

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

| | |
|-----------|--|
| SAR | = local specific absorption rate in mW/g |
| E_{tot} | = total field strength in V/m |
| σ | = conductivity in [mho/m] or [Siemens/m] |
| ρ | = equivalent tissue density in g/cm ³ |

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid. The entire evaluation of the spatial peak values is performed within the Post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

1. The extraction of the measured data (grid and values) from the Zoom Scan
2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
3. The generation of a high-resolution mesh within the measured volume
4. The interpolation of all measured values from the measurement grid to the high-resolution grid
5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 5 x 5 x 7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 32 x 32 x 30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (42875 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

3. RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with tissue simulation liquid to a depth of 15 cm

The following ingredients are used :

- **WATER-** Deionized water (pure H₂O), resistivity ≈ 16 M - as basis for the liquid
- **DGMBE-** Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH, CAS # 112-34-5 - to reduce relative permittivity

THE RECIPES FOR 2450MHz SIMULATING LIQUID TABLE

| INGREDIENT | BODY SIMULATING LIQUID 2450MHz (MSL-2450) |
|--------------------------------|--|
| Water | 69.83% |
| DGMBE | 30.17% |
| Dielectric Parameters at 22 °C | f= 2450MHz $\epsilon = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\%$ S/m |

Testing the liquids using the Agilent Network Analyzer E8358A and Agilent Dielectric Probe Kit 85070D. The testing procedure is following as

1. Turn Network Analyzer on and allow at least 30min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature ($\pm 1^\circ$).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with $>8\text{mm}$ thickness $\epsilon' = 10.0$, $\epsilon'' = 0.0$). If measured parameters do not fit within tolerance, repeat calibration (± 0.2 for ϵ' : ± 0.1 for ϵ'').
7. Conductivity can be calculated from ϵ'' by $\sigma = \omega \epsilon_0 \epsilon'' = \epsilon'' f [\text{GHz}] / 18$.
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample ($\sim 50\text{ml}$) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY52 for the frequencies necessary for the measurements.
14. Select the current medium for the frequency of the validation.

FOR SIMULATING LIQUID

| Frequency (MHz) | Liquid Type | Liquid Temp. ($^\circ\text{C}$) | Measured Conductivity (σ) | Targeted Conductivity / Deviation | Measured Permittivity (ϵ_r) | Targeted Permittivity / Deviation | Date |
|-----------------|-------------|-----------------------------------|------------------------------------|-----------------------------------|--|-----------------------------------|---------------|
| 2450 | Body | 21.1 | 2.005 | 1.95 / 2.8% | 53.959 | 52.7 / 2.4% | Aug. 24, 2011 |
| 2450 | Body | 21.6 | 1.964 | 1.95 / 0.7% | 51.596 | 52.7 / -2.1% | Oct. 04, 2011 |

4. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 250mW RF input power was used.

4.1 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1. The "Power Reference Measurement" and "Power Drift Measurement" jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above ± 0.1 dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below ± 0.02 dB.
2. The "Surface Check" job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1 mm). In that case it is better to abort the system performance check and stir the liquid.

3. The "Area Scan" job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.
4. The "Zoom Scan" job measures the field in a volume around the peak SAR value assessed in the previous "Area Scan" job (for more information see the application note on SAR evaluation).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DAS52 system is less than $\pm 0.1\text{mm}$.

$$SAR_{tolerance} [\%] = 100 \times \left(\frac{(a + d)^2}{a^2} - 1 \right)$$

As the closest distance is 10mm, the resulting tolerance $SAR_{tolerance} [\%]$ is $< 2\%$.

4.2 VALIDATION RESULTS

| Date | Frequency (MHz) | Targeted SAR (W/kg) | Measured SAR (W/kg) | Normalized SAR (W/kg) | Deviation (%) |
|---------------|-----------------|---------------------|---------------------|-----------------------|---------------|
| Aug. 24, 2011 | 2450 | 53.300 | 12.50 | 50.00 | -6.19 |
| Oct. 04, 2011 | 2450 | 53.300 | 13.30 | 53.20 | -0.19 |

NOTE:

1. The target SAR is derived from validation dipole certificate report and it is calculated with nominal tissue parameter and normalized to 1W.
2. Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Above table shows the target SAR and measured SAR after normalized to 1W input power.
3. Please see Appendix for the photo of system validation test.



4.3 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the IEEE 1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

| Error Description | Tolerance (±%) | Probability Distribution | Divisor | (C _i) | | Standard Uncertainty (±%) | | (v _i) |
|--|----------------|--------------------------|---------|-------------------|-------|---------------------------|--------------|-------------------|
| | | | | (1g) | (10g) | (1g) | (10g) | |
| Measurement System | | | | | | | | |
| Probe Calibration | 6.55 | Normal | 1 | 1 | 1 | 6.55 | 6.55 | ∞ |
| Axial Isotropy | 0.25 | Rectangular | √3 | 0.7 | 0.7 | 0.10 | 0.10 | ∞ |
| Hemispherical Isotropy | 1.30 | Rectangular | √3 | 0.7 | 0.7 | 0.53 | 0.53 | ∞ |
| Boundary effects | 1.00 | Rectangular | √3 | 1 | 1 | 0.58 | 0.58 | ∞ |
| Linearity | 0.30 | Rectangular | √3 | 1 | 1 | 0.17 | 0.17 | ∞ |
| System Detection Limits | 1.00 | Rectangular | √3 | 1 | 1 | 0.58 | 0.58 | ∞ |
| Readout Electronics | 0.30 | Normal | 1 | 1 | 1 | 0.30 | 0.30 | ∞ |
| Response Time | 0.80 | Rectangular | √3 | 1 | 1 | 0.46 | 0.46 | ∞ |
| Integration Time | 2.60 | Rectangular | √3 | 1 | 1 | 1.50 | 1.50 | ∞ |
| RF Ambient Noise | 3.00 | Rectangular | √3 | 1 | 1 | 1.73 | 1.73 | 9 |
| RF Ambient Reflections | 3.00 | Rectangular | √3 | 1 | 1 | 1.73 | 1.73 | 9 |
| Probe Positioner | 0.40 | Rectangular | √3 | 1 | 1 | 0.23 | 0.23 | ∞ |
| Probe Positioning | 2.90 | Rectangular | √3 | 1 | 1 | 1.67 | 1.67 | ∞ |
| Max. SAR Eval. | 1.00 | Rectangular | √3 | 1 | 1 | 0.58 | 0.58 | ∞ |
| Test sample related | | | | | | | | |
| Sample positioning | 1.90 | Normal | 1 | 1 | 1 | 1.90 | 1.90 | 4 |
| Device holder uncertainty | 2.80 | Normal | 1 | 1 | 1 | 2.80 | 2.80 | 4 |
| Output power variation-SAR drift measurement | 4.50 | Rectangular | √3 | 1 | 1 | 2.60 | 2.60 | 1 |
| Dipole Related | | | | | | | | |
| Dipole Axis to Liquid Distance | 1.60 | Rectangular | √3 | 1 | 1 | 0.92 | 0.92 | 4 |
| Input Power Drift | 2.33 | Rectangular | √3 | 1 | 1 | 1.34 | 1.34 | 1 |
| Phantom and Tissue parameters | | | | | | | | |
| Phantom Uncertainty | 4.00 | Rectangular | √3 | 1 | 1 | 2.31 | 2.31 | ∞ |
| Liquid Conductivity (target) | 5.00 | Rectangular | √3 | 0.64 | 0.43 | 1.85 | 1.24 | ∞ |
| Liquid Conductivity (measurement) | 3.04 | Normal | 1 | 0.64 | 0.43 | 1.95 | 1.31 | 9 |
| Liquid Permittivity (target) | 5.00 | Rectangular | √3 | 0.6 | 0.49 | 1.73 | 1.41 | ∞ |
| Liquid Permittivity (measurement) | 2.73 | Normal | 1 | 0.6 | 0.49 | 1.64 | 1.34 | 9 |
| Combined Standard Uncertainty | | | | | | 9.73 | 9.43 | |
| Coverage Factor for 95% | | | | | | Kp=2 | | |
| Expanded Uncertainty (K=2) | | | | | | 19.46 | 18.85 | |

5. TEST RESULTS

5.1 TEST PROCEDURES

Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE 1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- Power reference measurement
- Verification of the power reference measurement
- Area scan
- Zoom scan
- Power reference measurement

The area scan was performed for the highest spatial SAR location. The zoom scan was performed for SAR value averaged over 1g and 10g spatial volumes.

In the zoom scan, the distance between the measurement point at the probe sensor location (geometric center behind the probe tip) and the phantom surface is 3mm and maintained at a constant distance of ± 0.5 mm during a zoom scan to determine peak SAR locations. The distance is 2mm between the first measurement point and the bottom surface of the phantom. The secondary measurement point to the bottom surface of the phantom is with 7mm separation distance. The cube size is 5 x 5 x 7 points consists of 343 points and the grid space is 5mm.

The measurement time is 0.5s at each point of the zoom scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 2mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoom scan. At last the reference power drift shall be less than $\pm 5\%$.

5.2 MEASURED SAR RESULTS

| Plot No. | Band | Test Position | Separation Distance (cm) | Channel | SAR _{1g} (W/kg) | Zoom Scan Setting (mm) |
|----------|---------|-----------------|--------------------------|---------|--------------------------|------------------------|
| 1 | 802.11b | Horizontal Up | 0.5 | 6 | 0.541 | 8x8x5 |
| 2 | 802.11b | Horizontal Down | 0.5 | 6 | 0.641 | 8x8x5 |
| 3 | 802.11b | Vertical Front | 0.5 | 6 | 0.333 | 8x8x5 |
| 4 | 802.11b | Vertical Back | 0.5 | 6 | 0.499 | 8x8x5 |
| 5 | 802.11b | Tip Mode | 0.5 | 6 | 0.059 | 8x8x5 |
| 6 | 802.11b | Horizontal Down | 0.5 | 6 | 0.629 | 5x5x5 |

NOTE:

1. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.
2. We verified the maximum SAR of zoom scan setting 8x8x5 for zoom scan setting 5x5x5. Since the SAR value is very close with the maximum SAR of 8x8x5, the zoom scan resolution will not cause the worse SAR.
3. Please see the Appendix A for the data.

6. SAR LIMITS

| HUMAN EXPOSURE | SAR (W/kg) | |
|--|--|--|
| | (GENERAL POPULATION / UNCONTROLLED EXPOSURE ENVIRONMENT) | (OCCUPATIONAL / CONTROLLED EXPOSURE ENVIRONMENT) |
| Spatial Average (whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over 1 g) | 1.6 | 8.0 |
| Spatial Peak (hands / wrists / feet / ankles averaged over 10 g) | 4.0 | 20.0 |

NOTE:

1. This limits accord to 47 CFR 2.1093 – Safety Limit.



7. INFORMATION ON THE TESTING LABORATORIES

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Copies of accreditation certificates of our laboratories obtained from approval agencies can be downloaded from our web site: www.adt.com.tw/index.5.phtml. If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:

Tel: 886-2-26052180

Fax: 886-2-26051924

Hsin Chu EMC/RF Lab:

Tel: 886-3-5935343

Fax: 886-3-5935342

Hwa Ya EMC/RF/Safety/Telecom Lab:

Tel: 886-3-3183232

Fax: 886-3-3185050

Email: service.adt@tw.bureauveritas.com

Web Site: www.adt.com.tw

The address and road map of all our labs can be found in our web site also.

---END---

System Check_MSL2450_20110824

DUT: Dipole 2450 MHz D2450V2

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2450$ MHz; $\sigma = 2.005$ mho/m; $\epsilon_r = 53.959$; $\rho = 1000$ kg/m³

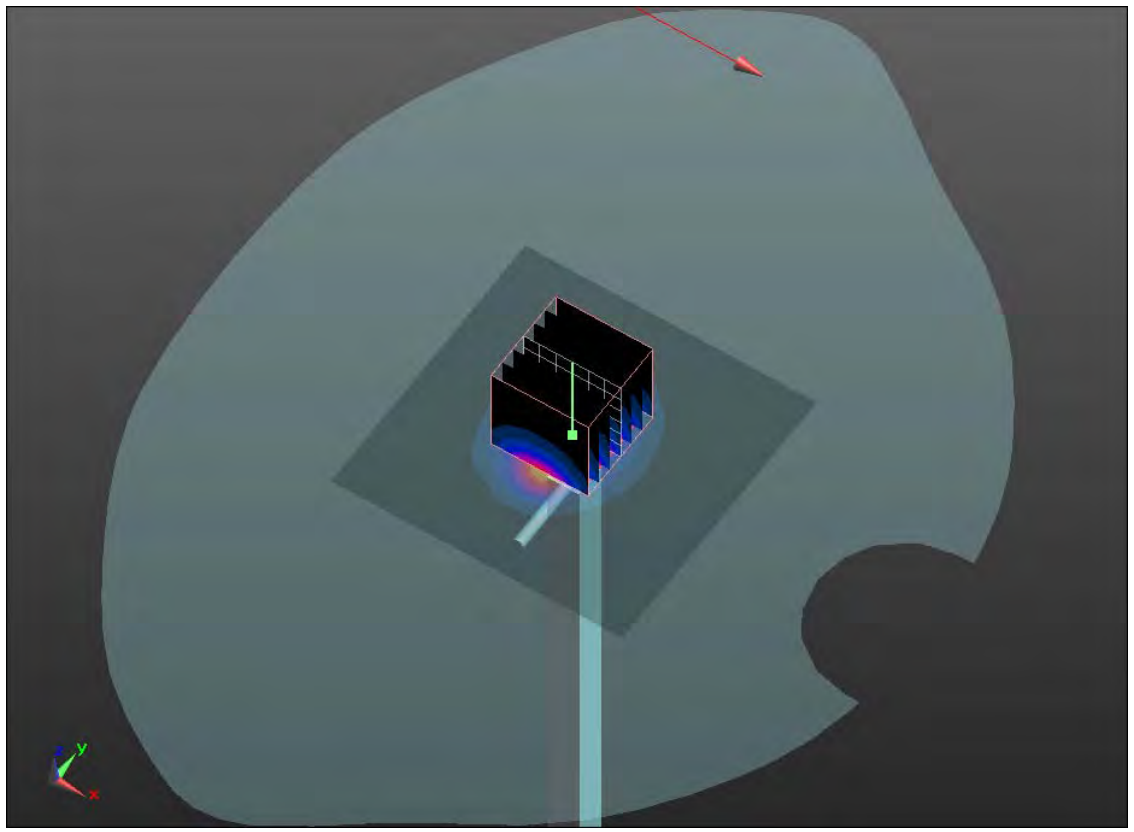
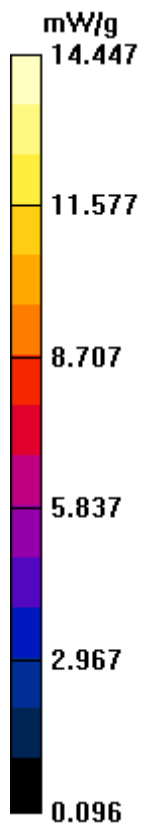
Ambient Temperature : 22.2 °C; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection), Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 18.959 mW/g

System Performance Check at Frequencies above 1 GHz/d=10mm, Pin=250 mW, dist=2.0mm (EX-Probe)/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 88.144 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 25.430 W/kg
SAR(1 g) = 12.5 mW/g; SAR(10 g) = 5.69 mW/g
Maximum value of SAR (measured) = 14.447 mW/g



System Check_MSL2450_111004

DUT: Dipole 2450 MHz

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL2450_1004 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.964$ mho/m; $\epsilon_r = 51.596$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.1 °C ; Liquid Temperature : 21.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3800; ConvF(6.75, 6.75, 6.75); Calibrated: 2011/8/5
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Pin=250mW/Area Scan (61x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 20.264 mW/g

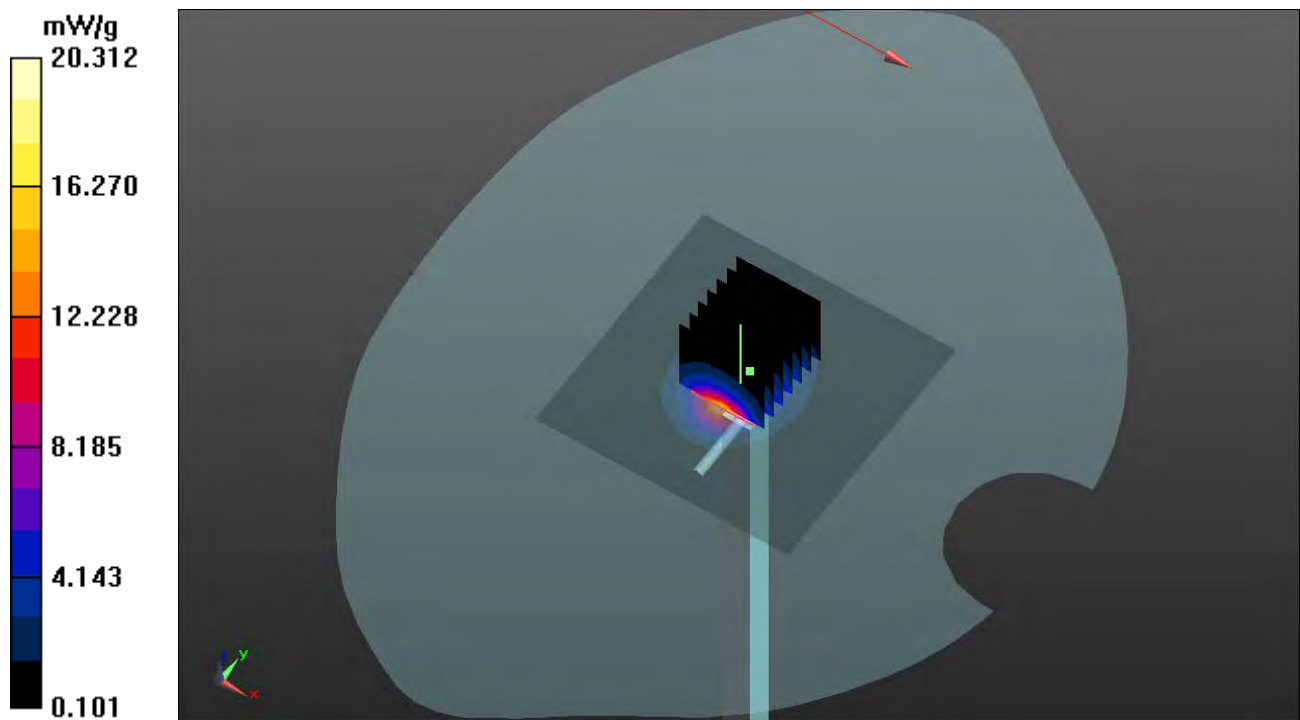
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.6 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.585 W/kg

SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.14 mW/g

Maximum value of SAR (measured) = 20.312 mW/g



P01 802.11b_Horizontal Up_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r = 53.972$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Configuration/Ch6/Area Scan (31x41x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.852 mW/g

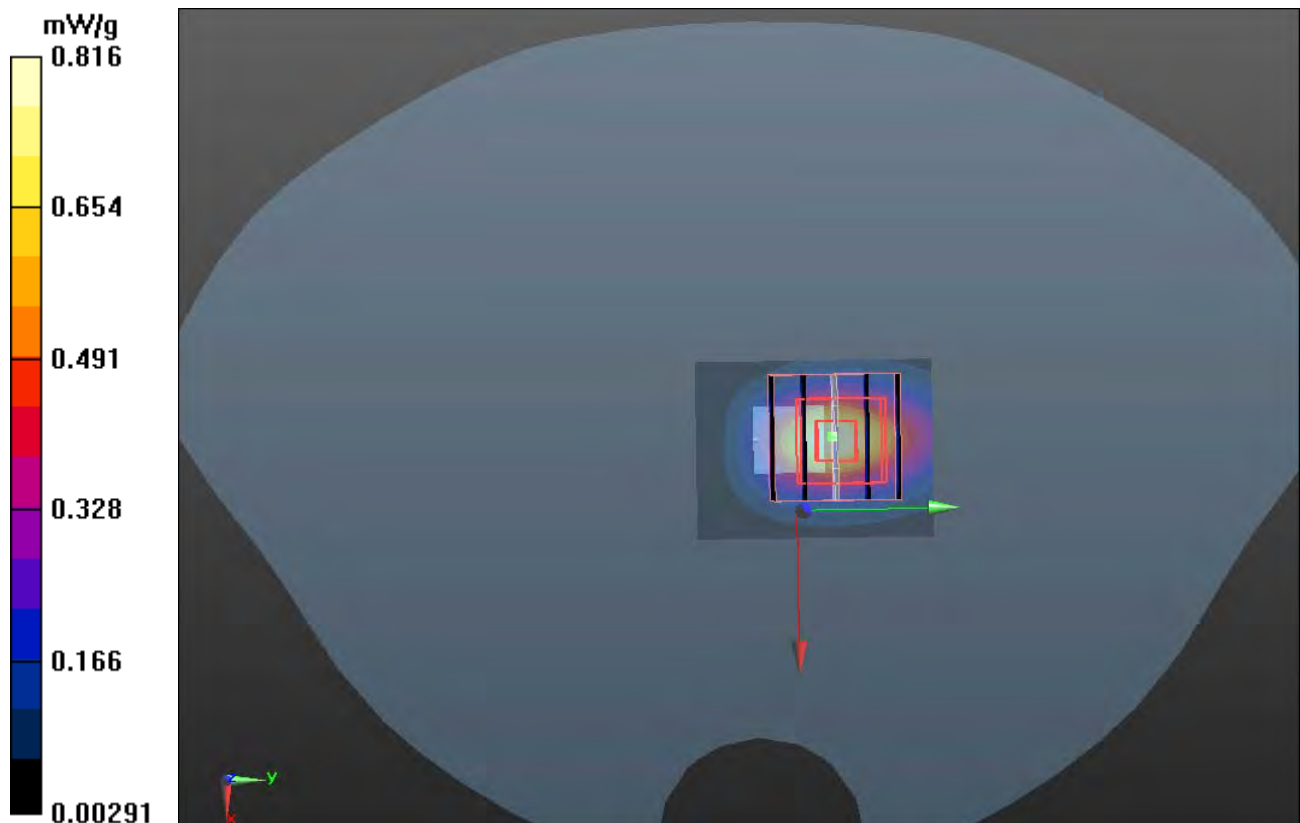
Configuration/Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.073 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 1.133 W/kg

SAR(1 g) = 0.541 mW/g; SAR(10 g) = 0.250 mW/g

Maximum value of SAR (measured) = 0.816 mW/g



P02 802.11b_Horizontal Down_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r = 53.972$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.4 °C ; Liquid Temperature : 21.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Configuration/Ch6/Area Scan (31x31x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.949 mW/g

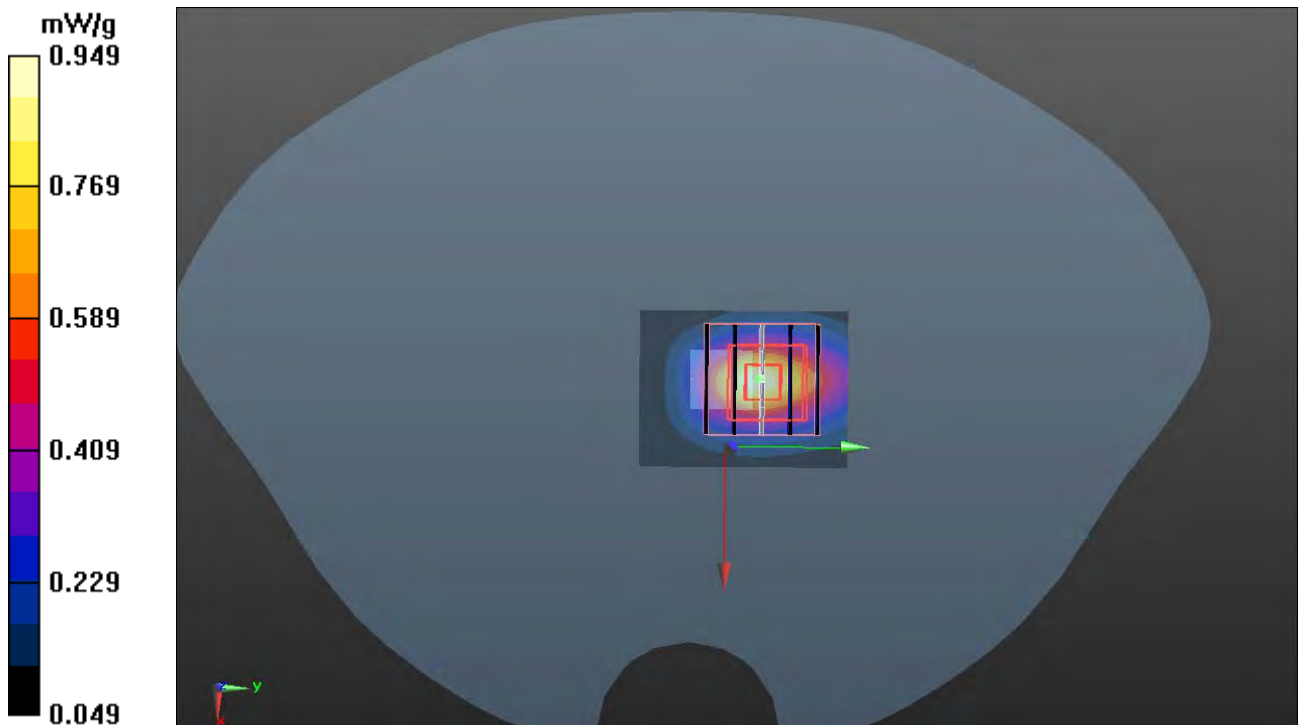
Configuration/Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 11.422 V/m; Power Drift = -0.18 dB

Peak SAR (extrapolated) = 1.453 W/kg

SAR(1 g) = 0.641 mW/g; SAR(10 g) = 0.276 mW/g

Maximum value of SAR (measured) = 1.035 mW/g



P03 802.11b_Verical Front_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r = 53.972$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.4 °C ; Liquid Temperature : 21.0°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Configuration/Ch6/Area Scan (31x41x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.521 mW/g

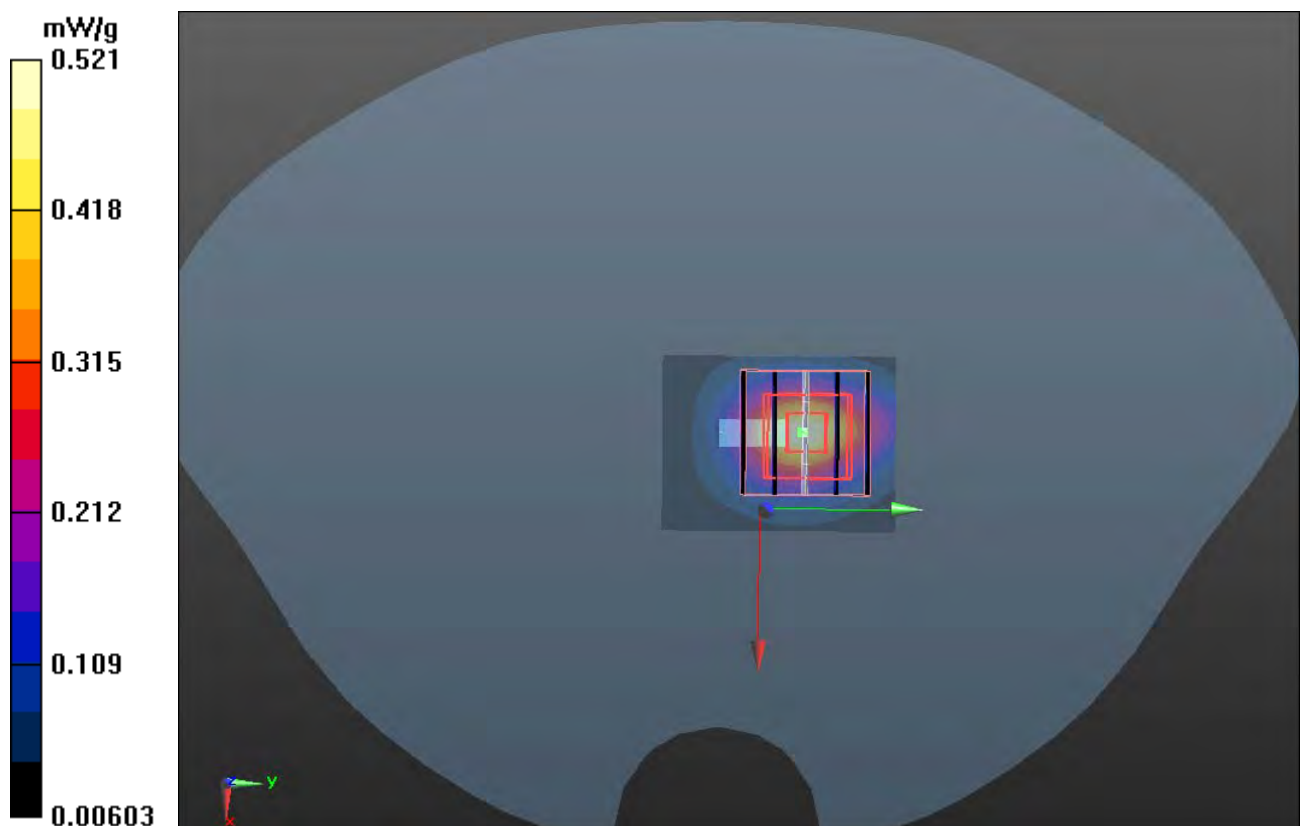
Configuration/Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 8.593 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.726 W/kg

SAR(1 g) = 0.333 mW/g; SAR(10 g) = 0.154 mW/g

Maximum value of SAR (measured) = 0.524 mW/g



P04 802.11b_Verical Back_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r = 53.972$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.3 °C ; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Configuration/Ch6/Area Scan (31x41x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.760 mW/g

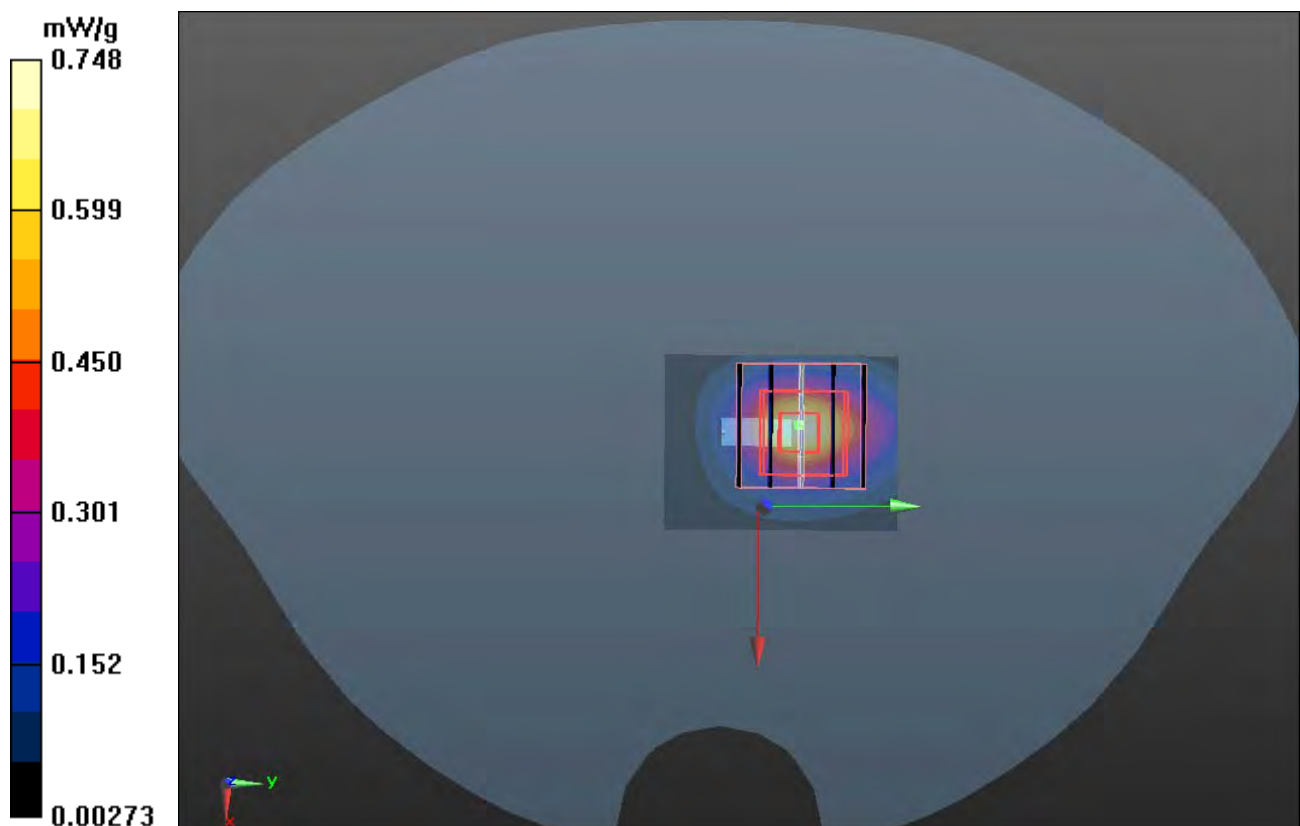
Configuration/Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.992 V/m; Power Drift = 0.18 dB

Peak SAR (extrapolated) = 1.044 W/kg

SAR(1 g) = 0.499 mW/g; SAR(10 g) = 0.227 mW/g

Maximum value of SAR (measured) = 0.748 mW/g



P05 802.11b_Tip_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: MSL2450_0824 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.985$ mho/m; $\epsilon_r = 53.972$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.3 °C ; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3590; ConvF(7.91, 7.91, 7.91); Calibrated: 2011/2/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2010/9/20
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Configuration/Ch6/Area Scan (31x41x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.069 mW/g

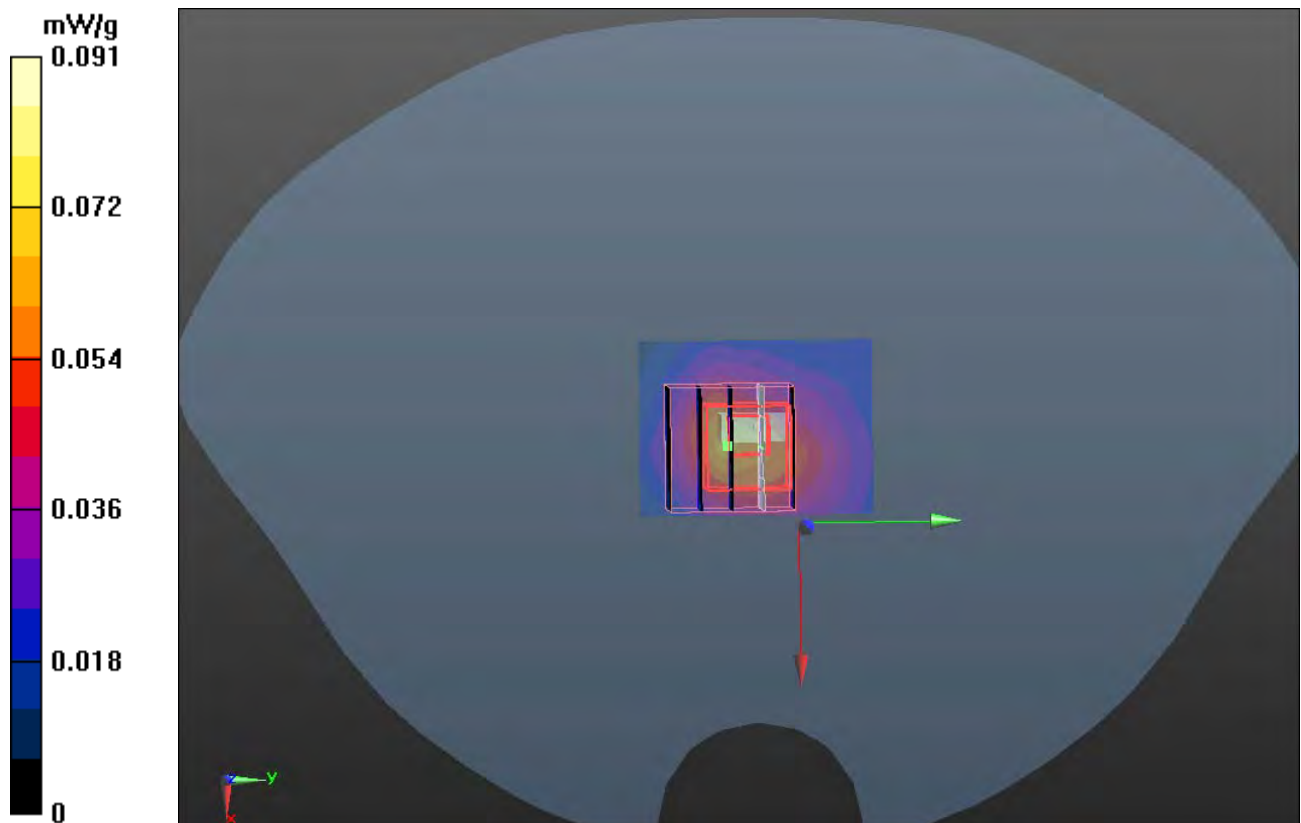
Configuration/Ch6/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.868 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.145 W/kg

SAR(1 g) = 0.059 mW/g; SAR(10 g) = 0.026 mW/g

Maximum value of SAR (measured) = 0.091 mW/g



P06 802.11b_Horizontal Down_0.5cm_Ch06_sample1_1M

DUT: 110817E02

Communication System: 802.11b; Frequency: 2437 MHz; Duty Cycle: 1:1

Medium: HSL2450_1004 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.904$ mho/m; $\epsilon_r = 53.32$; $\rho = 1000$ kg/m³

Ambient Temperature : 22.5 °C ; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3800; ConvF(6.75, 6.75, 6.75); Calibrated: 2011/8/5
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/8/29
- Phantom: SAM Phantom_Left; Type: SAM; Serial: 1202
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch6/Area Scan (31x31x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.897 mW/g

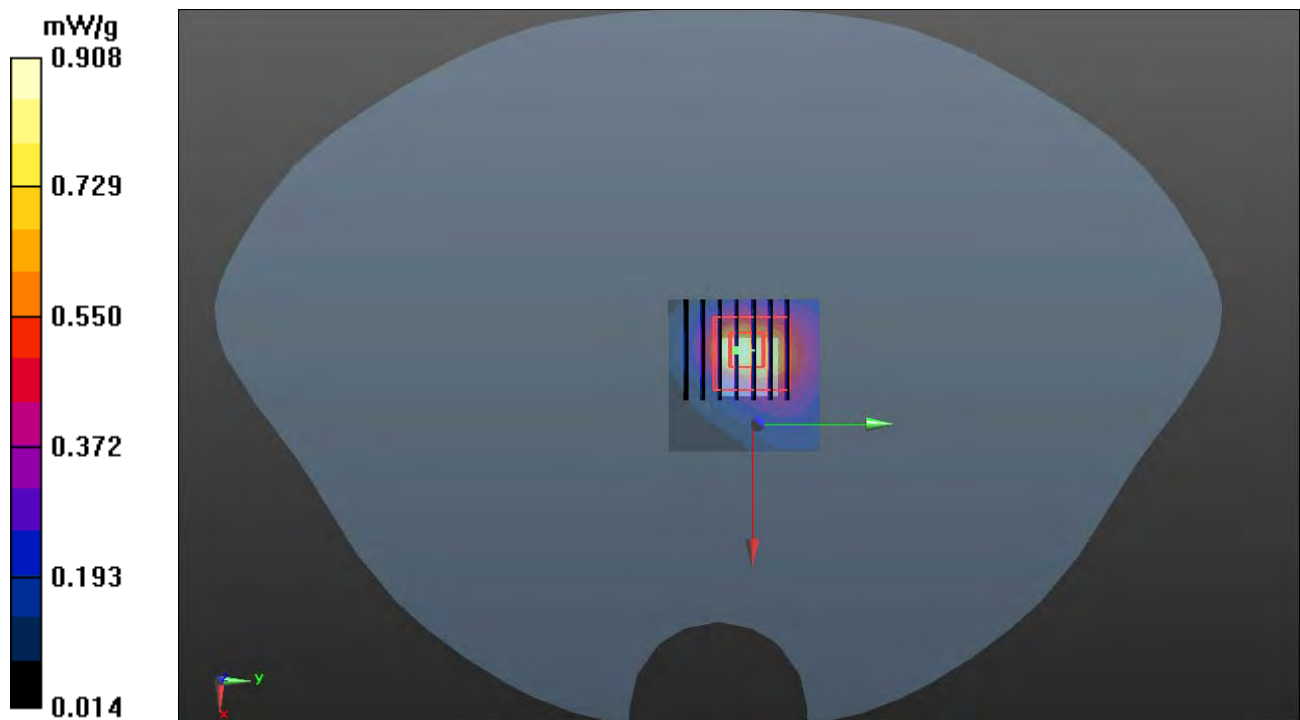
Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 17.377 V/m; Power Drift = 0.13 dB

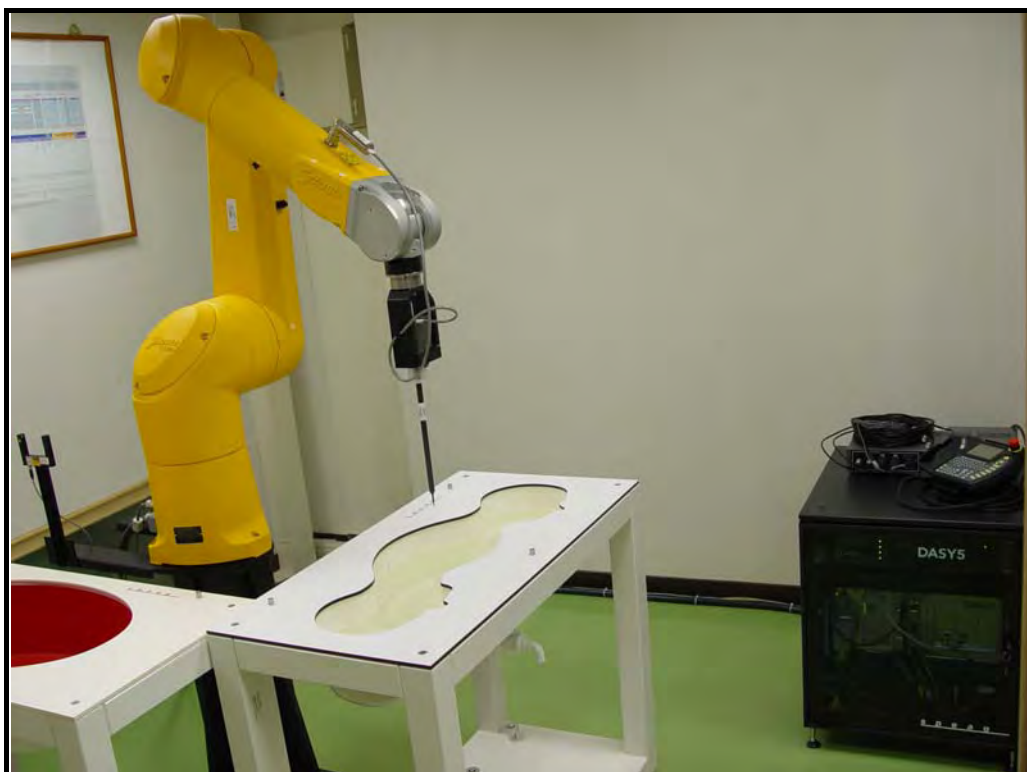
Peak SAR (extrapolated) = 1.253 W/kg

SAR(1 g) = 0.629 mW/g; SAR(10 g) = 0.287 mW/g

Maximum value of SAR (measured) = 0.908 mW/g



APPENDIX B: BV ADT SAR MEASUREMENT SYSTEM



APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION





APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION

D1: PHANTOM

Certificate of Conformity / First Article Inspection

| | |
|--------------|--|
| Item | SAM Twin Phantom V4.0 |
| Type No | QD 000 P40 C |
| Series No | TP-1150 and higher |
| Manufacturer | SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland |

Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

| Test | Requirement | Details | Units tested |
|-----------------------------|--|--|---|
| Dimensions | Compliant with the geometry according to the CAD model. | IT'IS CAD File (*) | First article, Samples |
| Material thickness of shell | Compliant with the requirements according to the standards | 2mm +/- 0.2mm in flat and specific areas of head section | First article, Samples, TP-1314 ff. |
| Material thickness at ERP | Compliant with the requirements according to the standards | 6mm +/- 0.2mm at ERP | First article, All items |
| Material parameters | Dielectric parameters for required frequencies | 300 MHz – 6 GHz: Relative permittivity < 5, Loss tangent < 0.05 | Material samples |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility. | DEGMBE based simulating liquids | Pre-series, First article, Material samples |
| Sagging | Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid. | < 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below | Prototypes, Sample testing |

Standards

- [1] CENELEC EN 50361
- [2] IEEE Std 1528-2003
- [3] IEC 62209 Part I
- [4] FCC OET Bulletin 65, Supplement C, Edition 01-01

(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standards [1] to [4].

Date 07.07.2005

Signature / Stamp



D2: DOSIMETRIC E-FIELD PROBE



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 **BV ADT (Auden)**

Certificate No: **EX3-3590_Feb11**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3590**

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: **February 25, 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 |

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

Issued: February 25, 2011

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

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., $\vartheta = 0$ 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 $\vartheta = 0$ ($f \leq 900$ 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(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 $f \leq 800$ 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.

Probe EX3DV4

SN:3590

Manufactured: March 23, 2009
Calibrated: February 25, 2011

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|--|----------|----------|----------|---------------|
| Norm ($\mu\text{V}/(\text{V/m})^2$) ^A | 0.51 | 0.48 | 0.51 | $\pm 10.1 \%$ |
| DCP (mV) ^B | 94.6 | 95.5 | 92.8 | |

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 | 119.0 | $\pm 2.7 \%$ |
| | | | Y | 0.00 | 0.00 | 1.00 | 141.4 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 115.0 | |

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 E²-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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

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 | 10.21 | 10.21 | 10.21 | 0.56 | 0.68 | ± 12.0 % |
| 1640 | 40.3 | 1.29 | 9.25 | 9.25 | 9.25 | 0.68 | 0.60 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 9.03 | 9.03 | 9.03 | 0.79 | 0.58 | ± 12.0 % |
| 1950 | 40.0 | 1.40 | 8.45 | 8.45 | 8.45 | 0.55 | 0.66 | ± 12.0 % |
| 2300 | 39.5 | 1.67 | 8.14 | 8.14 | 8.14 | 0.40 | 0.80 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.73 | 7.73 | 7.73 | 0.29 | 1.00 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.53 | 7.53 | 7.53 | 0.28 | 1.06 | ± 12.0 % |
| 3500 | 37.9 | 2.91 | 7.55 | 7.55 | 7.55 | 0.36 | 1.03 | ± 13.1 % |
| 5200 | 36.0 | 4.66 | 5.51 | 5.51 | 5.51 | 0.30 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 5.17 | 5.17 | 5.17 | 0.30 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 5.00 | 5.00 | 5.00 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.52 | 4.52 | 4.52 | 0.50 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.53 | 4.53 | 4.53 | 0.50 | 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.

DASY/EASY - Parameters of Probe: EX3DV4- SN:3590

Calibration Parameter Determined in Body Tissue Simulating Media

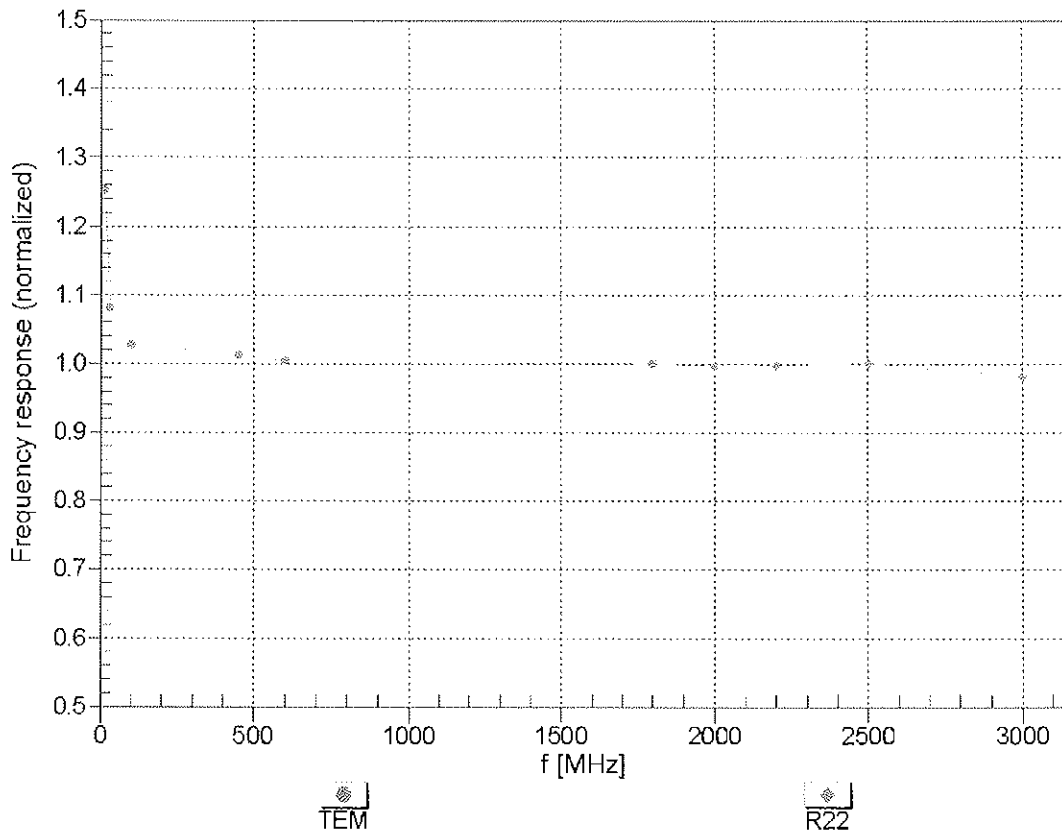
| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 835 | 55.2 | 0.97 | 10.32 | 10.32 | 10.32 | 0.38 | 0.82 | ± 12.0 % |
| 1640 | 53.8 | 1.40 | 9.72 | 9.72 | 9.72 | 0.51 | 0.79 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.77 | 8.77 | 8.77 | 0.37 | 0.92 | ± 12.0 % |
| 1950 | 53.3 | 1.52 | 8.49 | 8.49 | 8.49 | 0.60 | 0.67 | ± 12.0 % |
| 2300 | 52.9 | 1.81 | 8.08 | 8.08 | 8.08 | 0.30 | 1.00 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.91 | 7.91 | 7.91 | 0.42 | 0.82 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.78 | 7.78 | 7.78 | 0.25 | 1.17 | ± 12.0 % |
| 3500 | 51.3 | 3.31 | 7.14 | 7.14 | 7.14 | 0.43 | 0.96 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 4.81 | 4.81 | 4.81 | 0.50 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.56 | 4.56 | 4.56 | 0.50 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 4.32 | 4.32 | 4.32 | 0.50 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 4.01 | 4.01 | 4.01 | 0.60 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.55 | 4.55 | 4.55 | 0.50 | 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.

Frequency Response of E-Field

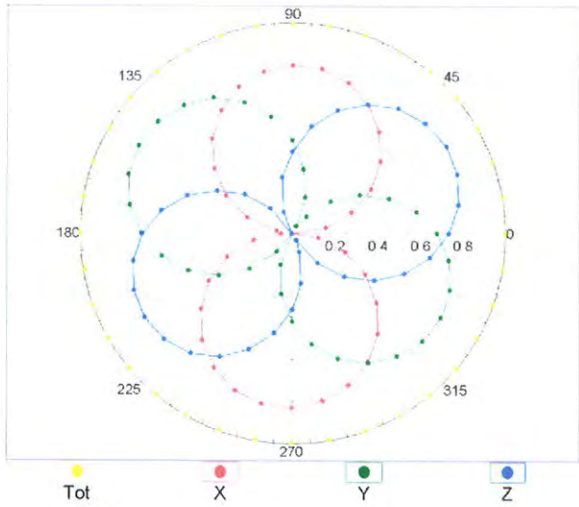
(TEM-Cell:ifi110 EXX, Waveguide: R22)



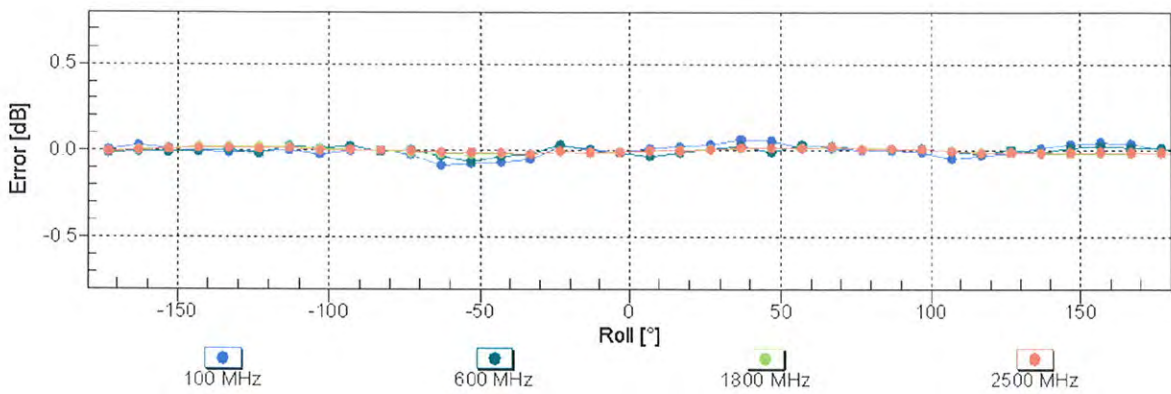
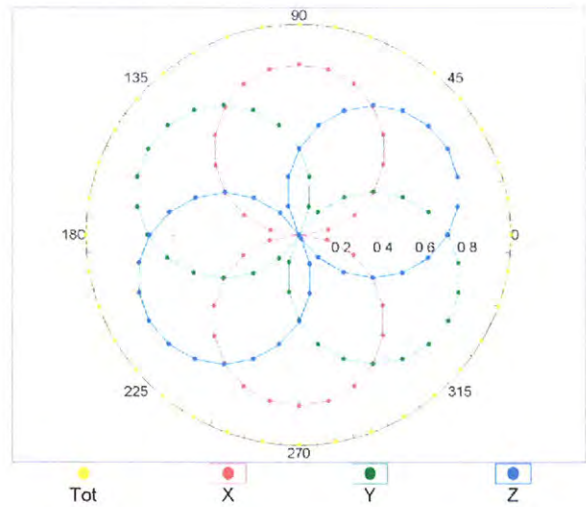
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz, TEM

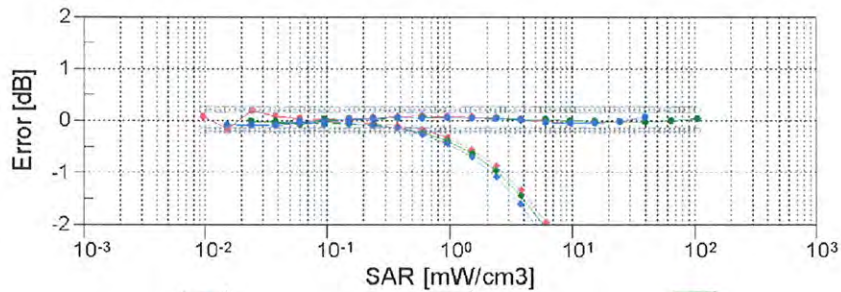
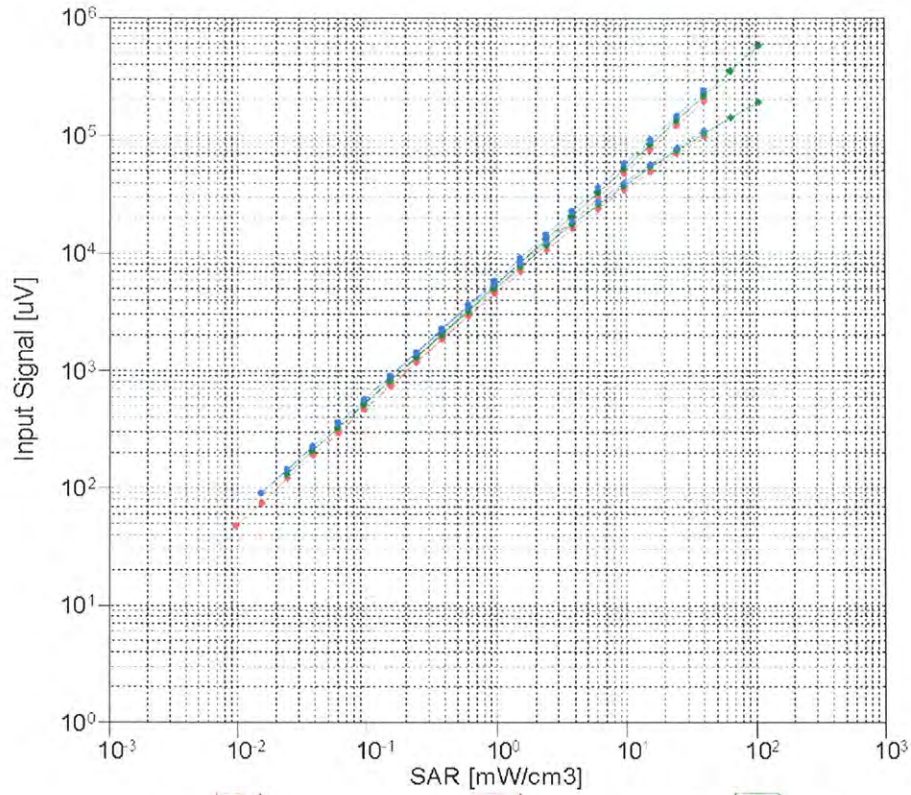


f=1800 MHz, R22



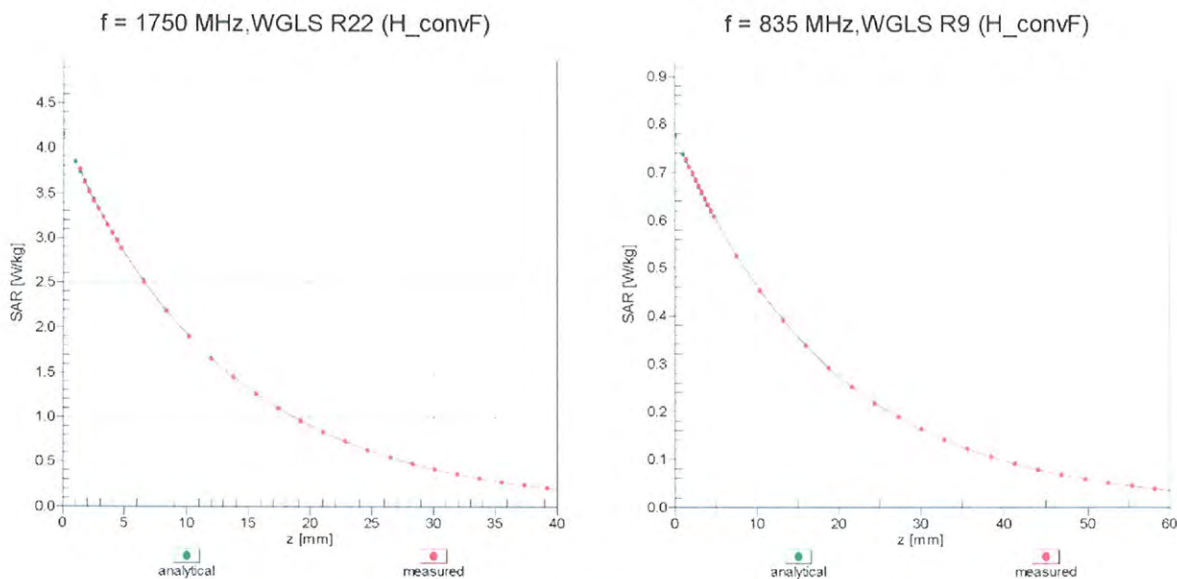
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

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

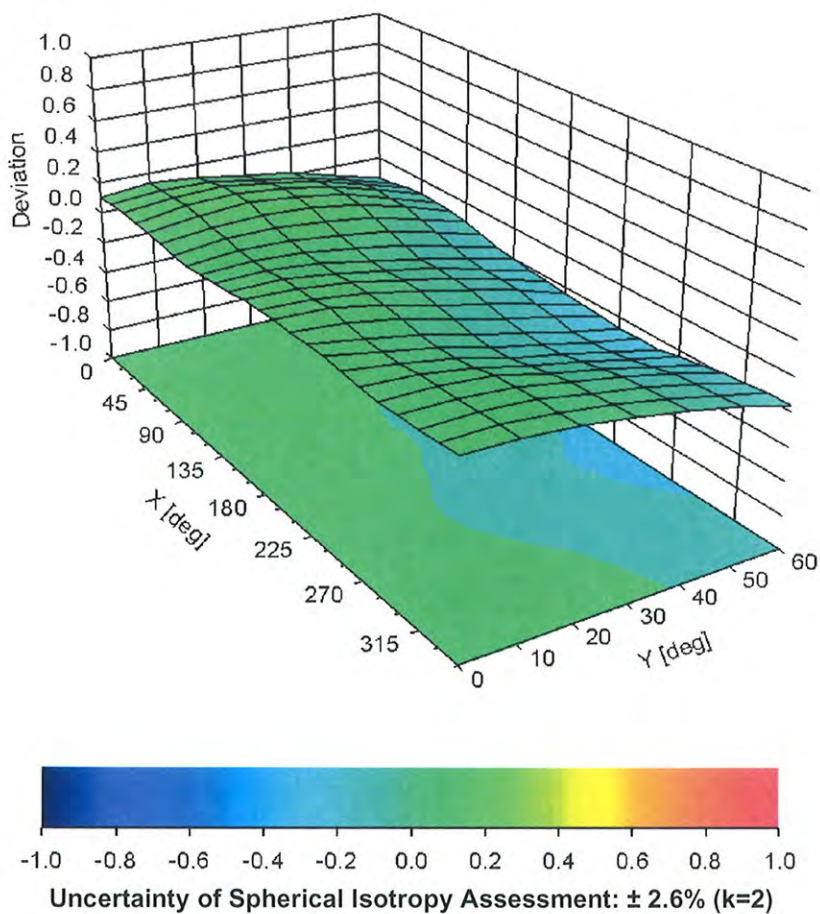


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Air Error (ϕ, ϑ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

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 |



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Accreditation No.: **SCS 108**

Client **B.V. ADT (Auden)**

Certificate No: **EX3-3800_Aug11**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3800**

Calibration procedure(s) **QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4
Calibration procedure for dosimetric E-field probes**

Calibration date: **August 5, 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 | 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 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 Bornholt | Function R&D Director | Signature |
| | | | Issued: August 8, 2011 |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. | | | |



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Accreditation No.: **SCS 108**

The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

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., $\vartheta = 0$ 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
- 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 $\vartheta = 0$ ($f \leq 900$ 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(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}; VR_{x,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.

Probe EX3DV4

SN:3800

Manufactured: April 5, 2011
Calibrated: August 5, 2011

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3800

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|---------------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.42 | 0.58 | 0.55 | $\pm 10.1 \%$ |
| DCP (mV) ^B | 100.6 | 96.7 | 98.8 | |

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 | 102.6 | $\pm 3.0 \%$ |
| | | | Y | 0.00 | 0.00 | 1.00 | 124.9 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 120.1 | |

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

^A The uncertainties of NormX,Y,Z do not affect the E²-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.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3800

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) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750 | 41.9 | 0.89 | 9.02 | 9.02 | 9.02 | 0.15 | 1.41 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 8.70 | 8.70 | 8.70 | 0.24 | 1.03 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 8.51 | 8.51 | 8.51 | 0.13 | 1.52 | ± 12.0 % |
| 1640 | 40.3 | 1.29 | 7.95 | 7.95 | 7.95 | 0.15 | 1.37 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 7.79 | 7.79 | 7.79 | 0.13 | 1.56 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.46 | 7.46 | 7.46 | 0.45 | 0.76 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 6.71 | 6.71 | 6.71 | 0.32 | 0.89 | ± 12.0 % |

^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.

DASY/EASY - Parameters of Probe: EX3DV4- SN:3800

Calibration Parameter Determined in Body Tissue Simulating Media

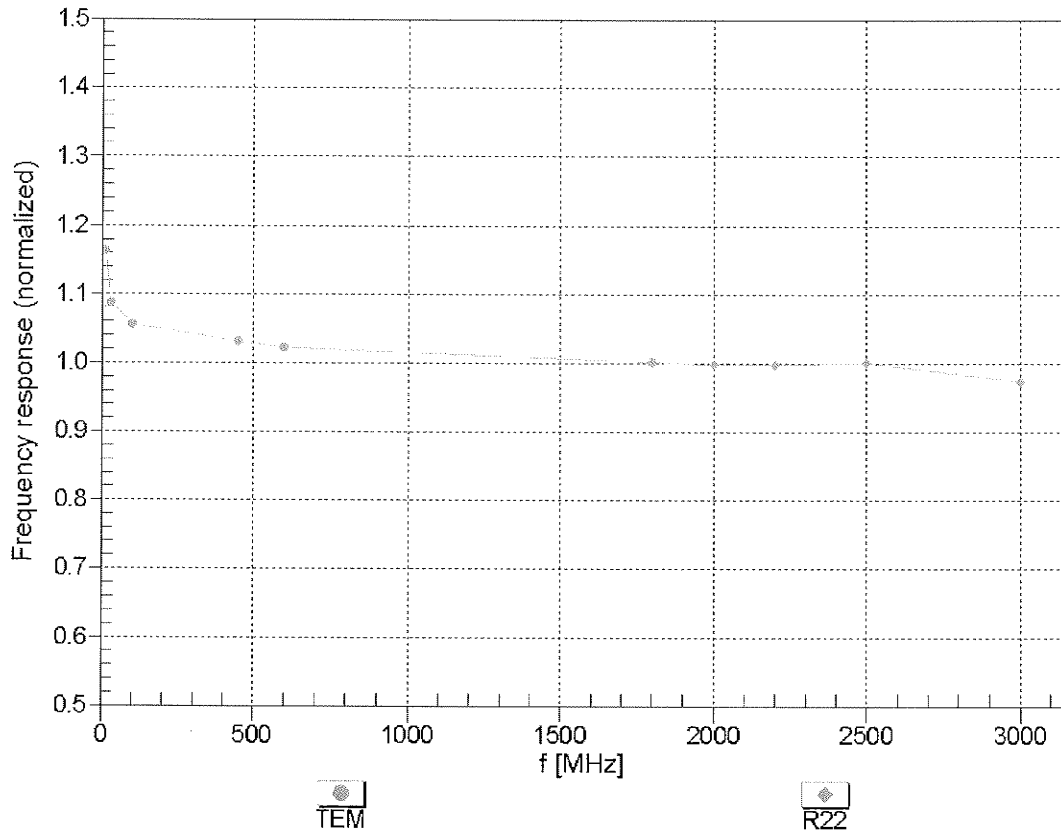
| f (MHz) ^C | Relative Permittivity ^F | Conductivity (S/m) ^F | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|-------|------------|-------------|
| 750 | 55.5 | 0.96 | 9.34 | 9.34 | 9.34 | 0.10 | 2.61 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 8.94 | 8.94 | 8.94 | 0.11 | 2.46 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 8.67 | 8.67 | 8.67 | 0.13 | 2.08 | ± 12.0 % |
| 1640 | 53.8 | 1.40 | 8.07 | 8.07 | 8.07 | 0.16 | 1.57 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 7.43 | 7.43 | 7.43 | 0.15 | 1.76 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 6.97 | 6.97 | 6.97 | 0.13 | 1.56 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 6.75 | 6.75 | 6.75 | 0.80 | 0.53 | ± 12.0 % |

^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.

Frequency Response of E-Field

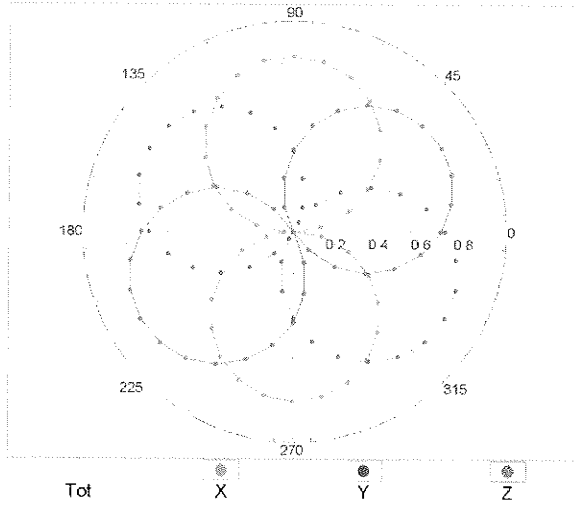
(TEM-Cell:ifi110 EXX, Waveguide: R22)



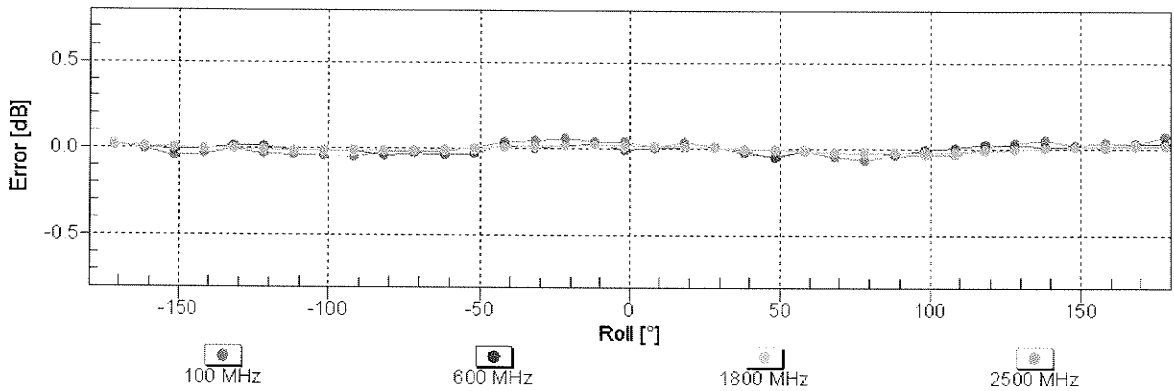
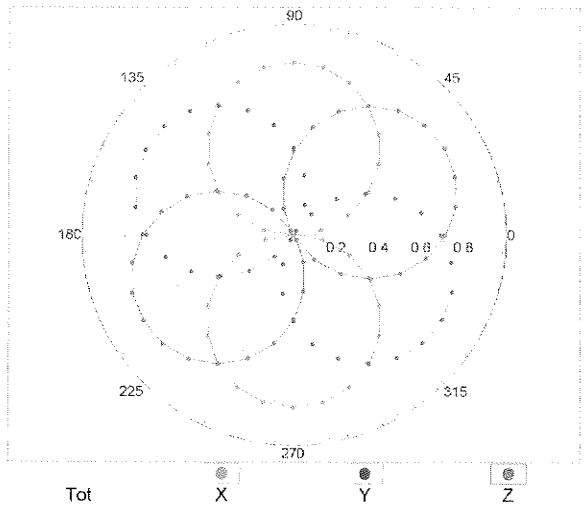
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM

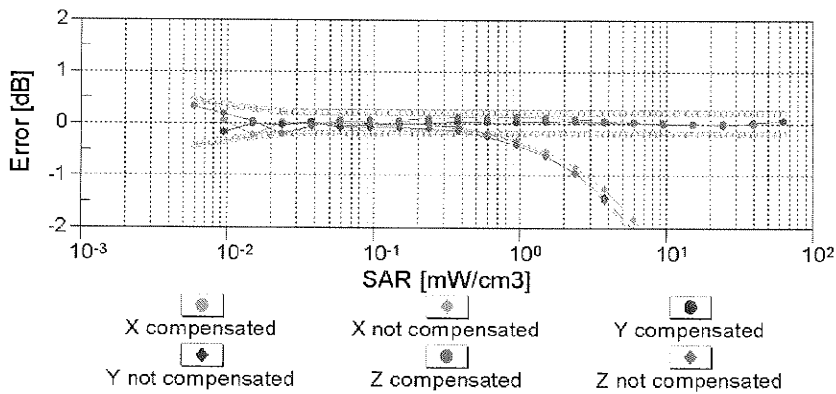
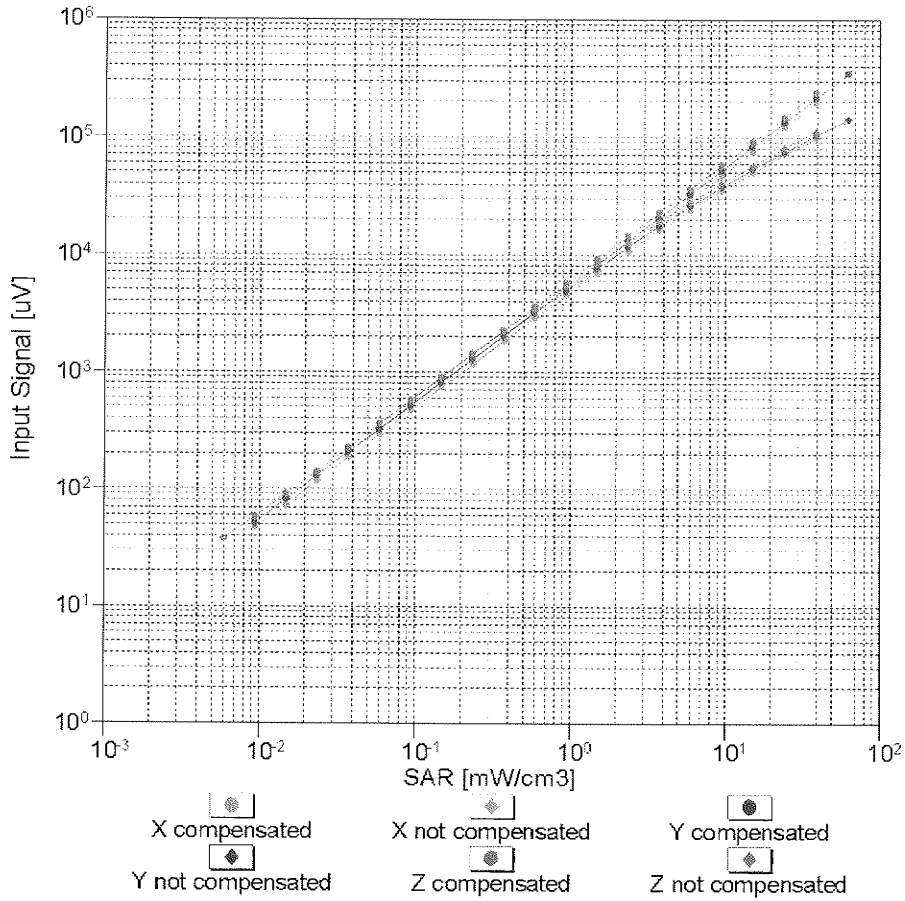


f=1800 MHz,R22



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

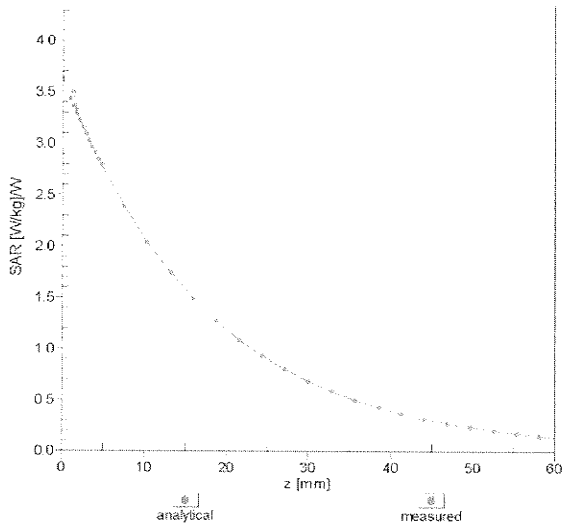
Dynamic Range $f(SAR_{head})$ (TEM cell , $f = 900$ MHz)



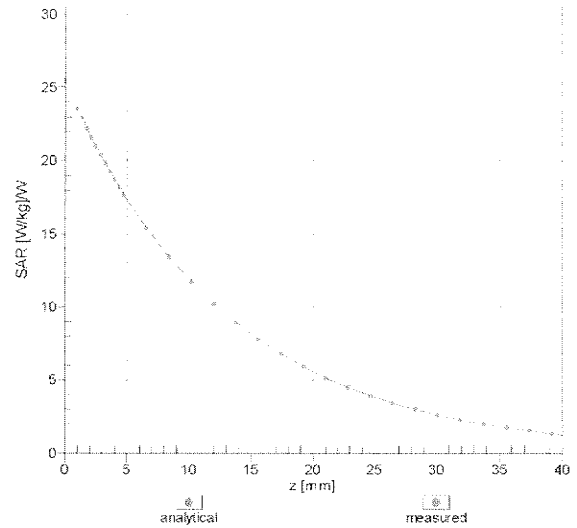
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment

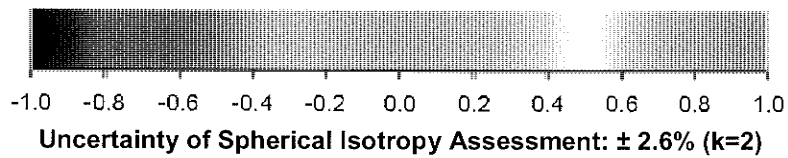
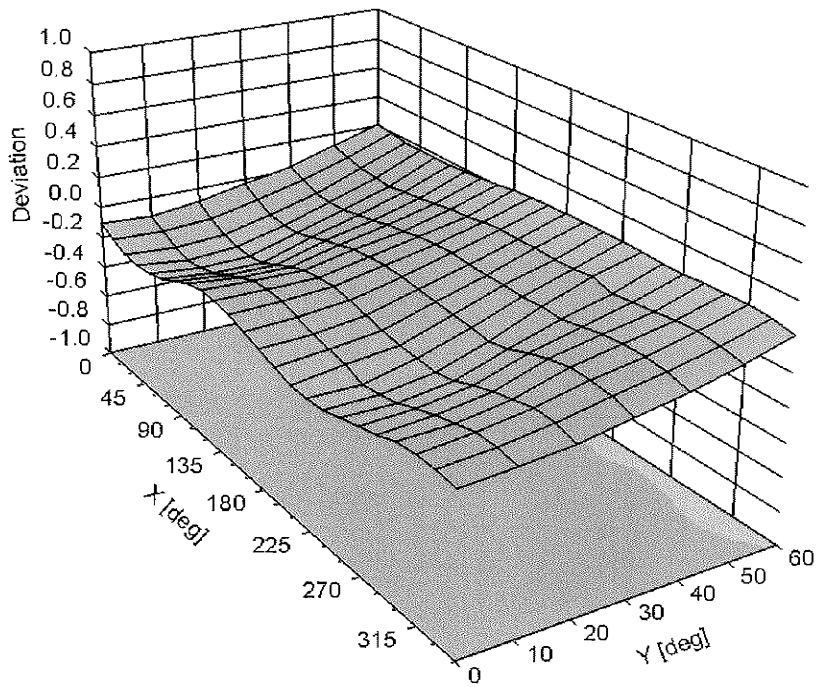
f = 900 MHz, WGLS R9 (H_convF)



f = 1750 MHz, WGLS R22 (H_convF)



Deviation from Isotropy in Liquid Error (ϕ, ϑ), f = 900 MHz



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3800

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 |



D3: DAE



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **BV-ADT (Auden)**

Certificate No: **DAE3-579_Sep10**

CALIBRATION CERTIFICATE

Object **DAE3 - SD 000 D03 AA - SN: 579**

Calibration procedure(s) **QA CAL-06.v22
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **September 20, 2010**

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278 | 1-Oct-09 (No: 9055) | Oct-10 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 07-Jun-10 (in house check) | In house check: Jun-11 |

| | Name | Function | Signature |
|----------------|-------------------|--------------|-----------|
| Calibrated by: | Dominique Steffen | Technician | |
| Approved by: | Fin Bomholt | R&D Director | |

Issued: September 20, 2010

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Accreditation No.: **SCS 108**

Glossary

DAE data 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 as documented in the Appendix 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:* Typical value for information: 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 = 6.1 μ V, 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 | 404.327 \pm 0.1% (k=2) | 404.379 \pm 0.1% (k=2) | 404.160 \pm 0.1% (k=2) |
| Low Range | 3.98675 \pm 0.7% (k=2) | 3.99301 \pm 0.7% (k=2) | 3.94834 \pm 0.7% (k=2) |

Connector Angle

| | |
|---|-------------------------------|
| Connector Angle to be used in DASY system | 358.0 \circ \pm 1 \circ |
|---|-------------------------------|

Appendix

1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|------------|---------|---------------------------|------------------------------|-----------|
| Channel X | + Input | 200003.9 | 0.96 | 0.00 |
| Channel X | + Input | 20003.19 | 3.09 | 0.02 |
| Channel X | - Input | -19994.55 | 4.75 | -0.02 |
| Channel Y | + Input | 199992.4 | -0.09 | -0.00 |
| Channel Y | + Input | 19999.51 | 0.41 | 0.00 |
| Channel Y | - Input | -19997.22 | 3.18 | -0.02 |
| Channel Z | + Input | 200002.0 | 0.91 | 0.00 |
| Channel Z | + Input | 20001.93 | 2.03 | 0.01 |
| Channel Z | - Input | -19997.58 | 2.82 | -0.01 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|-----------|---------|---------------------------|------------------------------|-----------|
| Channel X | + Input | 2000.0 | 0.02 | 0.00 |
| Channel X | + Input | 199.82 | 0.12 | 0.06 |
| Channel X | - Input | -200.46 | -0.56 | 0.28 |
| Channel Y | + Input | 2000.3 | 0.47 | 0.02 |
| Channel Y | + Input | 199.12 | -0.78 | -0.39 |
| Channel Y | - Input | -201.36 | -1.16 | 0.58 |
| Channel Z | + Input | 1999.9 | -0.07 | -0.00 |
| Channel Z | + Input | 199.18 | -0.72 | -0.36 |
| Channel Z | - Input | -201.47 | -1.47 | 0.73 |

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 | 7.07 | 5.75 |
| | - 200 | -4.60 | -6.25 |
| Channel Y | 200 | 9.48 | 9.62 |
| | - 200 | -10.39 | -10.96 |
| Channel Z | 200 | 8.79 | 8.42 |
| | - 200 | -9.64 | -9.80 |

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 | - | 0.03 | 0.35 |
| Channel Y | 200 | 1.14 | - | 2.31 |
| Channel Z | 200 | 2.01 | 0.80 | - |

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 | 16343 | 16314 |
| Channel Y | 16194 | 16427 |
| Channel Z | 15816 | 16265 |

5. Input Offset Measurement

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

Input 10M Ω

| | Average (μ V) | min. Offset (μ V) | max. Offset (μ V) | Std. Deviation (μ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | -0.70 | -1.94 | 0.80 | 0.49 |
| Channel Y | -1.55 | -2.12 | -0.66 | 0.27 |
| Channel Z | 0.57 | -0.11 | 5.61 | 0.62 |

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

| | Zeroing (kOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 200 | 200 |
| Channel Y | 200 | 200 |
| Channel Z | 200 | 200 |

8. Low Battery Alarm Voltage (Typical values for information)

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

9. Power Consumption (Typical values for information)

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



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **B.V. ADT (Auden)**

Certificate No: **DAE4-861_Aug11**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BJ - SN: 861**

Calibration procedure(s) **QA CAL-06.v23
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **August 29, 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 |
|-------------------------------|--------------------|----------------------------|------------------------|
| Keithley Multimeter Type 2001 | SN: 0810278 | 28-Sep-10 (No:10376) | Sep-11 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 08-Jun-11 (in house check) | In house check: Jun-12 |

| | Name | Function | Signature |
|----------------|-------------------|--------------|-----------|
| Calibrated by: | Dominique Steffen | Technician | |
| Approved by: | Fin Bomholt | R&D Director | |

Issued: August 29, 2011

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Accreditation No.: **SCS 108**

Glossary

DAE data 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 as documented in the Appendix 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:* Typical value for information: 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 = 6.1 μ V, 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 | 404.369 \pm 0.1% (k=2) | 404.758 \pm 0.1% (k=2) | 405.720 \pm 0.1% (k=2) |
| Low Range | 4.01191 \pm 0.7% (k=2) | 4.00807 \pm 0.7% (k=2) | 4.02061 \pm 0.7% (k=2) |

Connector Angle

| | |
|---|-------------------------------------|
| Connector Angle to be used in DASY system | 126.0 $^{\circ}$ \pm 1 $^{\circ}$ |
|---|-------------------------------------|

Appendix

1. DC Voltage Linearity

| High Range | Reading (μV) | Difference (μV) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 200003.7 | 2.18 | 0.00 |
| Channel X + Input | 19998.70 | -2.10 | -0.01 |
| Channel X - Input | -20000.72 | -0.82 | 0.00 |
| Channel Y + Input | 200003.3 | 3.09 | 0.00 |
| Channel Y + Input | 19997.06 | -2.54 | -0.01 |
| Channel Y - Input | -20001.61 | -1.81 | 0.01 |
| Channel Z + Input | 200001.0 | 1.32 | 0.00 |
| Channel Z + Input | 19998.31 | -1.39 | -0.01 |
| Channel Z - Input | -20000.55 | -0.75 | 0.00 |

| Low Range | Reading (μV) | Difference (μV) | Error (%) |
|-------------------|---------------------------|------------------------------|-----------|
| Channel X + Input | 2000.2 | 0.12 | 0.01 |
| Channel X + Input | 200.25 | 0.05 | 0.02 |
| Channel X - Input | -198.30 | 1.80 | -0.90 |
| Channel Y + Input | 2000.4 | 0.44 | 0.02 |
| Channel Y + Input | 198.69 | -1.21 | -0.60 |
| Channel Y - Input | -200.48 | -0.48 | 0.24 |
| Channel Z + Input | 2000.1 | 0.13 | 0.01 |
| Channel Z + Input | 199.88 | -0.22 | -0.11 |
| Channel Z - Input | -201.71 | -1.81 | 0.91 |

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 | 5.00 | 3.52 |
| | - 200 | -2.54 | -4.10 |
| Channel Y | 200 | 0.95 | 1.43 |
| | - 200 | -2.77 | -2.63 |
| Channel Z | 200 | -9.47 | -9.71 |
| | - 200 | 7.61 | 7.59 |

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 | - | 4.12 | -0.79 |
| Channel Y | 200 | 2.04 | - | 4.95 |
| Channel Z | 200 | 1.95 | -0.33 | - |

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 | 15976 | 16003 |
| Channel Y | 16064 | 16134 |
| Channel Z | 16042 | 16211 |

5. Input Offset Measurement

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

Input 10M Ω

| | Average (μ V) | min. Offset (μ V) | max. Offset (μ V) | Std. Deviation (μ V) |
|-----------|--------------------|------------------------|------------------------|---------------------------|
| Channel X | -0.28 | -2.06 | 1.31 | 0.64 |
| Channel Y | -0.44 | -1.89 | 2.45 | 0.60 |
| Channel Z | -1.18 | -2.63 | 1.47 | 0.74 |

6. Input Offset Current

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

7. Input Resistance (Typical values for information)

| | Zeroing (kOhm) | Measuring (MOhm) |
|-----------|----------------|------------------|
| Channel X | 200 | 200 |
| Channel Y | 200 | 200 |
| Channel Z | 200 | 200 |

8. Low Battery Alarm Voltage (Typical values for information)

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

9. Power Consumption (Typical values for information)

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



D4: SYSTEM VALIDATION DIPOLE



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Accreditation No.: **SCS 108**

Client **B.V. ADT (Auden)**

Certificate No: **D2450V2-716_Jan11**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 716**

Calibration procedure(s) **QA CAL-05.v8
Calibration procedure for dipole validation kits**

Calibration date: **January 26, 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 $(22 \pm 3)^\circ\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|-----------------------------|--------------------|-----------------------------------|------------------------|
| Power meter EPM-442A | GB37480704 | 06-Oct-10 (No. 217-01266) | Oct-11 |
| Power sensor HP 8481A | US37292783 | 06-Oct-10 (No. 217-01266) | Oct-11 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 30-Mar-10 (No. 217-01158) | Mar-11 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 30-Mar-10 (No. 217-01162) | Mar-11 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Apr-10 (No. ES3-3205_Apr10) | Apr-11 |
| DAE4 | SN: 601 | 10-Jun-10 (No. DAE4-601_Jun10) | Jun-11 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-09) | In house check: Oct-11 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-10) | In house check: Oct-11 |

| | Name | Function | Signature |
|----------------|----------------------|-----------------------|-----------|
| Calibrated by: | Dimce Iliev | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: January 27, 2011

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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

DASY system configuration, as far as not given on page 1.

| | | |
|------------------------------|---------------------------|-------------|
| DASY Version | DASY5 | V52.6 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom V5.0 | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz \pm 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|----------------------------------|---------------------|----------------|----------------------|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 \pm 0.2) °C | 37.9 \pm 6 % | 1.74 mho/m \pm 6 % |
| Head TSL temperature during test | (20.5 \pm 0.2) °C | ---- | ---- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--|
| SAR measured | 250 mW input power | 13.6 mW / g |
| SAR normalized | normalized to 1W | 54.4 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 54.8 mW / g \pm 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--|
| SAR measured | 250 mW input power | 6.37 mW / g |
| SAR normalized | normalized to 1W | 25.5 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 25.5 mW / g \pm 16.5 % (k=2) |

Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|----------------------------------|-----------------|--------------|------------------|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.5 ± 6 % | 1.96 mho/m ± 6 % |
| Body TSL temperature during test | (20.8 ± 0.2) °C | ---- | ---- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|-----------------------------------|
| SAR measured | 250 mW input power | 13.4 mW / g |
| SAR normalized | normalized to 1W | 53.6 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 53.3 mW / g ± 17.0 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|-----------------------------------|
| SAR measured | 250 mW input power | 6.22 mW / g |
| SAR normalized | normalized to 1W | 24.9 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 24.8 mW / g ± 16.5 % (k=2) |

Appendix

Antenna Parameters with Head TSL

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 55.0 Ω + 2.1 j Ω |
| Return Loss | - 25.7 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 50.1 Ω + 4.4 j Ω |
| Return Loss | - 27.2 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.143 ns |
|----------------------------------|----------|

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

| | |
|-----------------|--------------------|
| Manufactured by | SPEAG |
| Manufactured on | September 10, 2002 |

DASY5 Validation Report for Head TSL

Date/Time: 24.01.2011 13:05:38

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:716

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.75$ mho/m; $\epsilon_r = 38.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

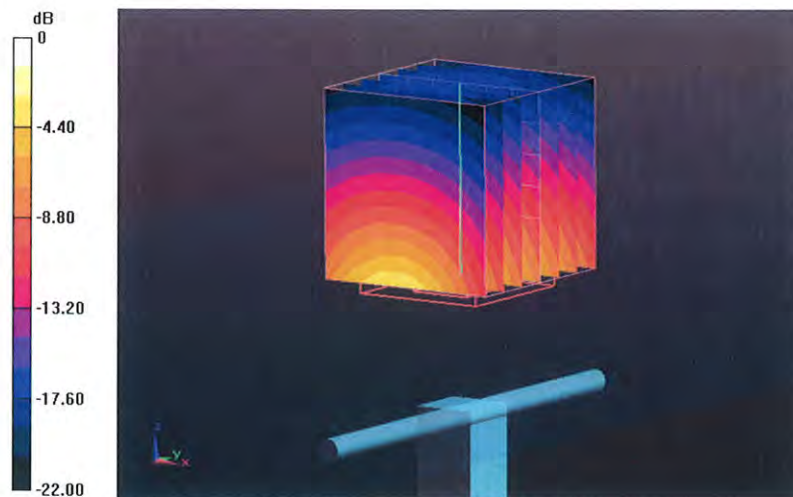
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 103.2 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 27.976 W/kg

SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.37 mW/g

Maximum value of SAR (measured) = 17.366 mW/g

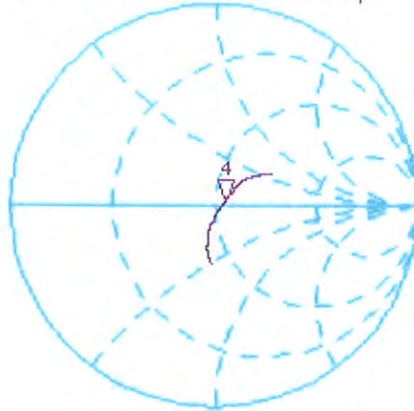


Impedance Measurement Plot for Head TSL

24 Jan 2011 10:25:33

CH1 S11 1 U FS 4: 55.020 Ω 2.0840 Ω 135.38 pF 2 450.000 000 MHz

*
De l
C Δ



Avg
16
↑

CH2 S11 LOG 5 dB/REF -20 dB 4:-25.719 dB 2 450.000 000 MHz

C Δ
A
Avg
16
↑



DASY5 Validation Report for Body TSL

Date/Time: 26.01.2011 13:56:41

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN:716

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: MSL U12 BB

Medium parameters used: $f = 2450$ MHz; $\sigma = 1.97$ mho/m; $\epsilon_r = 52.7$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.31, 4.31, 4.31); Calibrated: 30.04.2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 10.06.2010
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- Measurement SW: DASY52, V52.6.1 Build (408)
- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

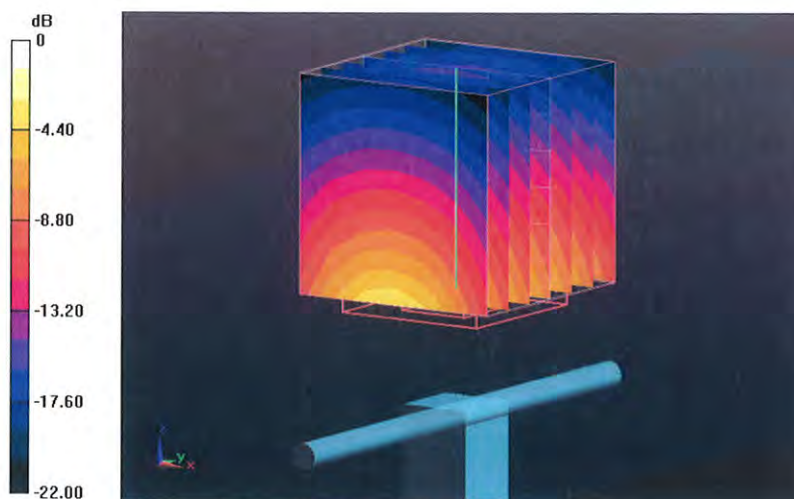
Pin=250 mW /d=10mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7) /Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 97.445 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 28.276 W/kg

SAR(1 g) = 13.4 mW/g; SAR(10 g) = 6.22 mW/g

Maximum value of SAR (measured) = 17.680 mW/g



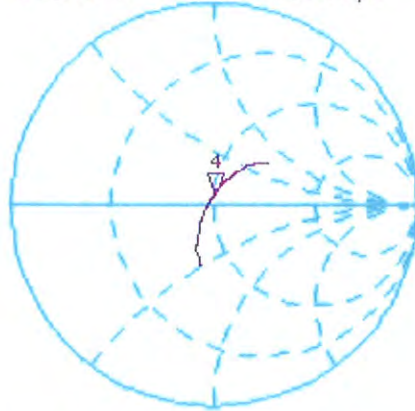
0 dB = 17.680mW/g

Impedance Measurement Plot for Body TSL

26 Jan 2011 10:53:07

[CH1] S11 1 U FS 4: 50.141 Ω 4.3887 Ω 285.09 μH 2 450.000 000 MHz

*
Del
CA



Avg
16
↑

CH2 S11 LOG 5 dB/REF -20 dB 4:-27.158 dB 2 450.000 000 MHz

CA
Avg
16
↑



START 2 250.000 000 MHz

STOP 2 650.000 000 MHz