# SAR TEST REPORT

| | |
|---|---|
| **Equipment Under Test** | Mini-PCIe wireless WAN card INSTALLED IN AN HP HSTNN-I71C SERIES LAPTOP |
| **Model Number** | HSTNN-I71C |
| **Company Name** | Qualcomm Incorporated |
| **Company Address** | 5775 Morehouse Dr.San Diego, CA 92121,U.S.A |
| **Date of Receipt** | 2009.04.21 |
| **Date of Test(s)** | 2009.04.29 |
| **Date of Issue** | 2009.06.22 |

Standards:

**FCC OET Bulletin 65 supplement C,**
**ANSI / IEEE C95.1 , C95.3, IEEE 1528**
**Canada RSS102**

In the configuration tested, the EUT complied with the standards specified above.

**Remarks:**

This report details the results of the testing carried out on one sample, the results contained in this test report do not relate to other samples of the same product. The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report.

This report may only be reproduced and distributed in full. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS Taiwan Electronic & Communication Laboratory or testing done by SGS Taiwan Electronic & Communication Laboratory in connection with distribution or use of the product described in this report must be approved by SGS Taiwan Electronic & Communication Laboratory in writing.

**Tested by : Ricky Huang** **Date : 2009.05.06**
**Asst. Supervisor**

**Approved by : Robert Chang** **Date : 2009.06.22**
**Tech Manager**

# Contents

# 1. General Information

## 1.1 Testing Laboratory

| | |
|---|---|
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## 1.2 Details of Applicant

| | |
|---|---|
| Name | Qualcomm Incorporated |
| Address | 5775 Morehouse Dr.San Diego, CA 92121,U.S.A |

## 1.3 Description of EUT

| | | | | | | |
|---|---|---|---|---|---|---|
| EUT Name | Mini-PCIe wireless WAN card INSTALLED IN AN HP HSTNN-I71C SERIES LAPTOP | | | | | |
| Model number | HSTNN-I71C | | | | | |
| Definition | Production unit | | | | | |
| Mode of Operation | GSM\GPRS\WCDMA\HSDPA\HSUPA\Cellular\US PCS\EVDO band | | | | | |
| Duty Cycle | GPRS(EGPRS) | | | WCDMA/cdma2000/EVDO | | |
| | 1/4 | | | 1 | | |
| Maximum RF Conducted Power(Average) | GPRS 850 | GPRS 1900 | WCDMA B2 | WCDMA B5 | Cellular 850 | UP PCS 1900 |
| | 25.8dbm | 24.2dbm | 24.9dbm | 24.88dbm | 24.87dbm | 24.92dbm |
| TX Frequency range (MHz) | GPRS 850 | GPRS 1900 | WCDMA B2 | WCDMA B5 | Cellular 850 | UP PCS 1900 |
| | 824.2-848.8 | 1850.20-1909.80 | 1852.40-1907.60 | 826.40-846.60 | 824.70-848.31 | 1851.25-1908.75 |

| Channel Number (ARFCN) | GPRS 850 | GPRS 1900 | WCDMA B2 | WCDMA B5 | Cellular 850 | UP PCS 1900 |
|---|---|---|---|---|---|---|
| | 128-251 | 512-810 | 9262-9538 | 4132-4233 | 1013-777 | 25-1175 |
| IMEI CODE | 352354022703909 | | | | | |
| Power Supply | 14.8Vdc re-chargeable battery or 18.5Vdc by AC/DC power adapter | | | | | |
| Antenna position of EUT |  | | | | | |
| Max. SAR Measured (1g) | **0.105W/kg** (At US PCS1900_EVDO mode _ CH1175_ Configuration 1) | | | | | |

**Note:**

**Conducted power:**

| | **CDMA2000 850** | | | **CDMA2000 1900** | | |
|---|---|---|---|---|---|---|
| **Mode\ARFCN** | 1013 | 384 | 777 | 25 | 600 | 1175 |
| RC1 | 24.8 | 24.81 | 24.81 | 24.91 | 24.87 | 24.86 |
| RC3 | 24.76 | 24.84 | 24.81 | 24.88 | 24.86 | 24.82 |
| EVDO Release 0 RTAP-153.5k | 24.78 | 24.87 | 24.8 | 24.92 | 24.89 | 24.87 |
| EVDO Release A RETAP = 4096 | 24.76 | 24.85 | 24.73 | 24.9 | 24.88 | 24.85 |

| | GSM 850 (Average) | | | GSM 1900 (Average) | | |
|---|---|---|---|---|---|---|
| **Mode\ARFCN** | 128 | 190 | 251 | 512 | 661 | 810 |
| GPRS 8 | 22.4 | 22.6 | 22.7 | 21.1 | 21.1 | 20.9 |
| GPRS 10 | 25.5 | 25.7 | 25.8 | 24.2 | 24.1 | 24 |
| EGPRS 8 | 18.3 | 18.6 | 18.7 | 17.6 | 17.6 | 17.5 |
| EGPRS 10 | 21.3 | 21.5 | 21.6 | 20.6 | 20.6 | 20.5 |

| | | WCDMA Band V Channel | | | WCDMA Band II Channel | | |
|---|---|---|---|---|---|---|---|
| **Mode** | **Subtest** | **4132** | **4182** | **4233** | **9262** | **9400** | **9538** |
| Rel99 | R99 | 24.90 | 24.75 | 24.79 | 24.87 | 24.74 | 24.81 |
| Rel6 HSDPA | 1 | 24.88 | 24.71 | 24.73 | 24.88 | 24.64 | 24.76 |
| | 2 | 24.86 | 24.72 | 24.71 | 24.81 | 24.53 | 24.69 |
| | 3 | 24.35 | 24.25 | 24.74 | 24.45 | 24.27 | 24.36 |
| | 4 | 24.27 | 24.26 | 24.72 | 24.25 | 24.24 | 24.37 |
| Rel6 HSUPA | 1 | 24.89 | 24.73 | 24.75 | 24.79 | 24.71 | 24.79 |
| | 2 | 22.85 | 22.68 | 22.72 | 22.91 | 22.79 | 22.84 |
| | 3 | 23.87 | 23.70 | 23.69 | 23.88 | 23.76 | 23.84 |
| | 4 | 22.84 | 22.69 | 23.73 | 22.89 | 22.78 | 22.86 |
| | 5 | 24.86 | 24.73 | 24.72 | 24.84 | 24.70 | 24.71 |

## 1.4 Test Environment

Ambient Temperature: 22±2° C
Tissue Simulating Liquid: 22±2° C

## 1.5 Operation description

The EUT is controlled by using a Radio Communication Tester (R&S CMU200), and the communication between the EUT and the tester is established by air link. Measurements are performed respectively on the lowest, middle and highest channels of the operating band(s). The EUT is set to maximum power level during all tests, and at the beginning of each test the battery is fully charged.

Value of Crest Factors are 4.1 for GPRS mode (multi-slot=2) and 1 for WCDMA & CDMA 2000 were used for SAR testing according to the nature of the EUT.
The test configuration tested at the low, middle and high frequency channels, and then test of set in highest power with 1 configuration:

Configuration 1: Bottom side of the Notebook is paralleled with flat phantom, open the panel with 90 degrees, bottom side is contact with flat phantom. ( Appendix-Fig.3 & Fig.4)

For Cellular band , we tested the conducted power under all modes (GSM/GPRS/EGPRS/ WCDMA/HSDPA/HSUPA/cdma2000/EVDO), and found that the highest power happens on GPRS mode. And for US PCS band , we also tested the conducted power under all modes (GSM/GPRS/EGPRS/WCDMA/ HSDPA/HSUPA/cdma2000/EVDO), and found that the highest power happens on EVDO mode. For engineer's reasonal judgement, we can choose the operation modes with highest conduct power and measure the SAR. Since SAR value of other modes will not over the SAR of this mode.
Due to WWAN/main-to-WLAN/Aux antenna separation distance is > 5 cm, the sum of individual 1-g SAR value is used to assess simultaneous SAR requirement. The highest 1-g SAR for WLAN is 0.119 W/kg and the highest 1-g SAR for WWAN/main is 0.105 W/kg. The sum of 1-g for simultaneous transmitting WLAN and WWAN antenna pair is 0.119+0.105 = 0.22 W/kg < 1.6 W/kg. According to KDB616217 Simultaneous SAR evaluation is not required.

## 1.6 The SAR Measurement System

A photograph of the SAR measurement System is given in Fig. a. This SAR Measurement System uses a Computer-controlled 3-D stepper motor system ( SPEAG DASY 4 professional system ). A Model EX3DV3 field probe is used to determine the internal electric fields. The SAR can be obtained from the equation SAR= $\sigma (|Ei|^2)/ \rho$ where σ and ρ are the conductivity and mass density of the tissue-simulant.
The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli RX family) with controller, teach pendant and software. An arm extension is for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector

system.

- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc.

The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

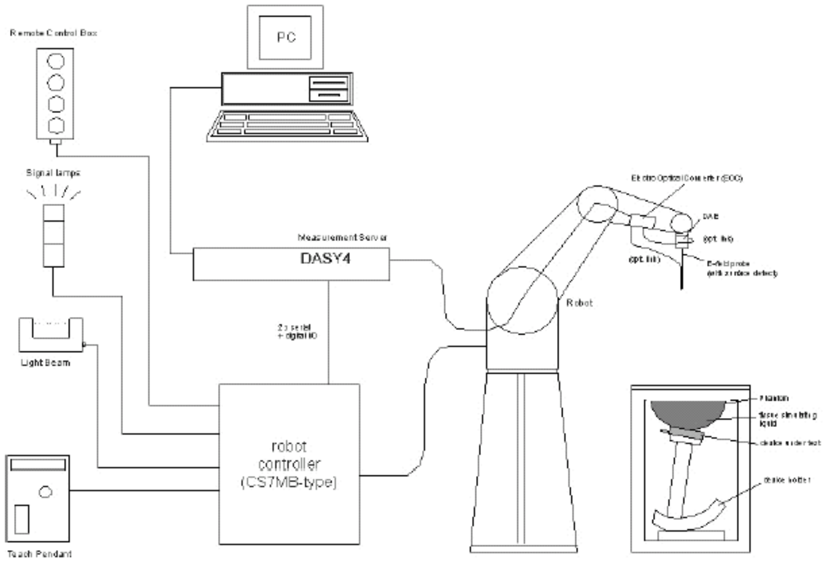


Fig.a The block diagram of SAR system

- The Electro-optical converter (EOC) performs the conversion between optical and electrical of the signals for the digital communication to the DAE and for the analog signal from the optical surface detection. The EOC is connected to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
  - A computer operating Windows 2000 or Windows XP.
  - DASY4 software.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
  - The SAM twin phantom enabling testing left-hand and right-hand usage.

- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

## 1.7 System Components

### EX3DV3 E-Field Probe

| | | |
|---|---|---|
| Construction | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |  |
| Calibration | Basic Broad Band Calibration in air<br>Conversion Factors (CF) for HSL850 & 1900 MHZ Additional CF for other liquids and frequencies upon request | |
| 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)<br>± 0.5 dB in tissue material (rotation normal to probe axis) | |
| Dynamic Range | 10 µW/g to > 100 mW/g<br>Linearity: ± 0.2 dB (noise: typically < 1 µW/g) | |
| Dimensions | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>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%. | |


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**SAM PHANTOM V4.0C**

| | |
|---|---|
| Construction | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-200X, CENELEC 50361 and IEC 62209.<br>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 | Approx. 25 liters |
| Dimensions | Height: 251 mm;<br>Length: 1000 mm;<br>Width: 500 mm |

**DEVICE HOLDER**

| | |
|---|---|
| Construction | In combination with the Twin SAM Phantom V4.0/V4.0C or Twin SAM, the Mounting Device (made from POM) enables the rotation of the mounted transmitter in spherical coordinates, whereby the rotation point is the ear opening. The devices can be easily and accurately positioned according to IEC, IEEE, CENELEC, FCC or other specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom). |

Device Holder



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## 1.8 SAR System Verification

The microwave circuit arrangement for system verification is sketched in Fig. b. The daily system accuracy verification occurs within the flat section of the SAM phantom. A SAR measurement was performed to see if the measured SAR was within +/- 5% from the target SAR values. These tests were done at 850&1900 MHz. The tests were conducted on the same days as the measurement of the DUT. The obtained results from the system accuracy verification are displayed in the table 1 (SAR values are normalized to 1W forward power delivered to the dipole). During the tests, the ambient temperature of the laboratory was in the range 22.1°C, the relative humidity was in the range 62% and the liquid depth above the ear reference points was above 15 cm in all the cases. It is seen that the system is operating within its specification, as the results are within acceptable tolerance of the reference values.

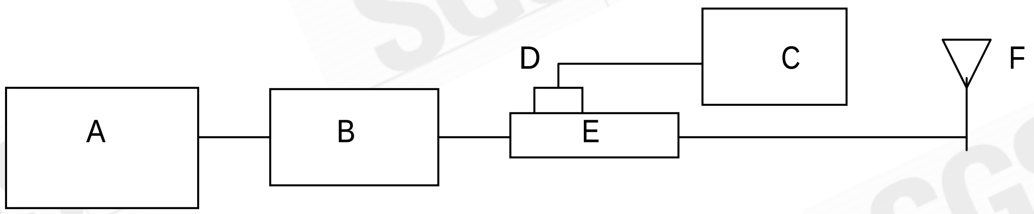
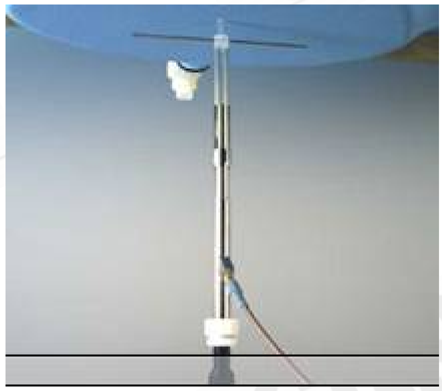



Fig.b The block diagram for SAR system verification

A. Agilent Model 8648D Signal Generator
B. Mini circuits Model ZHL-42 Amplifier
C. Agilent Model E4416A Power Meter
D. Agilent Model 8481H Power Sensor
E. Agilent Model 778D Dual directional Coupling
F. Reference dipole antenna



Photograph of the dipole Antenna

| Validation Kit | Frequency Hz | Target SAR (1g) (Pin=250mW) | Measured SAR (1g) | Measured Date |
|---|---|---|---|---|
| D835V2 S/N: 4d063 | 850 MHz (Body) | 2.44m W/g | 2.33m W/g | 2009-04-29 |
| D1900V2 S/N: 5d018 | 1900 MHz (Body) | 9.6m W/g | 9.33m W/g | 2009-04-29 |


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Table 1. Results of system validation

## 1.9 Tissue Simulant Fluid for the Frequency Band

The dielectric properties for this body-simulant fluid were measured by using the HP Model 85070D Dielectric Probe (rates frequency band 200 MHz to 20 GHz) in conjunction with HP 8753D Network Analyzer (30 KHz-6000 MHz ) by using a procedure detailed in Section V.

All dielectric parameters of tissue simulates were measured within 24 hours of SAR measurements. The depth of the tissue simulant in the ear reference point of the phantom was 15cm±5mm during all tests. (Fig .2)

| Frequency (MHz) | Tissue type | Measurement date/ Limits | Dielectric Parameters | | |
|---|---|---|---|---|---|
| | | | ρ | σ (S/m) | Simulated Tissue Temperature(° C) |
| 850 | Body | Measured, 2009.04.29 | 54 | 0.957 | 21.7 |
| | | Recommended Limits | 50.73-56.07 | 0.94-1.04 | 20-24 |
| 1900 | Body | Measured, 2009.04.29 | 51 | 1.58 | 21.7 |
| | | Recommended Limits | 49.4-54.6 | 1.46-1.62 | 20-24 |

Table 2. Dielectric Parameters of Tissue Simulant Fluid

The composition of the body tissue simulating liquid is:

| Ingredient | 850MHz (Body) | 1900MHz (Body) |
|---|---|---|
| DGMBE | X | 300.67g |
| Water | 631.68 g | 716.56 g |
| Salt | 11.72 g | 4.0 g |
| Preventol D-7 | 1.2 g | X |
| Cellulose | X | X |
| Sugar | 600 g | X |
| Total amount | 1 L (1.0kg) | 1 L (1.0kg) |

Table 3. Recipes for tissue simulating liquid


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## 1.10 EVALUATION PROCEDURES

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 1 g and 10 g 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.

In the Area Scan, the gradient of the interpolation function is evaluated to find all the extreme of the SAR distribution. The uncertainty on the locations of the extreme is less than 1/20 of the grid size. Only local maximum within –2 dB of the global maximum are searched and passed for the Cube Scan measurement. In the Cube Scan, the interpolation function is used to extrapolate the Peak SAR from the lowest measurement points to the inner phantom surface (the extrapolation distance). The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5mm.

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 7x7x7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements.

The measured volume of 30x30x30mm 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 the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the 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.

## 1.11 Test Standards and Limits

According to FCC 47CFR §2.1093(d) The limits to be used for evaluation are based generally on criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (''SAR'') in Section 4.2 of ''IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz,'' ANSI/IEEE C95.1–1992, Copyright 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in ''Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields,'' NCRP Report No. 86, Section 17.4.5. Copyright NCRP, 1986, Bethesda, Maryland 20814.

SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards. The criteria to be used are specified in paragraphs (d)(1) and (d)(2) of this section and shall apply for portable devices transmitting in the frequency range from 100 kHz to 6 GHz. Portable devices that transmit at frequencies above 6 GHz are to be evaluated in terms of the MPE limits specified in § 1.1310 of this chapter. Measurements and calculations to demonstrate compliance with MPE field strength or power density limits for devices operating above 6 GHz should be made at a minimum distance of 5 cm from the radiating source.

(1) Limits for Occupational/Controlled exposure: 0.4 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 8 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 20 W/kg, as averaged over an 10 grams of tissue (defined as a tissue volume in the shape of a cube).

(2) Occupational/Controlled limits apply when persons are exposed as a consequence of their employment provided these persons are fully aware of and exercise control over their exposure. Awareness of exposure can be accomplished by use of warning labels or by specific training or education through appropriate means, such as an RF safety program in a work environment.

(3) Limits for General Population/Uncontrolled exposure: 0.08 W/kg as averaged over the whole-body and spatial peak SAR not exceeding 1.6 W/kg as averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube). Exceptions are the hands, wrists, feet and ankles where the spatial peak SAR shall not exceed 4 W/kg, as averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube). General Population/Uncontrolled limits apply when the general public may be exposed, or when persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or do not exercise control over their exposure. Warning labels placed on consumer devices such as cellular telephones will not be sufficient reason to allow these devices to be evaluated subject to limits for occupational/controlled exposure in paragraph (d)(1) of this section.(Table .4)

| **Human Exposure** | **Uncontrolled Environment General Population** | **Controlled Environment Occupational** |
|---|---|---|
| **Spatial Peak SAR** (Brain) | 1.60 m W/g | 8.00 m W/g |
| **Spatial Average SAR** (Whole Body) | 0.08 m W/g | 0.40 m W/g |
| **Spatial Peak SAR** (Hands/Feet/Ankle/Wrist) | 4.00 m W/g | 20.00 m W/g |

Table .4 RF exposure limits

Notes:

1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

## 2. Summary of Results

### GSM (GPRS)850

**Configuration 1:** Bottom side of the Notebook is paralleled with flat phantom, open the panel with 90 degrees, bottom side is contact with flat phantom.

| Frequency | Channel | MHz | Conducted Output Power (Average) | Measured(W/kg) 1g | Amb. Temp[˚C] | Liquid Temp[˚C] |
|---|---|---|---|---|---|---|
| 850MHz | 128 | 824.2 | 25.5dbm | 0.047 | 22.1 | 21.7 |
| | 190 | 836.6 | 25.7dbm | 0.044 | 22.1 | 21.7 |
| | 251 | 848.8 | 25.8dbm | 0.046 | 22.1 | 21.7 |

### US PCS1900(EVDO mode)

**Configuration 1:** Bottom side of the Notebook is paralleled with flat phantom, open the panel with 90 degrees, bottom side is contact with flat phantom.

| Frequency | Channel | MHz | Conducted Output Power (Average) | Measured(W/kg) 1g | Amb. Temp[˚C] | Liquid Temp[˚C] |
|---|---|---|---|---|---|---|
| 1900MHz | 25 | 1851.25 | 24.92dbm | 0.070 | 22.1 | 21.7 |
| | 600 | 1880 | 24.89dbm | 0.094 | 22.1 | 21.7 |
| | 1175 | 1908.75 | 24.87dbm | 0.105 | 22.1 | 21.7 |

Note:

SAR measurement results with transmitter at maximum output power.



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# 3. Instruments List

| Manufacturer | Device | Type | Serial number | Date of last calibration |
|---|---|---|---|---|
| Schmid & Partner Engineering AG | Dosimetric E-Field Probe | EX3DV3 | 3526 | Aug.26.2008 |
| Schmid & Partner Engineering AG | 850 &1900 MHz System Validation Dipole | D835V2 | 4d063 | Jun.06.2008 |
| | | D1900V2 | 5d018 | May.22.2008 |
| Schmid & Partner Engineering AG | Data acquisition Electronics | DAE4 | 547 | Jan.20.2009 |
| Schmid & Partner Engineering AG | Software | DASY 4 V4.7 Build 80 | N/A | Calibration not required |
| Schmid & Partner Engineering AG | Phantom | SAM | N/A | Calibration not required |
| Agilent | Network Analyzer | 8753D | 3410A05547 | Mar.31.2009 |
| Agilent | Dielectric Probe Kit | 85070D | US01440168 | Calibration not required |
| Agilent | Dual-directional coupler | 778D | 50313 | Aug.18.2008 |
| Agilent | RF Signal Generator | 8648D | 3847M00432 | May.21.2008 |
| Agilent | Power Sensor | 8481H | MY41091361 | May.20.2008 |
| R&S | Radio Communication Test | CMU200 | 113505 | Sep.03.2008 |

# 4. Measurements

Date/Time: 2009/4/29 02:16:50

## Configuration 1_CH128

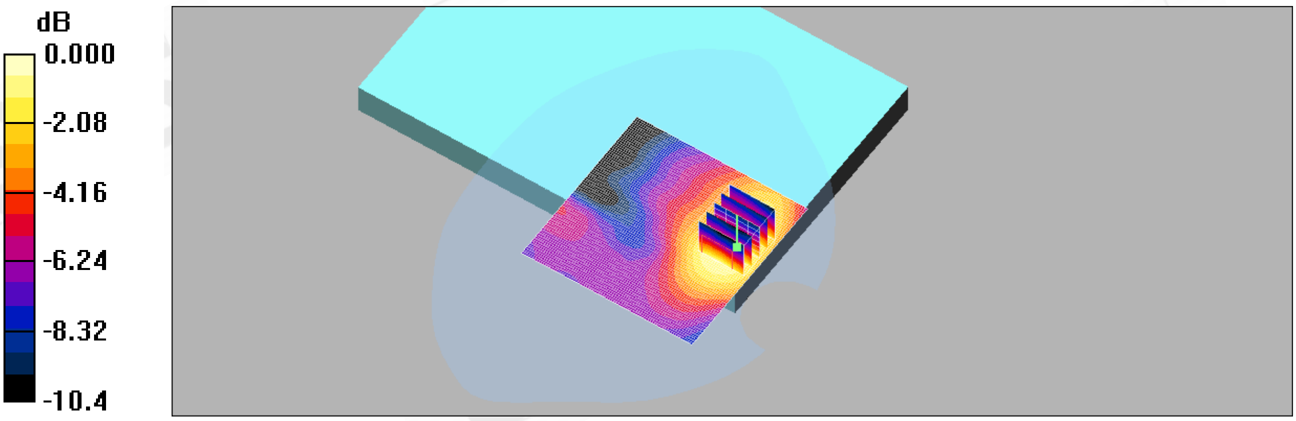
**DUT: HSTNN-I71C;**

Communication System: GSM 850; Frequency: 824.2 MHz;Duty Cycle: 1:4.1
Medium: Muscle 900 MHz Medium parameters used (interpolated): f = 824.2 MHz; σ = 0.941 mho/m; $\varepsilon_r$ = 53.8; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(10.87, 10.87, 10.87); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.049 mW/g
**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.81 V/m; Power Drift = 0.143 dB
Peak SAR (extrapolated) = 0.071 W/kg
**SAR(1 g) = 0.047 mW/g; SAR(10 g) = 0.031 mW/g**
Maximum value of SAR (measured) = 0.051 mW/g




0 dB = 0.051mW/g

## Configuration 1_CH190

**DUT: HSTNN-I71C;**

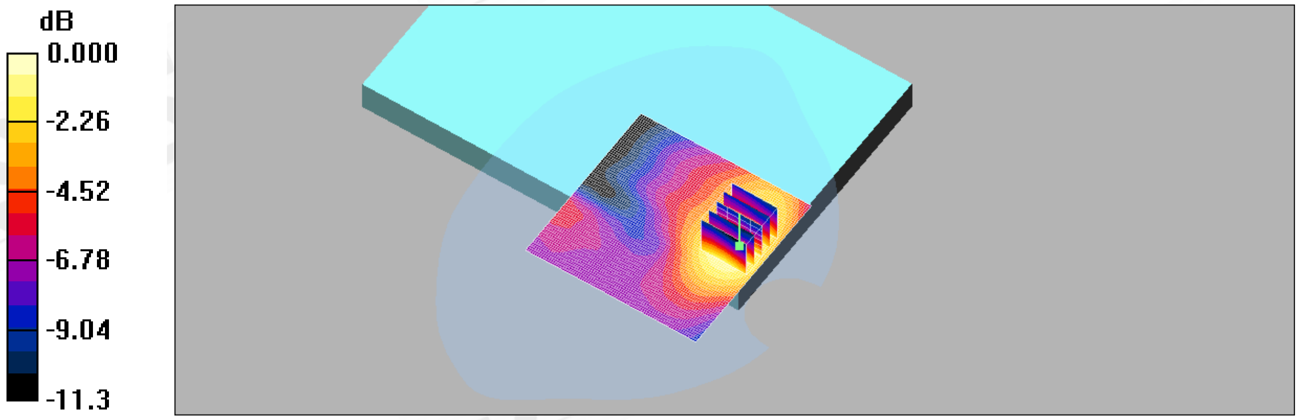
Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:4.1
Medium: Muscle 900 MHz Medium parameters used: f = 837 MHz; $\sigma$ = 0.952 mho/m; $\varepsilon_r$ = 53.7; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(10.87, 10.87, 10.87); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.046 mW/g

**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.60 V/m; Power Drift = 0.175 dB
Peak SAR (extrapolated) = 0.066 W/kg
**SAR(1 g) = 0.044 mW/g; SAR(10 g) = 0.029 mW/g**
Maximum value of SAR (measured) = 0.049 mW/g




0 dB = 0.049mW/g

## Configuration 1_CH251

**DUT: HSTNN-I71C;**

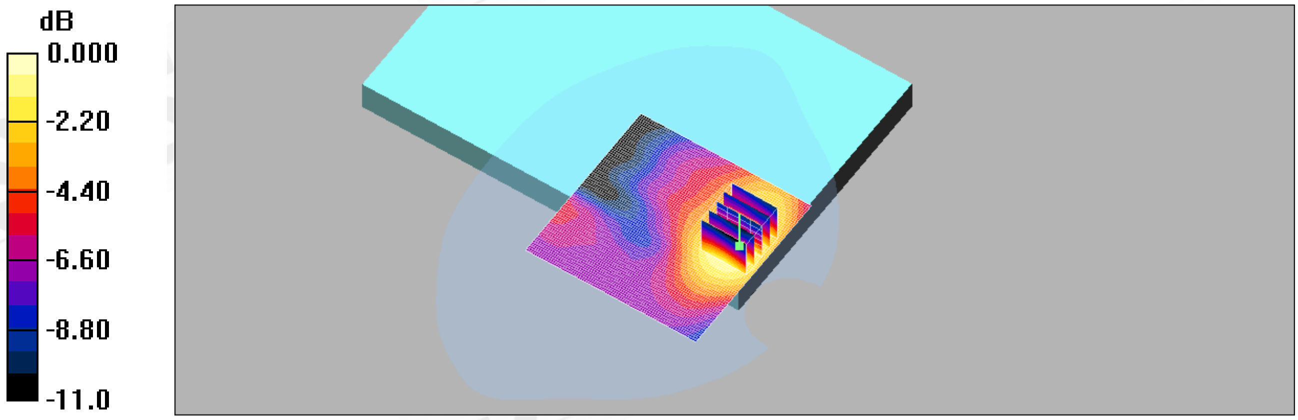
Communication System: GSM 850; Frequency: 848.8 MHz;Duty Cycle: 1:4.1
Medium: Muscle 900 MHz Medium parameters used: f = 849 MHz; σ = 0.964 mho/m; $\varepsilon_r$ = 53.6; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(10.87, 10.87, 10.87); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.047 mW/g

**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.65 V/m; Power Drift = 0.146 dB
Peak SAR (extrapolated) = 0.069 W/kg
**SAR(1 g) = 0.046 mW/g; SAR(10 g) = 0.029 mW/g**
Maximum value of SAR (measured) = 0.050 mW/g




0 dB = 0.050mW/g



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## Configuration 1_CH25_EVDO mode

**DUT: HSTNN-I71C;**

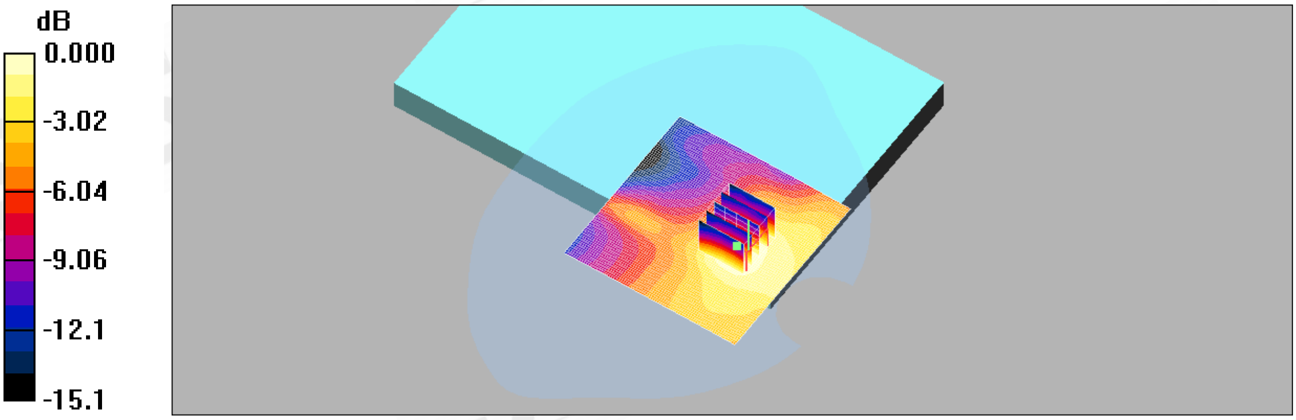
Communication System: CDMA2000; Frequency: 1851.25 MHz;Duty Cycle: 1:1
Medium: M1800 & 1900 Medium parameters used (interpolated): f = 1851.25 MHz; σ = 1.5 mho/m; $\varepsilon_r$ = 51.1; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(9.28, 9.28, 9.28); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.075 mW/g

**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.88 V/m; Power Drift = -0.006 dB
Peak SAR (extrapolated) = 0.110 W/kg
**SAR(1 g) = 0.070 mW/g; SAR(10 g) = 0.044 mW/g**
Maximum value of SAR (measured) = 0.074 mW/g




0 dB = 0.074mW/g

## Configuration 1_CH600_EVDO mode

**DUT: HSTNN-I71C;**

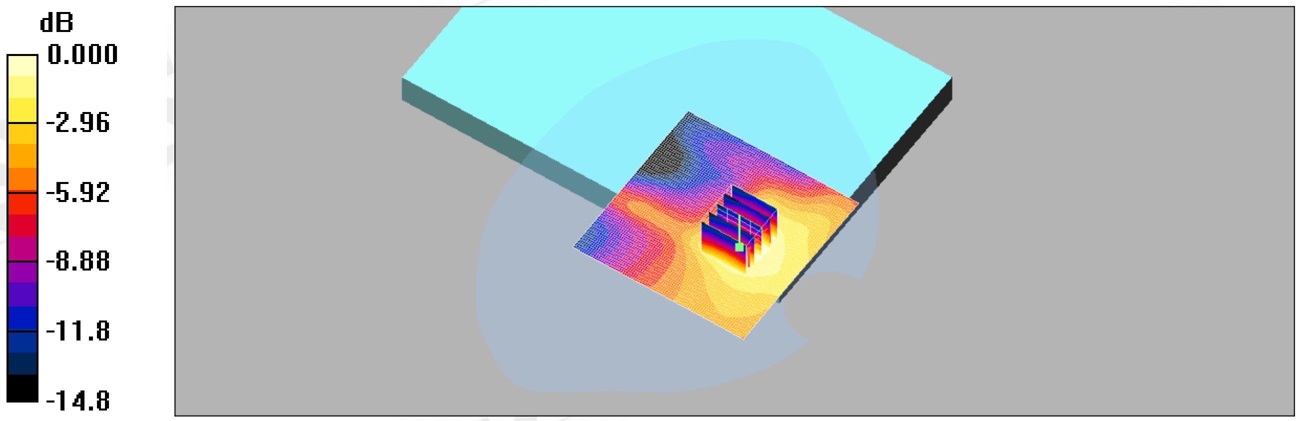
Communication System: CDMA2000; Frequency: 1880 MHz;Duty Cycle: 1:1
Medium: M1800 & 1900 Medium parameters used: f = 1880 MHz; σ = 1.54 mho/m; $\varepsilon_r$ = 51; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(9.28, 9.28, 9.28); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.099 mW/g

**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.29 V/m; Power Drift = 0.135 dB
Peak SAR (extrapolated) = 0.154 W/kg
**SAR(1 g) = 0.094 mW/g; SAR(10 g) = 0.058 mW/g**
Maximum value of SAR (measured) = 0.102 mW/g




0 dB = 0.102mW/g

## Configuration 1_CH1175_EVDO mode

**DUT: HSTNN-I71C;**

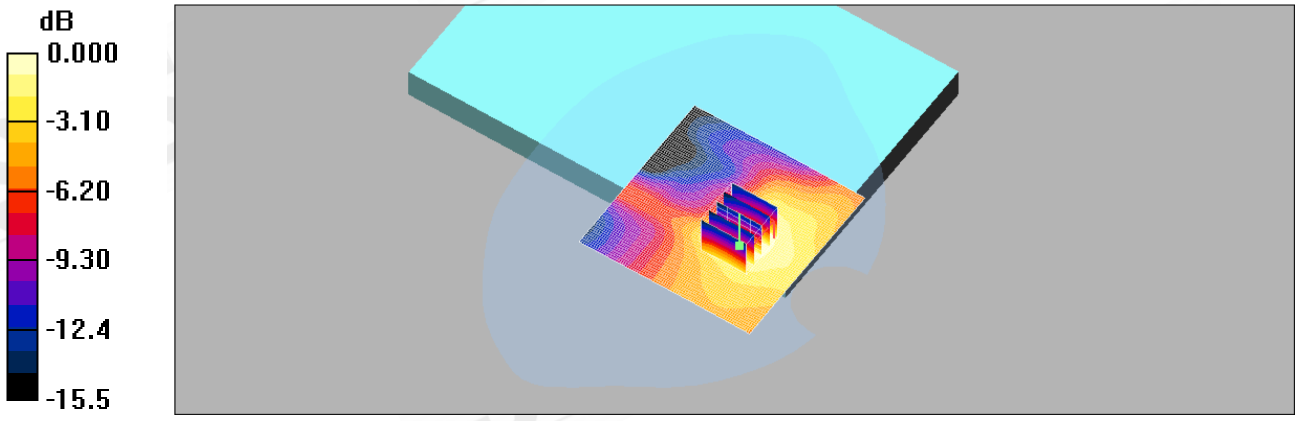
Communication System: CDMA2000; Frequency: 1908.75 MHz;Duty Cycle: 1:1
Medium: M1800 & 1900 Medium parameters used: f = 1909 MHz; σ = 1.59 mho/m; $\varepsilon_r$ = 51.1; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

DASY4 Configuration:

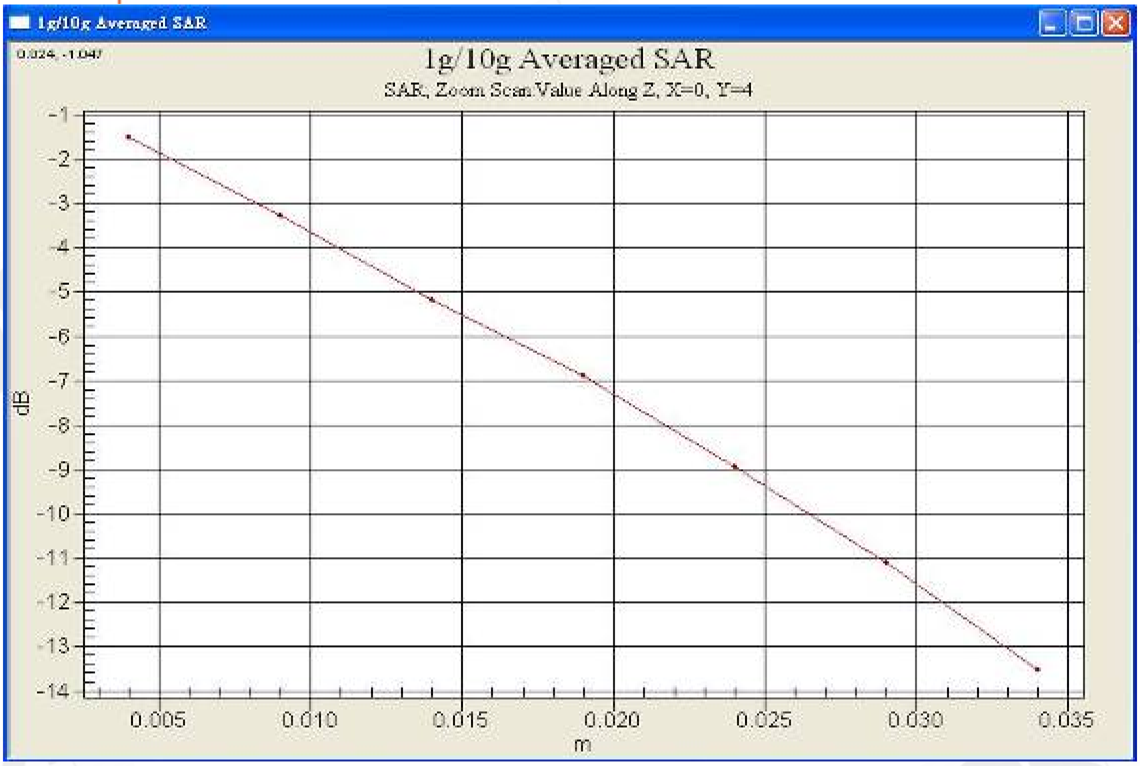
- Probe: EX3DV3 - SN3526; ConvF(9.28, 9.28, 9.28); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**body/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 0.113 mW/g

**body/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.67 V/m; Power Drift = -0.113 dB
Peak SAR (extrapolated) = 0.178 W/kg
**SAR(1 g) = 0.105 mW/g; SAR(10 g) = 0.063 mW/g**
Maximum value of SAR (measured) = 0.113 mW/g




0 dB = 0.113mW/g


1g/10g Averaged SAR
1g/10g Averaged SAR
SAR, Zoom Scan Value Along Z, X=0, Y=4
dB
m
-1
-2
-3
-4
-5
-6
-7
-8
-9
-10
-11
-12
-13
-14
0.005
0.010
0.015
0.020
0.025
0.030
0.035

# 5. SAR System Performance Verification

Date/Time: 2009/4/29 01:03:11

**DUT: Dipole 835 MHz;**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: Muscle 900 MHz Medium parameters used: f = 835 MHz; σ = 0.957 mho/m; $\varepsilon_r$ = 54; ρ = 1000 kg/$m^3$
Phantom section: Flat Section

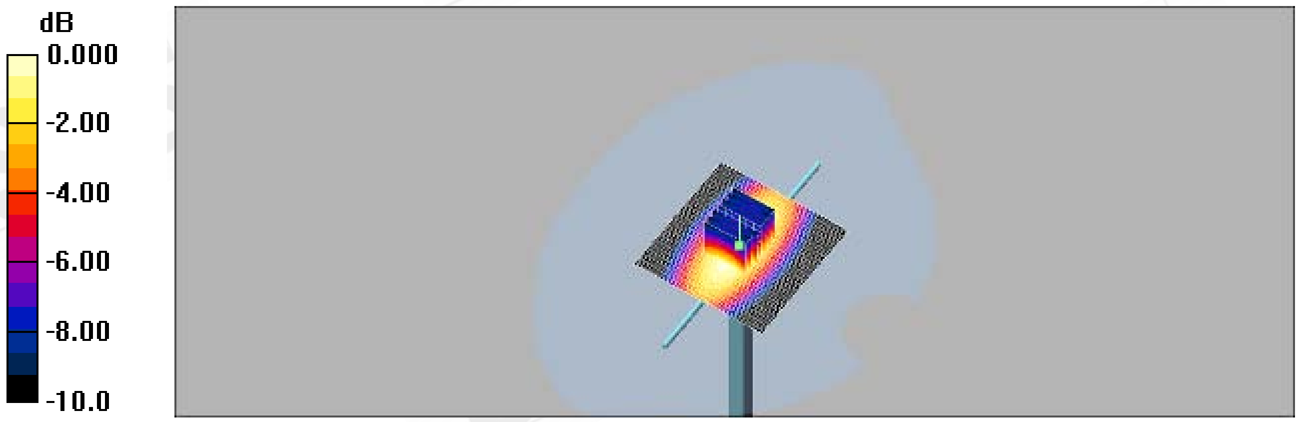
DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(10.87, 10.87, 10.87); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Pin=250mW/Area Scan (61x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.51 mW/g

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.2 V/m; Power Drift = -0.026 dB
Peak SAR (extrapolated) = 3.47 W/kg

**SAR(1 g) = 2.33 mW/g; SAR(10 g) = 1.54 mW/g**
Maximum value of SAR (measured) = 2.52 mW/g




0 dB = 2.52mW/g



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**DUT: Dipole 1900 MHz;**

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: M1800 & 1900 Medium parameters used: f = 1900 MHz; σ = 1.58 mho/m; $\varepsilon_r$ = 51; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

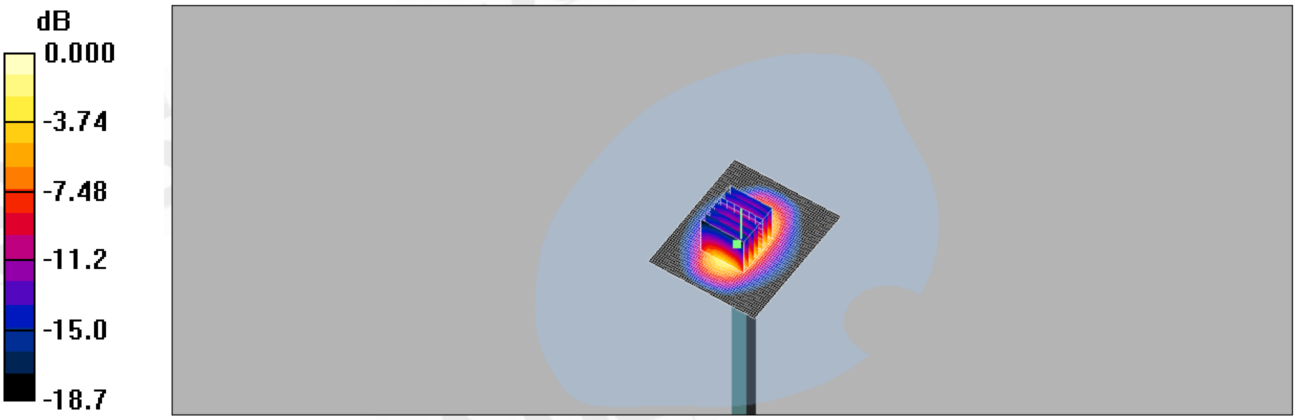
DASY4 Configuration:

- Probe: EX3DV3 - SN3526; ConvF(9.28, 9.28, 9.28); Calibrated: 2008/8/26
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn547; Calibrated: 2009/1/20
- Phantom: SAM1; Type: SAM 4.0; Serial: TP:1419
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

**Pin=250mW/Area Scan (51x61x1):** Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 13.1 mW/g

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.3 V/m; Power Drift = 0.008 dB
Peak SAR (extrapolated) = 17.2 W/kg

**SAR(1 g) = 9.33 mW/g; SAR(10 g) = 4.81 mW/g**
Maximum value of SAR (measured) = 10.4 mW/g




0 dB = 10.4mW/g



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# 6. DAE & Probe Calibration certificate

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

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C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
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**Accreditation No.: SCS 108**

Client **SGS (Auden)**

**Certificate No: DAE4-547_Jan09**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BJ - SN: 547 |
| Calibration procedure(s) | QA CAL-06.v12<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | January 19, 2009 |
| Condition of the calibrated item | In Tolerance |

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Fluke Process Calibrator Type 702 | SN: 6295803 | 30-Sep-08 (No: 7673) | Sep-09 |
| Keithley Multimeter Type 2001 | SN: 0810278 | 30-Sep-08 (No: 7670) | Sep-09 |
| **Secondary Standards** | **ID #** | **Check Date (in house)** | **Scheduled Check** |
| Calibrator Box V1.1 | SE UMS 006 AB 1004 | 06-Jun-08 (in house check) | In house check: Jun-09 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Daniel Hess | Technician | D. Hess |
| Approved by: | Fin Bomholt | R&D Director | i.V. B. [signature] |

Issued: January 20, 2009

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Certificate No: DAE4-547_Jan09 Page 1 of 5

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Engineering AG
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Accreditation No.: **SCS 108**

Client **SGS (Auden)**

Certificate No: **EX3-3526_Aug08**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV3 - SN:3526 |
| Calibration procedure(s) | QA CAL-01.v6, QA CAL-14.v3 and QA CAL-23.v3<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | August 26, 2008 |
| Condition of the calibrated item | In Tolerance |

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter E4419B | GB41293874 | 1-Apr-08 (No. 217-00788) | Apr-09 |
| Power sensor E4412A | MY41495277 | 1-Apr-08 (No. 217-00788) | Apr-09 |
| Power sensor E4412A | MY41498087 | 1-Apr-08 (No. 217-00788) | Apr-09 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 1-Jul-08 (No. 217-00865) | Jul-09 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 31-Mar-08 (No. 217-00787) | Apr-09 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 1-Jul-08 (No. 217-00866) | Jul-09 |
| Reference Probe ES3DV2 | SN: 3013 | 2-Jan-08 (No. ES3-3013_Jan08) | Jan-09 |
| DAE4 | SN: 660 | 3-Sep-07 (No. DAE4-660_Sep07) | Sep-08 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-07) | In house check: Oct-08 |

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

Issued: August 26, 2008

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Certificate No: EX3-3526_Aug08    Page 1 of 9

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Accreditation No.: **SCS 108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

**Methods Applied and Interpretation of Parameters:**

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect the $E^2$-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep (no uncertainty required). DCP does not depend on frequency nor media.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.





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# Probe EX3DV3

## SN:3526

| | |
|---|---|
| Manufactured: | March 19, 2004 |
| Last calibrated: | August 29, 2007 |
| Recalibrated: | August 26, 2008 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)





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EX3DV3 SN:3526 August 26, 2008

# DASY - Parameters of Probe: EX3DV3 SN:3526

## Sensitivity in Free Space[A]

| | | |
|---|---|---|
| NormX | **0.99** ± 10.1% | $\mu V/(V/m)^2$ |
| NormY | **0.81** ± 10.1% | $\mu V/(V/m)^2$ |
| NormZ | **0.89** ± 10.1% | $\mu V/(V/m)^2$ |

## Diode Compression[B]

| | |
|---|---|
| DCP X | **93** mV |
| DCP Y | **94** mV |
| DCP Z | **94** mV |

## Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Please see Page 8.**

## Boundary Effect

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

| Sensor Center to Phantom Surface Distance | | **2.0 mm** | **3.0 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 8.9 | 5.3 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.8 | 0.4 |

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

| Sensor Center to Phantom Surface Distance | | **2.0 mm** | **3.0 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 6.8 | 3.6 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.5 | 0.2 |

## Sensor Offset

Probe Tip to Sensor Center **1.0** mm

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

[A] The uncertainties of NormX,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Page 8).
[B] Numerical linearization parameter: uncertainty not required.




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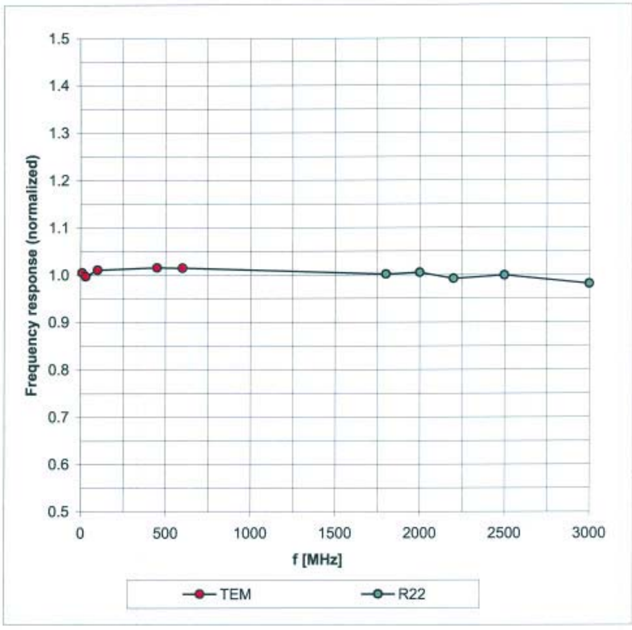
EX3DV3 SN:3526 August 26, 2008

# Frequency Response of E-Field

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




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





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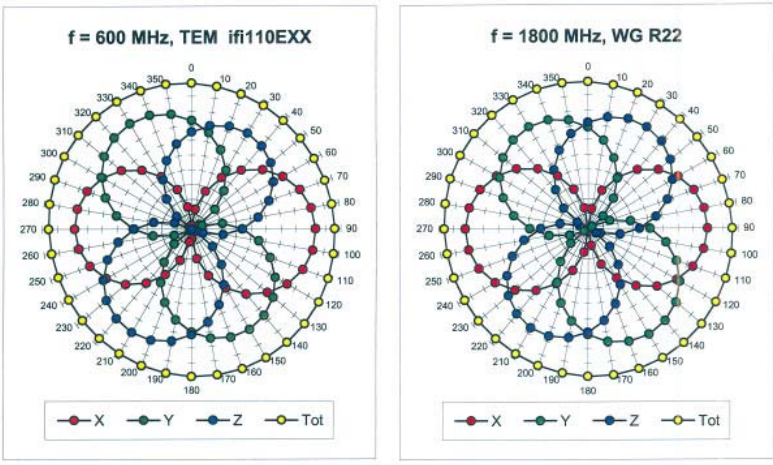
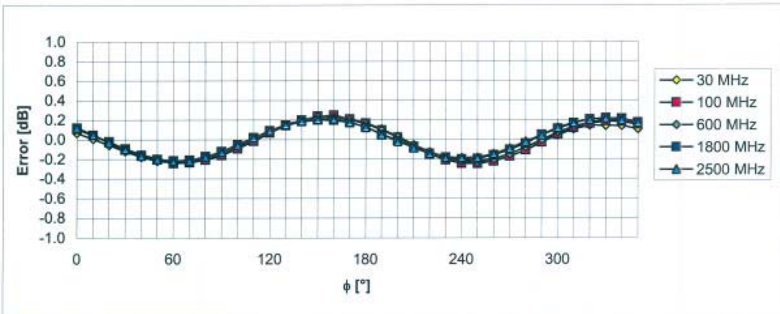
EX3DV3 SN:3526 August 26, 2008

# Receiving Pattern (ϕ), ϑ = 0°




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





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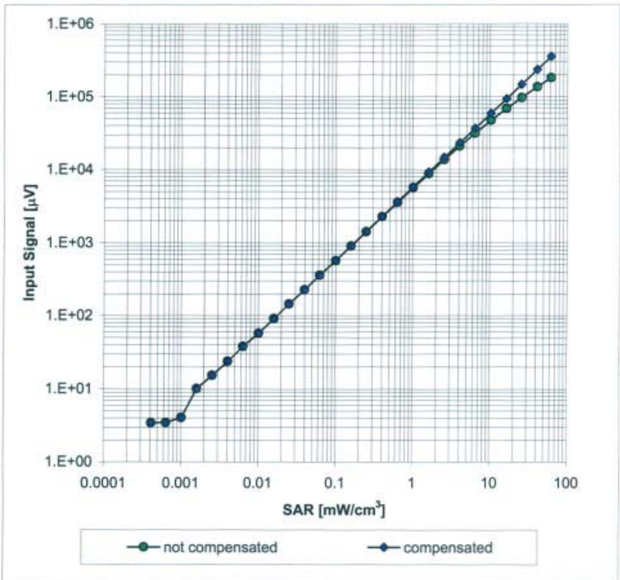
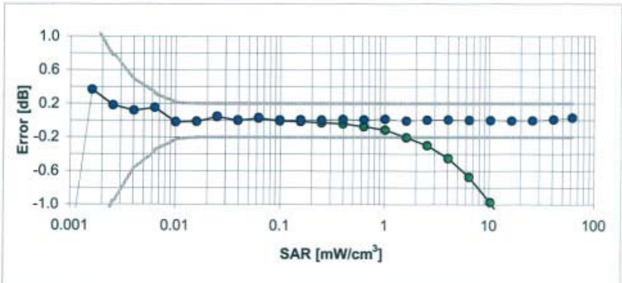
EX3DV3 SN:3526 August 26, 2008

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

(Waveguide R22, f = 1800 MHz)




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

Certificate No: EX3-3526_Aug08 Page 7 of 9

# Conversion Factor Assessment

| f [MHz] | Validity [MHz][C] | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---|---|---|---|---|---|---|---|---|
| 900 | ± 50 / ± 100 | Head | 41.5 ± 5% | 0.97 ± 5% | 0.54 | 0.76 | 10.93 | ± 11.0% (k=2) |
| 1810 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.52 | 0.68 | 9.46 | ± 11.0% (k=2) |
| 1950 | ± 50 / ± 100 | Head | 40.0 ± 5% | 1.40 ± 5% | 0.58 | 0.61 | 9.15 | ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.42 | 0.74 | 8.49 | ± 11.0% (k=2) |
| 2600 | ± 50 / ± 100 | Head | 39.0 ± 5% | 1.96 ± 5% | 0.42 | 0.75 | 8.53 | ± 11.0% (k=2) |
| 3500 | ± 50 / ± 100 | Head | 37.9 ± 5% | 2.91 ± 5% | 0.30 | 1.20 | 8.15 | ± 13.1% (k=2) |
| 5200 | ± 50 / ± 100 | Head | 36.0 ± 5% | 4.66 ± 5% | 0.40 | 1.65 | 5.68 | ± 13.1% (k=2) |
| 5500 | ± 50 / ± 100 | Head | 35.6 ± 5% | 4.96 ± 5% | 0.40 | 1.65 | 5.01 | ± 13.1% (k=2) |
| 5800 | ± 50 / ± 100 | Head | 35.3 ± 5% | 5.27 ± 5% | 0.40 | 1.65 | 4.90 | ± 13.1% (k=2) |
| | | | | | | | | |
| 900 | ± 50 / ± 100 | Body | 55.0 ± 5% | 1.05 ± 5% | 0.66 | 0.68 | 10.87 | ± 11.0% (k=2) |
| 1810 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.50 | 0.74 | 9.28 | ± 11.0% (k=2) |
| 1950 | ± 50 / ± 100 | Body | 53.3 ± 5% | 1.52 ± 5% | 0.45 | 0.78 | 9.17 | ± 11.0% (k=2) |
| 2450 | ± 50 / ± 100 | Body | 52.7 ± 5% | 1.95 ± 5% | 0.44 | 0.80 | 8.18 | ± 11.0% (k=2) |
| 2600 | ± 50 / ± 100 | Body | 52.5 ± 5% | 2.16 ± 5% | 0.47 | 0.76 | 8.14 | ± 11.0% (k=2) |
| 3500 | ± 50 / ± 100 | Body | 51.3 ± 5% | 3.31 ± 5% | 0.30 | 1.20 | 7.36 | ± 13.1% (k=2) |
| 5200 | ± 50 / ± 100 | Body | 49.0 ± 5% | 5.30 ± 5% | 0.40 | 1.70 | 4.89 | ± 13.1% (k=2) |
| 5500 | ± 50 / ± 100 | Body | 48.6 ± 5% | 5.65 ± 5% | 0.40 | 1.70 | 4.39 | ± 13.1% (k=2) |
| 5800 | ± 50 / ± 100 | Body | 48.2 ± 5% | 6.00 ± 5% | 0.40 | 1.70 | 4.44 | ± 13.1% (k=2) |

[C] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.





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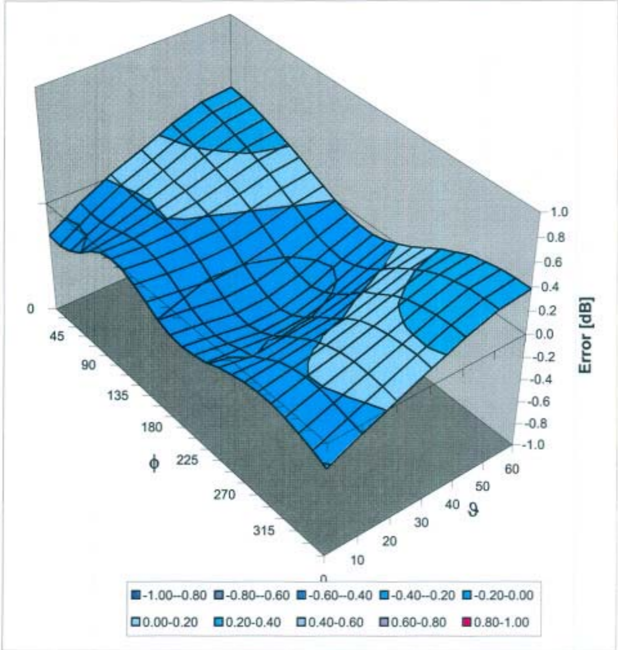
## Deviation from Isotropy in HSL

**Error (ϕ, ϑ), f = 900 MHz**




**Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)**





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# 7. Uncertainty Analysis

**DASY4 Uncertainty Budget**
**According to IEEE P1528 [1]**

| Error Description | Uncertainty value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±4.8 % | N | 1 | 1 | 1 | ±4.8 % | ±4.8 % | ∞ |
| Axial Isotropy | ±4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9 % | ±3.9 % | ∞ |
| Boundary Effects | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Linearity | ±4.7 % | R | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Readout Electronics | ±1.0 % | N | 1 | 1 | 1 | ±1.0 % | ±1.0 % | ∞ |
| Response Time | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Integration Time | ±2.6 % | R | $\sqrt{3}$ | 1 | 1 | ±1.5 % | ±1.5 % | ∞ |
| RF Ambient Conditions | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Probe Positioner | ±0.4 % | R | $\sqrt{3}$ | 1 | 1 | ±0.2 % | ±0.2 % | ∞ |
| Probe Positioning | ±2.9 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Max. SAR Eval. | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9 % | N | 1 | 1 | 1 | ±2.9 % | ±2.9 % | 875 |
| Device Holder | ±3.6 % | N | 1 | 1 | 1 | ±3.6 % | ±3.6 % | 5 |
| Power Drift | ±5.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.9 % | ±2.9 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±4.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| Liquid Conductivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.64 | 0.43 | ±1.8 % | ±1.2 % | ∞ |
| Liquid Conductivity (meas.) | ±2.5 % | N | 1 | 0.64 | 0.43 | ±1.6 % | ±1.1 % | ∞ |
| Liquid Permittivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.6 | 0.49 | ±1.7 % | ±1.4 % | ∞ |
| Liquid Permittivity (meas.) | ±2.5 % | N | 1 | 0.6 | 0.49 | ±1.5 % | ±1.2 % | ∞ |
| Combined Std. Uncertainty | | | | | | ±10.3 % | ±10.0 % | 331 |
| **Expanded STD Uncertainty** | | | | | | **±20.6 %** | **±20.1 %** | |


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# 8. Phantom Description

Schmid & Partner Engineering AG    s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

## 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<br>Zeughausstrasse 43<br>CH-8004 Zürich<br>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**

s p e a g
Schmid & Partner Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Doc No 881 – QD 000 P40 C – F    Page 1 (1)

# 9. System Validation from Original equipment supplier

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

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

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **SGS (Auden)**

Certificate No: **D835V2-4d063_Jun08**

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN: 4d063 |
| Calibration procedure(s) | QA CAL-05.v7<br>Calibration procedure for dipole validation kits |
| Calibration date: | June 06, 2008 |
| Condition of the calibrated item | In Tolerance |

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 04-Oct-07 (METAS, No. 217-00736) | Oct-08 |
| Power sensor HP 8481A | US37292783 | 04-Oct-07 (METAS, No. 217-00736) | Oct-08 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 07-Aug-07 (METAS, No 217-00718) | Aug-08 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 08-Aug-07 (No. 217-00721) | Aug-08 |
| Reference Probe ES3DV2 | SN: 3025 | 28-Apr-08 (No. ES3-3025_Apr08) | Apr-09 |
| DAE4 | SN: 601 | 14-Mar-08 (No. DAE4-601_Mar08) | Mar-09 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (SPEAG, in house check Oct-07) | In house check: Oct-09 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (SPEAG, in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (SPEAG, in house check Oct-07) | In house check: Oct-08 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Jeton Kastrati | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: June 13, 2008

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

Certificate No: D835V2-4d063_Jun08 Page 1 of 9

**DASY4 Validation Report for Body TSL**

Date/Time: 06.06.2008 14:01:1

Test Laboratory: SPEAG, Zurich, Switzerland

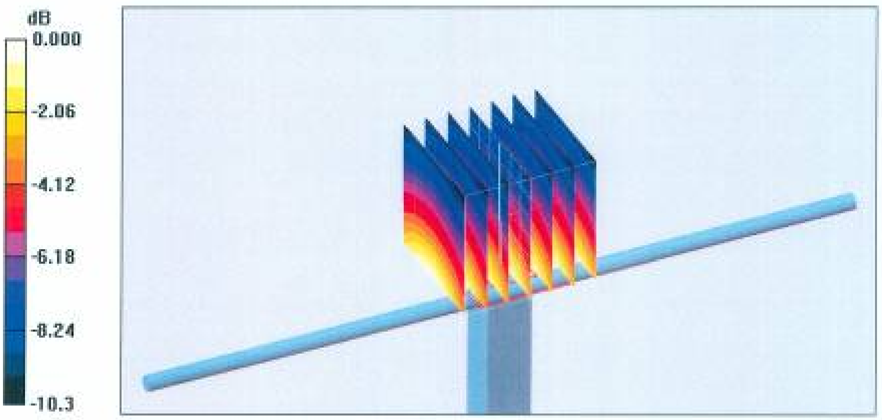
**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d063**

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: MSL900;
Medium parameters used: f = 835 MHz; $\sigma$ = 0.99 mho/m; $\varepsilon_r$ = 53.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(5.9, 5.9, 5.9); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; ;
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Pin = 250mW, d = 15mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.6 V/m; Power Drift = 0.010 dB
Peak SAR (extrapolated) = 3.53 W/kg
**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.61 mW/g**
Maximum value of SAR (measured) = 2.73 mW/g




0 dB = 2.73mW/g

Certificate No: D835V2-4d063_Jun08 Page 8 of 9

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

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

Accredited by the Swiss Federal Office of Metrology and Accreditation
**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 **Auden**

Certificate No: **D1900V2-5d018_May08**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d018 |
| Calibration procedure(s) | QA CAL-05.v7<br>Calibration procedure for dipole validation kits |
| Calibration date: | May 22, 2008 |
| Condition of the calibrated item | In Tolerance |

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 04-Oct-07 (No. 217-00736) | Oct-08 |
| Power sensor HP 8481A | US37292783 | 04-Oct-07 (No. 217-00736) | Oct-08 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 07-Aug-07 (No. 217-00718) | Aug-08 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 08-Aug-07 (No. 217-00721) | Aug-08 |
| Reference Probe ES3DV2 | SN: 3025 | 28-Apr-08 (No. ES3-3025_Apr08) | Apr-09 |
| DAE4 | SN: 601 | 14-Mar-08 (No. DAE4-601_Mar08) | Mar-09 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-07) | In house check: Oct-08 |
| RF generator R&S SMT-06 | 100005 | 4-Aug-99 (in house check Oct-07) | In house check: Oct-09 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-07) | In house check: Oct-08 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Mike Meili | Laboratory Technician | M. Meili |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: May 22, 2008

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Certificate No: D1900V2-5d018_May08 Page 1 of 9

**DASY4 Validation Report for Body TSL**

Date/Time: 22.05.2008 12:29:54

Test Laboratory: SPEAG, Zurich, Switzerland

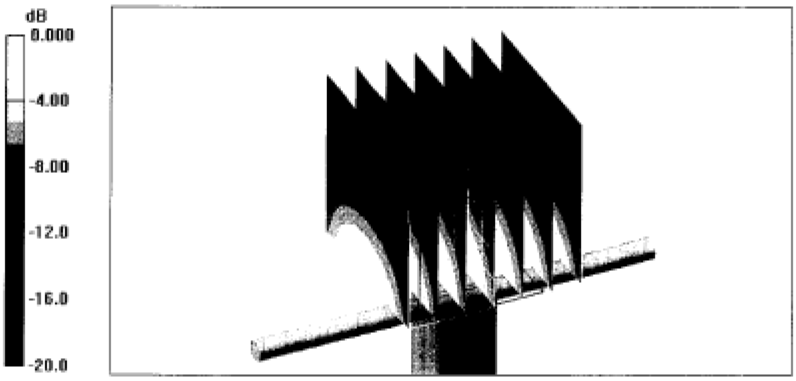
**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d018**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: MSL U10 BB;
Medium parameters used: f = 1900 MHz; σ = 1.54 mho/m; $\varepsilon_r$ = 52; ρ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3025; ConvF(4.5, 4.5, 4.5); Calibrated: 28.04.2008
- Sensor-Surface: 3.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 14.03.2008
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 90.1 V/m; Power Drift = -0.011 dB
Peak SAR (extrapolated) = 16.8 W/kg
**SAR(1 g) = 9.6 mW/g; SAR(10 g) = 5.04 mW/g**
Maximum value of SAR (measured) = 11.7 mW/g




0 dB = 11.7mW/g

## End of 1st part of report



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