# TEST REPORT
# FROM
# RFI GLOBAL SERVICES LTD

Test of: TAGSYS SAS
WiFi Inventory Reader

To: OET Bulletin 65 Supplement C : 2001-01

**Test Report Serial No:**
RFI/SARE2/RP49232JD03A

**Supersedes Test Report Serial No:**
RFI/SARE1/RP49232JD03A

| | |
|---|---|
| **This Test Report Is Issued Under The Authority Of Michael Derby, Wireless Radio Performance Service Leader:** | |
| **Tested By: Richelieu Quoi** | **Checked By: Michael Derby** |
| **Report Copy No: PDF01** | |
| **Issue Date: 22 June 2007** | **Test Dates: 25 May 2007 to 29 May 2007** |

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This report may be copied in full. The results in this report apply only to the sample(s) tested.


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## Table of Contents

# 1. Customer Information

| | |
|---|---|
| **Company Name:** | TAGSYS SAS |
| **Address:** | 180 Chemin Saint Lambert<br>13821 La Penne sur Huveaune<br>Huveaune<br>France |
| **Contact Name:** | Mr F DAnnunzio |

## 2. Equipment Under Test (EUT)

The following information (with the exception of the date of receipt) has been supplied by the customer:

### 2.1. Description of EUT

The equipment under test is a hand held RFID WiFi Library Inventory Reader.

WiFi Inventory Reader with its dedicated LW2 antenna operates at medium range 13.56 MHz.
The EUT product compatibility standards for wireless local area network (WLAN) are based on the IEEC 802.11b specification.

## 2.2. Identification of Equipment Under Test (EUT)

| | |
|---|---|
| **Description:** | RFID Handheld library Inventory Reader<br>with Connection to Remote Host PC or PDA |
| **Brand Name:** | Tagsys RFID™ |
| **Model Name or Number:** | WiFi Inventory Reader |
| **Serial Number:** | E0715010B0 |
| **Type Number:** | SE12142B0 |
| **Device ID:** | 00000000-00000000-00409DFF-FF2C1028 |
| **MAC Address:** | 00:40:9D:2C:10:28 |
| **Firmware:** | 2.4.0.0 (Version 8200097_G 05/03/2006) |
| **Boot Version:** | 1.1.3 (Release – 82000942_E1) |
| **Post Version:** | 1.1.3 (Release – 82000941_G) |
| **DSP Firmware Release:** | LF12039 (Medio P101 Library) |
| **FCC ID Number:** | QHKWIFILIBINVREAD |
| **Country of Manufacture:** | France |
| **Date of Receipt:** | 22 May 2007 |

| | |
|---|---|
| **Description:** | Library Wand Antenna |
| **Brand Name:** | Tagsys RFID™ |
| **Model Name or Number:** | LW2 |
| **Type Number:** | SE12143A0 |
| **Serial Number:** | E0715030A0 |
| **Country of Manufacture:** | France |
| **Date of Receipt:** | 22 May 2007 |

## 2.3. Modifications Incorporated in the EUT

During the course of testing the EUT was not modified.

## 2.4. Accessories

The following accessory was attached to the EUT during testing:

| | |
|---|---|
| **Description:** | Belt Clip |
| **Brand Name:** | Tagsys RFID™ |
| **Model Name or Number:** | Not Applicable |
| **Serial Number:** | None Stated |
| **Cable Length and Type:** | Not Applicable |
| **Connected to Port:** | Belt Clip |

## 2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

| | |
|---|---|
| **Description:** | Laptop |
| **Brand Name:** | Dell |
| **Model Name or Number:** | PP18L |
| **Serial Number:** | RF621 A01 |
| **Cable Length and Type:** | 54.5 cm, LAN Cable |
| **Connected to Port:** | LAN Port (To Router) |

| | |
|---|---|
| **Description:** | Wireless Firewall Router |
| **Brand Name:** | Netgear |
| **Model Name or Number:** | WGT624 |
| **Serial Number:** | 15W35A7606AB2 |
| **Cable Length and Type:** | 54.5 cm, LAN Cable |
| **Connected to Port:** | LAN Port and Antenna Port |

| | |
|---|---|
| **Description:** | Support Test Software |
| **Brand Name:** | Tagsys RFID™ |
| **Model Name or Number:** | PX Explorer V1.5.7 |
| **Serial Number:** | LF11533 |
| **Cable Length and Type:** | Not Applicable |
| **Connected to Port:** | Not Applicable |

## 2.6. Additional Information Related to Testing

| | | | |
|---|---|---|---|
| **Equipment Category** | WiFi RFID (RLAN Wideband) | | |
| **Type of Unit** | Portable (Standalone battery powered device) | | |
| **Intended Operating Environment:** | Within WiFi and RFID coverage | | |
| **Transmitter Maximum Output Power Characteristics:** | WiFi 2450 MHz | 16 dBm | |
| **Transmitter Maximum Measured Output Power:** | WiFi 2450 MHz | 18.1 dBm | |
| **Transmitter Frequency Range:** | WiFi 2450 MHz | 2412 MHz to 2462 MHz | |
| | RFID | 13.56 MHz | |
| **Transmitter Frequency Allocation of EUT When Under Test:** | **Channel Number** | **Channel Description** | **Frequency (MHz)** |
| | 1 | Low | 2412 |
| | 7 | Middle | 2442 |
| | 11 | High | 2462 |
| **Modulation(s):** | 0 Hz | | |
| **Modulation Scheme (Crest Factor):** | 1 | | |
| **Antenna Type:** | WiFi: Internal | | |
| **Antenna Length:** | WiFi: Unknown | | |
| **Number of Antenna Positions:** | 1 Fixed | | |
| **Power Supply Requirement:** | Internal Battery Supply of 13.38 V DC as measured | | |
| **Battery Type(s):** | Lithium-ion | | |

# 3. Test Specification, Methods and Procedures

## 3.1. Test Specification

| | |
|---|---|
| **Reference:** | OET Bulletin 65 Supplement C: (2001-01) |
| **Title:** | Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields. |
| **Purpose of Test:** | To determine whether the equipment met the basic restrictions as defined in OET Bulletin 65 Supplement C: (2001-01) using the SAR averaging method as described in the test specification above. |

## 3.2. Methods and Procedures Reference Documentation

The methods and procedures used were as detailed in:

EN 62209-1: 2006
Title: Basic standard for the measurement of specific absorption rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz).

ANSI/IEEE C95.1: 1999
IEEE standard for safety levels with respect to human exposure to radio frequency electromagnetic fields, 3 kHz to 300 GHz.

Federal Communications Commission, “Evaluating compliance with FCC Guidelines for human exposure to radio frequency electromagnetic fields”, OET Bulletin 65 Supplement C, FCC, Washington, D.C, 20554, 2001.

Thomas Schmid, Oliver Egger and Neils Kuster, “Automated E-field scanning system for dosimetric assessments”, IEEE Transaction on microwave theory and techniques,
Vol. 44, pp. 105-113, January 1996.

Neils Kuster, Ralph Kastle and Thomas Schmid, “Dosimetric evaluation of mobile communications equipment with know precision”, IEICE Transactions of communications, Vol. E80-B, No.5, pp. 645-652, May 1997.

## 3.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the methods & procedures section above. Appendix 1 contains a list of the test equipment used.

# 4. Deviations from the Test Specification

At the customer’s request the EUT was tested in the body worn configuration only.

The maximum transmit power of the EUT was set to 16 dBm. This power level is set as default by the module manufacturer.

# 5. Operation and Configuration of the EUT during Testing

## 5.1. Operating Modes

The EUT was tested in the following operating mode(s) unless otherwise stated:

WiFi Data Allocated continuous transmit test mode with RFID active.

The reason for choosing this configuration was that it has been defined by the customer as being typical of normal use and likely to be worst case.

## 5.2. Configuration and Peripherals

The EUT was tested in the following configuration(s) unless otherwise stated:

Standalone Battery powered with RFID Library Wand Antenna LW2 attached in the Body-worn configuration on the flat section of the 'SAM' phantom with a separation distance of 0mm.

**Body Configuration**

a) The EUT was placed in a normal operating position where the centre of EUT was aligned with the centre reference point on the flat section of the 'SAM' phantom.

b) With the EUT touching the phantom at an imaginary centre line. The EUT was aligned with a marked plane (X and Y axis) consisting of two lines.

c) For the touch-safe position the handset was gradually moved towards the flat section of the 'SAM' phantom until any point of the EUT touched the phantom.

d) For position(s) greater then 0mm separation the EUT was positioned as per the touch-safe position, and then the vertical height was decreased/adjusted as required.

e) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimise the drift.

f) The device was keyed to operate continuously in the transmit mode for the duration of the test.

g) The location of the maximum spatial SAR distribution (hot spot) was determined relative to the handset and its antenna.

h) The EUT was transmitting at full power throughout the duration of the test powered by a fully charged battery.

## 6. Summary of Test Results

| Test Name | Specification Reference | Compliancy Status |
|---|---|---|
| Specific Absorption Rate (SAR) WiFi – Body Configuration | OET Bulletin 65 Supplement C:(2001-01) | Complied |

### 6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, UK.

# 7. Measurements, Examinations and Derived Results

## 7.1. General Comments

This section contains test results only.

Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to section 8 for details of measurement uncertainties.

## 7.2. Test Results

### 7.2.1. Specific Absorption Rate – WiFi – Body Configuration

**Test Summary:**

| | |
|---|---|
| **Tissue Volume:** | 1g |
| **Maximum Level (W/kg):** | 0.073 |

**Environmental Conditions:**

| | |
|---|---|
| **Temperature Variation in Lab (°C):** | 24 to 25 |
| **Temperature Variation in Liquid (°C):** | 24 to 24 |

**Results:**

| EUT Position | Phantom Configuration | Channel Number | Level (W/kg) | Limit (W/kg) | Margin (W/kg) | Note(s) | Result |
|---|---|---|---|---|---|---|---|
| Front of EUT Facing Phantom | Flat (SAM) | 7 | 0.058 | 1.600 | 1.542 | 1 | Complied |
| Rear of EUT Facing Phantom | Flat (SAM) | 7 | 0.073 | 1.600 | 1.528 | 1 | Complied |
| Rear of EUT Facing Phantom With Belt Clip | Flat (SAM) | 7 | 0.040 | 1.600 | 1.560 | 1 | Complied |

**Note(s):**

1. *SAR measurement was performed with the EUT at a separation distance of 0 mm from the 'SAM' phantom flat section.*

### 7.2.2. EIRP Measurement

| Channel | Frequency (MHz) | TX Power before Test (dBm) |
|---|---|---|
| 1 | 2412 | 15.7 |
| 7 | 2442 | 16.1 |
| 11 | 2462 | 18.1 |

## 8. Measurement Uncertainty

No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

The uncertainty of the result may need to be taken into account when interpreting the measurement results.

The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document “approximately” is interpreted as meaning “effectively” or “for most practical purposes”.

| Test Name | Confidence Level | Calculated Uncertainty |
|---|---|---|
| Specific Absorption Rate Uncertainty at 2450 MHz Body 1g, WiFi Modulation Scheme calculated in accordance with IEC 62209-1 & IEEE 1528. | 95% | ±19.33% |

The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

## Measurement Uncertainty (Continued)

### 8.0.1. WiFi2450MHz – Body Configuration

**Specific Absorption Rate Uncertainty at 2450 MHz Body 1g, WiFi Modulation Scheme calculated in accordance with IEC 62209-1 & IEEE 1528**

| Type | Source of uncertainty | + Value | - Value | Probability Distribution | Divisor | $c_{i\,(1g)}$ | Standard Uncertainty + u (%) | Standard Uncertainty - u (%) | $\upsilon_i$ or $\upsilon_{eff}$ |
|---|---|---|---|---|---|---|---|---|---|
| B | Probe calibration | 11.800 | 11.800 | normal (k=2) | 2.0000 | 1.0000 | 5.900 | 5.900 | ∞ |
| B | Axial Isotropy | 0.500 | 0.500 | normal (k=2) | 2.0000 | 1.0000 | 0.250 | 0.250 | ∞ |
| B | Hemispherical Isotropy | 2.600 | 2.600 | normal (k=2) | 2.0000 | 1.0000 | 1.300 | 1.300 | ∞ |
| B | Spatial Resolution | 0.500 | 0.500 | Rectangular | 1.7321 | 1.0000 | 0.289 | 0.289 | ∞ |
| B | Boundary Effect | 0.769 | 0.769 | Rectangular | 1.7321 | 1.0000 | 0.444 | 0.444 | ∞ |
| B | Linearity | 0.600 | 0.600 | Rectangular | 1.7321 | 1.0000 | 0.346 | 0.346 | ∞ |
| B | Detection Limits | 0.200 | 0.200 | Rectangular | 1.7321 | 1.0000 | 0.115 | 0.115 | ∞ |
| B | Readout Electronics | 0.560 | 0.560 | normal (k=2) | 2.0000 | 1.0000 | 0.280 | 0.280 | ∞ |
| B | Response Time | 0.000 | 0.000 | Rectangular | 1.7321 | 1.0000 | 0.000 | 0.000 | ∞ |
| B | Integration Time | 0.000 | 0.000 | Rectangular | 1.7321 | 1.0000 | 0.000 | 0.000 | ∞ |
| B | RF Ambient conditions | 3.000 | 3.000 | Rectangular | 1.7321 | 1.0000 | 1.732 | 1.732 | ∞ |
| B | Probe Positioner Mechanical Restrictions | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Probe Positioning with regard to Phantom Shell | 2.850 | 2.850 | Rectangular | 1.7321 | 1.0000 | 1.645 | 1.645 | ∞ |
| B | Extrapolation and integration/ Maximum SAR evaluation | 5.080 | 5.080 | Rectangular | 1.7321 | 1.0000 | 2.933 | 2.933 | ∞ |
| A | Test Sample Positioning | 2.920 | 2.920 | normal (k=1) | 1.0000 | 1.0000 | 2.920 | 2.920 | 10 |
| A | Device Holder uncertainty | 0.154 | 0.154 | normal (k=1) | 1.0000 | 1.0000 | 0.154 | 0.154 | 10 |
| B | Phantom Uncertainty | 4.000 | 4.000 | Rectangular | 1.7321 | 1.0000 | 2.309 | 2.309 | ∞ |
| B | Drift of output power | 5.000 | 5.000 | Rectangular | 1.7321 | 1.0000 | 2.887 | 2.887 | ∞ |
| B | Liquid Conductivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 0.6400 | 1.848 | 1.848 | ∞ |
| A | Liquid Conductivity (measured value) | 3.930 | 3.930 | normal (k=1) | 1.0000 | 0.6400 | 2.515 | 2.515 | 5 |
| B | Liquid Permittivity (target value) | 5.000 | 5.000 | Rectangular | 1.7321 | 0.6000 | 1.732 | 1.732 | ∞ |
| A | Liquid Permittivity (measured value) | 3.940 | 3.940 | normal (k=1) | 1.0000 | 0.6000 | 2.364 | 2.364 | 5 |
| | Combined standard uncertainty | | | t-distribution | | | 9.86 | 9.86 | >400 |
| | Expanded uncertainty | | | k = 1.96 | | | 19.33 | 19.33 | >400 |

## Appendix 1. Test Equipment Used

| RFI No. | Instrument | Manufacturer | Type No. | Serial No. | Date Last Calibrated | Cal. Interval (months) |
|---|---|---|---|---|---|---|
| A034 | Narda 20W Termination | Narda | 374BNM | 8706 | Calibrated as part of system | 0 |
| A1097 | SMA Directional Coupler | MiDISCO | MDC6223-30 | None | Calibrated as part of system | 0 |
| A1137 | 3dB Attenuator | Narda | 779 | 04690 | Calibrated as part of system | 0 |
| A1174 | Dielectric Probe Kit | Agilent Technologies | 85070C | Us99360 072 | Calibrated before use | 0 |
| A1234 | DAE for SAR | Schmid & Partner | DAE3 | 450 | 14 Jul 2006 | 12 |
| A1322 | D2450V2 | Schmid & Partner Engineering AG | D2450V2 | 725 | 17 Jan 2007 | 24 |
| A1378 | EX3DV3 | Schmid & Partner | EX3DV3 | 3508 | 20 Apr 2007 | 12 |
| A1410 | DC-4.0GHz 3dB | Omni Spectra | FSC 16179 | 20510-3 | Calibrated as part of system | 0 |
| A1497 | Amplifier | Mini-Circuits | zhl-42w (sma) | e020105 | Calibrated as part of system | 0 |
| A1566 | SAM Phantom | SPEAG | 002 | 002 | Calibrated before use | 0 |
| A215 | 20 dB Attenuator to 4GHz 20W | Narda | 766-20 | 9402 | Calibrated as part of system | 0 |
| C1144 | 155 mm UTIFLEX Cable | Rosenberger MICRO-COAX | FA147AF0015 03030 | 41842-1 | Calibrated as part of system | 0 |
| C1145 | 300 mm UTIFLEX Cable | Rosenberger MICRO-COAX | FA147AF0030 03030 | 41843-1 | Calibrated as part of system | 0 |
| C1146 | 3 m UTIFLEX Cable | Rosenberger MICRO-COAX | FA147AF0300 03030 | 41752-1 | Calibrated as part of system | 0 |
| G051 | 10 MHz to 20.1 GHz | Gigatronics | 7100/.01-20 | 749472 | 06 Nov 2006 | 12 |

## Test Equipment Used (Continued)

| RFI No. | Instrument | Manufacturer | Type No. | Serial No. | Date Last Calibrated | Cal. Interval (months) |
|---|---|---|---|---|---|---|
| G0528 | Robot Power Supply | Schmid & Partner | DASY | None | Calibrated before use | 0 |
| G087 | Dual 35V 10A | Thurlby Thandar | CPX200 | 100701 | Calibration not required | - |
| M010 | NRV Power Meter | Rohde & Schwarz | NRV | 882 317/065 | 19 Jun 2006 | 12 |
| M025 | Fluke 87 Multimeter | Fluke | 87 | 473 50093 | 20 Jun 2006 | 12 |
| M1015 | Network Analyser | Agilent Technologies | 8753ES | US39172 406 | 19 Sep 2006 | 12 |
| M1047 | Robot Arm | Staubli | RX908 L | F00/SD8 9A1/A/01 | Calibrated before use | 0 |
| M1069 | Power Head | Rohde & Schwarz | NRV-Z2 | 838824/0 10 | 19 Apr 2007 | 12 |
| M1129 | URY-Z2 | Rohde & Schwarz | URY-Z2 | 890242/1 6 | Calibrated as part of system | 0 |
| M136 | 4 Display Digital Version | RS Components | None | None | 19 Apr 2007 | 12 |
| S256 | SAR Laboratory | RFI | N/A | N/A | Calibrated before use | 0 |

**NB** In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

## A.1.1. Calibration Certificates

This section contains the calibration certificates and data for the Probe(s) and Dipole(s) used, which are not included in the total number of pages for this report.

A1378

**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: RFI

Certificate No: EX3-3508_Nov06

# CALIBRATION CERTIFICATE

CAL DUE 16/11/07

| | |
|---|---|
| Object | EX3DV3 - SN:3508 |
| Calibration procedure(s) | QA CAL-01.v5<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | November 16, 2006 |
| 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 E4419B | GB41293874 | 5-Apr-06 (METAS, No. 251-00557) | Apr-07 |
| Power sensor E4412A | MY41495277 | 5-Apr-06 (METAS, No. 251-00557) | Apr-07 |
| Power sensor E4412A | MY41498087 | 5-Apr-06 (METAS, No. 251-00557) | Apr-07 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 10-Aug-06 (METAS, No. 217-00592) | Aug-07 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 4-Apr-06 (METAS, No. 251-00558) | Apr-07 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 10-Aug-06 (METAS, No. 217-00593) | Aug-07 |
| Reference Probe ES3DV2 | SN: 3013 | 2-Jan-06 (SPEAG, No. ES3-3013_Jan06) | Jan-07 |
| DAE4 | SN: 654 | 21-Jun-06 (SPEAG, No. DAE4-654_Jun06) | Jun-07 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (SPEAG, in house check Nov-05) | In house check: Nov-07 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (SPEAG, in house check Oct-06) | In house check: Oct-07 |

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

Issued: November 17, 2006

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| Polarization $\varphi$ | $\varphi$ rotation around probe axis |
| Polarization $\vartheta$ | $\vartheta$ 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) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (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.

# Probe EX3DV3

## SN:3508

| | |
|---|---|
| Manufactured: | December 19, 2003 |
| Last calibrated: | March 18, 2006 |
| Recalibrated: | November 16, 2006 |

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

# DASY - Parameters of Probe: EX3DV3 SN:3508

## Sensitivity in Free Space[A]

## Diode Compression[B]

| | | | | |
|---|---|---|---|---|
| NormX | **0.780** ± 10.1% | $\mu V/(V/m)^2$ | DCP X | **95** mV |
| NormY | **0.640** ± 10.1% | $\mu V/(V/m)^2$ | DCP Y | **96** mV |
| NormZ | **0.610** ± 10.1% | $\mu V/(V/m)^2$ | DCP Z | **97** mV |

## Sensitivity in Tissue Simulating Liquid (Conversion Factors)

**Please see Page 8.**

## Boundary Effect

**TSL** **2450 MHz** **Typical SAR gradient: 10 % per mm**

| Sensor Center to Phantom Surface Distance | | **2.0 mm** | **3.0 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 2.6 | 1.0 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.2 | 0.4 |

## Sensor Offset

Probe Tip to Sensor Center **1.0** mm

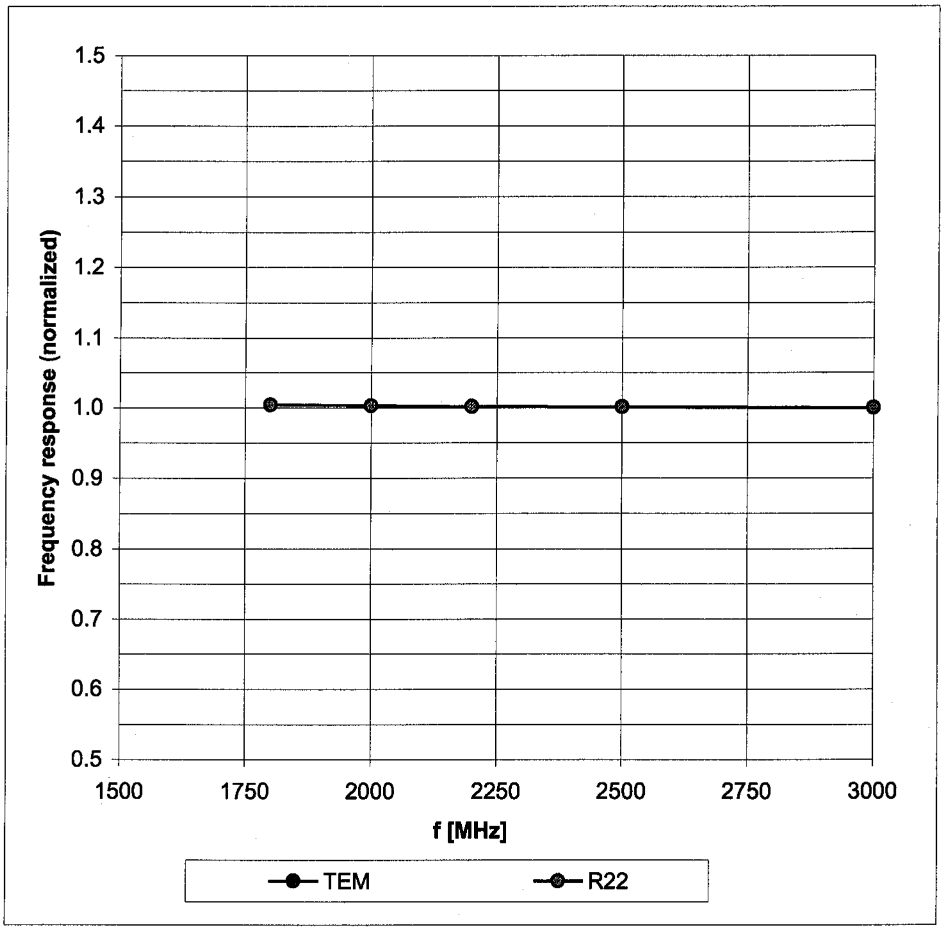
**The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.**

[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.

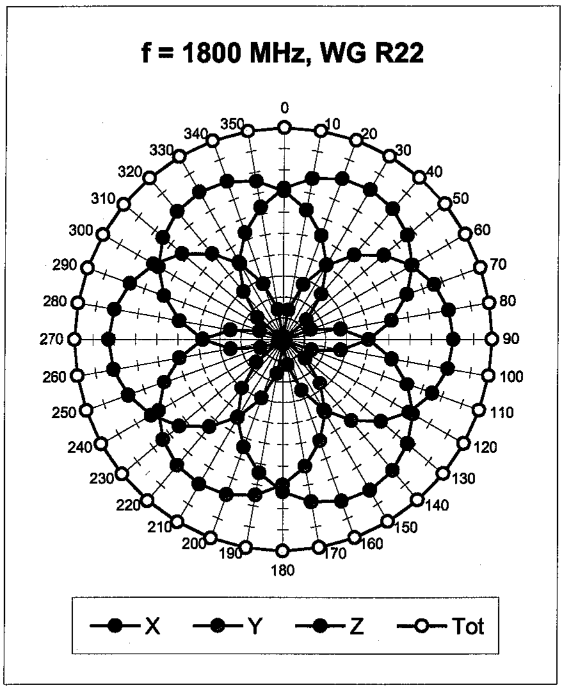
# Frequency Response of E-Field

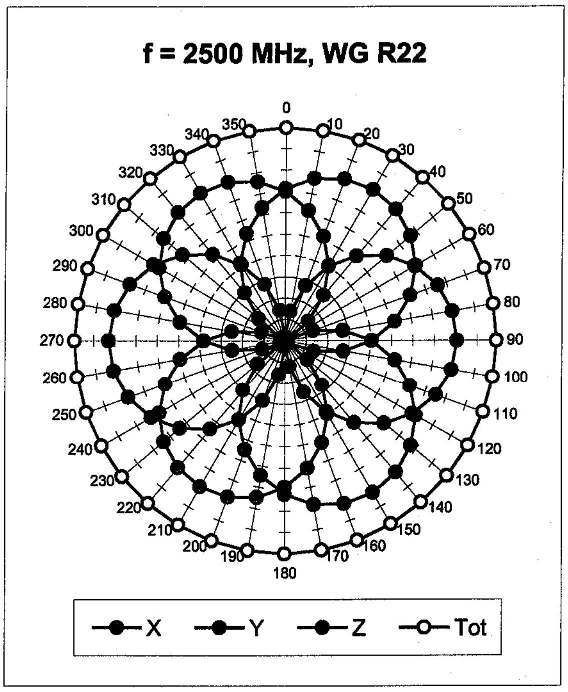
**(TEM-Cell:ifi110 EXX, Waveguide: R22)**

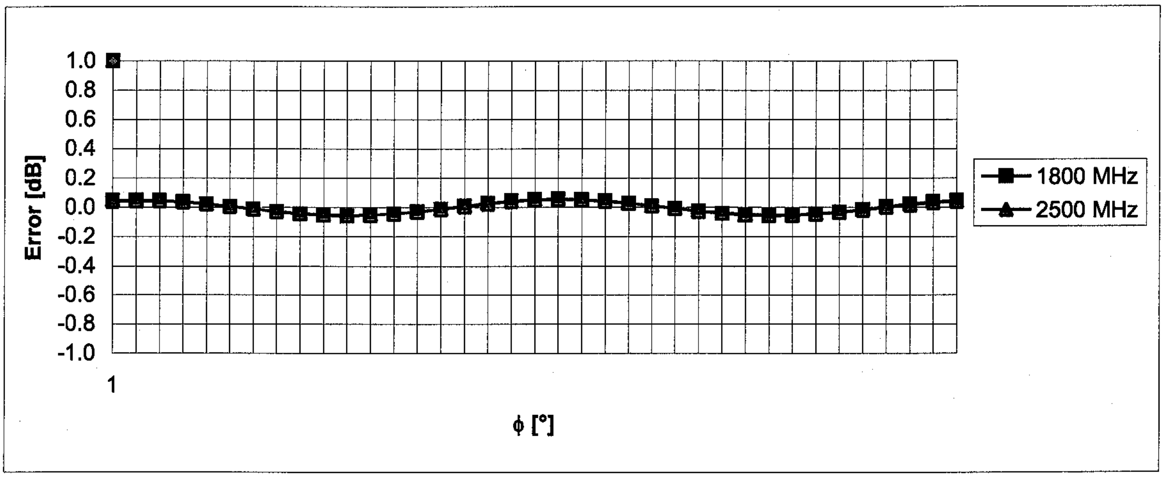



**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

# Receiving Pattern (ϕ), ϑ = 0°



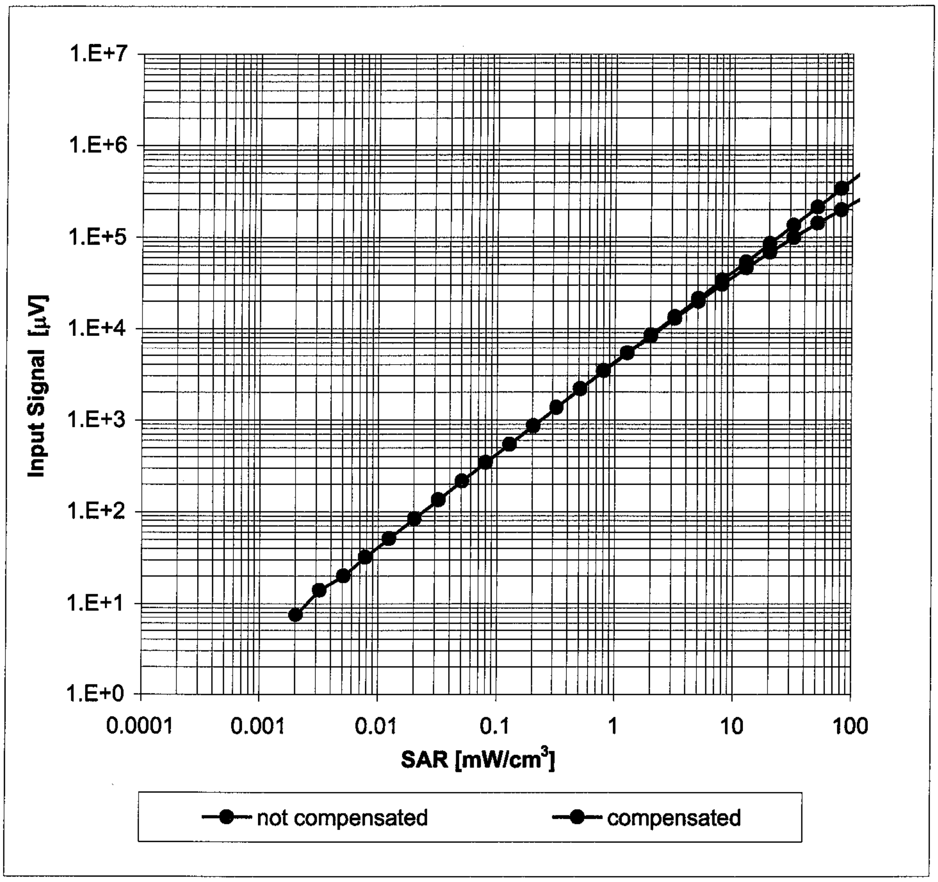



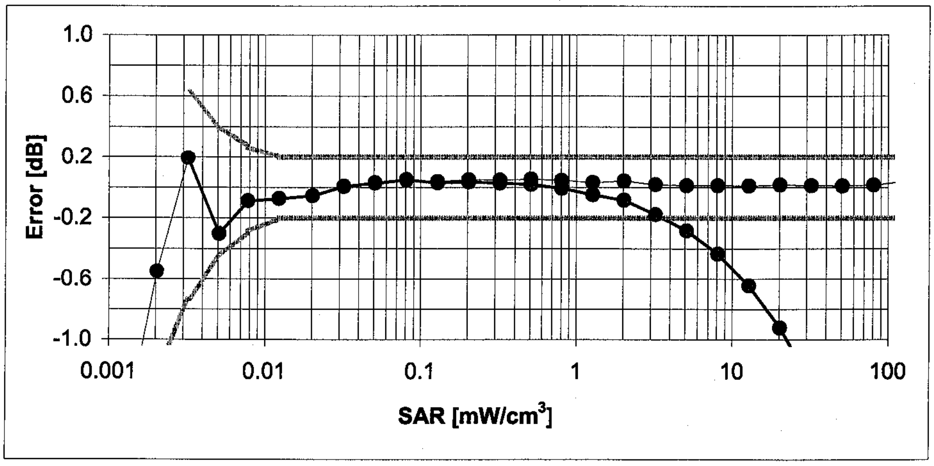




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

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

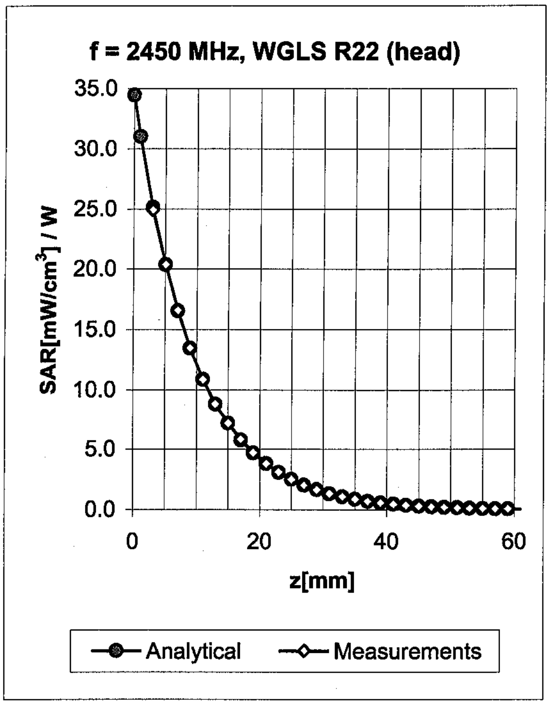
**(Waveguide R22, f = 1800 MHz)**

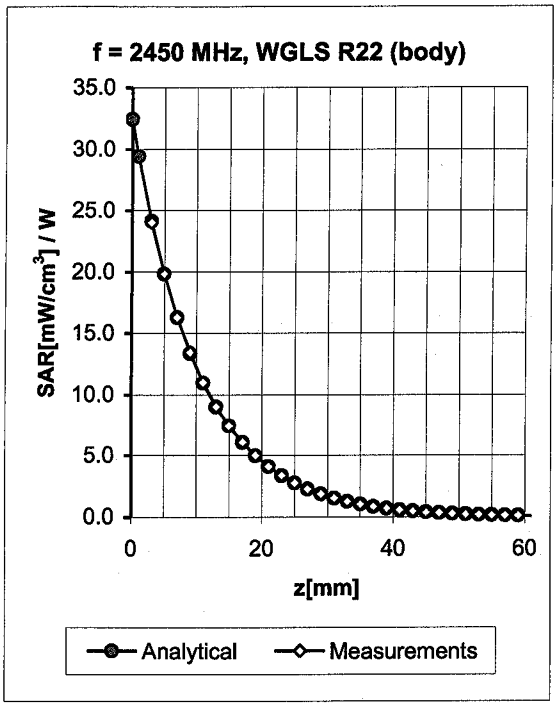



**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment



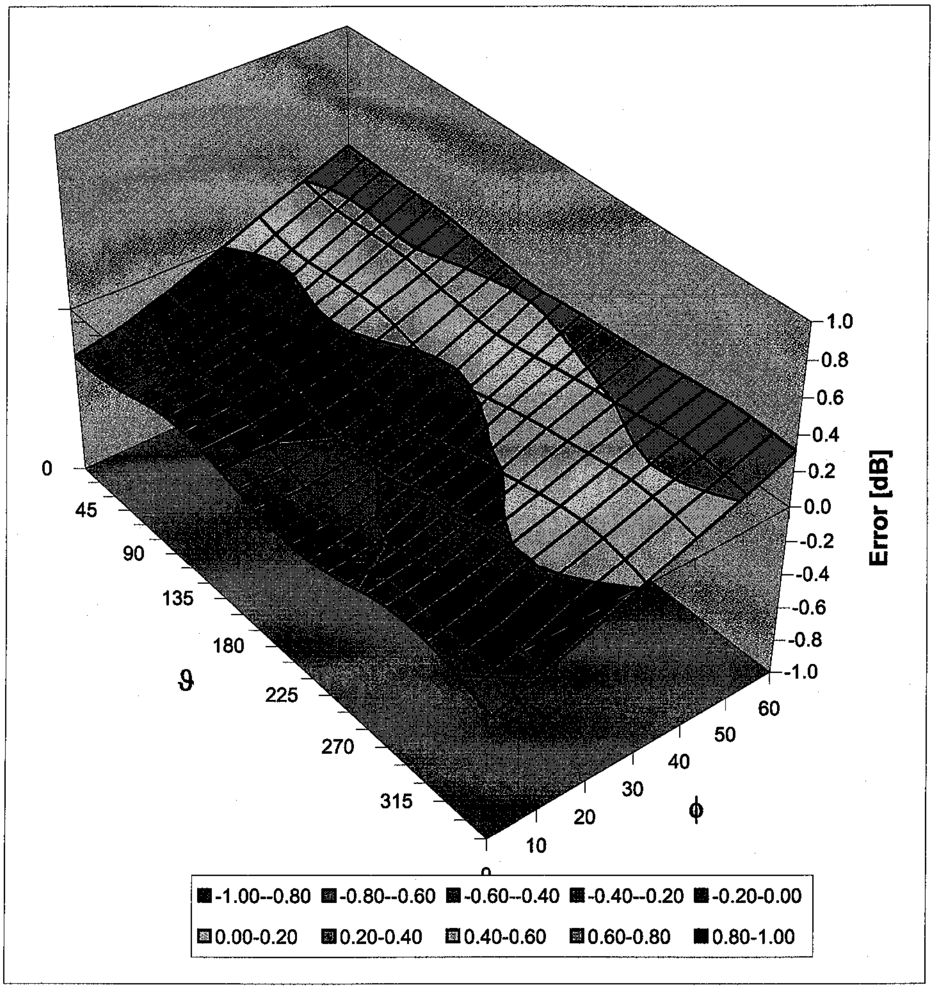




| f [MHz] | Validity [MHz][C] | TSL | Permittivity | Conductivity | Alpha | Depth | ConvF | Uncertainty |
|---|---|---|---|---|---|---|---|---|
| 2450 | ± 50 / ± 100 | Head | 39.2 ± 5% | 1.80 ± 5% | 0.33 | 1.00 | 8.00 | ± 11.8% (k=2) |
| 2450 | ± 50 / ± 100 | Body | 52.7 ± 5% | 1.95 ± 5% | 0.33 | 1.00 | 7.89 | ± 11.8% (k=2) |
| 2600 | ± 50 / ± 100 | Body | 52.5 ± 5% | 2.16 ± 5% | 0.29 | 1.00 | 7.76 | ± 11.8% (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.

# Deviation from Isotropy in HSL

**Error (ϕ, ϑ), f = 900 MHz**




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

NM 24/01/07

A1322


**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**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**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** RFI

**Certificate No: D2450V2-725_Jan07**

# CALIBRATION CERTIFICATE

Object: D2450V2 - SN: 725

Calibration procedure(s): QA CAL-05.v6
Calibration procedure for dipole validation kits

Calibration date: January 17, 2007

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-05 (METAS, No. 251-00516) | Oct-06 |
| Power sensor HP 8481A | US37292783 | 04-Oct-05 (METAS, No. 251-00516) | Oct-06 |
| Reference 20 dB Attenuator | SN: 5086 (20g) | 10-Aug-06 (METAS, No 217-00591) | Aug-07 |
| Reference 10 dB Attenuator | SN: 5047.2 (10r) | 10-Aug-06 (METAS, No 217-00591) | Aug-07 |
| Reference Probe ES3DV2 | SN 3025 | 19-Oct-06 (SPEAG, No. ES3-3025_Oct06) | Oct-07 |
| DAE4 | SN: 907 | 20-Jul-06 (SPEAG, No. DAE4-907_Jul06) | Jul-07 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (SPEAG, in house check Oct-05) | In house check: Oct-07 |
| RF generator Agilent E4421B | MY41000675 | 11-May-05 (SPEAG, in house check Nov-05) | In house check: Nov-07 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (SPEAG, in house check Nov-05) | In house check: Nov-06 |

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

Issued: January 18, 2007

## 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:

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) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
c) 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:

d) DASY4 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** | DASY4 | V4.7 |
| **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 ± 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 ± 0.2) °C | 38.0 ± 6 % | 1.79 mho/m ± 6 % |
| **Head TSL temperature during test** | (22.3 ± 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 | 13.5 mW / g |
| SAR normalized | normalized to 1W | 54.0 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **53.3 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.26 mW / g |
| SAR normalized | normalized to 1W | 25.0 mW / g |
| SAR for nominal Head TSL parameters [1] | normalized to 1W | **24.8 mW / g ± 16.5 % (k=2)** |

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## 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 | 51.2 ± 6 % | 1.97 mho/m ± 6 % |
| **Body TSL temperature during test** | (22.1 ± 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 | 13.6 mW / g |
| SAR normalized | normalized to 1W | 54.4 mW / g |
| SAR for nominal Body TSL parameters [2] | 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 | 6.21 mW / g |
| SAR normalized | normalized to 1W | 24.8 mW / g |
| SAR for nominal Body TSL parameters [2] | normalized to 1W | **24.5 mW / g ± 16.5 % (k=2)** |

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.4 Ω + 7.7 jΩ |
| Return Loss | – 22.1 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 47.8 Ω + 7.7 jΩ |
| Return Loss | – 21.8 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.154 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 | October 16, 2002 |