# TEST REPORT

## OET 65C

| | | |
|---|---|---|
| **Report Reference No.......................:** | **TRE13040081 R/C: 99027** | |
| **FCC ID..............................................:** | **QGDTD-Q8** | |
| Compiled by ( position+printed name+signature)..: | File administrators Tim Zhang | Tim Zhang |
| Supervised by ( position+printed name+signature)..: | Test Engineer Eric Zhang | Eric Zhang |
| Approved by ( position+printed name+signature)..: | Manager Wenliang Li | Wenliang Li |
| Date of issue.....................................: | Apr 23, 2013 | |
| **Testing Laboratory Name ..............:** | **Shenzhen Huatongwei International Inspection Co., Ltd** | |
| Address ............................................: | Keji Nan No.12 Road, Hi-tech Park, Shenzhen, China | |
| **Applicant's name.............................:** | **Tongdaxin Electronics Co., Ltd** | |
| Address ............................................: | Tongdaxin Ind. Bldg, Houting, Donghai, Quanzhou, Fujian | |
| **Test specification:** | | |
| Standard ...........................................: | **OET 65C** | |
| TRF Originator..................................: | Shenzhen Huatongwei International Inspection CO., Ltd | |
| Master TRF.......................................: | Dated 2006-06 | |



| | |
|---|---|
| **Test item description .....................:** | Two Way Radio |
| Trade Mark ........................................: | TDXone |
| Manufacturer .....................................: | **Access Device Integrated Communications Corp.** |
| Model/Type reference........................: | TD-Q8 |
| Listed Models ..................................: | TD-Q6,TD-Q7 |
| Ratings .............................................: | DC 7.4V |
| Modulation .......................................: | FM |
| Channel Separation........................... | 12.5KHz |
| Operation Frequency Range ............. | From 136 MHz to 174 MHz and 400MHz to 480MHz |
| Result...............................................: | **Positive** |

# T E S T R E P O R T

| **Test Report No. :** | **TRE13040081** | Apr 23, 2013<br>Date of issue |
|---|---|---|

| | | |
|---|---|---|
| Equipment under Test | : | Two Way Radio |
| Model /Type | : | TD-Q8 |
| Listed Models | : | TD-Q6,TD-Q7 |
| **Applicant** | : | **Tongdaxin Electronics Co., Ltd.** |
| Address | : | Tongdaxin Ind. Bldg, Houting, Donghai, Quanzhou, Fujian |
| **Manufacturer** | : | **Tongdaxin Electronics Co., Ltd.** |
| Address | : | Tongdaxin Ind. Bldg, Houting, Donghai, Quanzhou, Fujian |

| **Test Result** according to the standards on page 4: | **Positive** |
|---|---|

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

# Contents


1. TEST STANDARDS 4

2. SUMMARY 5

2.1. General Remarks 5
2.2. Product Description 5
2.3. Equipment under Test 5
2.4. Short description of the Equipment under Test (EUT) 5
2.5. TEST Configuration 6
2.6. EUT operation mode 6
2.7. EUT configuration 6
2.8. Note 6

3. TEST ENVIRONMENT 7

3.1. Address of the test laboratory 7
3.2. Test Facility 7
3.3. Environmental conditions 7
3.4. SAR Limits 7
3.5. Equipments Used during the Test 8

4. SAR MEASUREMENTS SYSTEM CONFIGURATION 9

4.1. SAR Measurement Set-up 9
4.2. DASY5 E-field Probe System 10
4.3. Phantoms 11
4.4. Device Holder 11
4.5. Scanning Procedure 12
4.6. Data Storage and Evaluation 13
4.7. Tissue Dielectric Parameters for Head and Body Phantoms 14
4.8. Tissue equivalent liquid properties 15
4.9. System Check 15

5. TEST CONDITIONS AND RESULTS 17

5.1. Conducted Power Results 17
5.2. Sar Measurement Results 17
5.3. Measurement Uncertainty 18
5.4. System Check Results 19
5.5. Sar Test Graph Results 19

6. CALIBRATION CERTIFICATE 28

6.1. Probe Calibration Ceriticate 28
6.2. D450V3 Dipole Calibration Ceriticate 39
6.3. DAE4 Calibration Ceriticate 48

7. TEST SETUP PHOTOS 48

8. EUT PHOTOS 55

# 1. TEST STANDARDS

The tests were performed according to following standards:

**IEEE Std C95.1, 1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz.**

**IEEE Std 1528™-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.**

**SUPPLEMENT C Edition 01-01 to OET BULLETIN 65 Edition 97-01 June 2001 including DA 02-1438 June 19, 2002: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields Additional Information for Evaluation Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions.**

**KDB 447498 D01 Mobile Portable RF Exposure v05: Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies**

**KDB 643646: SAR Test Reduction Considerations for Occupational PTT Radios**

# 2. SUMMARY

## 2.1. General Remarks

| | | |
|---|---|---|
| Date of receipt of test sample | : | Apr 17, 2013 |
| | | |
| | | |
| Testing commenced on | : | Apr 17, 2013 |
| | | |
| | | |
| Testing concluded on | : | Apr 23, 2013 |

## 2.2. Product Description

The Tongdaxin Electronics Co., Ltd.'s Model: TD-Q8 or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

| | | |
|---|---|---|
| Name of EUT | Two Way Radio | |
| Model Number | TD-Q8, TD-Q6, TD-Q7 | |
| FCC ID | QGDTD-Q8 | |
| Modilation Type | FM for Analog Voice | |
| | Analog | 11K0F3E for 12.5KHz Channel Separation |
| Channel Separation | Analog Voice | 12.5KHz |
| Antenna Type | External | |
| Frequency Range | From 136 MHz to 174 MHz/From 400MHz to 480MHz | |
| Maximum SAR Values | 1.727 W/Kg (50% duty cycle) | |

## 2.3. Equipment under Test

**Power supply system utilised**

| | | | | | |
|---|---|---|---|---|---|
| Power supply voltage | : | ○ | 120V / 60 Hz | ○ | 115V / 60Hz |
| | | ○ | 12 V DC | ○ | 24 V DC |
| | | ● | Other (specified in blank below) | | |

DC 7.4V from battery

**Test frequency list**

| Modulation Type | Test Channel | Test Frequency |
|---|---|---|
| Analog | Low Channel | 400.000 MHz |
| | Low Channel | 416.000 MHz |
| | Middle Channel | 432.000 MHz |
| | Middle Channel | 448.000 MHz |
| | High Channel | 464.000 MHz |
| | High Channel | 480.000 MHz |

## 2.4. Short description of the Equipment under Test (EUT)

136-174 MHz/ 400-480 MHz frequency band FM TRANSCEIVER.

The spatial peak SAR values were assessed for UHF systems. Battery and accessories shell be specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

## 2.5. TEST Configuration

Face-held Configuration

The front of the EUT is towards the phantom.

The front surface of the EUT is positioned at 25mm parallel to the flat phantom.

Body-worn Configuration

Due to the form factor and remote-only PTT switch of this device, and the vest accessory shown in user manual, intended use conditions appear to include transmitting while held covertly in user’s pocket. For such use conditions, SAR will be tested with front and back surfaces of device contacted with the flat phantom

The front of the EUT towards ground, the EUT directed tightly to touch the bottom of the flat phantom

## 2.6. EUT operation mode

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

## 2.7. EUT configuration

**The following peripheral devices and interface cables were connected during the measurement:**

● - supplied by the manufacturer

○ - supplied by the lab

| | | | |
|---|---|---|---|
| ○ | Power Cable | Length (m) : | / |
| | | Shield : | / |
| | | Detachable : | / |
| ○ | Multimeter | Manufacturer : | / |
| | | Model No. : | / |

**Battery:** Model: DC-Q8
DC 7.4V 1600mAh

## 2.8. Note

The EUT is FM TRANSCEIVER,The functions of the EUT listed as below:

| | Test Standards | Reference Report |
|---|---|---|
| EMF | OET 65C | TRE13040081 |

# 3. TEST ENVIRONMENT

## 3.1. Address of the test laboratory

Shenzhen Huatongwei International Inspection Co., Ltd
Keji Nan No.12 Road, Hi-tech Park, Shenzhen, China
Phone: 86-755-26715686 Fax: 86-755-26748089

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 (2009) and CISPR Publication 22.

## 3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

### CNAS-Lab Code: L1225

Shenzhen Huatongwei International Inspection Co., Ltd has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: August 02, 2007. Valid time is until Feb 28, 2015.

### A2LA-Lab Cert. No. 2243.01

Shenzhen Huatongwei International Inspection Co., Ltd, EMC Laboratory has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025: 2005 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing. Valid time is until Sept 30, 2013.

### FCC-Registration No.: 662850

Shenzhen Huatongwei International Inspection Co., Ltd, EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Registration 662850, Renewal date June 01, 2015.
2, 2014.

## 3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

| | |
|---|---|
| Temperature: | 18-25 ° C |
| | |
| Humidity: | 40-65 % |
| | |
| Atmospheric pressure: | 950-1050mbar |

## 3.4. SAR Limits

FCC Limit (1g Tissue)

| EXPOSURE LIMITS | SAR (W/kg) | |
|---|---|---|
| | (General Population / Uncontrolled Exposure Environment) | (Occupational / Controlled Exposure Environment) |
| Spatial Average (averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over any 1 g of tissue) | 1.60 | 8.0 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10 g) | 4.0 | 20.0 |

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

## 3.5. Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Calibration Interval |
| Data Acquisition Electronics DAEx | SPEAG | DAE4 | 1315 | 2013/02/27 | 1 |
| E-field Probe | SPEAG | ES3DV3 | 3292 | 2013/02/24 | 1 |
| System Validation Dipole D450V3 | SPEAG | D450V3 | 1061 | 2012/09/11 | 1 |
| Network analyzer | Agilent | 8753E | US37390562 | 2013/03/26 | 1 |
| Signal generator | IFR | 2032 | 203002/100 | 2012/10/27 | 1 |
| Amplifier | AR | 75A250 | 302205 | 2012/10/27 | 1 |

# 4. SAR Measurements System configuration

## 4.1. SAR Measurement Set-up

The DASY5 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension 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 electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

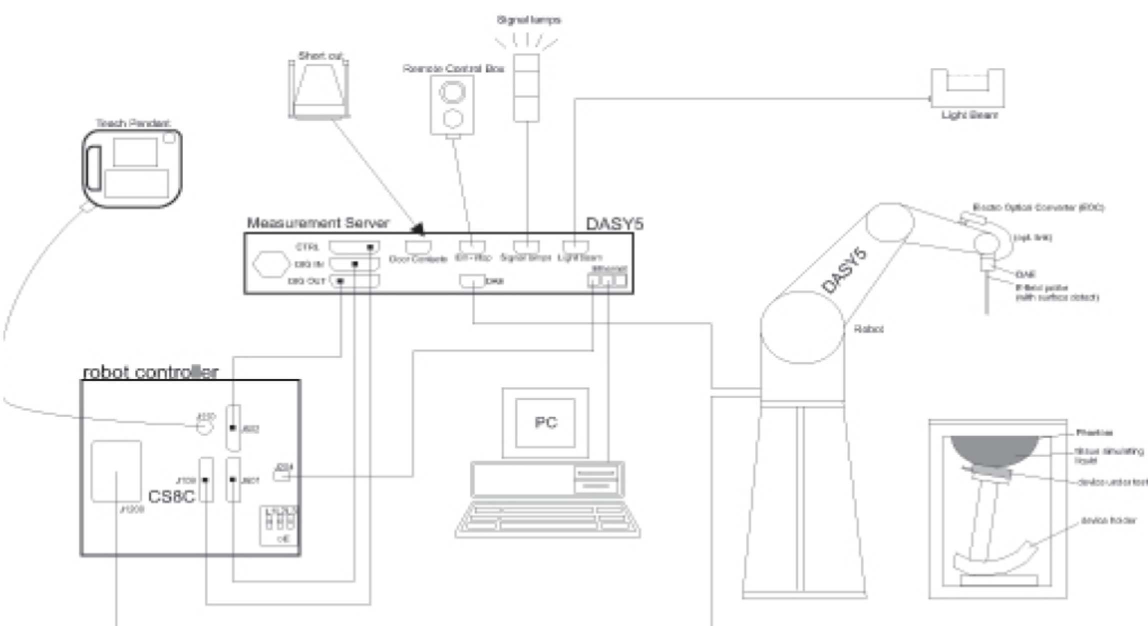
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld mobile phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



## 4.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

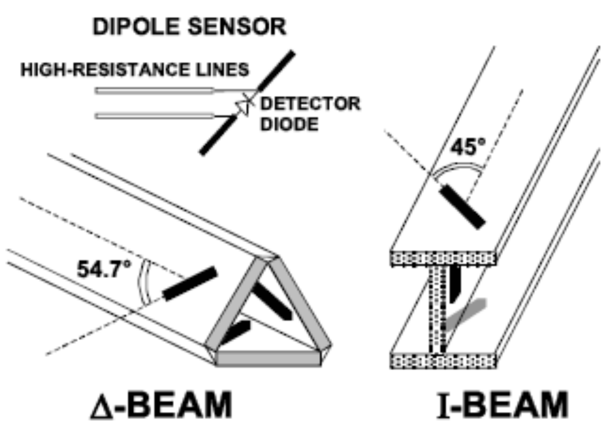
Probe Specification

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 10 MHz to 4 GHz;<br>Linearity: ± 0.2 dB (30 MHz to 4 GHz) |
| Directivity | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.3 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 5 μW/g to > 100 mW/g;<br>Linearity: ± 0.2 dB |
| Dimensions | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 3.9 mm (Body: 12 mm)<br>Distance from probe tip to dipole centers: 2.0 mm |
| Application | General dosimetry up to 4 GHz<br>Dosimetry in strong gradient fields<br>Compliance tests of mobile phones |
| Compatibility | DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI |

Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



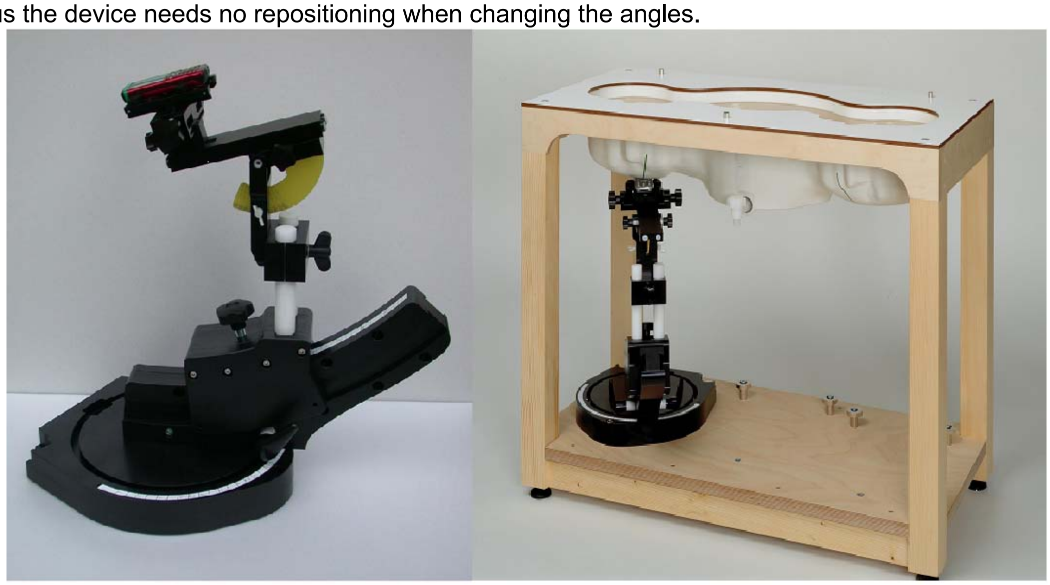
## 4.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

## 4.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

## 4.5. Scanning Procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. ± 5 %.

The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ± 0.1mm). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within ± 30°.)

Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot.Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

Zoom Scan
Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

Spatial Peak Detection
The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses.The DASY5 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard’s method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard’s method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## 4.6. Data Storage and Evaluation

Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

Data Evaluation

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

| | | |
|---|---|---|
| Probe parameters: | - Sensitivity | Normi, ai0, ai1, ai2 |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | σ |
| | - Density | ρ |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

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

With Vi = compensated signal of channel i ( i = x, y, z )
Ui = input signal of channel i ( i = x, y, z )
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

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

$$\mathrm{E-fieldprobes:} \quad E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\mathrm{H-fieldprobes:} \quad H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

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

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

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

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

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm3

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

## 4.7. Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

| Ingredients (% by weight) | Frequency (MHz) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 450 | | 835 | | 915 | | 1900 | | 2450 | |
| Tissue Type | Head | Body | Head | Body | Head | Body | Head | Body | Head | Body |
| Water | 38.56 | 51.16 | 41.45 | 52.4 | 41.05 | 56.0 | 54.9 | 40.4 | 62.7 | 73.2 |
| Salt (Nacl) | 3.95 | 1.49 | 1.45 | 1.4 | 1.35 | 0.76 | 0.18 | 0.5 | 0.5 | 0.04 |
| Sugar | 56.32 | 46.78 | 56.0 | 45.0 | 56.5 | 41.76 | 0.0 | 58.0 | 0.0 | 0.0 |
| HEC | 0.98 | 0.52 | 1.0 | 1.0 | 1.0 | 1.21 | 0.0 | 1.0 | 0.0 | 0.0 |
| Bactericide | 0.19 | 0.05 | 0.1 | 0.1 | 0.1 | 0.27 | 0.0 | 0.1 | 0.0 | 0.0 |
| Triton x-100 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 36.8 | 0.0 |
| DGBE | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 44.92 | 0.0 | 0.0 | 26.7 |
| Dielectric Constant | 43.42 | 58.0 | 42.54 | 56.1 | 42.0 | 56.8 | 39.9 | 54.0 | 39.8 | 52.5 |
| Conductivity (s/m) | 0.85 | 0.83 | 0.91 | 0.95 | 1.0 | 1.07 | 1.42 | 1.45 | 1.88 | 1.78 |

IEEE SCC-34/SC-2 P1528 Recommended Tissue Dielectric Parameters

| Frequency (MHz) | Head Tissue | | Body Tissue | |
|---|---|---|---|---|
| | εr | Ơ (S/m) | εr | Ơ (S/m) |
| 150 | 52.3 | 0.76 | 61.9 | 0.80 |
| 300 | 45.3 | 0.87 | 58.2 | 0.92 |
| 450 | 43.5 | 0.87 | 56.7 | 0.94 |
| 835 | 41.5 | 0.90 | 55.2 | 0.97 |
| 900 | 41.5 | 0.97 | 55.0 | 1.05 |
| 915 | 41.5 | 0.98 | 55.0 | 1.06 |
| 1450 | 40.5 | 1.20 | 54.0 | 1.30 |
| 1610 | 40.3 | 1.29 | 53.8 | 1.40 |
| 1800-2000 | 40.0 | 1.40 | 53.3 | 1.52 |
| 2450 | 39.2 | 1.80 | 52.7 | 1.95 |
| 3000 | 38.5 | 2.40 | 52.0 | 2.73 |
| 5800 | 35.3 | 5.27 | 48.2 | 6.00 |

## 4.8. Tissue equivalent liquid properties

Dielectric performance of Head tissue simulating liquid

| Frequency | Description | Dielectric paramenters | |
|---|---|---|---|
| | | $\varepsilon_r$ | σ |
| 450MHz(Head) | Target Value ±5% | 43.50 (41.33-45.68) | 0.87 (0.83-0.91) |
| | Measurement Value 2013-04-20 | 44.56 | 0.88 |

Dielectric performance of Body tissue simulating liquid

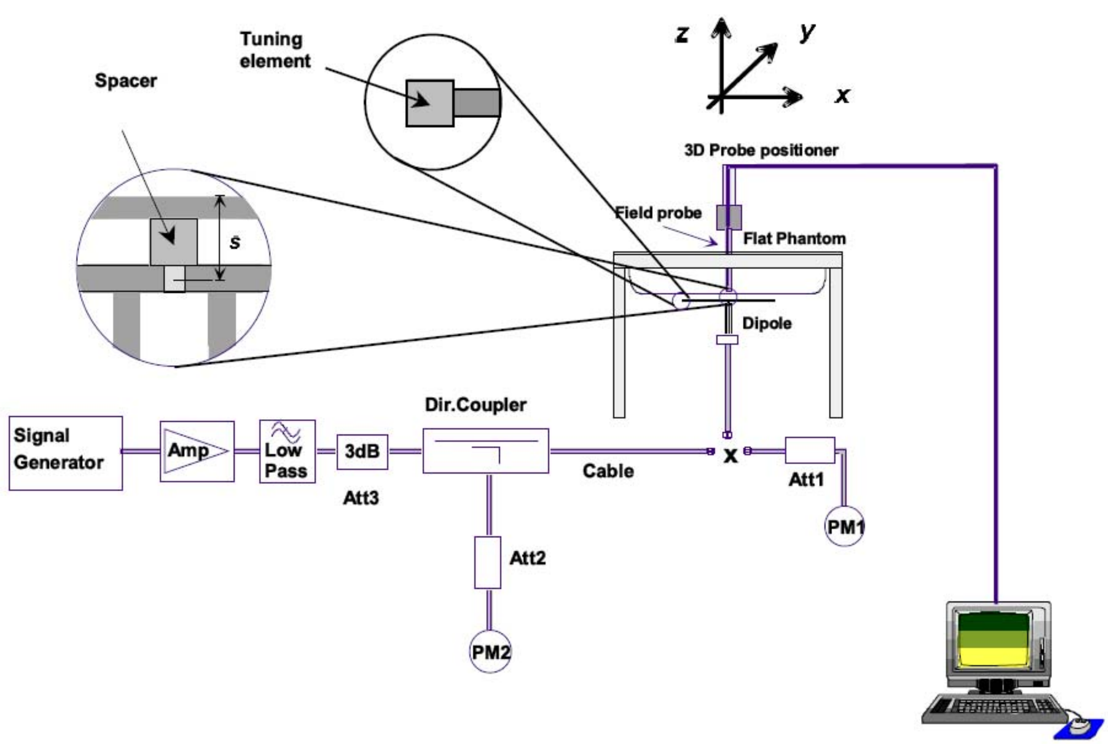
| Frequency | Description | Dielectric paramenters | |
|---|---|---|---|
| | | $\varepsilon_r$ | σ |
| 450MHz(Body) | Target Value ±5% | 56.70 (53.87-59.54) | 0.94 (0.89-0.99) |
| | Measurement Value 2013-04-20 | 55.56 | 0.93 |

## 4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the decice test frequency.The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system (±10 %).

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.



## 4.10. System Check Result

System check of Head tissue simulating liquid

| Frequency | Measure Value(W/Kg) | Normalized Value(W/Kg) | Target Value(W/Kg) |
|---|---|---|---|
| 450MHz | 1.83 | 4.597 | 4.76 |

System check of Body tissue simulating liquid

| Frequency | Measure Value(W/Kg) | Normalized Value(W/Kg) | Target Value(W/Kg) |
|---|---|---|---|
| 450MHz | 1.78 | 4.472 | 4.51 |

# 5. TEST CONDITIONS AND RESULTS

## 5.1. Conducted Power Results

Conducted power measurement results

| Modulation Type | Channel Separation | Test Channel | Test Frequency | Power Level (dBm) |
|---|---|---|---|---|
| Analog/FM | 12.5KHz | Low Channel | 400.000 MHz | 36.46 |
| | | Low Channel | 416.000 MHz | 36.12 |
| | | Middle Channel | 432.000 MHz | 36.25 |
| | | Middle Channel | 448.000 MHz | 36.50 |
| | | High Channel | 464.000 MHz | 36.42 |
| | | High Channel | 480.000 MHz | 36.60 |

## 5.2. Sar Measurement Results

| Limits | 1 g Average(W/Kg) | | Power Drift(dB) | Graph results |
|---|---|---|---|---|
| | 8.0 | | ±0.21 | |
| Frequency | Duty Cycle | | Power Drift(dB) | |
| | 100% | 50% | | |
| **The EUT display towards phantom for 12.5KHz(analog,face held)** | | | | |
| 416.00 MHz | 2.19 | 1.095 | -0.01 | Figure 1 |
| **The EUT display towards ground for 12.5KHz(analog,Body-worn)** | | | | |
| 400.00 MHz | 3.20 | 1.600 | 0.02 | Figure 2 |
| 416.00 MHz | 3.83 | 1.915 | -0.05 | Figure 3 |
| 432.00 MHz | 2.30 | 1.150 | -0.02 | Figure 4 |
| 448.00 MHz | 3.05 | 1.525 | -0.05 | Figure 5 |
| 464.00 MHz | 2.75 | 1.375 | -0.09 | Figure 6 |
| 480.00 MHz | 3.03 | 1.515 | -0.03 | Figure 7 |

| Limits | 1 g Average(W/Kg) | | Power Drift(dB) | Power Drift 10^(dB/10) | Scaling Factor | SAR Values Include the Power Drift and Scaling factor | |
|---|---|---|---|---|---|---|---|
| | 8.0 | | ±0.21 | | | Duty Cycle | |
| Frequency | Duty Cycle | | Power Drift(dB) | | | 100% | 50% |
| | 100% | 50% | | | | | |
| **Worst case position including the power drift and scaling factor** | | | | | | | |
| 416.00 MHz | 3.83 | 1.915 | -0.05 | 0.989 | 0.912 | 3.455 | 1.727 |

## 5.3. Measurement Uncertainty

| Uncertainty Component | Tol. (%) | Prob Dist. | Div | ci (10g) | ci.ui(%) (10g) | vi |
|---|---|---|---|---|---|---|
| Measurement System | | | | | | |
| Probe Calibration | 5.9 | N | 1 | 1 | 5.9 | ∞ |
| Axial Isotropy | 4.7 | R | $\sqrt{3}$ | 0.7 | 1.9 | ∞ |
| Hemispherical Isotropy | 9.6 | R | $\sqrt{3}$ | 0.7 | 3.9 | ∞ |
| Boundary Effect | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ |
| Linearity | 4.7 | R | $\sqrt{3}$ | 1 | 2.7 | ∞ |
| System Detection Limits | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ |
| Readout Electronics | 0.3 | N | 1 | 1 | 0.3 | ∞ |
| Response Time | 0.8 | R | $\sqrt{3}$ | 1 | 0.5 | ∞ |
| Integration Time | 2.6 | R | $\sqrt{3}$ | 1 | 1.5 | ∞ |
| RF Ambient Conditions - Noise | 3.0 | R | $\sqrt{3}$ | 1 | 1.7 | ∞ |
| RF Ambient Conditions - Reflections | 3.0 | R | $\sqrt{3}$ | 1 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | 0.4 | R | $\sqrt{3}$ | 1 | 0.2 | ∞ |
| Probe Positioning with respect to Phantom Shell | 2.9 | R | $\sqrt{3}$ | 1 | 1.7 | ∞ |
| Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation | 1.0 | R | $\sqrt{3}$ | 1 | 0.6 | ∞ |
| **Test Sample Related** | | | | | | |
| Test Sample Positioning | 2.9 | N | 1 | 1 | 2.9 | 145 |
| Device Holder Uncertainty | 3.6 | N | 1 | 1 | 3.6 | 5 |
| Output Power Variation - SAR drift measurement | 5.0 | R | $\sqrt{3}$ | 1 | 2.9 | ∞ |
| **Phantom and Tissue Parameters** | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 4.0 | R | $\sqrt{3}$ | 1 | 2.3 | ∞ |
| Conductivity Target - tolerance | 5.0 | R | $\sqrt{3}$ | 0.43 | 1.2 | ∞ |
| Conductivity - measurement uncertainty | 2.5 | N | 1 | 0.43 | 1.1 | ∞ |
| Permittivity Target - tolerance | 5.0 | R | $\sqrt{3}$ | 0.49 | 1.4 | ∞ |
| Permittivity - measurement uncertainty | 2.5 | N | 1 | 0.49 | 1.2 | 5 |
| **Combined Standard Uncertainty** | | | | | **10.7** | **387** |
| **Expanded STD Uncertainty** | | | | | **21.4** | |

## 5.4. System Check Results

**System Performance Check at 450 MHz Head TSL**

DUT: Dipole450 MHz; Type: D450V3; Serial: 1061

Date/Time: 12/20/2012 10:05:01 AM

Communication System: DuiJiangJi; Frequency: 450 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 450 MHz; σ = 0.88 mho/m; ε r = 44.56; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(6.71, 6.71,6.71); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x131x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 1.89 W/kg

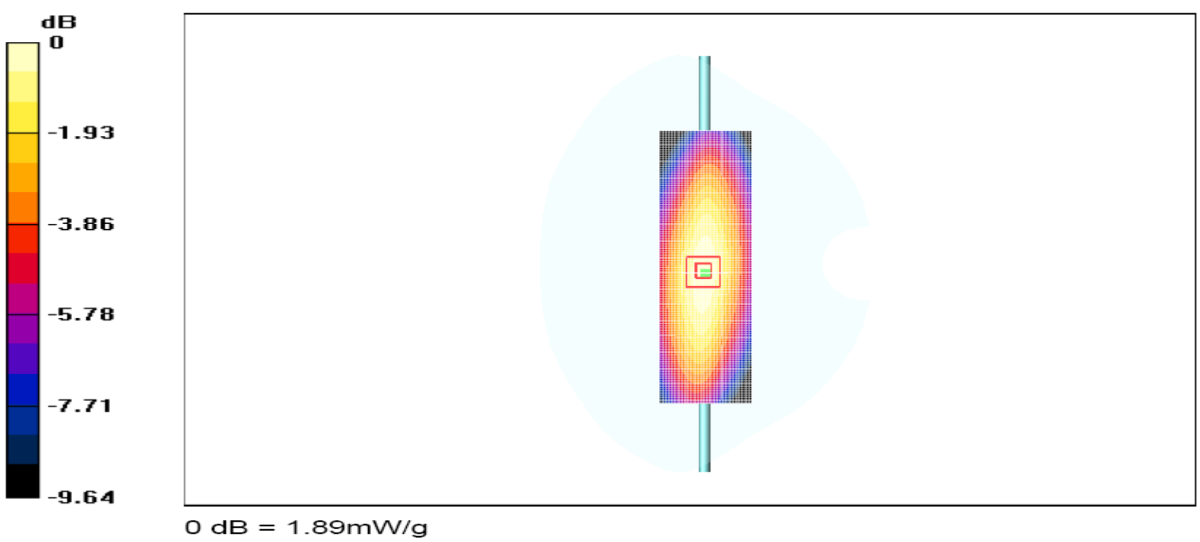
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 47.20 V/m; Power Drift = -0.028 dB

Peak SAR (extrapolated) = 2.87 mW/g

**SAR(1 g) = 1.83 mW/g; SAR(10 g) = 1.19 mW/g**

Maximum value of SAR (measured) =1.92 W/kg




System Performance Check 450MHz 398mW

**System Performance Check at 450 MHz Body TSL**

DUT: Dipole450 MHz; Type: D450V3; Serial: 1061

Date/Time: 12/20/2012 13:20:02 PM

Communication System: DuiJiangJi; Frequency: 450 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 450 MHz; σ = 0.93 mho/m; ε r = 55.56; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1,7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (61x221x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 1.9 W/kg

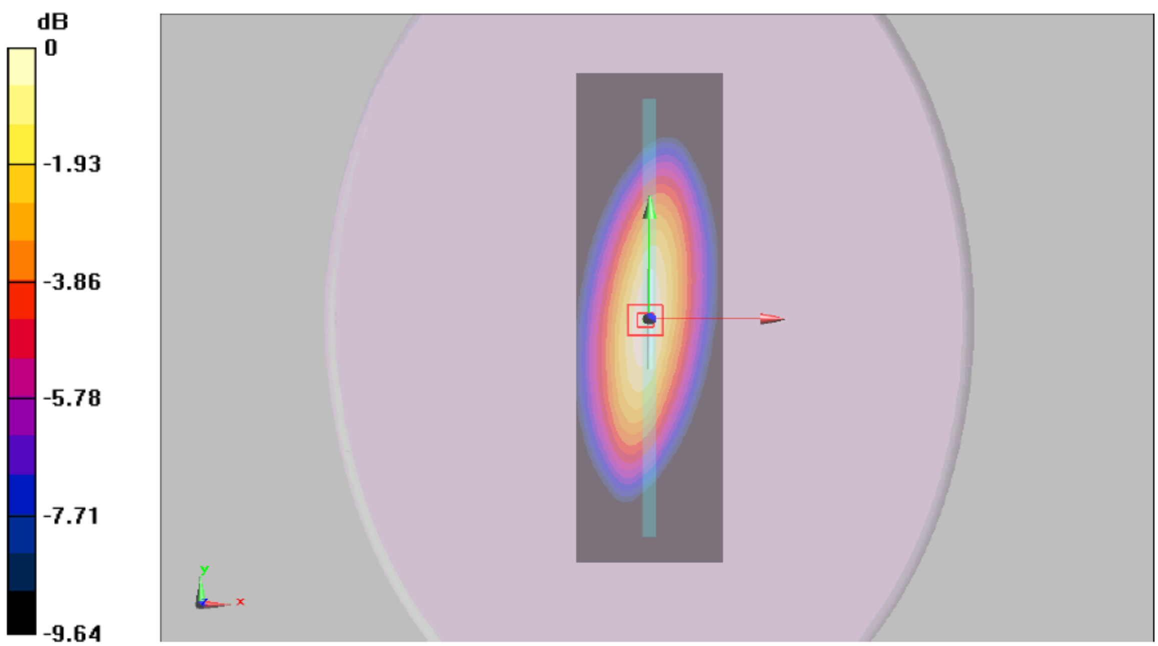
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 44.9 V/m; Power Drift = -0.014 dB

Peak SAR (extrapolated) = 2.64 mW/g

**SAR(1 g) = 1.78 mW/g; SAR(10 g) = 1.17 mW/g**

Maximum value of SAR (measured) =1.89 W/kg




0dB=1.8mW/g

System Performance Check 450MHz 398mW

## 5.5. Sar Test Graph Results

**Face Held for 12.5 KHz, Front towards Phantom 416 MHz**

Communication System: DuiJiangJi; Frequency: 416 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 416 MHz; σ = 0.86 mho/m; ε r = 44.63; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(6.71, 6.71, 6.71); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x131x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 2.48 W/kg

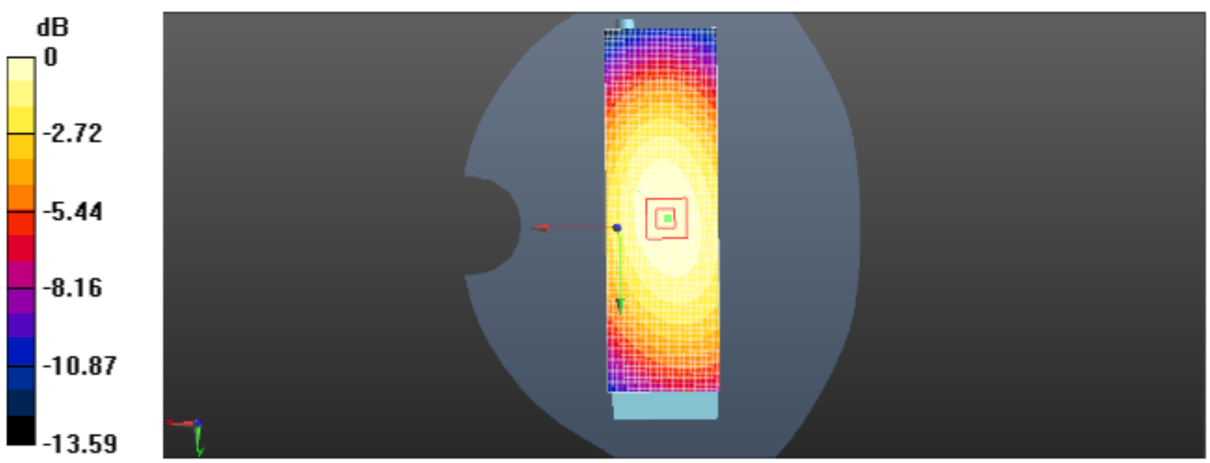
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 28.362 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 2.258 mW/g

**SAR(1 g) = 2.19 mW/g; SAR(10 g) = 1.27 mW/g**

Maximum value of SAR (measured) = 2.26 W/kg




0 dB = 2.48 W/kg = 7.90 dB W/kg

Figure 1: Face Held for 12.5 KHz, Front towards Phantom 416 MHz

**Body-worn for 12.5 KHz, Front towards Ground 400 MHz**

Communication System: DuiJiangJi; Frequency: 400 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 400 MHz; σ = 0.92 mho/m; ε r = 56.54; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =3.15 W/kg

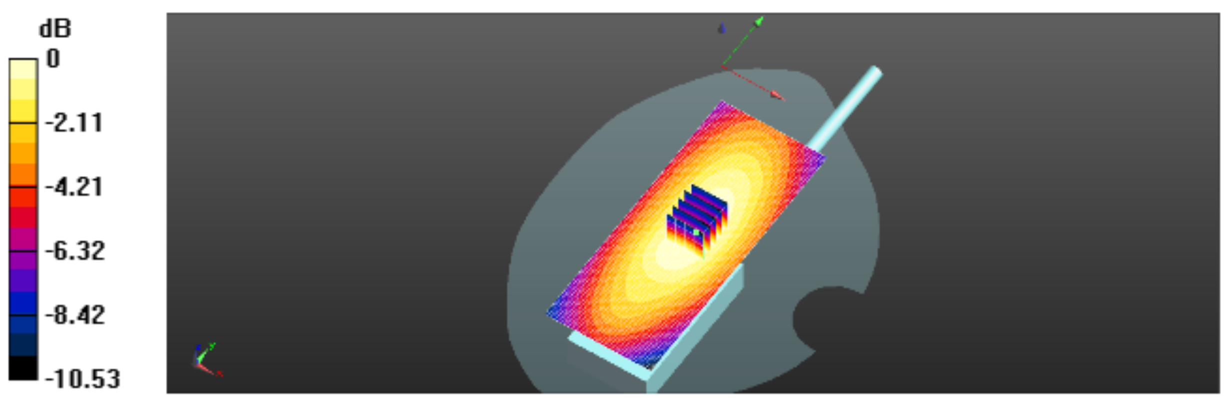
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 30.154 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 6.214 mW/g

**SAR(1 g) =3.20 mW/g; SAR(10 g) = 2.24 mW/g**

Maximum value of SAR (measured) = 3.09 W/kg




0 dB = 3.15 W/kg = 10.14 dB W/kg

Figure 2: Body-worn for 12.5 KHz, Front towards Ground 400 MHz

**Body-worn for 12.5 KHz, Front towards Ground 416 MHz**

Communication System: DuiJiangJi; Frequency: 416 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 416 MHz; σ = 0.92 mho/m; ε r = 56.54; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =4.75 W/kg

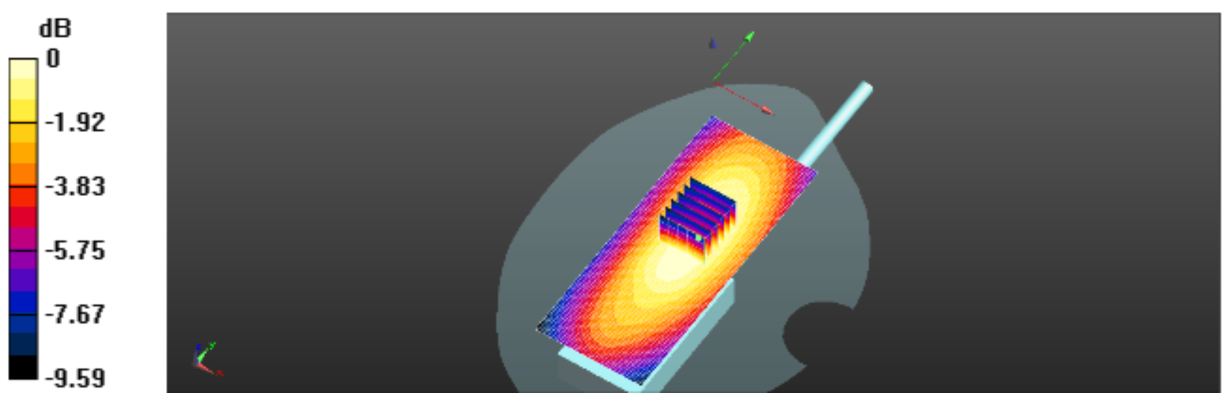
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 16.947 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 4.510 mW/g

**SAR(1 g) = 3.83 mW/g; SAR(10 g) = 2.74 mW/g**

Maximum value of SAR (measured) = 4.31 W/kg




0 dB = 4.75 W/kg = 15.58 dB W/kg

Figure 3: Body-worn for 12.5 KHz, Front towards Ground 416 MHz

**Body-worn for 12.5 KHz, Front towards Ground 432 MHz**

Communication System: DuiJiangJi; Frequency: 432 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 432 MHz; σ = 0.948 mho/m; ε r = 55.903; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =3.08 W/kg

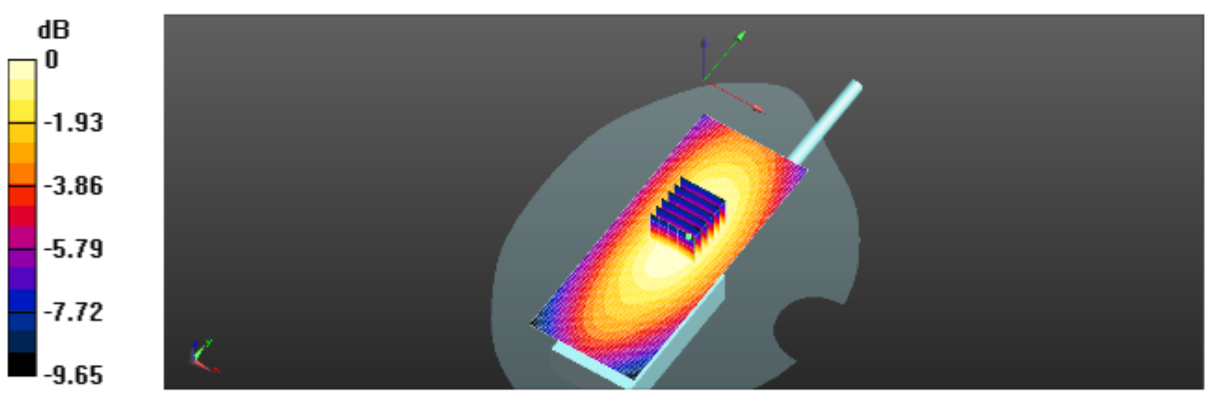
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 17.541 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 5.235 mW/g

**SAR(1 g) = 2.30 mW/g; SAR(10 g) = 1.96 mW/g**

Maximum value of SAR (measured) = 3.07 W/kg




0 dB = 3.08 W/kg = 14.92 dB W/kg

Figure 4: Body-worn for 12.5 KHz, Front towards Ground 432 MHz

**Body-worn for 12.5 KHz, Front towards Ground 448 MHz**

Communication System: DuiJiangJi; Frequency: 448 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 448 MHz; σ = 0.979 mho/m; ε r = 55.63; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =4.11 W/kg

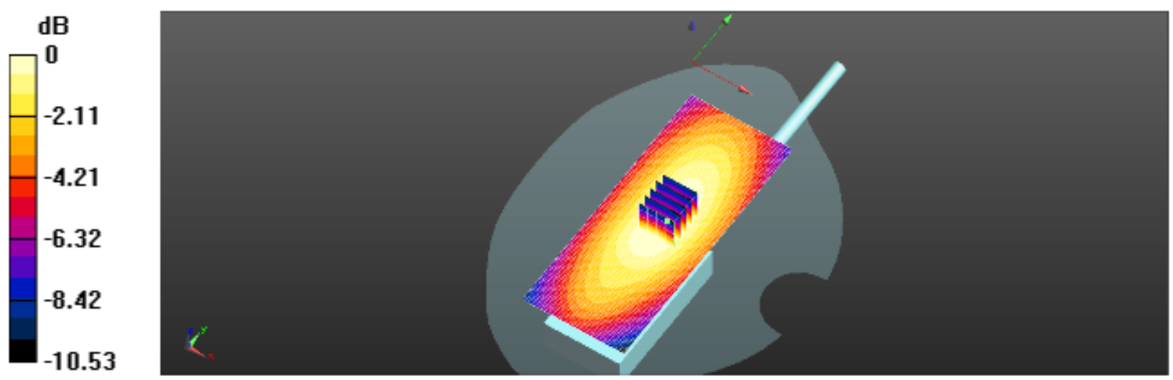
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 18.222 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) =5.241 mW/g

**SAR(1 g) = 3.05 mW/g; SAR(10 g) = 2.42 mW/g**

Maximum value of SAR (measured) = 4.03W/kg




0 dB = 4.11 W/kg = 14.53 dB W/kg

Figure 5: Body-worn for 12.5 KHz, Front towards Ground 448 MHz

**Body-worn for 12.5 KHz, Front towards Ground 464 MHz**

Communication System: DuiJiangJi; Frequency: 464 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 464 MHz; σ = 0.979 mho/m; ε r = 55.63; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =3.13 W/kg

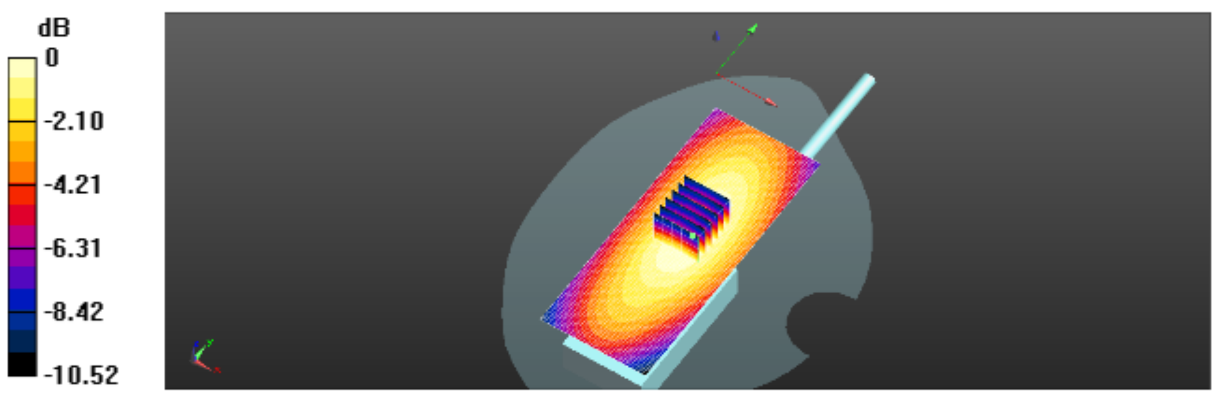
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 20.942 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 5.537 mW/g

**SAR(1 g) = 2.75 mW/g; SAR(10 g) = 1.32 mW/g**

Maximum value of SAR (measured) = 3.03 W/kg




0 dB = 3.13 W/kg = 12.25 dB W/kg

Figure 6: Body-worn for 12.5 KHz, Front towards Ground 464 MHz

**Body-worn for 12.5 KHz, Front towards Ground 480 MHz**

Communication System: DuiJiangJi; Frequency: 480 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 480 MHz; σ = 0.979 mho/m; ε r = 55.63; ρ = 1000 kg/m

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3292; ConvF(7.1, 7.1, 7.1); Calibrated: 24/02/2013

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 27/02/2013

Phantom: SAM 1; Type: SAM;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**Area Scan (41x101x1):** Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) =4.11 W/kg

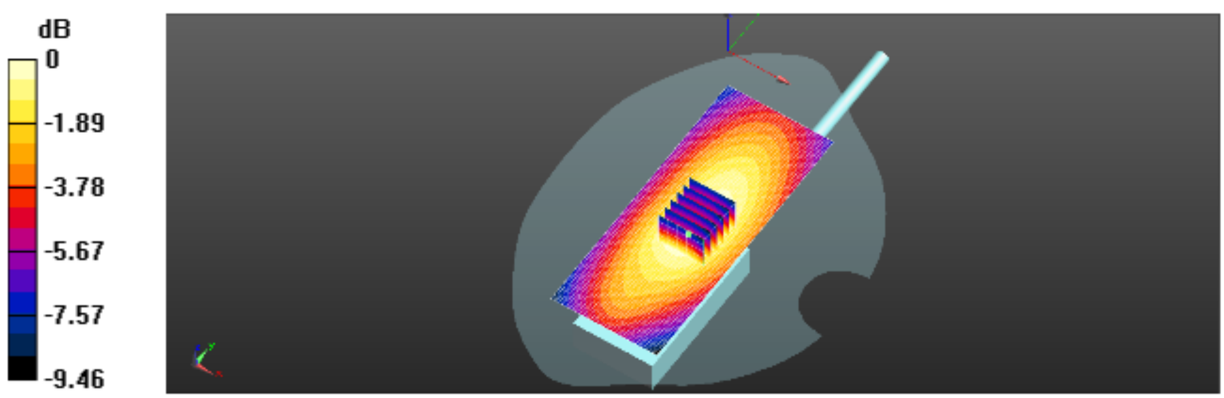
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 17.025 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 4.794 mW/g

**SAR(1 g) =3.03 mW/g; SAR(10 g) = 2.48 mW/g**

Maximum value of SAR (measured) = 4.21 W/kg




0 dB = 4.11 W/kg = 14.54 dB W/kg

Figure 7: Body-worn for 12.5 KHz, Front towards Ground 480 MHz

# 6. Calibration Certificate

## 6.1. Probe Calibration Ceriticate

**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** CIQ SZ (Auden)

**Certificate No:** ES3-3292_Feb13

# CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3292

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

Calibration date: February 24, 2013

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter E4419B | GB41293874 | 31-Mar-12 (No. 217-01372) | Apr-13 |
| Power sensor E4412A | MY41498087 | 31-Mar-12 (No. 217-01372) | Apr-13 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 29-Mar-12 (No. 217-01369) | Apr-13 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 29-Mar-12 (No. 217-01367) | Apr-13 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 29-Mar-12 (No. 217-01370) | Apr-13 |
| Reference Probe ES3DV2 | SN: 3013 | 29-Dec-12 (No. ES3-3013_Dec12) | Dec-13 |
| DAE4 | SN: 654 | 3-May-12 (No. DAE4-654_May12) | May-13 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-12) | In house check: Apr-13 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

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

Issued: February 27, 2013

**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**

## Glossary:

| | |
|---|---|
| TSL | tissue simulating liquid |
| NORMx,y,z | sensitivity in free space |
| ConvF | sensitivity in TSL / NORMx,y,z |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C | modulation dependent linearization parameters |
| 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) 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 $\vartheta = 0$ ($f \leq 900$ 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 affect 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 with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *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 ES3DV3

## SN:3292

Manufactured: July 6, 2010
Calibrated: February 24, 2013

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

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.81 | 0.90 | 1.18 | ± 10.1 % |
| DCP (mV)[B] | 105.9 | 104.7 | 102.0 | |

## Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 10000 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 117.3 | ±2.2 % |
| | | | Y | 0.00 | 0.00 | 1.00 | 94.2 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 108.2 | |

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

[A] The uncertainties of NormX,Y,Z do not affect the $E^2$-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 43.5 | 0.87 | 6.71 | 6.71 | 6.71 | 0.15 | 1.80 | ± 13.4 % |
| 835 | 41.5 | 0.90 | 6.06 | 6.06 | 6.06 | 0.26 | 2.19 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 6.03 | 6.03 | 6.03 | 0.29 | 2.00 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 5.25 | 5.25 | 5.25 | 0.80 | 1.17 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 5.21 | 5.21 | 5.21 | 0.63 | 1.38 | ± 12.0 % |
| 2100 | 39.8 | 1.49 | 5.15 | 5.15 | 5.15 | 0.80 | 1.20 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 4.47 | 4.47 | 4.47 | 0.63 | 1.50 | ± 12.0 % |

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

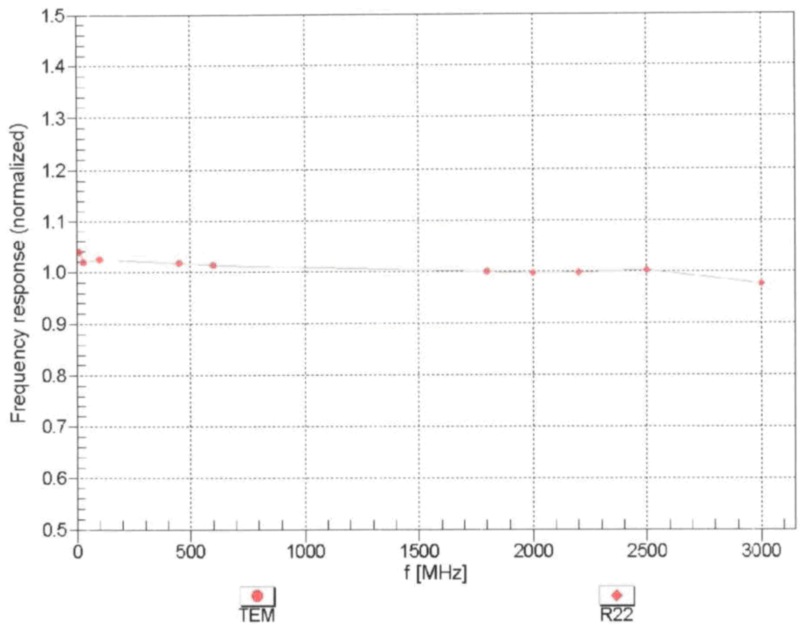
## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 450 | 56.7 | 0.94 | 7.10 | 7.10 | 7.10 | 0.09 | 1.00 | ± 13.4 % |
| 835 | 55.2 | 0.97 | 6.14 | 6.14 | 6.14 | 0.42 | 1.57 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 6.07 | 6.07 | 6.07 | 0.48 | 1.49 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 4.86 | 4.86 | 4.86 | 0.62 | 1.42 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 4.66 | 4.66 | 4.66 | 0.47 | 1.75 | ± 12.0 % |
| 2100 | 53.2 | 1.62 | 4.76 | 4.76 | 4.76 | 0.70 | 1.39 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 4.25 | 4.25 | 4.25 | 0.80 | 1.03 | ± 12.0 % |

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

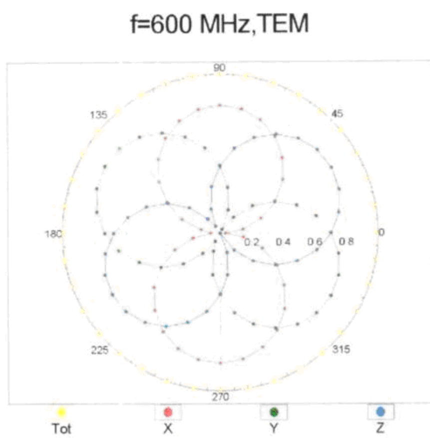
# Frequency Response of E-Field

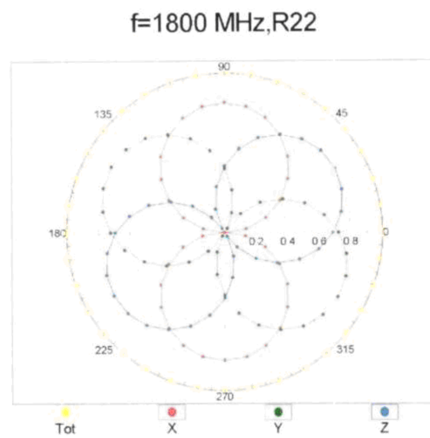
**(TEM-Cell:ifi110 EXX, Waveguide: R22)**

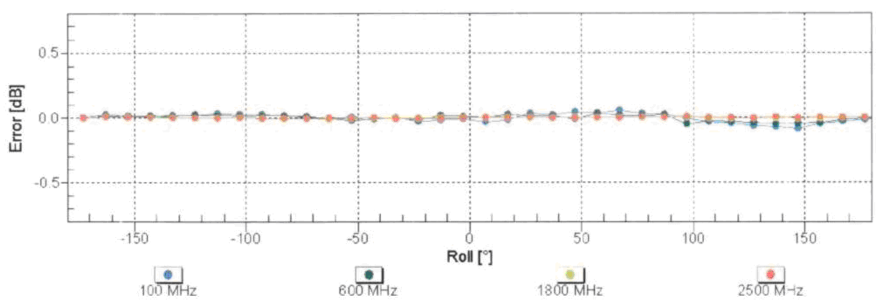



**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

# Receiving Pattern (ϕ), ϑ = 0°

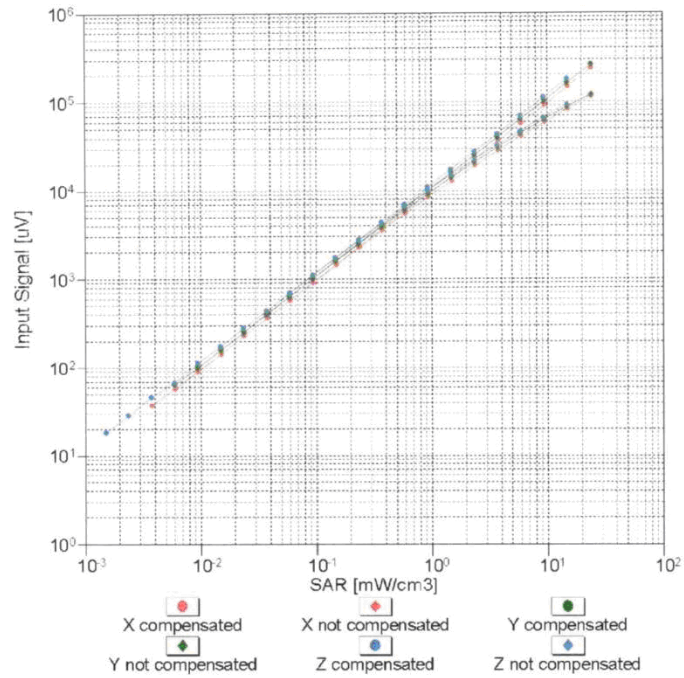


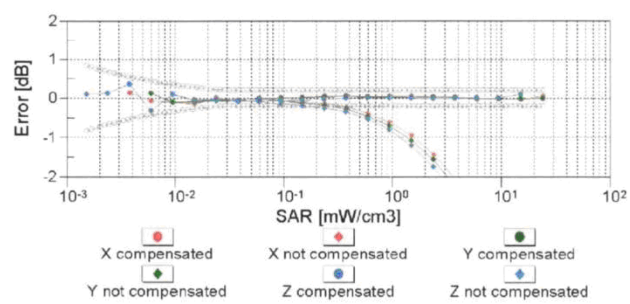




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

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



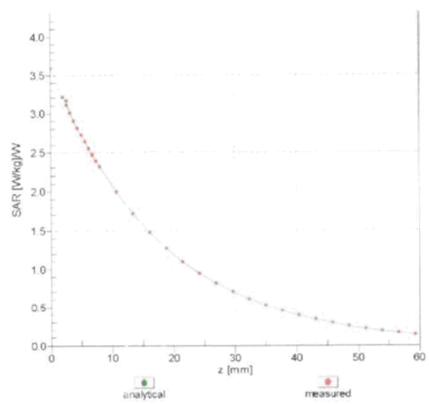




**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

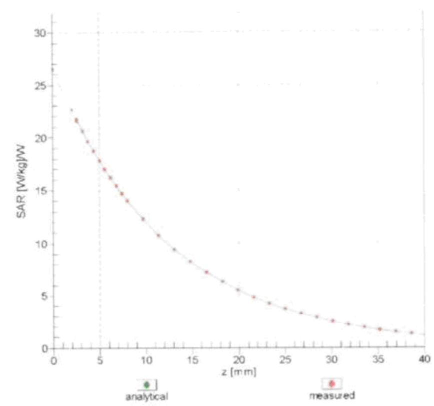
ES3DV3– SN:3292 February 24, 2013

# Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

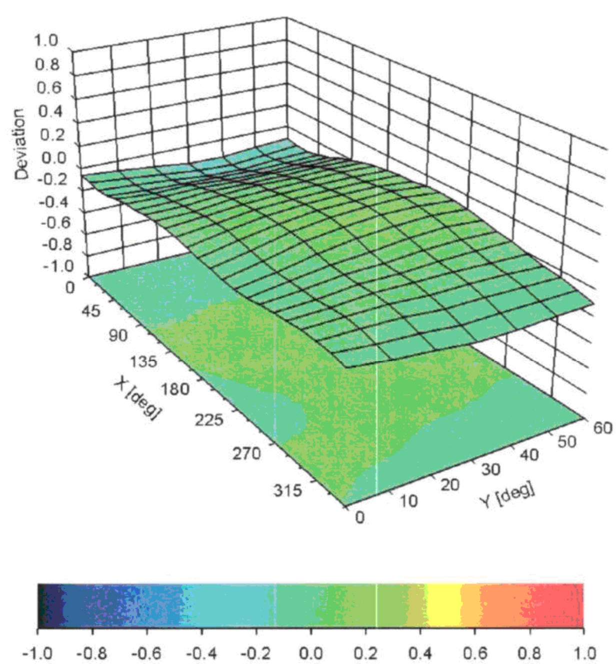



f = 1810 MHz,WGLS R22 (H_convF)




# Deviation from Isotropy in Liquid

**Error (ϕ, ϑ), f = 900 MHz**




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

# DASY/EASY - Parameters of Probe: ES3DV3 - SN:3292

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | Not applicable |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 10 mm |
| Tip Diameter | 4 mm |
| Probe Tip to Sensor X Calibration Point | 2 mm |
| Probe Tip to Sensor Y Calibration Point | 2 mm |
| Probe Tip to Sensor Z Calibration Point | 2 mm |
| Recommended Measurement Distance from Surface | 3 mm |

## 6.2. D450V3 Dipole Calibration Ceriticate

**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 **SMQ (Auden)**

Certificate No: **D450V3-1061_Sep10**

# CALIBRATION CERTIFICATE

Object: D450V3 - SN: 1061

Calibration procedure(s): QA CAL-15.v5
Calibration Procedure for dipole validation kits below 800 MHz

Calibration date: September 11, 2012

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 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41495277 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Power sensor E4412A | MY41498087 | 1-Apr-10 (No. 217-01136) | Apr-11 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 30-Mar-10 (No. 217-01159) | Mar-11 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 30-Mar-10 (No. 217-01161) | Mar-11 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 30-Mar-10 (No. 217-01162) | Mar-11 |
| Reference Probe ET3DV6 | SN: 1507 | 30-Apr-10 (No. ET3-1507_Apr10) | Apr-11 |
| DAE4 | SN: 654 | 23-Apr-10 (No. DAE4-654_Apr10) | Apr-11 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator HP 8648C | US3642U01700 | 04-Aug-99 (in house check Oct-09) | In house check: Oct-11 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-09) | In house check: Oct-10 |

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

Issued: September 11, 2012

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

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

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

Accreditation No.: **SCS 108**

**Glossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConF | 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) 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
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.