

FCC SAR TEST REPORT

FOR

| | | |
|-----------------------------|---|--|
| Applicant | : | Giant Telecom Limited |
| Address | : | 33/F, AIA Kowloon Tower, Landmark East, 100 How Ming Street, Kwun Tong , Kowloon |
| Equipment under Test | : | Two-way radio |
| Model No | : | R500 |
| Trade Mark | : | OLYMPIA |
| FCC ID | : | RAQLYAE |
| Manufacturer | : | DONGGUAN WISETRONICS TELECOM EQUIPMENT CO. LTD |
| Address | : | Elite Industrial City, Melin District, Dailing Mount Town, Dongguan Guangdong, China |

Issued By: Dongguan Dongdian Testing Service Co., Ltd.

Add: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808

Tel: +86-0769-22891499 [Http://www.dgddt.com](http://www.dgddt.com)

REPORT

TEST REPORT DECLARE

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We Declare:

The equipment described above is evaluation by Dongguan Dongdian Testing Service Co., Ltd and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and Dongguan Dongdian Testing Service Co., Ltd is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above standards.

| | | | |
|----------------------|-----------------------|------------------------|-----------|
| Report No: | DDT-RE140475 | | |
| Date of Test: | 2014/05/25~2014/05/25 | Date of Report: | 2014/5/27 |

Prepared By:

*Leo Liu/Engineer**Approved By:**Jamy Yu/EMC Manager*

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan Dongdian Testing Service Co., Ltd.

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1. TEST STANDARDS/PROCEDURES REFERENCE/FCC KDBs

The tests were performed according to following standards:

[IEEE 1528-2003 \(2003-04\)](#): Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques:

[IEEE 1528-2013 \(2014-06\)](#): Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques

[RSS-102 Issue 4 \(2010-03\)](#): Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

[Canada's Safety Code No. 6 \(99-EHD-237\)](#): Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3 kHz to 300 GHz

[IEEE Std. C95-3 \(2002\)](#): IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave

[IEEE Std. C95-1 \(1992\)](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

[IEC 62209-2 \(2010\)](#): Human exposure to radio frequency fields from hand-held and bodymounted wireless communication devices. Human models, instrumentation, and procedures. Procedure to determine the specific absorption rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)

[KDB 865664D01v01r03 \(February 7, 2014\)](#): SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB 865664D02v01r01 \(May 28, 2013\)](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB 447498D01v05r02 \(February 7, 2014\)](#): Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies

2. SUMMARY

2.1. General Remarks

| | |
|-----------------------------|---|
| EUT* Name | : Two-way radio |
| Model Number | : R500 |
| Trade Mark | : OLYMPIA |
| EUT function description | : Please reference user manual of this device |
| Power supply | : DC 3.6V/4.5V from battery or DC 5V from power adapter for charge |
| Operation frequency range | : GMRS:462.55MHz-462.7250MHz; 467.5500MHz-467.7250MHz FRS: 467.5625MHz-467.7125MHz |
| Modulation type | : FM |
| Max Tx deviation | : 2.5KHz |
| Emission type | : F3E |
| Maximum Reported SAR Values | : Head: 0.502 W/Kg(50% Duty Cycle) Body: 0.594 W/Kg(50% Duty Cycle) |
| Antenna Type | : Integrated |
| Date of Receipt | : 2014/05/06 |
| Sample Type | : Series production |
| Exposure category: | : General population / Uncontrolled environment |

Note1: EUT is the ab.of equipment under test.

2.2. Accessories of EUT

| Description of Accessories | Manufacturer | Model number or Type | Serial No. | Other |
|----------------------------|------------------------------------|----------------------|------------|---------------|
| Power adapter | HSK Electronics Technology Co.,Ltd | HSK-SAD0900200 | / | Power adapter |
| Earphone | / | / | / | 1.2m |

2.3. Short description of the Equipment under Test (EUT)

PMR Radio;

The spatial peak SAR values were assessed for systems. Battery and accessories shell be specified by the manufacturer. Peak SAR value for EUT with both 4.5V Alkaline Battery and rechargeable battery pack had been scanned and final test will be performed with the battery having the highest peak SAR. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

2.4. TEST Configuration

Face-Held Configuration

Face-held Configuration- per FCC KDB447498 page 22: "A test separation distance of 25 mm must be applied for in-front-of the face SAR test exclusion and SAR measurements."

Body-worn Configuration

Body-worn measurements-per FCC KDB447498 page 22 "When body-worn accessory SAR testing is required, the body-worn accessory requirements in section 4.2.2 should be applied. PTT two-way radios that support held-to-ear operating mode must also be tested according to the exposure configurations required for handsets. This generally does not apply to cellphones with PTT options that have already been tested in more conservative configurations in applicable wireless modes for SAR compliance at 100% duty factor."

| CH # | FREQ (MHz) | CODE | TYPE | CH # | FREQ (MHz) | CODE | TYPE |
|------|------------|------|------|------|------------|------|------|
| 1 | 462.5625 | ANY | GMRS | 26 | 462.7125 | 29 | GMRS |
| 2 | 462.5875 | ANY | GMRS | 27 | 462.55 | 26 | GMRS |
| 3 | 462.6125 | ANY | GMRS | 28 | 462.6 | 23 | GMRS |
| 4 | 462.6375 | ANY | GMRS | 29 | 462.65 | 20 | GMRS |

| CH # | FREQ (MHz) | CODE | TYPE | CH # | FREQ (MHz) | CODE | TYPE |
|------|------------|------|---------|------|------------|------|---------|
| 5 | 462.6625 | ANY | GMRS | 30 | 462.7 | 17 | GMRS |
| 6 | 462.6875 | ANY | GMRS | 31 | 462.5875 | 39 | GMRS |
| 7 | 462.7125 | ANY | GMRS | 32 | 462.6375 | 42 | GMRS |
| 8 | 467.5625 | ANY | FRS | 33 | 462.6875 | 45 | GMRS |
| 9 | 467.5875 | ANY | FRS | 34 | 467.5625 | 48 | FRS |
| 10 | 467.6125 | ANY | FRS | 35 | 467.6125 | 51 | FRS |
| 11 | 467.6375 | ANY | FRS | 36 | 467.6625 | 54 | FRS |
| 12 | 467.6625 | ANY | FRS | 37 | 467.7125 | 57 | FRS |
| 13 | 467.6875 | ANY | FRS | 38 | 462.575 | 60 | GMRS |
| 14 | 467.7125 | ANY | FRS | 39 | 462.625 | 63 | GMRS |
| 15 | 462.55 | ANY | GMRS | 40 | 462.675 | 66 | GMRS |
| 16 | 462.575 | ANY | GMRS | 41 | 462.725 | 69 | GMRS |
| 17 | 462.6 | ANY | GMRS | 42 | 462.5625 | 14 | GMRS |
| 18 | 462.625 | ANY | GMRS | 43 | 462.6125 | 11 | GMRS |
| 19 | 462.65 | ANY | GMRS | 44 | 462.6625 | 8 | GMRS |
| 20 | 462.675 | ANY | GMRS | 45 | 462.7125 | 5 | GMRS |
| 21 | 462.7 | ANY | GMRS | 46 | 462.55 | 2 | GMRS |
| 22 | 462.725 | ANY | GMRS | 47 | 462.6 | 37 | GMRS |
| 23 | 462.5625 | 38 | GMRS | 48 | 462.65 | 34 | GMRS |
| 24 | 462.6125 | 35 | GMRS | 49 | 462.7 | 31 | GMRS |
| 25 | 462.6625 | 32 | GMRS | 50 | 462.5875 | 40 | GMRS |
| 15R | 462.5500 | ANY | RX GMRS | 16R | 462.5750 | ANY | RX GMRS |
| | 467.550 | ANY | TX GMRS | | 467.5750 | ANY | TX GMRS |
| 17R | 462.6000 | ANY | RX GMRS | 18R | 462.6250 | ANY | RX GMRS |
| | 467.6000 | ANY | TX GMRS | | 467.6250 | ANY | TX GMRS |
| 19R | 462.6500 | ANY | RX GMRS | 20R | 462.6750 | ANY | RX GMRS |
| | 467.6500 | ANY | TX GMRS | | 467.7000 | ANY | TX GMRS |
| 21R | 462.7000 | ANY | RX GMRS | 22R | 462.7250 | ANY | RX GMRS |
| | 467.7000 | ANY | TX GMRS | | 467.7250 | ANY | TX GMRS |

Note: From channel 23 to channel 50 have repeated frequency with channel 1 to channel 22, and only have different code. Channel 4, channel 11 and channel 17R were chosen for test. 15R to 22R are repeater mode channel, only have difference Rx channel and Tx channel, all other parameters as power, modulation type are same with normal mode.

Note2: In normal work, this device can be powered by 3.6V NiMH battery or 4.5V by AA battery and according to explorer test, when transmitting with 4.5V AA battery have maximum RF power and SAR result, so the final test was performed with 4.5V AA battery.

2.5. 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.

2.6. EUT configuration

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

● - supplied by the manufacturer

○ - supplied by the lab

| | | |
|-----------------------------------|--------------|---|
| <input type="radio"/> Power Cable | Length (m) : | / |
|-----------------------------------|--------------|---|

| | | | |
|---|------------|----------------|---|
| | | Shield : | / |
| | | Detachable : | / |
| ○ | Multimeter | Manufacturer : | / |
| | | Model No. : | / |

Battery1#: Model: KEBT-650
3XAA 3.6V-650mAh

Battery2#: Model: DURACELL ULTRA MX1500 LR6
3XAA 1.5V Alkaline Battery

3. TEST ENVIRONMENT

3.1. Address of the test laboratory

The test was subcontracted to The Testing and Technology Center for Industrial Products of Shenzhen Entry-Exit Inspection and Quarantine Bureau
No.289, 8th Industry Road, Nanshan District, Shenzhen, Guangdong, China

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

3.2. Environmental conditions

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

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

3.3. 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).

3.4. Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|-----------------------------------|--------------|------------|---------------|------------------|----------------------|
| | | | | Last Calibration | Calibration Interval |
| Data Acquisition Electronics DAEx | SPEAG | DAE4 | 1315 | 2013/11/25 | 1 |
| E-field Probe | SPEAG | EX3DV4 | 3842 | 2013/06/06 | 1 |
| System Validation Dipole D450V3 | SPEAG | D450V3 | 1079 | 2013/02/28 | 2 |
| Network analyzer | Agilent | 8753E | US37390562 | 2013/03/26 | 1 |
| Dielectric Probe Kit | Agilent | 85070E | US44020288 | / | / |
| Power meter | Agilent | E4417A | GB41292254 | 2013/12/26 | 1 |
| Power sensor | Agilent | 8481H | MY41095360 | 2013/12/26 | 1 |
| Signal generator | IFR | 2032 | 203002/100 | 2013/10/25 | 1 |
| Amplifier | AR | 75A250 | 302205 | 2013/10/26 | 1 |

Note:

Diploe Annual Check Result

Per KDB 865664 Dipole SAR Validation Verification, system validation Dipole D450V3 adopted 2 years calibration intervals on annual basis, and has been evaluated and is in compliance with the following criteria:

1. There is no physical damage on the dipole.
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss is within 20% of calibrated measurement;
4. Impedance is within 5ohm of calibrated measurement

Date: May. 21, 2014

| Dipole | Liquid Type | Return-loss(dB) | | | Impedance | | |
|--------|-------------|-----------------|----------------|-----------|------------------------------|------------------------------|------------------------------|
| | | Target Value | Measured Value | Deviation | Target Value | Measured Value | Deviation |
| D450V3 | Head | -21.0 | -21.45 | 2.14 | 59.8 Ω -0.5j Ω | 58.1 Ω -1.2j Ω | 1.7 Ω +0.7j Ω |
| | Body | -21.7 | -22.23 | 2.44 | 56.4 Ω -5.9j Ω | 57.2 Ω -6.3j Ω | -0.8 Ω +0.4j Ω |

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.

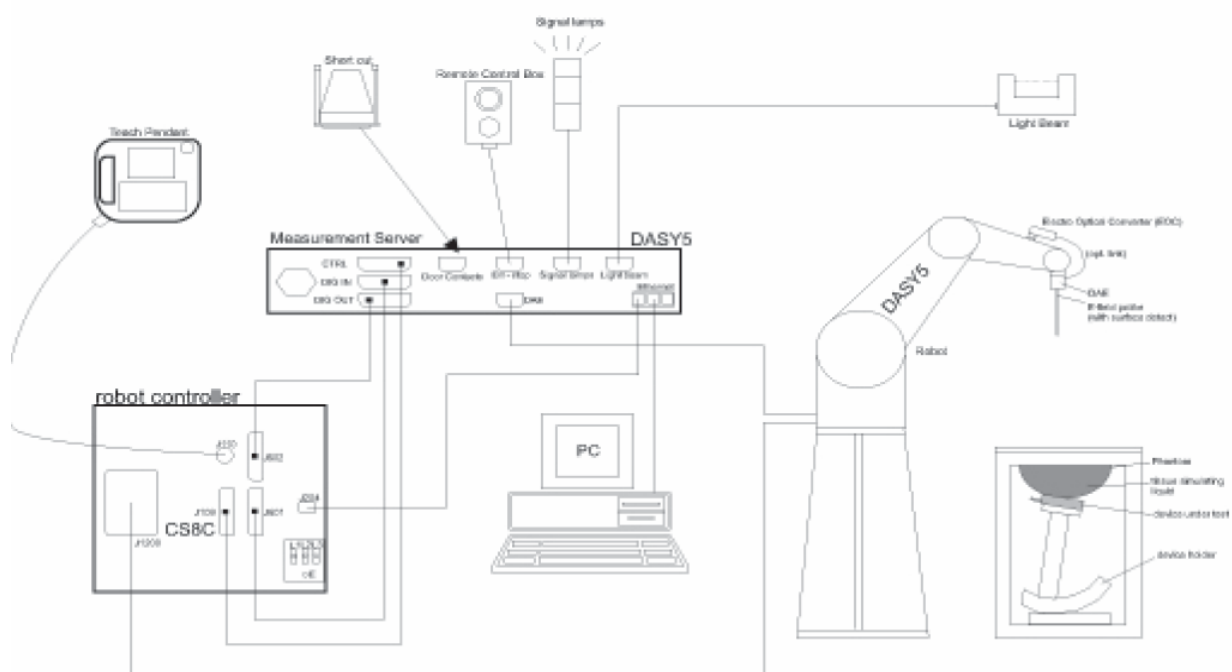
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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

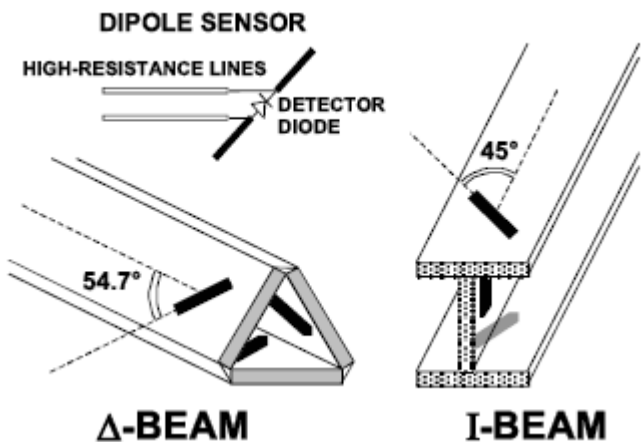
| | |
|---------------|--|
| Construction | Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | ISO/IEC 17025 calibration service available. |
| Frequency | 10 MHz to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

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 $\pm 0.1\text{mm}$). 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 $\pm 30^\circ$.)

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 $15\text{ mm} \times 15\text{ mm}$ 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 $7 \times 7 \times 7$ 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 $7 \times 7 \times 7$ 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 $7 \times 7 \times 7$ 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 | V_i | = compensated signal of channel i | (i = x, y, z) |
| | U_i | = input signal of channel i | (i = x, y, z) |
| | cf | = crest factor of exciting field | (DASY parameter) |
| | dcp _i | = diode compression point | (DASY parameter) |

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

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

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

| | | | |
|------|-------|---|---------------|
| With | V_i | = 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 |
| | E _{tot} | = total field strength in V/m |
| | σ | = conductivity in [mho/m] or [Siemens/m] |
| | ρ | = equivalent tissue density in g/cm ³ |

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

4.7. SAR Measurement System

The SAR measurement system being used is the DASY5 system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

4.7.1 Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case. It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

| Target Frequency | Head | | Body | |
|------------------|--------------|----------------|--------------|----------------|
| (MHz) | ϵ_r | σ (S/m) | ϵ_r | σ (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 |

(ϵ_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m³)

4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid.

Table 3: Dielectric Performance of Body Tissue Simulating Liquid

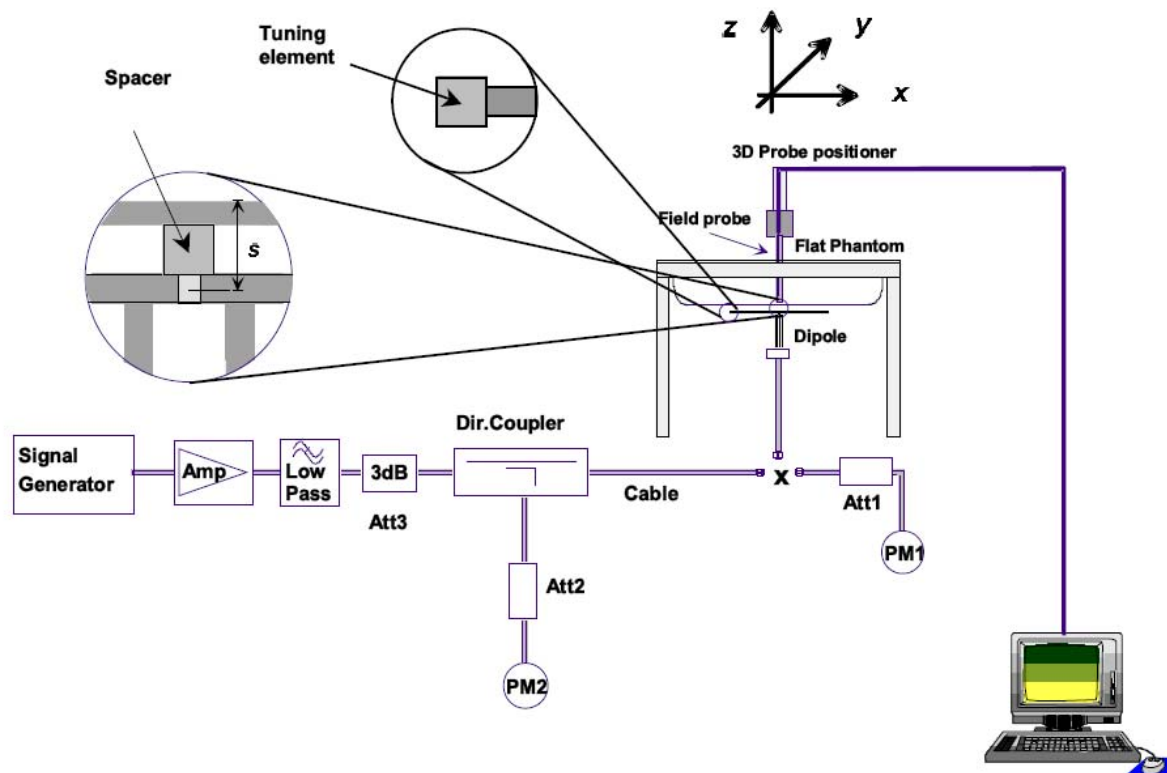
| Frequency | Description | Dielectric parameters | |
|--------------|---------------------------------|------------------------|---------------------|
| | | ϵ_r | σ |
| 450MHz(Head) | Target Value $\pm 5\%$ | 43.50 (41.33-45.68) | 0.87 (0.83-0.91) |
| | Measurement Value 2014-05-25 | 43.95 | 0.85 |
| 450MHz(Body) | Target Value $\pm 5\%$ | 56.70 (53.87-59.54) | 0.94 (0.89-0.99) |
| | Measurement Value 2014-05-25 | 56.25 | 0.92 |

4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the device 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 ($\pm 10\%$).

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



The output power on dipole port must be calibrated to 26 dBm (398mW) before dipole is connected.



System Validation of Head

| Measurement is made at temperature 22.0 °C and relative humidity 55%. | | | | | | | |
|---|-----------------|---------------------|--------------|-----------------------|--------------|-------------|--------------|
| Tissue temperature 22.0 °C | | | | | | | |
| Measurement Date: 450 MHz May 25 th | | | | | | | |
| Verification results | Frequency (MHz) | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
| | | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average |
| | 450 | 1.21 | 1.81 | 1.15 | 1.72 | -4.96% | -4.94% |

System Validation of Body

| Measurement is made at temperature 22.0 °C and relative humidity 55%. | | | | | | | |
|---|-----------------|---------------------|--------------|-----------------------|--------------|-------------|--------------|
| Tissue temperature 22.0 °C | | | | | | | |
| Measurement Date: 450 MHz May 25 th | | | | | | | |
| Verification results | Frequency (MHz) | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
| | | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average |
| | 450 | 1.16 | 1.74 | 1.09 | 1.66 | -6.03% | -4.60% |

4.10. SAR measurement procedure

4.10.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes with the battery having the highest peak SAR shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in Picture 11.1.

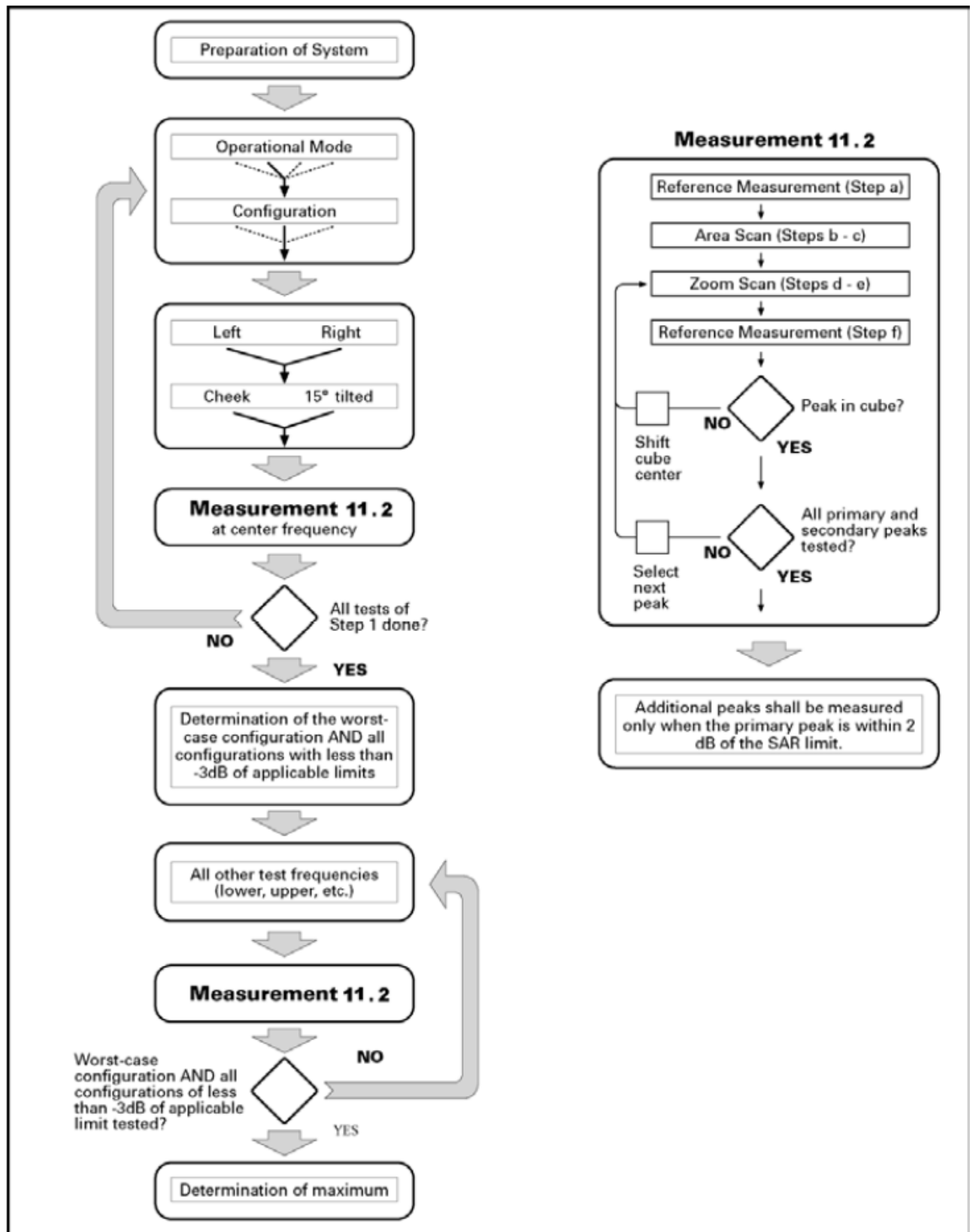
Step 1: The tests described in 11.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

- a). all device positions (cheek and tilt, for both left and right sides of the SAM phantom;
- b). all configurations for each device position in a), e.g., antenna extended and retracted, and
- c). all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c > 3$), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 11.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.



Picture 10.1 Block diagram of the tests to be performed

4.10.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements,

according to the reference distribution functions specified in IEEE Std 1528-2003. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

| | | | | |
|--|------------------------------------|--|--|---|
| | | | ≤ 3 GHz | > 3 GHz |
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | | 5 ± 1 mm | $\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | | | $30^\circ \pm 1^\circ$ | $20^\circ \pm 1^\circ$ |
| Maximum area scan spatial resolution: Δx_{Area} , Δy_{Area} | | | ≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm |
| | | | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be \leq the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |
| Maximum zoom scan spatial resolution: Δx_{Zoom} , Δy_{Zoom} | | | ≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1 st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm |
| Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. | | | | |
| * When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz. | | | | |

4.10.3 Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.11 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

4.10.4 Area Scan Based 1-g SAR

4.10.4.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

5. TEST CONDITIONS AND RESULTS

5.1. Conducted Power Results

According KDB 447498 D01 General RF Exposure Guidance v05r01 Section 4.1 2) states that “Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE. When an antenna port is not available on the device to support conducted power measurement, such as FRS and certain Part 15 transmitters with built-in integral antennas, the maximum output power allowed for production units should be used to determine RF exposure test exclusion and compliance.”

| Mode/ Modulation Type | Test Frequency (MHz) | ERP (dBm) |
|-----------------------|----------------------|-----------|
| FRS/FM | CH11:467.6375 | 23.66 |
| GMRS/FM | CH4: 462.6375 | 29.88 |
| GMRS/FM | CH17R:467.6000MHz | 29.68 |

Manufacturing tolerance

| GMRS CH4 | |
|-----------------|-------------|
| Test Frequency | 462.6375MHz |
| Target (dBm) | 29.00 (ERP) |
| Tolerance ±(dB) | ±1.00 |
| FRS | |
| Test Frequency | 467.6375MHz |
| Target (dBm) | 23.00 (ERP) |
| Tolerance ±(dB) | ±1.00 |
| GMRS CH17R | |
| Test Frequency | 467.600MHz |
| Target (dBm) | 29.00 (ERP) |
| Tolerance ±(dB) | ±1.00 |

5.2. Test reduction procedure

The maximum power level, $P_{\max,m}$, that can be transmitted by a device before the SAR averaged over a mass, m , exceeds a given limit, SAR_{\lim} , can be defined. Any device transmitting at power levels below $P_{\max,m}$ can then be excluded from SAR testing. The lowest possible value for $P_{\max,m}$ is: $P_{\max,m} = SAR_{\lim} * m$.

5.3. SAR Measurement Results

SAR Values -Head

| Test Frequency | | Mode/ Band | Maximum Allowed Power (dBm) | ERP (dBm) | Test Config. | Measurement SAR over 1g(W/kg) | | Power drift | Scaling Factor | Reported SAR over1g (W/kg) | | SAR limit 1g (W/kg) | Ref. Plot # |
|----------------|----------|---------------|--------------------------------------|--------------|-----------------|-------------------------------------|----------------------|----------------|-------------------|----------------------------------|----------------------|------------------------------|-------------------|
| Chann. | MHz | | | | | 100% Duty Cycle | 50% Duty Cycle | | | 100% Duty Cycle | 50% Duty Cycle | | |
| 4 | 462.6375 | PTT/GMRS | 30.00 | 29.88 | Face Held | 0.944 | 0.472 | -0.12 | 1.03 | 0.972 | 0.486 | 1.60 | 1 |
| 11 | 467.6375 | PTT/FRS | 24.00 | 23.66 | Face Held | 0.655 | 0.328 | -0.34 | 1.08 | 0.707 | 0.354 | 1.60 | 3 |
| 17R | 467.6000 | PTT/GMRS | 30 | 29.68 | Face Held | 0.930 | 0.465 | -0.32 | 1.08 | 1.004 | 0.502 | 1.60 | 2 |

SAR Values -Body

| Test Frequency | | Mode/ Band | Maximum Allowed Power (dBm) | ERP (dBm) | Test Config. | Measurement SAR over 1g(W/kg) | | Power drift | Scaling Factor | Reported SAR over1g (W/kg) | | SAR limit 1g (W/kg) | Ref. Plot # |
|----------------|----------|---------------|--------------------------------------|--------------|-----------------|-------------------------------------|----------------------|----------------|-------------------|----------------------------------|----------------------|------------------------------|-------------------|
| Chann. | MHz | | | | | 100% Duty Cycle | 50% Duty Cycle | | | 100% Duty Cycle | 50% Duty Cycle | | |
| 4 | 462.6375 | PTT/GMRS | 30.00 | 29.88 | Body Worn | 1.116 | 0.558 | -0.12 | 1.03 | 1.149 | 0.575 | 1.60 | 4 |
| 11 | 467.6375 | PTT/FRS | 24.00 | 23.66 | Body Worn | 0.848 | 0.424 | -0.34 | 1.08 | 0.916 | 0.458 | 1.60 | 5 |

| | | | | | | | | | | | | | |
|-----|----------|----------|----|-------|-----------|------|------|-------|------|-------|-------|------|---|
| 17R | 467.6000 | PTT/GMRS | 30 | 29.68 | Body Worn | 1.10 | 0.55 | -0.32 | 1.08 | 1.188 | 0.594 | 1.60 | 6 |
|-----|----------|----------|----|-------|-----------|------|------|-------|------|-------|-------|------|---|

Note: 1.Body Worn test configuration was state Towards Ground with belt clip&Headset.

5.4. SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. The following procedures are applied to determine if repeated measurements are required.

- 1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps 2) through 4) do not apply.
- 2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.
- 3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

5.5. Measurement Uncertainty(300MHz-3GHz)

| According to IEEE 1528/2011 and IEC62209-1/2011 | | | | | | | | | | |
|---|---|------|-------------------|-----------------------|------------|---------|----------|----------------|-----------------|-------------------|
| No. | Error Description | Type | Uncertainty Value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
| Measurement System | | | | | | | | | | |
| 1 | Probe calibration | B | 5.50% | N | 1 | 1 | 1 | 5.50% | 5.50% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.90% | 3.90% | ∞ |
| 4 | Boundary Effects | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.70% | 2.70% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 7 | RF ambient conditions-noise | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 8 | RF ambient conditions-reflection | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Response time | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 10 | Integration time | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| 11 | RF ambient | B | 3.00% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.40% | R | $\sqrt{3}$ | 1 | 1 | 0.20% | 0.20% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 2.90% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 14 | Max.SAR evalation | B | 3.90% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |

| Test Sample Related | | | | | | | | | | |
|--|--|---|-------|---|------------|------|------|--------|--------|----------|
| 15 | Test sample positioning | A | 1.86% | N | 1 | 1 | 1 | 1.86% | 1.86% | ∞ |
| 16 | Device holder uncertainty | A | 1.70% | N | 1 | 1 | 1 | 1.70% | 1.70% | ∞ |
| 17 | Drift of output power | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| Phantom and Set-up | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.00% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| 19 | Liquid conductivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 20 | Liquid conductivity (meas.) | A | 0.50% | N | 1 | 0.64 | 0.43 | 0.32% | 0.26% | ∞ |
| 21 | Liquid permittivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 22 | Liquid permittivity (meas.) | A | 0.16% | N | 1 | 0.64 | 0.43 | 0.10% | 0.07% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 10.20% | 10.00% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 20.40% | 20.00% | ∞ |

| According to IEC62209-2/2010 | | | | | | | | | | |
|------------------------------|-------------------------------------|------|-------------------|-----------------------|------------|---------|----------|----------------|-----------------|-------------------|
| No. | Error Description | Type | Uncertainty Value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
| Measurement System | | | | | | | | | | |
| 1 | Probe calibration | B | 6.20% | N | 1 | 1 | 1 | 6.20% | 6.20% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.90% | 3.90% | ∞ |
| 4 | Boundary Effects | B | 2.00% | R | $\sqrt{3}$ | 1 | 1 | 1.20% | 1.20% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.70% | 2.70% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 7 | RF ambient conditions-noise | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 8 | RF ambient conditions-reflection | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Response time | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 10 | Integration time | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| 11 | RF ambient | B | 3.00% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |

| | | | | | | | | | | |
|--|---|---|-------|---|------------|------|------|--------|--------|----------|
| 13 | Probe positioning with respect to phantom shell | B | 6.70% | R | $\sqrt{3}$ | 1 | 1 | 3.90% | 3.90% | ∞ |
| 14 | Max.SAR evalation | B | 3.90% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| Test Sample Related | | | | | | | | | | |
| 15 | Test sample positioning | A | 1.86% | N | 1 | 1 | 1 | 1.86% | 1.86% | ∞ |
| 16 | Device holder uncertainty | A | 1.70% | N | 1 | 1 | 1 | 1.70% | 1.70% | ∞ |
| 17 | Drift of output power | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| Phantom and Set-up | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 6.10% | R | $\sqrt{3}$ | 1 | 1 | 3.50% | 3.50% | ∞ |
| 19 | Liquid conductivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 20 | Liquid conductivity (meas.) | A | 0.50% | N | 1 | 0.64 | 0.43 | 0.32% | 0.26% | ∞ |
| 21 | Liquid permittivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 22 | Liquid cpermittivity (meas.) | A | 0.16% | N | 1 | 0.64 | 0.43 | 0.10% | 0.07% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 12.40% | 12.10% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 24.80% | 24.20% | ∞ |

5.6. System Check Results

System Performance Check at 450 MHz Head TSL

DUT: Dipole450 MHz; Type: D450V3; Serial: 1079

Date/Time: 05/25/2014 08:26:11 AM

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

Medium parameters used (interpolated): $f = 450$ MHz; $\sigma = 0.85$ S/m; $\epsilon_r = 43.95$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.00, 10.00, 10.00); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (101x121x1): Measurement grid: $dx=15.00$ mm, $dy=15.00$ mm

Maximum value of SAR (interpolated) = 2.66 W/kg

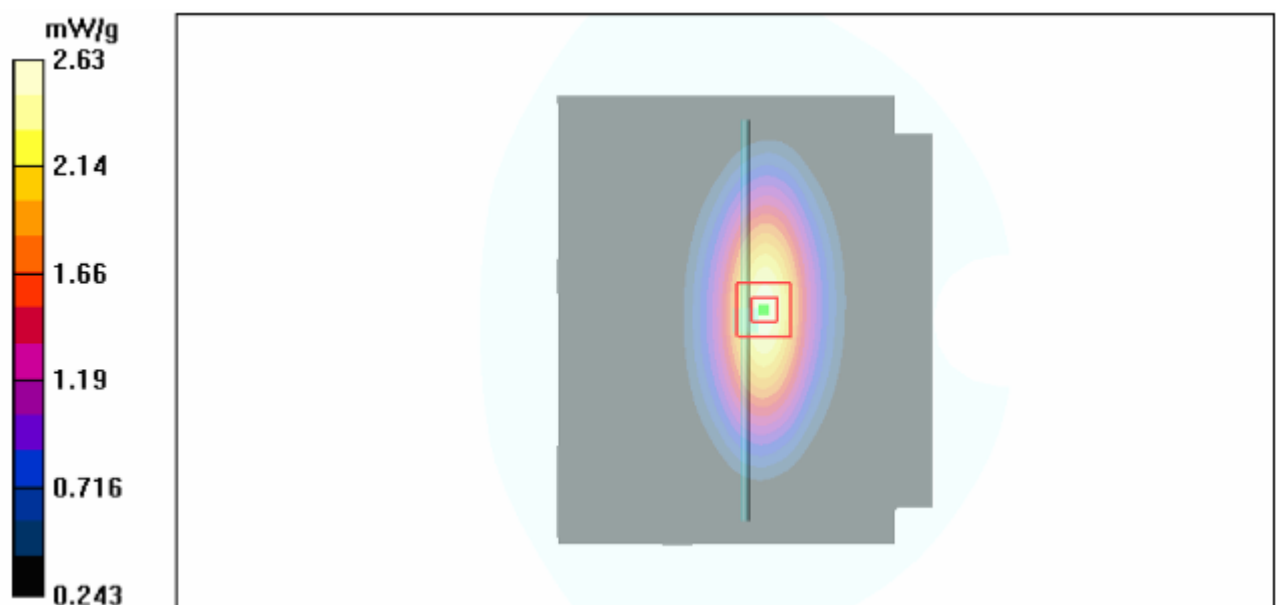
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 51.2 V/m; Power Drift = -0.031 dB

Peak SAR (extrapolated) = 3.87 mW/g

SAR(1 g) = 1.72 mW/g; SAR(10 g) = 1.15 mW/ g

Maximum value of SAR (measured) =2.58 W/kg



0 dB = 2.66 W/kg = 8.49 dB W/kg

System Performance Check 450MHz 398mW

System Performance Check at 450 MHz Body TSL

DUT: Dipole450 MHz; Type: D450V3; Serial: 1079

Date/Time: 05/25/2014 15:00:39 PM

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

Medium parameters used (interpolated): $f = 450$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 56.25$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.34, 10.34, 10.34); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (61x81x1): Measurement grid: $dx=15.00$ mm, $dy=15.00$ mm

Maximum value of SAR (interpolated) = 2.91 W/kg

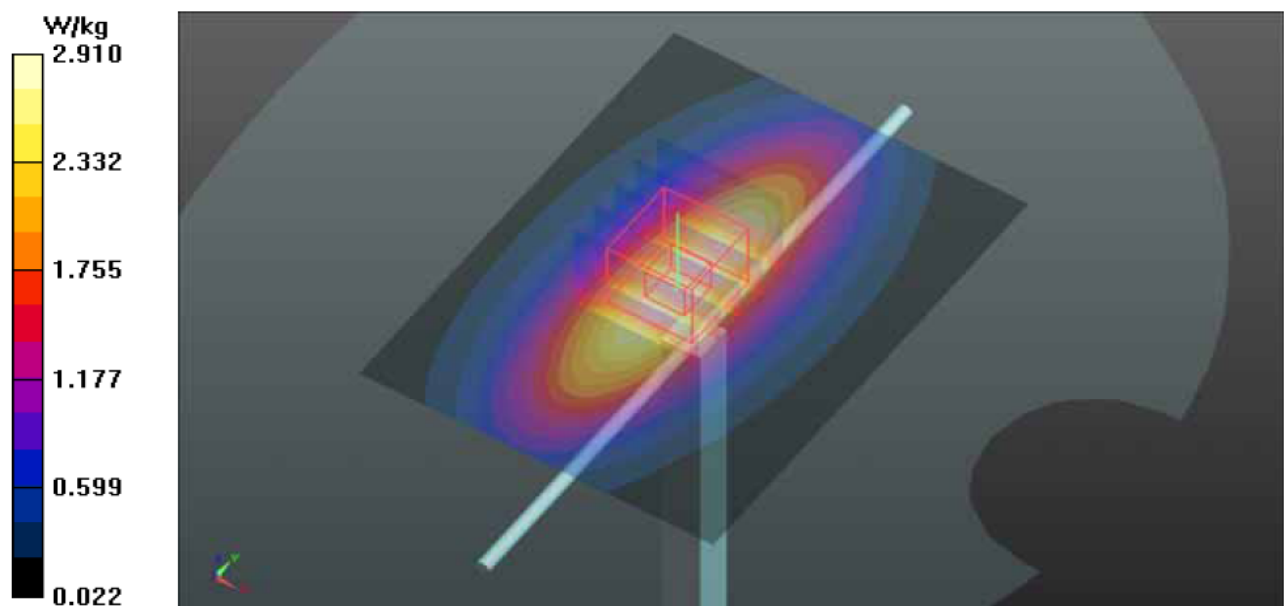
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 55.439 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 3.45 mW/g

SAR(1 g) = 1.66 mW/g; SAR(10 g) = 1.09 mW/g

Maximum value of SAR (measured) =2.94 W/kg



0 dB = 2.91 W/kg = 9.28 dB W/kg

System Performance Check 450MHz 398mW

5.7. SAR Test Graph Results

Face held for GMRS Analog Front towards Phantom 462.6375 MHz

Communication System: DuiJiangJi; Frequency: 462.6375 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 462.6375$ MHz; $\sigma = 0.88$ S/m; $\epsilon_r = 43.61$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.00, 10.00, 10.00); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (61x101x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 1.01 W/kg

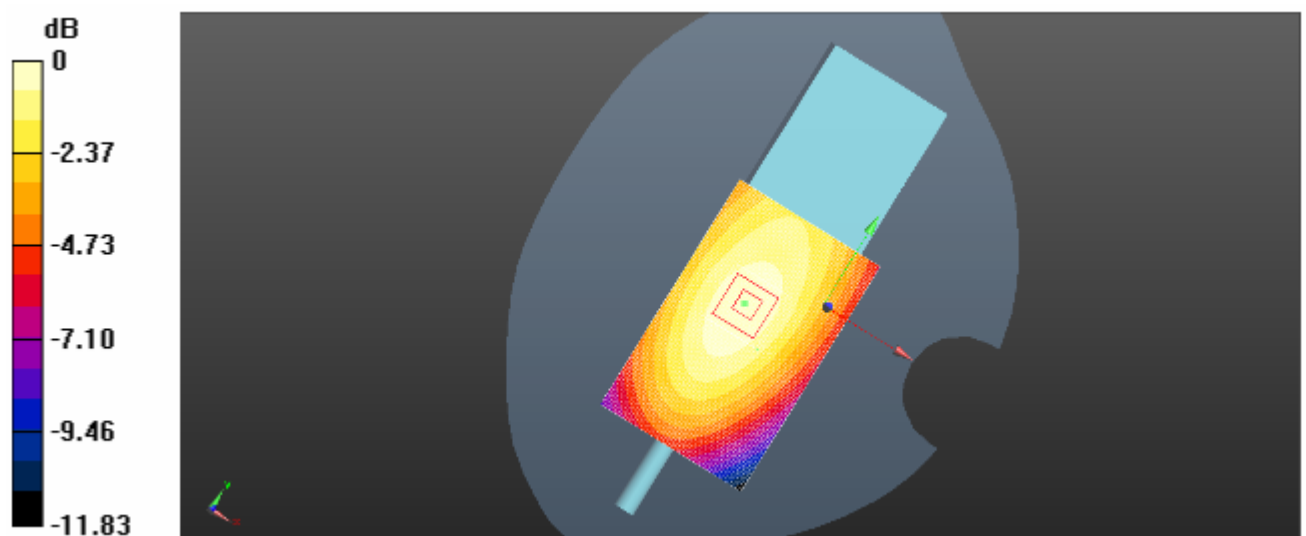
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 32.654 V/m; Power Drift = -0.13 dB

Peak SAR (extrapolated) = 1.32 mW/g

SAR(1 g) = 0.944 mW/g; SAR(10 g) = 0.673 mW/g

Maximum value of SAR (measured) = 1.01 W/kg



0 dB = 1.01 W/kg = 0.09 dB W/kg

Figure 1: Face held for GMRS Analog Front towards Phantom 462.6375 MHz

Face held for GMRS Analog Front towards Phantom 467.600 MHz

Communication System: DuiJiangJi; Frequency: 467.600 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 467.600$ MHz; $\sigma = 0.85$ S/m; $\epsilon_r = 43.64$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.00, 10.00, 10.00); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (71x111x1): Measurement grid: $dx=15.00$ mm, $dy=15.00$ mm

Maximum value of SAR (interpolated) = 0.992 W/kg

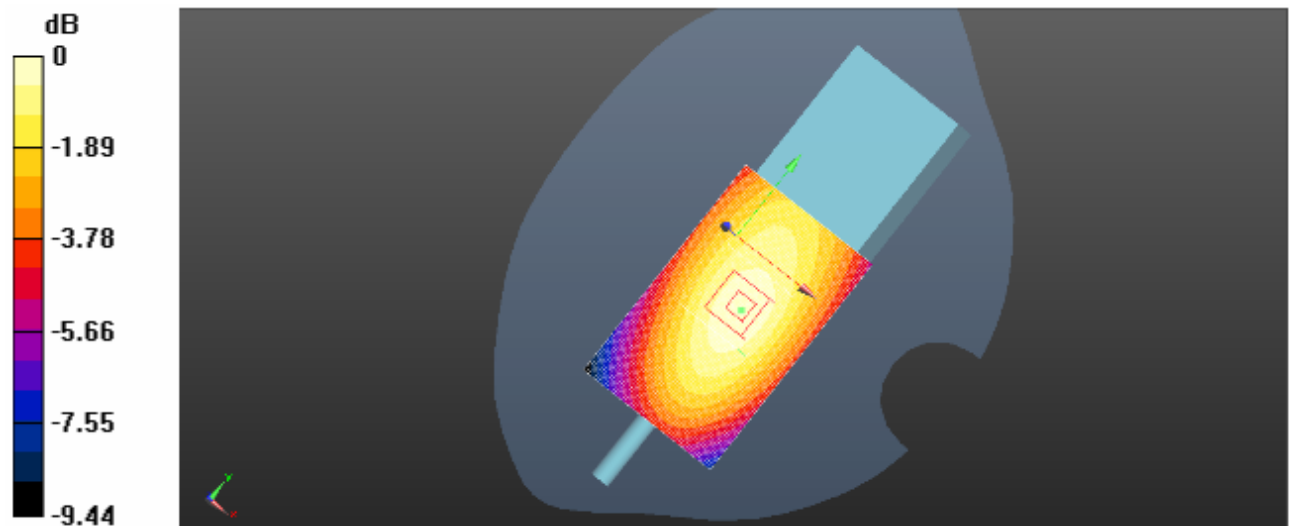
Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 30.321 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 1.21 mW/g

SAR(1 g) = 0.930 mW/g; SAR(10 g) = 0.671 mW/g

Maximum value of SAR (measured) = 0.976 W/kg



0 dB = 0.992 W/kg = -0.07 dB W/kg

Figure 2: Face held for GMRS Analog Front towards Phantom 467.6000 MHz

Face held for FRS Analog Front towards Phantom 467.6375 MHz

Communication System: DuiJiangJi; Frequency: 467.6375 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 463.6375$ MHz; $\sigma = 0.87$ S/m; $\epsilon_r = 43.34$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.00, 10.00, 10.00); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (61x101x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 0.834 W/kg

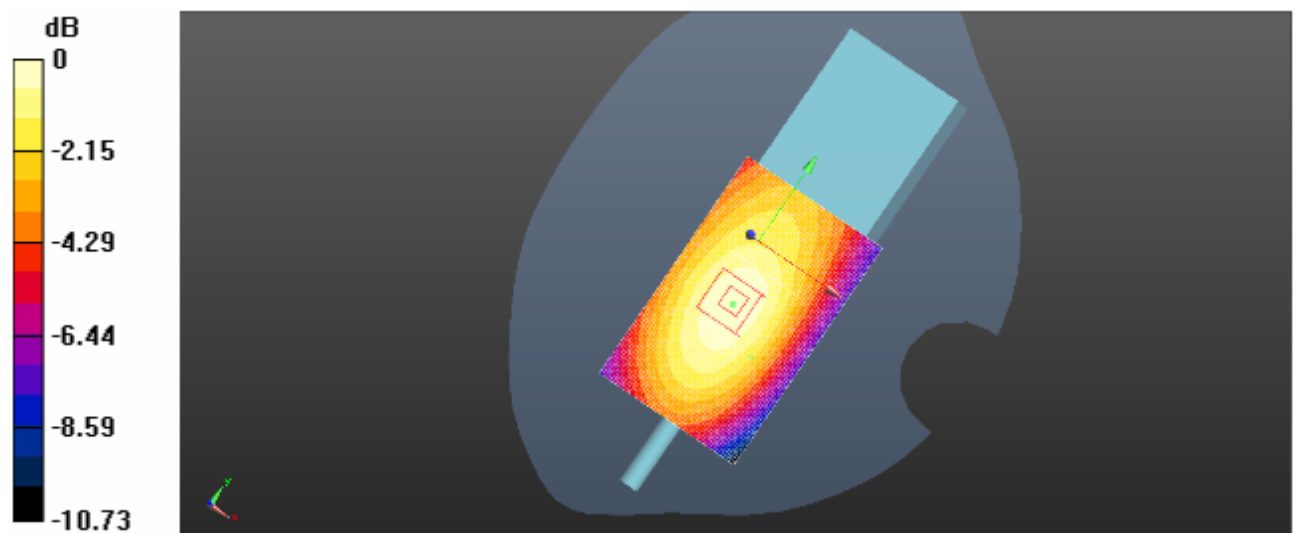
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 10.837 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 0.99 W/Kg

SAR(1 g) = 0.655 W/Kg; SAR(10 g) = 0.432 W/Kg

Maximum value of SAR (measured) = 0.862 W/kg



0 dB = 0.862 W/kg = -1.29 dB W/kg

Figure 3: Face held for FRS Analog Front towards Phantom 467.6375 MHz

Body-worn for GMRS Analog With Belt Clip and Headset Front towards Phantom 462.6375 MHz

Communication System: DuiJiangJi; Frequency: 462.6375 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 462.6375$ MHz; $\sigma = 0.95$ S/m; $\epsilon_r = 57.32$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.34, 10.34, 10.34); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (81x111x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 1.09 W/kg

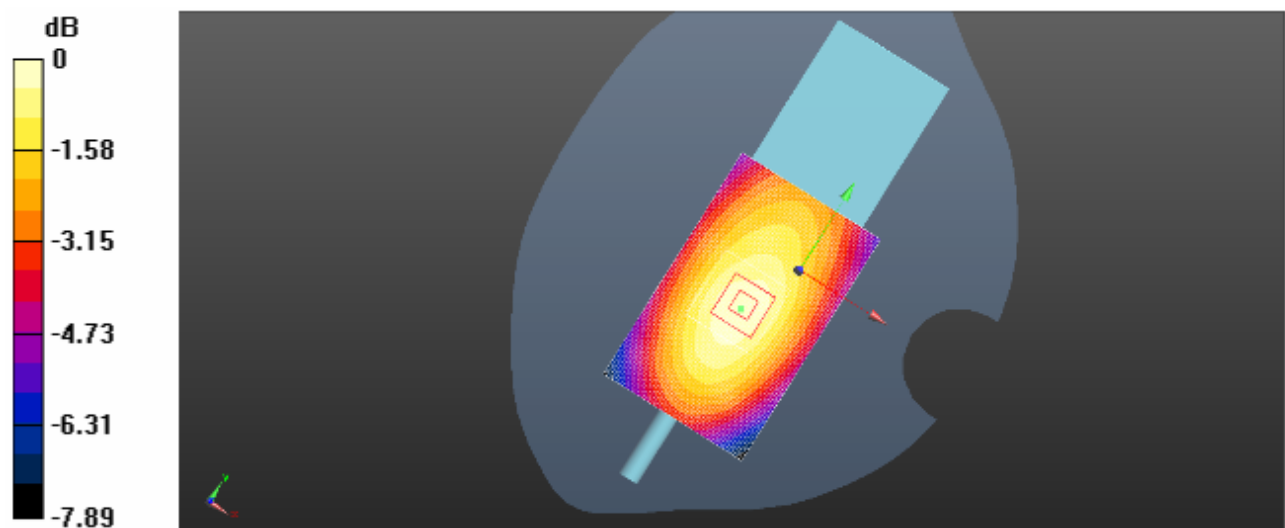
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 32.187 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 1.55 mW/g

SAR(1 g) = 1.116 mW/g; SAR(10 g) = 0.751 mW/g

Maximum value of SAR (measured) = 1.16 W/kg



0 dB = 1.09 W/kg = 0.75 dB W/kg

Plot 4: Body-worn for GMRS Analog With Belt Clip and Headset
Front towards Ground 462.6375 MHz

Body-worn for FRS Analog With Belt Clip and Headset Front towards Phantom 467.6375 MHz

Communication System: DuiJiangJi; Frequency: 467.6375 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 467.6375$ MHz; $\sigma = 0.95$ S/m; $\epsilon_r = 58.17$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.34, 10.34, 10.34); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (81x111x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 0.895 W/kg

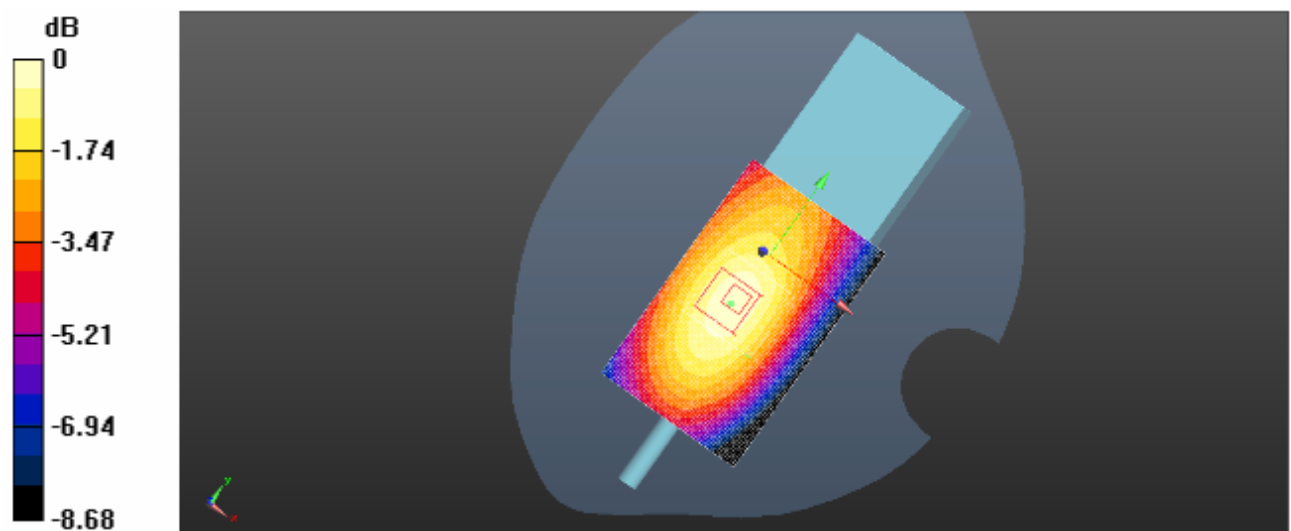
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.618 V/m; Power Drift = 0.10 dB

Peak SAR (extrapolated) = 1.20 mW/g

SAR(1 g) = 0.848 mW/g; SAR(10 g) = 0.605 mW/g

Maximum value of SAR (measured) = 0.902 W/kg



0 dB = 0.902 W/kg = -0.89 dB W/kg

Plot 5: Body-worn for FRS Analog With Belt Clip and Headset
Front towards Ground 467.6375 MHz

Body-worn for GMRS Analog With Belt Clip and Headset Front towards Phantom 467.600 MHz

Communication System: DuiJiangJi; Frequency: 467.600 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 467.600$ MHz; $\sigma = 0.94$ S/m; $\epsilon_r = 57.31$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

DASY5 Configuration:

Probe: ES3DV3 - SN3842; ConvF(10.34, 10.34, 10.34); Calibrated: 06/06/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1315; Calibrated: 25/11/2013

Phantom: SAM 1; Type: SAM;

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

Area Scan (81x121x1): Measurement grid: dx=15.00 mm, dy=15.00 mm

Maximum value of SAR (interpolated) = 1.21 W/kg

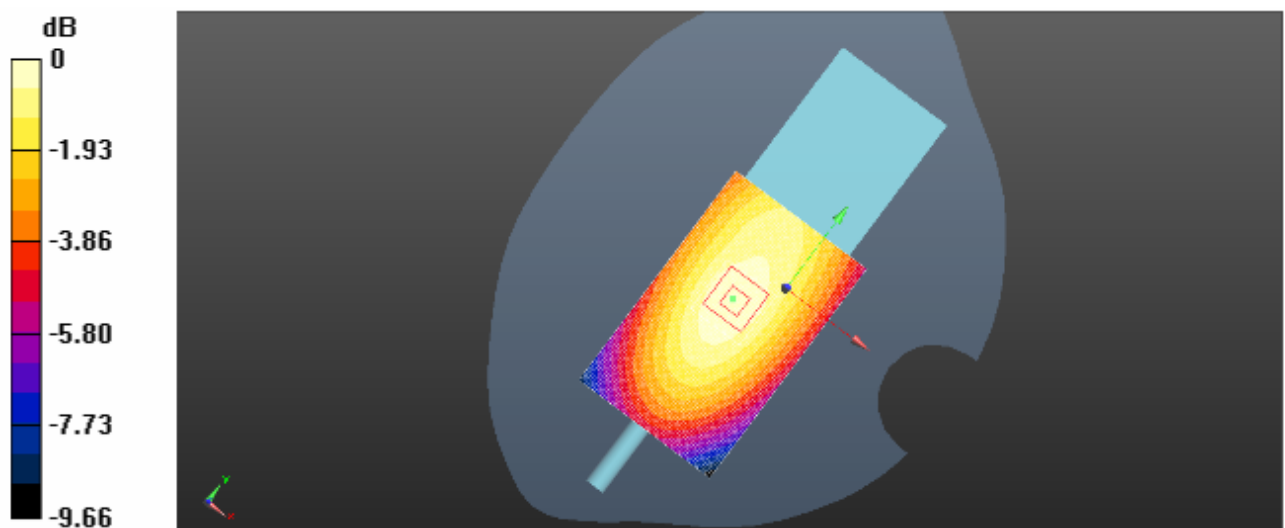
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 33.940 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 1.31 mW/g

SAR(1 g) = 1.10 mW/g; SAR(10 g) = 0.768 mW/g

Maximum value of SAR (measured) = 1.18 W/kg



0 dB = 1.21 W/kg = 1.58 dB W/kg

Plot 6: Body-worn for GMRS Analog With Belt Clip and Headset
Front towards Ground 467.600 MHz

6. Calibration Certificate

6.1. Probe Calibration Certificate

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
S 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: **EX3-3842_Jun13**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3842**

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

Calibration date: **June 6, 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 | 04-Apr-13 (No. 217-01733) | Apr-14 |
| Power sensor E4412A | MY41498087 | 04-Apr-13 (No. 217-01733) | Apr-14 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 04-Apr-13 (No. 217-01737) | Apr-14 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 04-Apr-13 (No. 217-01735) | Apr-14 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 04-Apr-13 (No. 217-01738) | Apr-14 |
| Reference Probe ES3DV2 | SN: 3013 | 28-Dec-12 (No. ES3-3013_Dec12) | Dec-13 |
| DAE4 | SN: 660 | 31-Jan-13 (No. DAE4-660_Jan13) | Jan-14 |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-13) | In house check: Apr-15 |
| 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: June 6, 2013 | | | |

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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Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

| | |
|--------------------------|---|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,y,z} |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A, B, C, D | modulation dependent linearization parameters |
| Polarization φ | φ rotation around probe axis |
| Polarization ϑ | ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis |

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}; A, B, C, D** are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

EX3DV4 – SN:3842

June 6, 2013

Probe EX3DV4

SN:3842

| | |
|---------------|------------------|
| Manufactured: | October 25, 2011 |
| Repaired: | June 3, 2013 |
| Calibrated: | June 6, 2013 |

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

EX3DV4- SN:3842

June 6, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842**Basic Calibration Parameters**

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-----------|
| Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A | 0.35 | 0.52 | 0.42 | ± 10.1 % |
| DCP (mV) ^B | 104.7 | 100.4 | 100.5 | |

Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB $\sqrt{\mu\text{V}}$ | C | D dB | VR mV | Unc ^E (k=2) |
|-----|---------------------------|---|---------|------------------------------|-----|---------|----------|---------------------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 132.3 | ±3.5 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 162.7 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 147.6 | |

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

^A The uncertainties of NormX,Y,Z do not affect the E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

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

EX3DV4- SN:3842

June 6, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842**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 | 10.00 | 10.00 | 10.00 | 0.15 | 1.10 | ± 13.4 % |
| 835 | 41.5 | 0.91 | 8.83 | 8.83 | 8.83 | 0.28 | 1.07 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 8.78 | 8.78 | 8.78 | 0.32 | 1.00 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 7.68 | 7.68 | 7.68 | 0.38 | 0.88 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.55 | 7.55 | 7.55 | 0.50 | 0.77 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.26 | 7.26 | 7.26 | 0.71 | 0.63 | ± 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.

EX3DV4- SN:3842

June 6, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842**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 | 10.34 | 10.34 | 10.34 | 0.09 | 1.00 | ± 13.4 % |
| 835 | 55.2 | 0.98 | 9.09 | 9.09 | 9.09 | 0.42 | 0.84 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.16 | 9.16 | 9.16 | 0.47 | 0.79 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 7.78 | 7.78 | 7.78 | 0.50 | 0.81 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.43 | 7.43 | 7.43 | 0.29 | 1.07 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 6.93 | 6.93 | 6.93 | 0.80 | 0.59 | ± 12.0 % |

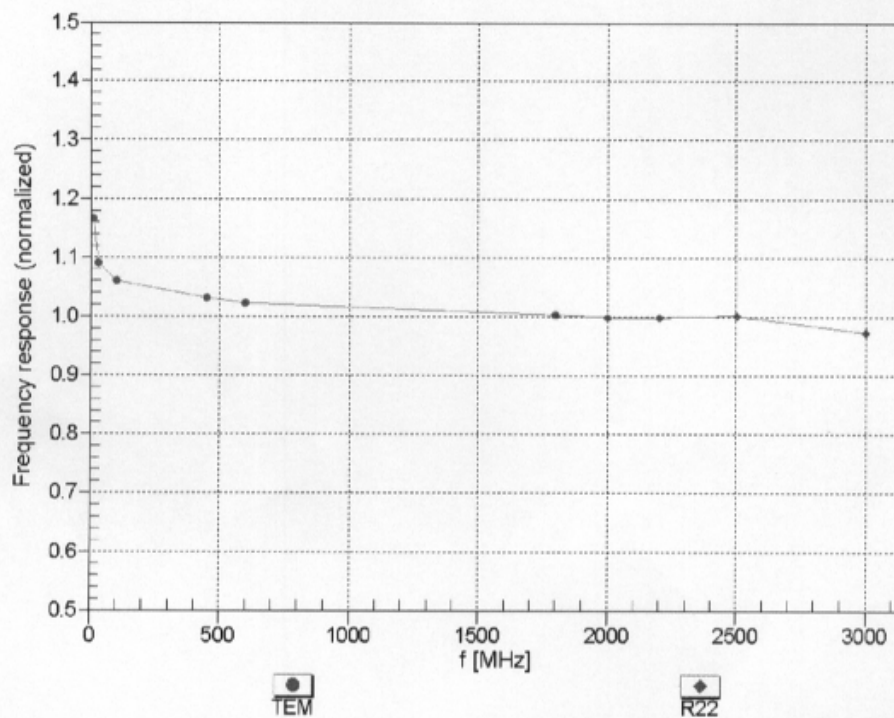
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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.

EX3DV4— SN:3842

June 6, 2013

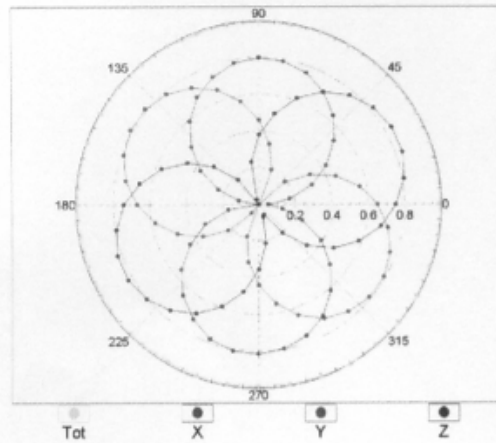
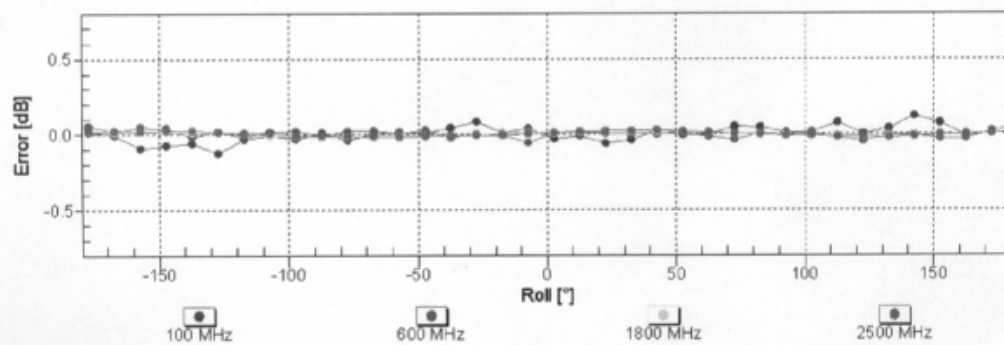
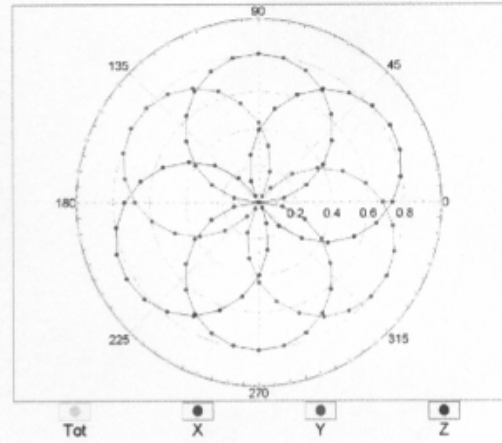
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

EX3DV4- SN:3842

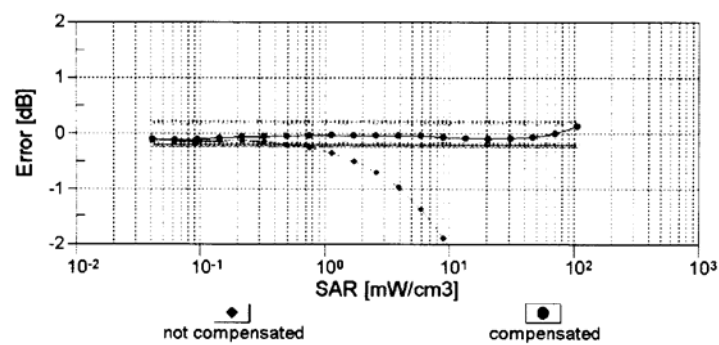
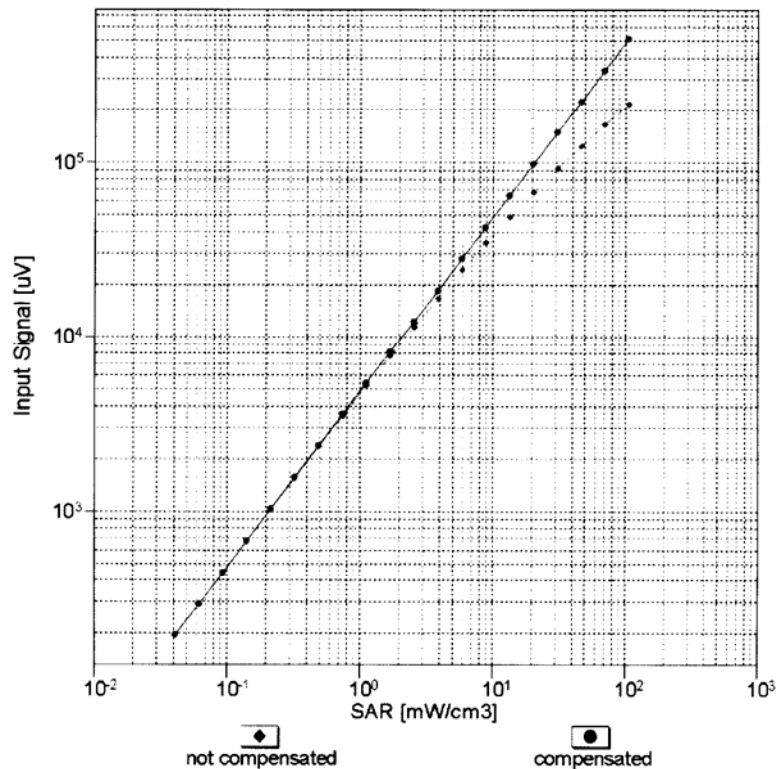
June 6, 2013

Receiving Pattern (ϕ), $\theta = 0^\circ$ **f=600 MHz,TEM****f=1800 MHz,R22****Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)**

EX3DV4- SN:3842

June 6, 2013

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

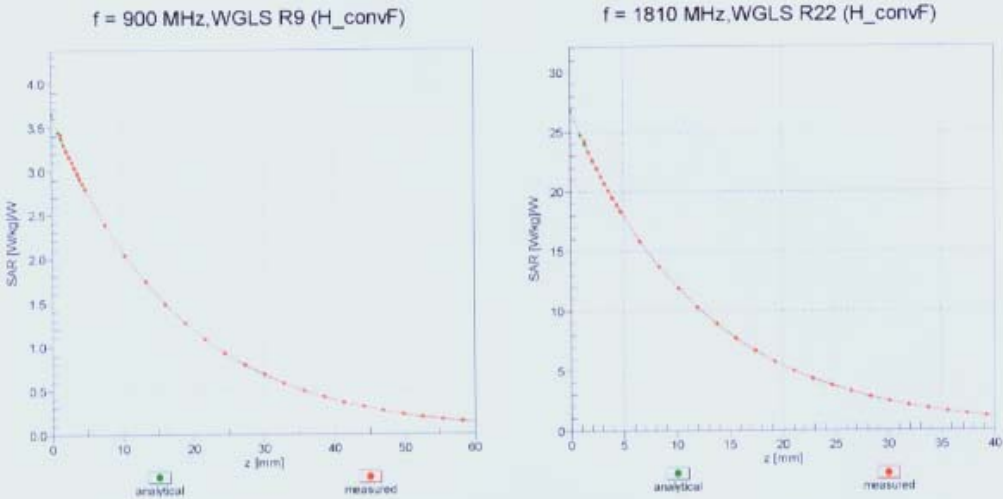


Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

EX3DV4- SN:3842

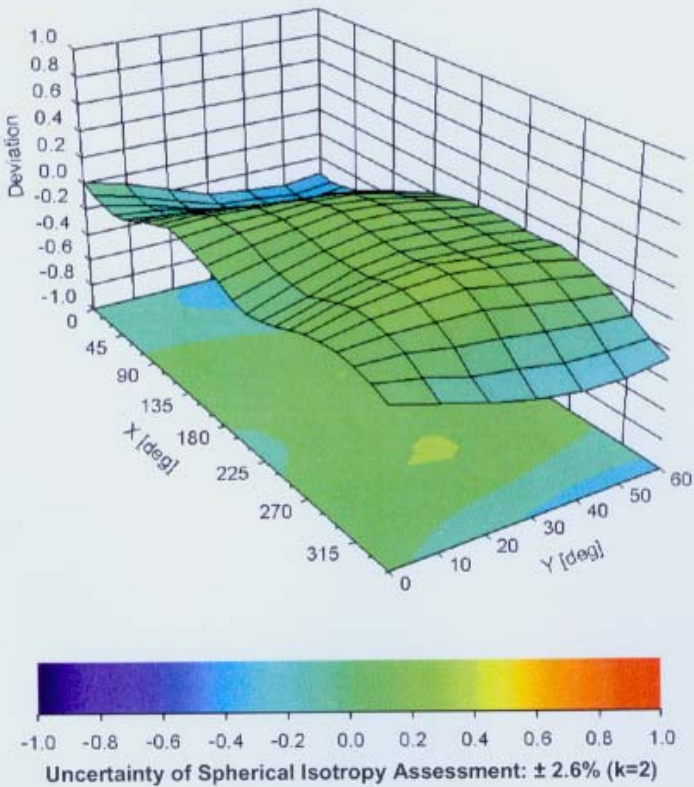
June 6, 2013

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), f = 900 MHz



EX3DV4- SN:3842

June 6, 2013

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3842**Other Probe Parameters**

| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -117.4 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 2 mm |

6.2. D450V3 Dipole Calibration Certificate

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



S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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S 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: **D450V3-1079_Feb13**

CALIBRATION CERTIFICATE

Object **D450V3 - SN: 1079**

Calibration procedure(s) **QA CAL-15.v6**
Calibration procedure for dipole validation kits below 700 MHz

Calibration date: **February 28, 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 | GR41293874 | 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 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 29-Mar-12 (No. 217-01168) | Apr-13 |
| Reference Probe ET3DV6 | SN: 1507 | 30-Dec-12 (No. ET3-1507_Dec11) | Dec-13 |
| DAE4 | SN: 654 | 03-May-12 (No. DAE4-654_May11) | May-13 |
| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-11) | In house check: Oct-12 |

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

Issued: February 28, 2013

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

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



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Accreditation No.: **SCS 108**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

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

| | | |
|------------------------------|------------------------|---------------------------------|
| DASY Version | DASY5 | V52.8.0 |
| Extrapolation | Advanced Extrapolation | |
| Phantom | ELI4 Flat Phantom | Shell thickness: 2 ± 0.2 mm |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 450 MHz \pm 1 MHz | |

Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---------------------|----------------|----------------------|
| Nominal Head TSL parameters | 22.0 °C | 43.5 | 0.87 mho/m |
| Measured Head TSL parameters | (22.0 \pm 0.2) °C | 43.6 \pm 6 % | 0.85 mho/m \pm 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

SAR result with Head TSL

| SAR averaged over 1 cm ³ (1 g) of Head TSL | Condition | |
|---|--------------------|--------------------------------|
| SAR measured | 398 mW input power | 1.81 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 4.63 mW / g \pm 18.1 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Head TSL | condition | |
|---|--------------------|--------------------------------|
| SAR measured | 398 mW input power | 1.21 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | 3.09 mW / g \pm 17.6 % (k=2) |

Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---------------------|----------------|----------------------|
| Nominal Body TSL parameters | 22.0 °C | 56.7 | 0.94 mho/m |
| Measured Body TSL parameters | (22.0 \pm 0.2) °C | 55.0 \pm 6 % | 0.91 mho/m \pm 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

SAR result with Body TSL

| SAR averaged over 1 cm ³ (1 g) of Body TSL | Condition | |
|---|--------------------|--------------------------------|
| SAR measured | 398 mW input power | 1.74 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 4.45 mW / g \pm 18.1 % (k=2) |

| SAR averaged over 10 cm ³ (10 g) of Body TSL | condition | |
|---|--------------------|--------------------------------|
| SAR measured | 398 mW input power | 1.16 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | 2.97 mW / g \pm 17.6 % (k=2) |

Appendix**Antenna Parameters with Head TSL**

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 59.8 Ω - 0.5 j Ω |
| Return Loss | - 21.0 dB |

Antenna Parameters with Body TSL

| | |
|--------------------------------------|--------------------------------|
| Impedance, transformed to feed point | 56.4 Ω - 5.9 j Ω |
| Return Loss | - 21.7 dB |

General Antenna Parameters and Design

| | |
|----------------------------------|----------|
| Electrical Delay (one direction) | 1.350 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. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

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 | March 03, 2011 |

DASY5 Validation Report for Head TSL

Date/Time: 28.02.2013

Test Laboratory: SPEAG

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN: 1079

Communication System: CW; Frequency: 450 MHz

Medium parameters used: $f = 450$ MHz; $\sigma = 0.85$ mho/m; $\epsilon_r = 43.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.59, 6.59, 6.59); Calibrated: 30.12.2012
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 03.05.2012
- Phantom: ELI 4.0; Type: QDOVA001BA; Serial: 1003
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Head Tissue/d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0:

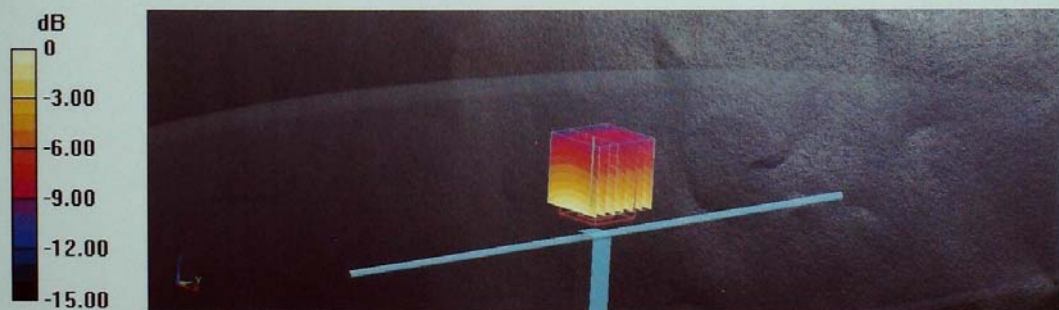
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 49.699 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 2.7560

SAR(1 g) = 1.81 mW/g; SAR(10 g) = 1.21 mW/g

Maximum value of SAR (measured) = 1.936 mW/g



0 dB = 1.940mW/g = 5.76 dB mW/g

Impedance Measurement Plot for Head TSL

