# FCC SAR Test Report

| | |
|---|---|
| **APPLICANT** | **: Huawei Technologies Co., Ltd** |
| **EQUIPMENT** | **: Mobile Wi-Fi** |
| **BRAND NAME** | **: Vodafone** |
| **MODEL NAME** | **: W5101** |
| **FCC ID** | **: QISW5101** |
| **STANDARD** | **: FCC 47 CFR Part 2 (2.1093)** |
| | **ANSI/IEEE C95.1-1992** |
| | **IEEE 1528-2003** |

**The product was completely tested on Dec. 10, 2013. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.**
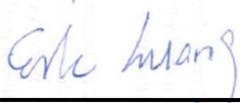
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**Reviewed by: Eric Huang / Deputy Manager**

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**Approved by: Jones Tsai / Manager**

ilac-MRA

TAF
Testing Laboratory
1190

## SPORTON INTERNATIONAL INC.
*No. 52, Hwa Ya 1ˢᵗ Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C.*

*SPORTON INTERNATIONAL INC.*
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# Revision History

| REPORT NO. | VERSION | DESCRIPTION | ISSUED DATE |
|---|---|---|---|
| FA3D0421 | Rev. 01 | Initial issue of report | Dec. 20, 2013 |
| FA3D0421 | Rev. 02 | Added recipe for 2600 MHz on page19 | Jan. 14, 2014 |
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## 1. *Statement of Compliance*

The maximum results of Specific Absorption Rate (SAR) found during testing for **Huawei Technologies Co., Ltd Mobile Wi-Fi, Vodafone, W5101** are as follows.

**<Highest SAR Summary>**

| Exposure Position | Frequency Band | Reported 1g-SAR (W/kg) | Equipment Class | Highest Reported 1g-SAR (W/kg) |
|---|---|---|---|---|
| Body (Separation 0.5cm) | GPRS850 | 0.88 | PCB | 0.88 |
| | GPRS1900 | 0.66 | | |
| | LTE Band 7 | 0.86 | | |
| | WLAN 2.4GHz Band | 0.20 | DTS | |

**<Highest Simultaneous transmission SAR>**

| Frequency Band | Equipment Class | Exposure Position | Highest Reported Simultaneous Transmission 1g-SAR (W/kg) |
|---|---|---|---|
| GSM850 | PCB | Body | 1.03 |
| WLAN 2.4GHz Band | DTS | | |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003.

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## 2. Administration Data

### 2.1 Testing Laboratory

| Test Site | SPORTON INTERNATIONAL INC. |
|---|---|
| Test Site Location | No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978 |

### 2.2 Applicant

| Company Name | Huawei Technologies Co., Ltd |
|---|---|
| Address | Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C |

### 2.3 Manufacturer

| Company Name | Huawei Technologies Co., Ltd |
|---|---|
| Address | Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District, Shenzhen, 518129, P.R.C |

### 2.4 Application Details

| Date of Start during the Test | Dec. 07, 2013 |
|---|---|
| Date of End during the Test | Dec. 10, 2013 |

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## 3. *General Information*

### 3.1 *Description of Equipment Under Test (EUT)*

| Product Feature & Specification | |
|---|---|
| EUT | Mobile Wi-Fi |
| Brand Name | Vodafone |
| Model Name | W5101 |
| FCC ID | QISW5101 |
| IMEI Code | 00440172822192 |
| Wireless Technology and Frequency Range | GSM850: 824.2 MHz ~ 848.8 MHz<br>GSM1900: 1850.2 MHz ~ 1909.8 MHz<br>LTE Band 7: 2502.5 MHz ~ 2567.5 MHz<br>WLAN 2.4GHz Band: 2412 MHz ~ 2437 MHz |
| Mode | ・GPRS/EGPRS<br>・LTE: QPSK, 16QAM<br>・802.11b/g/n HT20 |
| Antenna Type | WWAN: PCB Antenna<br>WLAN: Loop Antenna |
| HW Version | CH1E8278SM |
| SW Version | 21.261.67.02.5011 |
| EUT Stage | Production Unit |
| Remark:<br>1.  The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.<br>2.  802.11n- HT40 is not supported in 2.4GHz frequency band.<br>3.  For WLAN2.4GHz only supports 2400MHz~2453MHz operation frequency range, therefore selected middle (ch.6) and low (ch.1) channel perform SAR testing. | |

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### 3.2 *Maximum RF output power among production units*

| Mode / Band | GSM 850 | GSM 1900 |
|---|---|---|
| | Average Power (dBm) | |
| GPRS (GMSK, 1 Tx slot) | 33.0 | 30.0 |
| GPRS (GMSK, 2 Tx slots) | 32.0 | 29.0 |
| GPRS (GMSK, 3 Tx slots) | 30.0 | 27.0 |
| GPRS (GMSK, 4 Tx slots) | 28.0 | 25.0 |
| EDGE (8PSK, 1 Tx slot) | 26.5 | 26.0 |
| EDGE (8PSK, 2 Tx slots) | 26.0 | 25.0 |
| EDGE (8PSK, 3 Tx slot) | 24.0 | 23.0 |
| EDGE (8PSK, 4 Tx slots) | 22.0 | 21.0 |

| LTE Band 7 | | | | |
|---|---|---|---|---|
| Modulation | BW (MHz) | RB size | Target MPR (dB) | Average power (dBm) |
| QPSK | 20 | ≤ 18 | 0 | 23 |
| QPSK | 20 | > 18 | 1 | 22 |
| 16QAM | 20 | ≤ 18 | 1 | 22 |
| 16QAM | 20 | > 18 | 1 | 22 |
| QPSK | 15 | ≤ 16 | 0 | 23 |
| QPSK | 15 | > 16 | 1 | 22 |
| 16QAM | 15 | ≤ 16 | 1 | 22 |
| 16QAM | 15 | > 16 | 1 | 22 |
| QPSK | 10 | ≤ 12 | 0 | 23 |
| QPSK | 10 | > 12 | 1 | 22 |
| 16QAM | 10 | ≤ 12 | 1 | 22 |
| 16QAM | 10 | > 12 | 1 | 22 |
| QPSK | 5 | ≤ 8 | 0 | 23 |
| QPSK | 5 | > 8 | 1 | 22 |
| 16QAM | 5 | ≤ 8 | 1 | 22 |
| 16QAM | 5 | > 8 | 1 | 22 |

| Mode | IEEE 802.11 Average power(dBm) |
|---|---|
| WLAN 802.11 b | 14.0 |
| WLAN 802.11 g | 12.0 |
| WLAN 802.11 n | 11.0 |

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## The table below summarized necessary items addressed in KDB 941225 D05 v02.

| FCC ID | QISW5101 |
|---|---|
| EUT | Mobile Wi-Fi |
| Operating Frequency Range of each LTE transmission band | LTE Band 7: 2502.5 MHz ~ 2567.5 MHz |
| Channel Bandwidth | 5MHz, 10MHz, 15MHz, 20MHz |

| Transmission (H, M, L) channel numbers and frequencies in each LTE band | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LTE Band 7 | | | | | | | | |
| | Bandwidth 5 MHz | | Bandwidth 10 MHz | | Bandwidth 15 MHz | | Bandwidth 20 MHz | |
| | Ch. # | Freq. (MHz) | Ch. # | Freq. (MHz) | Ch. # | Freq. (MHz) | Ch. # | Freq. (MHz) |
| L | 20775 | 2502.5 | 20800 | 2505 | 20825 | 2507.5 | 20850 | 2510 |
| M | 21100 | 2535 | 21100 | 2535 | 21100 | 2535 | 21100 | 2535 |
| H | 21425 | 2567.5 | 21400 | 2565 | 21375 | 2562.5 | 21350 | 2560 |

| E category, uplink modulations used | Category 3, QPSK, and 16QAM |
|---|---|
| LTE transmitter and antenna implementation (standalone or sharing hardware components / antennas ) | A primary antenna is used for LTE and other wireless interfaces (GSM /WCDMA) for transmitting and receiving<br>A 2nd antenna is used for LTE and other wireless interfaces (GSM /WCDMA) for receiving only |
| LTE Voice / Data requirements | Data only |
| LTE MPR permanently built-in by design | Yes, per 3GPP TS 36.101 v11.0.0 |
| LTE A-MPR | In the base simulator configuration, Network Setting value is set to NS_01 to disable A-MPR during SAR testing. |
| Base station simulator used for Testing | Anritsu MT8820C |

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### 3.3 Applied Standard

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2003
- FCC KDB 941225 D03 SAR Test Reduction GSM GPRS EDGE v01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r01
- FCC KDB 447498 D02 SAR Procedures for Dongle Xmtr v02
- FCC KDB 248227 D01 SAR meas for 802 11abg v01r02
- FCC KDB 941225 D05 SAR for LTE Devices v02r03
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r02

### 3.4 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

### 3.5 Test Conditions

#### 3.5.1 Ambient Condition

| Ambient Temperature | 20 to 24 ℃ |
|---|---|
| Humidity | < 60 % |

#### 3.5.2 Test Configuration

For WWAN SAR testing, the device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the EUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of EUT.

During WLAN SAR testing EUT is configured with the WLAN continuous TX tool.
For WLAN SAR testing, WLAN engineering testing software installed on the EUT can provide continuous transmitting RF signal.

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# 4. *Specific Absorption Rate (SAR)*

## 4.1 *Introduction*

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

## 4.2 *SAR Definition*

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

SAR is expressed in units of Watts per kilogram (W/kg)

SAR measurement can be either related to the temperature elevation in tissue by
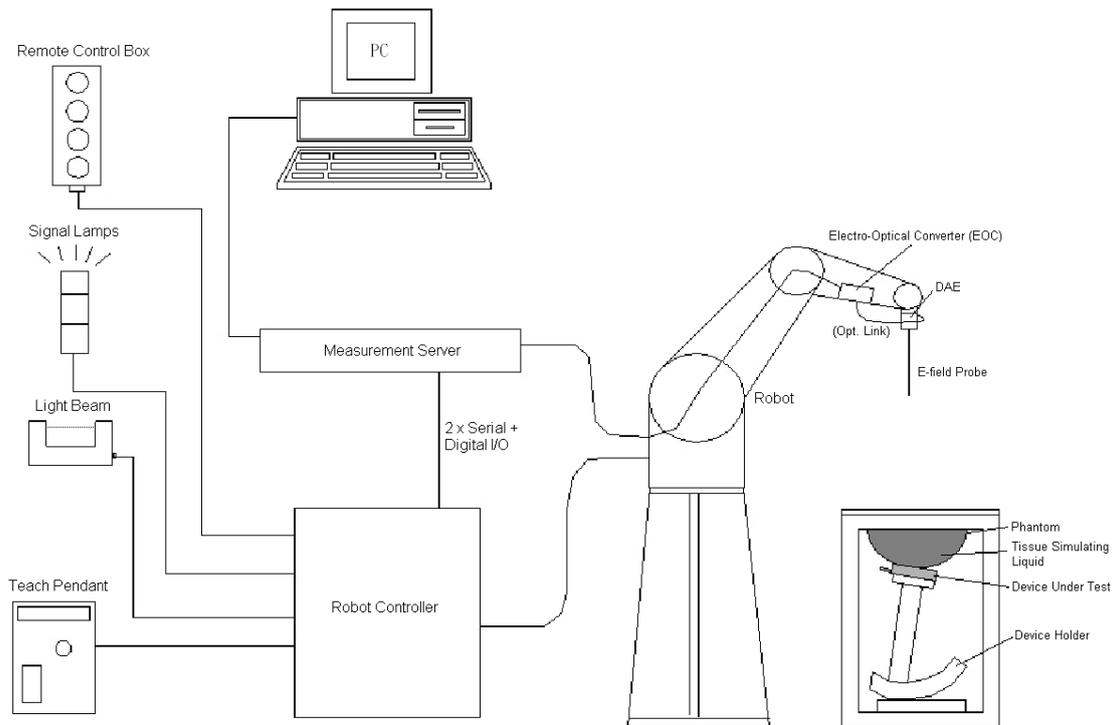
$$SAR = C\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

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# 5. SAR Measurement System



**Fig 5.1 SPEAG DASY System Configurations**

The DASY system for performance compliance tests is illustrated above graphically. This system consists of the following items:

➢ A standard high precision 6-axis robot with controller, a teach pendant and software
➢ A data acquisition electronic (DAE) attached to the robot arm extension
➢ A dosimetric probe equipped with an optical surface detector system
➢ The electro-optical converter (EOC) performs the conversion between optical and electrical signals
➢ A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
➢ A probe alignment unit which improves the accuracy of the probe positioning
➢ A computer operating Windows XP
➢ DASY software
➢ Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
➢ The SAM twin phantom
➢ A device holder
➢ Tissue simulating liquid
➢ Dipole for evaluating the proper functioning of the system

Component details are described in in the following sub-sections.

## 5.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. This probe has a built in optical surface detection system to prevent from collision with phantom.

### 5.1.1 E-Field Probe Specification

**<EX3DV4 Probe>**

| Construction | Symmetrical design with triangular core<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) | |
|---|---|---|
| Frequency | 10 MHz to 6 GHz; Linearity: ± 0.2 dB | |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis)<br>± 0.5 dB in tissue material (rotation normal to probe axis) | |
| Dynamic Range | 10 µW/g to 100 mW/g; Linearity: ± 0.2 dB<br>(noise: typically < 1 µW/g) | |
| Dimensions | Overall length: 330 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm | <br>**Fig 5.2 Photo of EX3DV4/ES3DV4** |

### 5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

## 5.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.


**Fig 5.3 Photo of DAE**

## 5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

➢ High precision (repeatability ±0.035 mm)
➢ High reliability (industrial design)
➢ Jerk-free straight movements
➢ Low ELF interference (the closed metallic construction shields against motor control fields)

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**Fig 5.4    Photo of DASY4**



**Fig 5.5    Photo of DASY5**

## 5.4 *Measurement Server*

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.



**Fig 5.6    Photo of Server for DASY4**



**Fig 5.7    Photo of Server for DASY5**

## 5.5 *Phantom*

**<SAM Twin Phantom>**

| | | |
|---|---|---|
| **Shell Thickness** | 2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm | |
| **Filling Volume** | Approx. 25 liters | |
| **Dimensions** | Length: 1000 mm; Width: 500 mm; Height: adjustable feet |  |
| **Measurement Areas** | Left Hand, Right Hand, Flat Phantom | |
| | | **Fig 5.8    Photo of SAM Phantom** |

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

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**<ELI4 Phantom>**

| | | |
|---|---|---|
| **Shell Thickness** | 2 ± 0.2 mm (sagging: <1%) | |
| **Filling Volume** | Approx. 30 liters | |
| **Dimensions** | Major ellipse axis: 600 mm<br>Minor axis: 400 mm | <br>**Fig 5.9     Photo of ELI4 Phantom** |
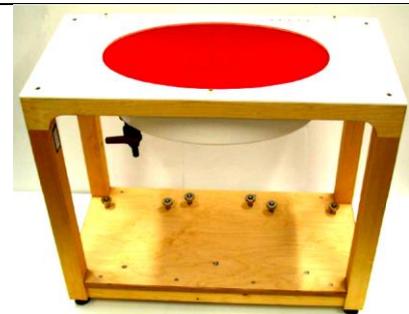
The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

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## 5.6 *Device Holder*

### <Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.



**Fig 5.10    Device Holder**

### <Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.
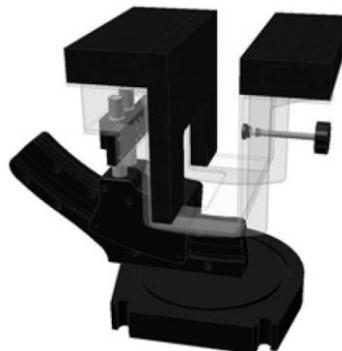


**Fig 5.11        Laptop Extension Kit**

## 5.7 Data Storage and Evaluation

### 5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing 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 erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

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

### 5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) 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 | $Norm_i$, $a_{i0}$, $a_{i1}$, $a_{i2}$ |
| | - Conversion factor | $ConvF_i$ |
| | - Diode compression point | $dcp_i$ |
| **Device parameters**： | - Frequency | $f$ |
| | - Crest factor | $cf$ |
| **Media parameters**： | - Conductivity | $\sigma$ |
| | - Density | $\rho$ |

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 DASY components. In the direct measuring mode of the multi-meter 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.

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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：

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

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

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

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with    SAR = local specific absorption rate in mW/g
$E_{tot}$ = total field strength in V/m
$\sigma$ = conductivity in [mho/m] or [Siemens/m]
$\rho$ = equivalent tissue density in g/cm$^3$

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

## 5.8 Test Equipment List

| Manufacturer | Name of Equipment | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| SPEAG | 835MHz System Validation Kit | D835V2 | 4d162 | Nov. 11, 2013 | Nov. 10, 2014 |
| SPEAG | 1900MHz System Validation Kit | D1900V2 | 5d182 | Nov. 12, 2013 | Nov. 11, 2014 |
| SPEAG | 2450MHz System Validation Kit | D2450V2 | 924 | Nov. 13, 2013 | Nov. 12, 2014 |
| SPEAG | 2600MHz System Validation Kit | D2600V2 | 1070 | Nov. 13, 2013 | Nov. 12, 2014 |
| SPEAG | Data Acquisition Electronics | DAE3 | 577 | May. 08, 2013 | May. 07, 2014 |
| SPEAG | Data Acquisition Electronics | DAE4 | 1279 | Jan. 28, 2013 | Jan. 27, 2014 |
| SPEAG | Data Acquisition Electronics | DAE4 | 1399 | Nov. 07, 2013 | Nov. 06, 2014 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3931 | Sep. 10, 2013 | Sep. 09, 2014 |
| SPEAG | Dosimetric E-Field Probe | EX3DV4 | 3898 | Jan. 14, 2013 | Jan. 13, 2014 |
| H.M.IRIS | Thermometer | TH-08 | TM658 | Oct. 22, 2013 | Oct. 21, 2014 |
| Anritsu | Radio Communication Analyzer | MT8820C | 6201074414 | Dec. 11, 2012 | Dec. 10, 2014 |
| Agilent | Wireless Communication Test Set | E5515C | MY50266977 | May. 06, 2013 | May. 05, 2015 |
| R&S | Radio communication Tester | CMW500 | 116160 | Jan. 09, 2013 | Jan. 08, 2014 |
| SPEAG | Device Holder | N/A | N/A | NCR | NCR |
| R&S | Signal Generator | SMF 100A | 101107 | May. 27, 2013 | May. 26, 2014 |
| SPEAG | Dielectric Probe Kit | DAK-3.5 | 1126 | Jul. 23, 2013 | Jul. 22, 2014 |
| Agilent | ENA Network Analyzer | E5071C | MY46316648 | Feb. 07, 2013 | Feb. 06, 2014 |
| Anritsu | Power Meter | ML2495A | 1132003 | Aug. 28, 2013 | Aug. 27, 2014 |
| Anritsu | Power Sensor | MA2411B | 1126017 | Aug. 27, 2013 | Aug. 26, 2014 |
| Agilent | Dual Directional Coupler | 778D | 50422 | Note 2 | |
| Woken | Attenuator 1 | WK0602-XX | N/A | Note 2 | |
| PE | Attenuator 2 | PE7005-10 | N/A | Note 2 | |
| PE | Attenuator 3 | PE7005- 3 | N/A | Note 2 | |
| AR | Power Amplifier | 5S1G4M2 | 328767 | Note 3 | |
| R&S | Spectrum Analyzer | FSP 7 | 101131 | Jul. 09, 2013 | Jul. 08, 2014 |

**Table 5.1 Test Equipment List**

**Note:**
1. The calibration certificate of DASY can be referred to appendix C of this report.
2. The Insertion Loss calibration of Dual Directional Coupler and Attenuator were characterized via the network analyzer and compensated during system check.
3. In system check we need to monitor the level on the power meter, and adjust the power amplifier level to have precise power level to the dipole; the measured SAR will be normalized to 1W input power according to the ratio of 1W to the input power to the dipole. For system check, the calibration of the power amplifier is deemed not critically required for correct measurement; the power meter is critical and we do have calibration for it
4. Attenuator 1 insertion loss is calibrated by the network Analyzer, which the calibration is valid, before system check.

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## 6. *Tissue Simulating Liquids*

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid 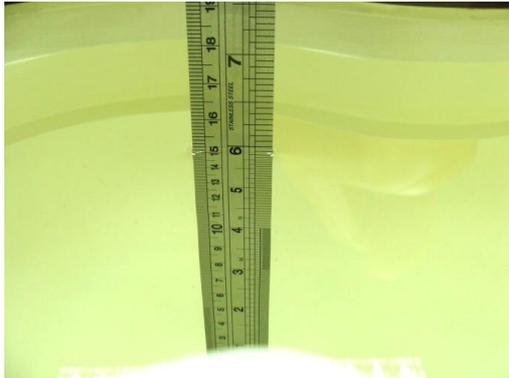top surface is larger than 15 cm, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.



**Fig 6.1 Photo of Liquid Height for Head SAR**



**Fig 6.2 Photo of Liquid Height for Body SAR**

The following table gives the recipes for tissue simulating liquid.

| Frequency (MHz) | Water (%) | Sugar (%) | Cellulose (%) | Salt (%) | Preventol (%) | DGBE (%) | Conductivity (σ) | Permittivity (εr) |
|---|---|---|---|---|---|---|---|---|
| **For Head** | | | | | | | | |
| 750 | 41.1 | 57.0 | 0.2 | 1.4 | 0.2 | 0 | 0.89 | 41.9 |
| 835 | 40.3 | 57.9 | 0.2 | 1.4 | 0.2 | 0 | 0.90 | 41.5 |
| 900 | 40.3 | 57.9 | 0.2 | 1.4 | 0.2 | 0 | 0.97 | 41.5 |
| 1800, 1900, 2000 | 55.2 | 0 | 0 | 0.3 | 0 | 44.5 | 1.40 | 40.0 |
| 2450 | 55.0 | 0 | 0 | 0 | 0 | 45.0 | 1.80 | 39.2 |
| 2600 | 54.8 | 0 | 0 | 0.1 | 0 | 45.1 | 1.96 | 39.0 |
| **For Body** | | | | | | | | |
| 750 | 51.7 | 47.2 | 0 | 0.9 | 0.1 | 0 | 0.96 | 55.5 |
| 835 | 50.8 | 48.2 | 0 | 0.9 | 0.1 | 0 | 0.97 | 55.2 |
| 900 | 50.8 | 48.2 | 0 | 0.9 | 0.1 | 0 | 1.05 | 55.0 |
| 1800, 1900, 2000 | 70.2 | 0 | 0 | 0.4 | 0 | 29.4 | 1.52 | 53.3 |
| 2450 | 68.6 | 0 | 0 | 0 | 0 | 31.4 | 1.95 | 52.7 |
| 2600 | 68.1 | 0 | 0 | 0.1 | 0 | 31.8 | 2.16 | 52.5 |

**Table 6.1 Recipes of Tissue Simulating Liquid**

**Simulating Liquid for 5G, Manufactured by SPEAG**

| Ingredients | (% by weight) |
|---|---|
| Water | 64~78% |
| Mineral oil | 11~18% |
| Emulsifiers | 9~15% |
| Additives and Salt | 2~3% |

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The dielectric parameters of the liquids were verified prior to the SAR evaluation using an SPEAG DAK-3.5 Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

| Frequency (MHz) | Tissue Type | Liquid Temp. (℃) | Conductivity (σ) | Permittivity (εr) | Conductivity Target (σ) | Permittivity Target (εr) | Delta (σ) (%) | Delta (εr) (%) | Limit (%) | Date |
|---|---|---|---|---|---|---|---|---|---|---|
| 835 | Body | 22.3 | 0.977 | 53.183 | 0.97 | 55.20 | 0.72 | -3.65 | ±5 | 2013/12/10 |
| 1900 | Body | 22.1 | 1.544 | 51.591 | 1.52 | 53.30 | 1.58 | -3.21 | ±5 | 2013/12/10 |
| 2450 | Body | 22.5 | 2.015 | 53.957 | 1.95 | 52.70 | 3.33 | 2.39 | ±5 | 2013/12/7 |
| 2600 | Body | 22.3 | 2.201 | 52.823 | 2.16 | 52.50 | 1.90 | 0.62 | ±5 | 2013/12/10 |

**Table 6.2 Measuring Results for Simulating Liquid**

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# 7. *System Verification Procedures*

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

## 7.1 *Purpose of System Performance check*

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

## 7.2 *System Setup*

In the simplified setup for system evaluation, the EUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:
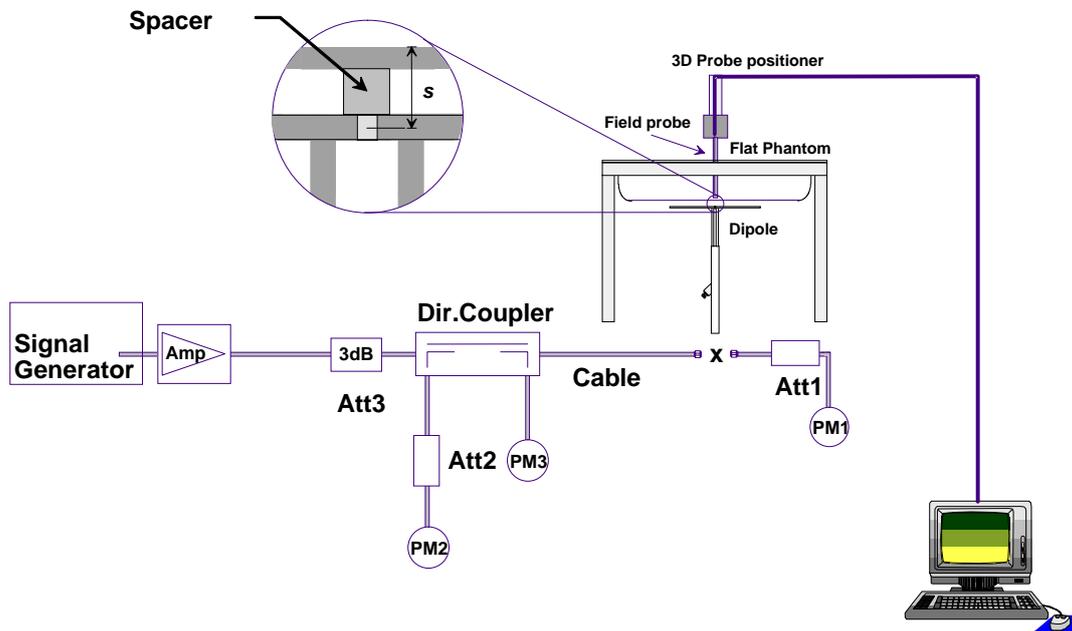


**Fig 7.1 System Setup for System Evaluation**

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole



**Fig 7.2 Photo of Dipole Setup**

## 7.3 SAR System Verification Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Table 7.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

| Date | Frequency (MHz) | Tissue Type | Input Power (mW) | Dipole S/N | Probe S/N | DAE S/N | Measured SAR (W/kg) | Targeted SAR (W/kg) | Normalized SAR (W/kg) | Deviation (%) |
|------|------|------|------|------|------|------|------|------|------|------|
| 2013/12/10 | 835 | Body | 250 | D835V2-SN:4d162 | 3931 | 577 | 2.45 | 9.28 | 9.8 | 5.60 |
| 2013/12/10 | 1900 | Body | 250 | D1900V2-SN:5d182 | 3931 | 577 | 10.40 | 39.50 | 41.6 | 5.32 |
| 2013/12/7 | 2450 | Body | 250 | D2450V2-SN:924 | 3898 | 1399 | 12.40 | 50.20 | 49.6 | -1.20 |
| 2013/12/10 | 2600 | Body | 250 | D2600V2-SN:1070 | 3898 | 1279 | 14.20 | 55.70 | 56.8 | 1.97 |

**Table 7.1 Target and Measurement SAR after Normalized**

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## 8. _EUT Testing Position_

This EUT was tested in four different USB configurations. They are "direct laptop plug-in for configuration 1 and 3", "USB cable plug-in for configuration 2 and 4", and "USB cable plug-in for Tip Mode (the tip of the EUT)" shown as below. Both direct laptop plug-in and USB cable plug-in test configurations are tested with 5 cm separation between the particular dongle orientation and the flat phantom. Please refer to Appendix D for the test setup photos.

| Configuration 1 (Horizontal Up) | Configuration 2 (Horizontal Down) | Configuration 3 (Vertical Front) | Configuration 4 (Vertical Back) |
|---|---|---|---|

**Fig 8.1 Illustration for USB Connector Orientations**

# 9. _Measurement Procedures_

The measurement procedures are as follows:

<Conducted power measurement>
(a)   For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
(b)   Read the WWAN RF power level from the base station simulator.
(c)   For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
(d)   Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>
(a)   Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
(b)   Place the EUT in the positions as Appendix E demonstrates.
(c)   Set scan area, grid size and other setting on the DASY software.
(d)   Measure SAR results for the highest power channel on each testing position.
(e)   Find out the largest SAR result on these testing positions of each band
(f)   Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a)   Power reference measurement
(b)   Area scan
(c)   Zoom scan
(d)   Power drift measurement

## 9.1 _Spatial Peak SAR Evaluation_

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

(a)   Extraction of the measured data (grid and values) from the Zoom Scan
(b)   Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
(c)   Generation of a high-resolution mesh within the measured volume
(d)   Interpolation of all measured values form the measurement grid to the high-resolution grid
(e)   Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
(f)   Calculation of the averaged SAR within masses of 1g and 10g

## 9.2 Power Reference Measurement

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

## 9.3 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. Area scan and zoom scan resolution setting follows KDB 865664 D01v01 quoted below.

For any secondary peaks found in the area scan which are within 2 dB of the maximum peak and are not within this zoom scan, the zoom scan should be repeated

| | | $\leq 3$ GHz | $> 3$ GHz |
|---|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | $5 \pm 1$ 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 | | $30° \pm 1°$ | $20° \pm 1°$ |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | | $\leq 2$ GHz: $\leq 15$ mm <br> $2 - 3$ GHz: $\leq 12$ mm | $3 - 4$ GHz: $\leq 12$ mm <br> $4 - 6$ GHz: $\leq 10$ 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: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | $\leq 2$ GHz: $\leq 8$ mm <br> $2 - 3$ GHz: $\leq 5$ mm[*] | $3 - 4$ GHz: $\leq 5$ mm[*] <br> $4 - 6$ GHz: $\leq 4$ mm[*] |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | $\leq 5$ mm | $3 - 4$ GHz: $\leq 4$ mm <br> $4 - 5$ GHz: $\leq 3$ mm <br> $5 - 6$ GHz: $\leq 2$ mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between $1^{st}$ two points closest to phantom surface — $\leq 4$ mm | $3 - 4$ GHz: $\leq 3$ mm <br> $4 - 5$ GHz: $\leq 2.5$ mm <br> $5 - 6$ GHz: $\leq 2$ 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 | $\geq 30$ mm | $3 - 4$ GHz: $\geq 28$ mm <br> $4 - 5$ GHz: $\geq 25$ mm <br> $5 - 6$ GHz: $\geq 22$ mm |

Note: $\delta$ 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 *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 447498 is $\leq 1.4$ W/kg, $\leq 8$ mm, $\leq 7$ mm and $\leq 5$ 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.

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## 9.4 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 9.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

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. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

## 9.6 Power Drift Monitoring

All SAR testing is under the EUT install full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.

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## 10. Conducted RF Output Power (Unit: dBm)

**<GSM Conducted Power>**

**Note:**
1.    Per KDB 447498 D01v05r01, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2.    For Body SAR testing, GPRS and EDGE should be evaluated, therefore the EUT was set in GPRS 2 Tx slots for GSM850/GSM1900 due to its highest frame-average power.

| Band GSM850 | Burst Average Power (dBm) | | | Tune-up Limit (dBm) | Frame-Average Power (dBm) | | | Tune-up Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| TX Channel | 128 | 189 | 251 | | 128 | 189 | 251 | |
| Frequency (MHz) | 824.2 | 836.4 | 848.8 | | 824.2 | 836.4 | 848.8 | |
| GPRS (GMSK, 1 Tx slot) | 31.88 | 31.94 | 31.93 | 33.00 | 22.88 | 22.94 | 22.93 | 24.00 |
| GPRS (GMSK, 2 Tx slots) | 31.16 | 31.19 | 31.16 | 32.00 | 25.16 | 25.19 | 25.16 | 26.00 |
| GPRS (GMSK, 3 Tx slots) | 29.16 | 29.21 | 29.19 | 30.00 | 24.90 | 24.95 | 24.93 | 25.74 |
| GPRS (GMSK, 4 Tx slots) | 27.13 | 27.12 | 27.13 | 28.00 | 24.13 | 24.12 | 24.13 | 25.00 |
| EDGE (8PSK, 1 Tx slot) | 25.46 | 25.51 | 25.49 | 26.50 | 16.46 | 16.51 | 16.49 | 17.50 |
| EDGE (8PSK, 2 Tx slots) | 24.86 | 24.89 | 24.86 | 26.00 | 18.86 | 18.89 | 18.86 | 20.00 |
| EDGE (8PSK, 3 Tx slots) | 22.93 | 22.88 | 22.87 | 24.00 | 18.67 | 18.62 | 18.61 | 19.74 |
| EDGE (8PSK, 4 Tx slots) | 20.99 | 21.00 | 20.96 | 22.00 | 17.99 | 18.00 | 17.96 | 19.00 |

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

| Band GSM1900 | Burst Average Power (dBm) | | | Tune-up Limit (dBm) | Frame-Average Power (dBm) | | | Tune-up Limit (dBm) |
|---|---|---|---|---|---|---|---|---|
| TX Channel | 512 | 661 | 810 | | 512 | 661 | 810 | |
| Frequency (MHz) | 1850.2 | 1880 | 1909.8 | | 1850.2 | 1880 | 1909.8 | |
| GPRS (GMSK, 1 Tx slot) | 28.85 | 29.02 | 29.02 | 30.00 | 19.85 | 20.02 | 20.02 | 21.00 |
| GPRS (GMSK, 2 Tx slots) | 27.81 | 27.95 | 28.04 | 29.00 | 21.81 | 21.95 | 22.04 | 23.00 |
| GPRS (GMSK, 3 Tx slots) | 25.73 | 25.98 | 25.99 | 27.00 | 21.47 | 21.72 | 21.73 | 22.74 |
| GPRS (GMSK, 4 Tx slots) | 23.74 | 23.86 | 23.96 | 25.00 | 20.74 | 20.86 | 20.96 | 22.00 |
| EDGE (8PSK, 1 Tx slot) | 24.44 | 24.58 | 24.56 | 26.00 | 15.44 | 15.58 | 15.56 | 17.00 |
| EDGE (8PSK, 2 Tx slots) | 23.84 | 23.98 | 23.99 | 25.00 | 17.84 | 17.98 | 17.99 | 19.00 |
| EDGE (8PSK, 3 Tx slots) | 21.71 | 21.98 | 21.96 | 23.00 | 17.45 | 17.72 | 17.70 | 18.74 |
| EDGE (8PSK, 4 Tx slots) | 19.65 | 19.82 | 19.77 | 21.00 | 16.65 | 16.82 | 16.77 | 18.00 |

Remark: The frame-averaged power is linearly scaled the maximum burst averaged power over 8 time slots.
The calculated method are shown as below:
Frame-averaged power = Maximum burst averaged power (1 Tx Slot) - 9 dB
Frame-averaged power = Maximum burst averaged power (2 Tx Slots) - 6 dB
Frame-averaged power = Maximum burst averaged power (3 Tx Slots) - 4.26 dB
Frame-averaged power = Maximum burst averaged power (4 Tx Slots) - 3 dB

**<LTE Conducted Power>**

**Note:**

1. Anritsu MT8820C base station simulator was used to setup the connection with EUT; the frequency band, channel bandwidth, RB allocation configuration, modulation type are set in the base station simulator to configure EUT transmitting at maximum power and at different configurations which are requested to be reported to FCC, for conducted power measurement and SAR testing.

2. Per KDB 941225 D05v02r03, when a properly configured base station simulator is used for the SAR and power measurements, spectrum plots for each RB allocation and offset configuration is not required.

3. Per KDB 941225 D05v02r03, start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel.

4. Per KDB 941225 D05v02r03, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.

5. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK ≤0.8W/kg, and 100%RB with QPSK output power is less than 1RB and 50%RB, 100%RB allocation for QPSK is not required.

6. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK >0.8W/kg for any exposure position, SAR testing of 100%RB allocation for QPSK is performed at the highest power channel.

7. 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.

8. Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.

### <LTE Band 7 Conducted Power>

| BW [MHz] | Modulation | RB Size | RB Offset | Power Low Ch. / Freq. | Power Middle Ch. / Freq. | Power High Ch. / Freq. | Tune up Limit (dBm) | Target MPR (dB) |
|---|---|---|---|---|---|---|---|---|
| Channel | | | | 20850 | 21100 | 21350 | Tune up Limit (dBm) | Target MPR (dB) |
| Frequency (MHz) | | | | 2510 | 2535 | 2560 | | |
| 20 | QPSK | 1 | 0 | 22.17 | 21.71 | 21.76 | 23 | 0 |
| 20 | QPSK | 1 | 49 | 22.87 | 22.34 | 21.78 | | |
| 20 | QPSK | 1 | 99 | 22.55 | 21.92 | 21.58 | | |
| 20 | QPSK | 50 | 0 | 21.58 | 21.16 | 21.18 | 22 | 1 |
| 20 | QPSK | 50 | 24 | 21.85 | 21.54 | 21.15 | | |
| 20 | QPSK | 50 | 49 | 21.44 | 21.40 | 21.00 | | |
| 20 | QPSK | 100 | 0 | 21.69 | 21.24 | 21.12 | | |
| 20 | 16QAM | 1 | 0 | 21.76 | 21.13 | 21.25 | 22 | 1 |
| 20 | 16QAM | 1 | 49 | 21.37 | 21.96 | 21.42 | | |
| 20 | 16QAM | 1 | 99 | 21.27 | 21.54 | 21.02 | | |
| 20 | 16QAM | 50 | 0 | 21.47 | 21.06 | 21.08 | 22 | 1 |
| 20 | 16QAM | 50 | 24 | 21.71 | 21.43 | 21.06 | | |
| 20 | 16QAM | 50 | 49 | 21.31 | 21.28 | 20.86 | | |
| 20 | 16QAM | 100 | 0 | 21.52 | 21.09 | 20.97 | | |
| Channel | | | | 20825 | 21100 | 21375 | Tune up Limit (dBm) | Target MPR (dB) |
| Frequency (MHz) | | | | 2507.5 | 2535 | 2562.5 | | |
| 15 | QPSK | 1 | 0 | 22.39 | 21.72 | 21.65 | 23 | 0 |
| 15 | QPSK | 1 | 37 | 22.85 | 22.30 | 21.96 | | |
| 15 | QPSK | 1 | 74 | 22.55 | 21.88 | 21.53 | | |
| 15 | QPSK | 36 | 0 | 21.70 | 21.41 | 20.91 | 22 | 1 |
| 15 | QPSK | 36 | 18 | 21.75 | 21.64 | 21.07 | | |
| 15 | QPSK | 36 | 37 | 21.74 | 21.44 | 21.02 | | |
| 15 | QPSK | 75 | 0 | 21.65 | 21.33 | 20.99 | | |
| 15 | 16QAM | 1 | 0 | 21.42 | 21.05 | 20.79 | 22 | 1 |
| 15 | 16QAM | 1 | 37 | 21.71 | 21.79 | 21.17 | | |
| 15 | 16QAM | 1 | 74 | 21.32 | 21.29 | 20.74 | | |
| 15 | 16QAM | 36 | 0 | 21.58 | 21.34 | 20.81 | 22 | 1 |
| 15 | 16QAM | 36 | 18 | 21.67 | 21.54 | 20.97 | | |
| 15 | 16QAM | 36 | 37 | 21.59 | 21.32 | 20.91 | | |
| 15 | 16QAM | 75 | 0 | 21.51 | 21.21 | 20.86 | | |
| Channel | | | | 20800 | 21100 | 21400 | Tune up Limit (dBm) | Target MPR (dB) |
| Frequency (MHz) | | | | 2505 | 2535 | 2565 | | |
| 10 | QPSK | 1 | 0 | 22.10 | 21.94 | 21.76 | 23 | 0 |
| 10 | QPSK | 1 | 24 | 22.79 | 22.55 | 22.02 | | |
| 10 | QPSK | 1 | 49 | 22.63 | 22.33 | 21.91 | | |
| 10 | QPSK | 25 | 0 | 21.52 | 21.41 | 20.91 | 22 | 1 |
| 10 | QPSK | 25 | 12 | 21.87 | 21.87 | 21.17 | | |
| 10 | QPSK | 25 | 24 | 21.69 | 21.55 | 21.14 | | |
| 10 | QPSK | 50 | 0 | 21.66 | 21.59 | 20.97 | | |
| 10 | 16QAM | 1 | 0 | 21.34 | 20.93 | 20.61 | 22 | 1 |
| 10 | 16QAM | 1 | 24 | 22.00 | 21.94 | 21.25 | | |
| 10 | 16QAM | 1 | 49 | 21.62 | 21.41 | 21.00 | | |
| 10 | 16QAM | 25 | 0 | 21.38 | 21.35 | 20.78 | 22 | 1 |
| 10 | 16QAM | 25 | 12 | 21.71 | 21.74 | 21.04 | | |
| 10 | 16QAM | 25 | 24 | 21.56 | 21.46 | 21.02 | | |
| 10 | 16QAM | 50 | 0 | 21.51 | 21.44 | 20.84 | | |

| Channel | | | | 20775 | 21100 | 21425 | Tune up Limit (dBm) | Target MPR (dB) |
|---|---|---|---|---|---|---|---|---|
| Frequency (MHz) | | | | 2502.5 | 2535 | 2567.5 | | |
| 5 | QPSK | 1 | 0 | 22.23 | 22.19 | 21.66 | 23 | 0 |
| 5 | QPSK | 1 | 12 | 22.78 | 22.75 | 22.20 | | |
| 5 | QPSK | 1 | 24 | 22.74 | 22.81 | 21.99 | | |
| 5 | QPSK | 12 | 0 | 21.84 | 21.87 | 21.29 | 22 | 1 |
| 5 | QPSK | 12 | 6 | 21.96 | 21.97 | 21.40 | | |
| 5 | QPSK | 12 | 11 | 21.87 | 21.98 | 21.37 | | |
| 5 | QPSK | 25 | 0 | 21.85 | 21.84 | 21.31 | | |
| 5 | 16QAM | 1 | 0 | 21.58 | 21.35 | 20.77 | 22 | 1 |
| 5 | 16QAM | 1 | 12 | 21.70 | 21.61 | 21.39 | | |
| 5 | 16QAM | 1 | 24 | 21.97 | 21.76 | 21.07 | | |
| 5 | 16QAM | 12 | 0 | 21.75 | 21.59 | 21.21 | 22 | 1 |
| 5 | 16QAM | 12 | 6 | 21.85 | 21.83 | 21.31 | | |
| 5 | 16QAM | 12 | 11 | 21.78 | 21.69 | 21.26 | | |
| 5 | 16QAM | 25 | 0 | 21.67 | 21.54 | 21.15 | | |

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**<WLAN 2.4GHz Conducted Power>**

| WLAN 2.4GHz 802.11b Average Power (dBm) | | | Tune up Limit (dBm) |
|---|---|---|---|
| Power vs. Channel | | | |
| Channel | Frequency (MHz) | Data Rate | |
| | | 1Mbps | |
| CH 1 | 2412 | 12.53 | 14.0 |
| CH 6 | 2437 | 13.05 | |

| WLAN 2.4GHz 802.11g Average Power (dBm) | | | Tune up limit (dBm) |
|---|---|---|---|
| Power vs. Channel | | | |
| Channel | Frequency (MHz) | Data Rate | |
| | | 6Mbps | |
| CH 1 | 2412 | 10.89 | 12.0 |
| CH 6 | 2437 | 11.24 | |

| WLAN 2.4GHz 802.11n-HT20 Average Power (dBm) | | | Tune up limit (dBm) |
|---|---|---|---|
| Power vs. Channel | | | |
| Channel | Frequency (MHz) | MCS Index | |
| | | MCS0 | |
| CH 1 | 2412 | 9.79 | 11.0 |
| CH 6 | 2437 | 10.27 | |

**Note:**

1. Per KDB 248227 D01 v01r02, choose the highest output power channel to test SAR and determine further SAR exclusion

2. For each frequency band, testing at higher data rates and higher order modulations is not required when the maximum average output power for each of these configurations is less than 1/4dB higher than those measured at the lowest data rate

3. Apply the test exclusion rule in KDB 248227 D01 v01r02 11g and 11n-HT20 output power is less than 1/4dB higher than 11b mode, thus the SAR can be excluded.

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## 11. *Antenna Location*

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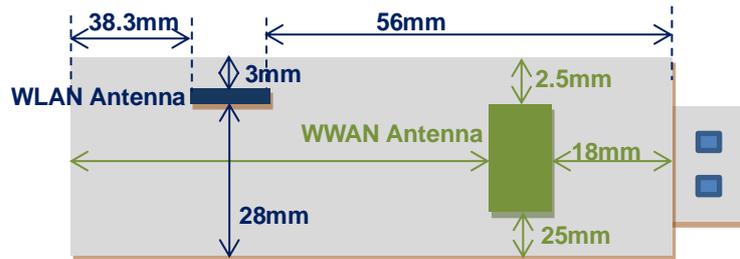
## 12. <u>SAR Test Results</u>

**Note:**
1. Per KDB 447498 D01v05r01, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   *Scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.*
   *Reported SAR(W/kg)= Measured SAR(W/kg)* Scaling Factor*
2. Per KDB 447498 D01v05r01, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
   - ≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
   - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
3. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK ≤0.8W/kg, and 100%RB with QPSK output power is less than 1RB and 50%RB, 100%RB allocation for QPSK is not required.
4. Per KDB 941225 D05v02r03, when reported SAR of 1RB and 50%RB allocation for QPSK >0.8W/kg for any exposure position, SAR testing of 100%RB allocation for QPSK is performed at the highest power channel.
5. 16QAM output power for each RB allocation configuration is > not ½ dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, 16QAM SAR testing is not required.
6. Smaller bandwidth output power for each RB allocation configuration is > not ½ dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is ≤ 1.45 W/kg; Per KDB 941225 D05v02r03, smaller bandwidth SAR testing is not required.

## 12.1 <u>Body SAR</u>

### <GSM SAR>

| Plot No. | Band | Mode | Test Position | Gap (cm) | Flip | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | GSM850 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | | 189 | 836.4 | 31.19 | 32 | 1.205 | 0.1 | 0.702 | 0.846 |
| 13 | GSM850 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | 90 degree | 189 | 836.4 | 31.19 | 32 | 1.205 | 0.05 | 0.076 | 0.092 |
| 14 | GSM850 | GPRS (2 Tx slots) | Horizontal Down | 0.5cm | | 189 | 836.4 | 31.19 | 32 | 1.205 | -0.03 | 0.599 | 0.722 |
| 15 | GSM850 | GPRS (2 Tx slots) | Vertical Front | 0.5cm | | 189 | 836.4 | 31.19 | 32 | 1.205 | 0.05 | 0.185 | 0.223 |
| 16 | GSM850 | GPRS (2 Tx slots) | Vertical Back | 0.5cm | | 189 | 836.4 | 31.19 | 32 | 1.205 | -0.07 | 0.34 | 0.410 |
| 17 | GSM850 | GPRS (2 Tx slots) | Tip Mode | 0.5cm | | 189 | 836.4 | 31.19 | 32 | 1.205 | 0.11 | 0.00753 | 0.009 |
| 18 | GSM850 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | | 128 | 824.2 | 31.16 | 32 | 1.213 | 0.11 | 0.685 | 0.831 |
| 19 | GSM850 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | | 251 | 848.8 | 31.16 | 32 | 1.213 | 0.08 | 0.727 | **0.882** |
| 6 | GSM1900 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | | 810 | 1909.8 | 28.04 | 29 | 1.247 | -0.05 | 0.528 | **0.659** |
| 7 | GSM1900 | GPRS (2 Tx slots) | Horizontal Up | 0.5cm | 90 degree | 810 | 1909.8 | 28.04 | 29 | 1.247 | -0.18 | 0.078 | 0.097 |
| 8 | GSM1900 | GPRS (2 Tx slots) | Horizontal Down | 0.5cm | | 810 | 1909.8 | 28.04 | 29 | 1.247 | 0 | 0.322 | 0.402 |
| 9 | GSM1900 | GPRS (2 Tx slots) | Vertical Front | 0.5cm | | 810 | 1909.8 | 28.04 | 29 | 1.247 | -0.01 | 0.042 | 0.052 |
| 10 | GSM1900 | GPRS (2 Tx slots) | Vertical Back | 0.5cm | | 810 | 1909.8 | 28.04 | 29 | 1.247 | -0.01 | 0.317 | 0.395 |
| 11 | GSM1900 | GPRS (2 Tx slots) | Tip Mode | 0.5cm | | 810 | 1909.8 | 28.04 | 29 | 1.247 | -0.11 | 0.026 | 0.032 |

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### <u>LTE SAR></u>

| Plot No. | Band | BW (MHz) | Modulation | RB Size | RB offset | Test Position | Gap (cm) | Flip | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | | 20850 | 2510 | 22.87 | 23 | 1.030 | 0.02 | 0.830 | 0.855 |
| 24 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | | 21100 | 2535 | 22.34 | 23 | 1.164 | -0.04 | 0.612 | 0.712 |
| 25 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | | 21350 | 2560 | 21.78 | 23 | 1.324 | 0.08 | 0.652 | **0.863** |
| 26 | LTE Band 7 | 20M | QPSK | 50 | 24 | Horizontal Up | 0.5cm | | 20850 | 2510 | 21.85 | 22 | 1.035 | -0.02 | 0.780 | 0.807 |
| 27 | LTE Band 7 | 20M | QPSK | 50 | 24 | Horizontal Up | 0.5cm | | 21100 | 2535 | 21.54 | 22 | 1.112 | -0.02 | 0.582 | 0.647 |
| 28 | LTE Band 7 | 20M | QPSK | 50 | 24 | Horizontal Up | 0.5cm | | 21350 | 2560 | 21.15 | 22 | 1.216 | 0.07 | 0.652 | 0.793 |
| 29 | LTE Band 7 | 20M | QPSK | 100 | 0 | Horizontal Up | 0.5cm | | 20850 | 2510 | 21.69 | 22 | 1.074 | 0.07 | 0.768 | 0.825 |
| 21 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | 90 degree | 20850 | 2510 | 22.87 | 23 | 1.030 | 0.17 | 0.239 | 0.246 |
| 22 | LTE Band 7 | 20M | QPSK | 50 | 24 | Horizontal Up | 0.5cm | 90 degree | 20850 | 2510 | 21.85 | 22 | 1.035 | 0.12 | 0.227 | 0.235 |
| 30 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Down | 0.5cm | | 20850 | 2510 | 22.87 | 23 | 1.030 | 0.1 | 0.504 | 0.519 |
| 31 | LTE Band 7 | 20M | QPSK | 50 | 24 | Horizontal Down | 0.5cm | | 20850 | 2510 | 21.85 | 22 | 1.035 | 0.09 | 0.474 | 0.491 |
| 34 | LTE Band 7 | 20M | QPSK | 1 | 49 | Vertical Front | 0.5cm | | 20850 | 2510 | 22.87 | 23 | 1.030 | -0.16 | 0.123 | 0.127 |
| 35 | LTE Band 7 | 20M | QPSK | 50 | 24 | Vertical Front | 0.5cm | | 20850 | 2510 | 21.85 | 22 | 1.035 | 0.06 | 0.115 | 0.119 |
| 32 | LTE Band 7 | 20M | QPSK | 1 | 24 | Vertical Back | 0.5cm | | 20850 | 2510 | 22.87 | 23 | 1.030 | -0.12 | 0.411 | 0.423 |
| 33 | LTE Band 7 | 20M | QPSK | 50 | 24 | Vertical Back | 0.5cm | | 20850 | 2510 | 21.85 | 22 | 1.035 | 0.03 | 0.471 | 0.488 |
| 36 | LTE Band 7 | 20M | QPSK | 1 | 49 | Tip Mode | 0.5cm | | 20850 | 2510 | 22.87 | 23 | 1.030 | 0.09 | 0.052 | 0.054 |
| 37 | LTE Band 7 | 20M | QPSK | 50 | 24 | Tip Mode | 0.5cm | | 20850 | 2510 | 21.85 | 22 | 1.035 | 0.1 | 0.049 | 0.051 |

### <u>WLAN2.4GHz SAR></u>

| Plot No. | Band | Mode | Test Position | Gap (cm) | Flip | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Reported 1g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WLAN2.4GHz | 802.11b 1Mbps | Horizontal Up | 0.5cm | | 6 | 2437 | 13.05 | 14 | 1.245 | 0.15 | 0.122 | 0.152 |
| 20 | WLAN2.4GHz | 802.11b 1Mbps | Horizontal Up | 0.5cm | 90 degree | 6 | 2437 | 13.05 | 14 | 1.245 | 0.14 | 0.029 | 0.036 |
| 2 | WLAN2.4GHz | 802.11b 1Mbps | Horizontal Down | 0.5cm | | 6 | 2437 | 13.05 | 14 | 1.245 | -0.12 | 0.055 | 0.068 |
| 3 | WLAN2.4GHz | 802.11b 1Mbps | Vertical Front | 0.5cm | | 6 | 2437 | 13.05 | 14 | 1.245 | 0.16 | 0.16 | **0.199** |
| 4 | WLAN2.4GHz | 802.11b 1Mbps | Vertical Back | 0.5cm | | 6 | 2437 | 13.05 | 14 | 1.245 | 0.11 | 0.00888 | 0.011 |
| 5 | WLAN2.4GHz | 802.11b 1Mbps | Tip Mode | 0.5cm | | 6 | 2437 | 13.05 | 14 | 1.245 | 0.13 | 0.00624 | 0.008 |

## 12.2 *Repeated SAR Measurement*

| Plot No. | Band | BW (MHz) | Modulation | RB Size | RB offset | Test Position | Gap (cm) | Ch. | Freq. (MHz) | Average Power (dBm) | Tune-Up Limit (dBm) | Tune-up Scaling Factor | Power Drift (dB) | Measured 1g SAR (W/kg) | Ratio | Reported 1g SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 23 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | 20850 | 2510 | 22.87 | 23 | 1.030 | 0.02 | 0.83 | - | 0.855 |
| 38 | LTE Band 7 | 20M | QPSK | 1 | 49 | Horizontal Up | 0.5cm | 20850 | 2510 | 22.87 | 23 | 1.030 | -0.1 | 0.814 | 1.02 | 0.839 |

**Note:**

1. Per KDB 865664 D01v01r02, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg

2. Per KDB 865664 D01v01r02, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.

3. The ratio is the largest SAR to the smallest SAR among original and repeated measurement.

4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

## 12.3 *Highest SAR Plot*

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab          Date: 2013/12/10
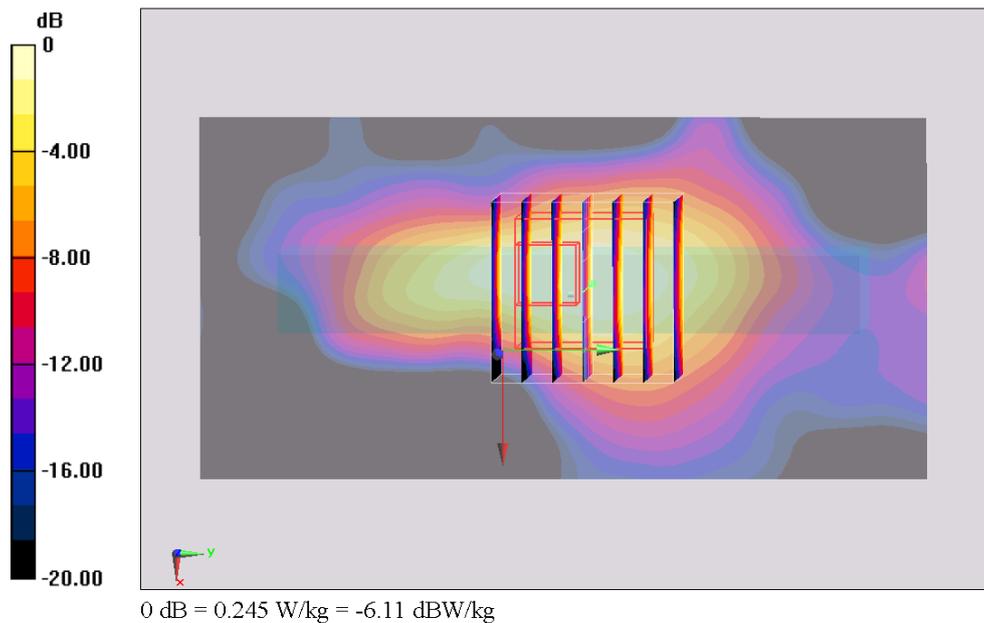
**#19_GSM850_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch251**

Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 849 MHz; $\sigma$ = 0.991 S/m; $\varepsilon_r$ = 53.022; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch251/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.909 W/kg

**Configuration/Ch251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.715 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.11 W/kg
**SAR(1 g) = 0.727 W/kg; SAR(10 g) = 0.459 W/kg**
Maximum value of SAR (measured) = 0.930 W/kg



0 dB = 0.930 W/kg = -0.32 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab          Date: 2013/12/10

## #06_GSM1900_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; $\sigma$ = 1.554 S/m; $\varepsilon_r$ = 51.552; $\rho$
= 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.773 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm,
dz=5mm
Reference Value = 21.886 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.910 W/kg
**SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.285 W/kg**
Maximum value of SAR (measured) = 0.711 W/kg



0 dB = 0.711 W/kg = -1.48 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab          Date: 2013/12/10

## #25_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch21350

Communication System: LTE; Frequency: 2560 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2560 MHz; $\sigma$ = 2.149 S/m; $\varepsilon_r$ = 52.782; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch21350/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.919 W/kg

**Configuration/Ch21350/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.918 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.43 W/kg
**SAR(1 g) = 0.652 W/kg; SAR(10 g) = 0.282 W/kg**
Maximum value of SAR (measured) = 1.03 W/kg



0 dB = 1.03 W/kg = 0.13 dBW/kg

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Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab          Date: 2013/12/7

### #03_WLAN2.4GHz_802.11b 1Mbps_Vertical Front_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.996 S/m; $\varepsilon_r$ = 53.979; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.269 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.311 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.353 W/kg
**SAR(1 g) = 0.160 W/kg; SAR(10 g) = 0.077 W/kg**
Maximum value of SAR (measured) = 0.245 W/kg



0 dB = 0.245 W/kg = -6.11 dBW/kg

## 13. Simultaneous Transmission Analysis

| NO. | Simultaneous Transmission Configurations | Dongle | Note |
|-----|------------------------------------------|--------|------|
|     |                                          | Body   |      |
| 1.  | GPRS/EDGE(Data) + WLAN2.4GHz(data)       | Yes    | 2.4GHz Hotspot |
| 2.  | LTE(Data) + WLAN2.4GHz(data)             | Yes    | 2.4GHz Hotspot |

**Note:**
1. The Scaled SAR summation is calculated based on the same configuration and test position.
2. Per KDB 447498 D01v05r01, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) $SPLSR = (SAR_1 + SAR_2)^{1.5}$ / ($min.$ $separation$ $distance, mm$), and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where $(x_1, y_1, z_1)$ and $(x_2, y_2, z_2)$ are the coordinates of the extrapolated peak SAR locations in the zoom scan
   If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary
   iii) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg
3. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r01 based on the formula below.
   i) ($max.$ $power$ $of$ $channel, including tune-up tolerance, mW$)/($min.$ $test$ $separation$ $distance, mm$)]·[$\sqrt{f(GHz)}/x$] W/kg for $test$ $separation$ $distances$ ≤ 50 mm; where $x$ = 7.5 for 1-g SAR, and $x$ = 18.75 for 10-g SAR.
   ii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the $test$ $separation$ $distances$ is > 50 mm.
In this report, 50mm separation is applied to conservatively estimate SAR value for separation distance > 50mm

## 13.1 Body Exposure Conditions

< WWAN + WLAN >

| Position | WWAN | | | WLAN | | Summed SAR (W/kg) |
|----------|------|--|--|------|--|-------------------|
| | WWAN Band | Plot No | SAR (W/kg) | Plot No | SAR (W/kg) | |
| Horizontal Up | GSM850 | 19 | 0.882 | 1 | 0.152 | **1.034** |
| | GSM1900 | 6 | 0.659 | 1 | 0.152 | **0.811** |
| | LTE Band 7 | 25 | 0.863 | 1 | 0.152 | **1.015** |
| Horizontal Down | GSM850 | 14 | 0.722 | 2 | 0.068 | **0.790** |
| | GSM1900 | 8 | 0.402 | 2 | 0.068 | **0.470** |
| | LTE Band 7 | 30 | 0.519 | 2 | 0.068 | **0.587** |
| Vertical Front | GSM850 | 15 | 0.223 | 3 | 0.199 | **0.422** |
| | GSM1900 | 9 | 0.052 | 3 | 0.199 | **0.251** |
| | LTE Band 7 | 34 | 0.127 | 3 | 0.199 | **0.326** |
| Vertical Back | GSM850 | 16 | 0.41 | 4 | 0.011 | **0.421** |
| | GSM1900 | 10 | 0.395 | 4 | 0.011 | **0.406** |
| | LTE Band 7 | 33 | 0.488 | 4 | 0.011 | **0.499** |
| Tip Mode | GSM850 | 17 | 0.009 | 5 | 0.008 | **0.017** |
| | GSM1900 | 11 | 0.032 | 5 | 0.008 | **0.040** |
| | LTE Band 7 | 36 | 0.054 | 5 | 0.008 | **0.062** |
| Horizontal Down Ant Angle 90 | GSM850 | 13 | 0.092 | 20 | 0.036 | **0.128** |
| | GSM1900 | 7 | 0.097 | 20 | 0.036 | **0.133** |
| | LTE Band 7 | 21 | 0.246 | 20 | 0.036 | **0.282** |

**Test Engineer**： Angelo Change, Galen Chang, Bevis Chang and San Lin

## 14. _Uncertainty Assessment_

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 12.1

| Uncertainty Distributions | Normal | Rectangular | Triangular | U-Shape |
|---|---|---|---|---|
| Multi-plying Factor[a] | $1/k$ [b] | $1/\sqrt{3}$ | $1/\sqrt{6}$ | $1/\sqrt{2}$ |

(a)  standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b)  $\kappa$ is the coverage factor

**Table 14.1 Standard Uncertainty for Assumed Distribution**

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (1g) | Ci (10g) | Standard Uncertainty (1g) | Standard Uncertainty (10g) |
|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | |
| Probe Calibration | 6.0 | Normal | 1 | 1 | 1 | ± 6.0 % | ± 6.0 % |
| Axial Isotropy | 4.7 | Rectangular | √3 | 0.7 | 0.7 | ± 1.9 % | ± 1.9 % |
| Hemispherical Isotropy | 9.6 | Rectangular | √3 | 0.7 | 0.7 | ± 3.9 % | ± 3.9 % |
| Boundary Effects | 1.0 | Rectangular | √3 | 1 | 1 | ± 0.6 % | ± 0.6 % |
| Linearity | 4.7 | Rectangular | √3 | 1 | 1 | ± 2.7 % | ± 2.7 % |
| System Detection Limits | 1.0 | Rectangular | √3 | 1 | 1 | ± 0.6 % | ± 0.6 % |
| Readout Electronics | 0.3 | Normal | 1 | 1 | 1 | ± 0.3 % | ± 0.3 % |
| Response Time | 0.8 | Rectangular | √3 | 1 | 1 | ± 0.5 % | ± 0.5 % |
| Integration Time | 2.6 | Rectangular | √3 | 1 | 1 | ± 1.5 % | ± 1.5 % |
| RF Ambient Noise | 3.0 | Rectangular | √3 | 1 | 1 | ± 1.7 % | ± 1.7 % |
| RF Ambient Reflections | 3.0 | Rectangular | √3 | 1 | 1 | ± 1.7 % | ± 1.7 % |
| Probe Positioner | 0.4 | Rectangular | √3 | 1 | 1 | ± 0.2 % | ± 0.2 % |
| Probe Positioning | 2.9 | Rectangular | √3 | 1 | 1 | ± 1.7 % | ± 1.7 % |
| Max. SAR Eval. | 1.0 | Rectangular | √3 | 1 | 1 | ± 0.6 % | ± 0.6 % |
| **Test Sample Related** | | | | | | | |
| Device Positioning | 2.9 | Normal | 1 | 1 | 1 | ± 2.9 % | ± 2.9 % |
| Device Holder | 3.6 | Normal | 1 | 1 | 1 | ± 3.6 % | ± 3.6 % |
| Power Drift | 5.0 | Rectangular | √3 | 1 | 1 | ± 2.9 % | ± 2.9 % |
| **Phantom and Setup** | | | | | | | |
| Phantom Uncertainty | 4.0 | Rectangular | √3 | 1 | 1 | ± 2.3 % | ± 2.3 % |
| Liquid Conductivity (Target) | 5.0 | Rectangular | √3 | 0.64 | 0.43 | ± 1.8 % | ± 1.2 % |
| Liquid Conductivity (Meas.) | 2.5 | Normal | 1 | 0.64 | 0.43 | ± 1.6 % | ± 1.1 % |
| Liquid Permittivity (Target) | 5.0 | Rectangular | √3 | 0.6 | 0.49 | ± 1.7 % | ± 1.4 % |
| Liquid Permittivity (Meas.) | 2.5 | Normal | 1 | 0.6 | 0.49 | ± 1.5 % | ± 1.2 % |
| **Combined Standard Uncertainty** | | | | | | ± 11.0 % | ± 10.8 % |
| **Coverage Factor for 95 %** | | | | | | K=2 | |
| **Expanded Uncertainty** | | | | | | **± 22.0 %** | **± 21.5 %** |

**Table 14.2 Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz from IEEE Std 1528™-2003**

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## 15. *References*

[1]     FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"

[2]     ANSI/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", September 1992

[3]     IEEE Std. 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

[4]     SPEAG DASY System Handbook

[5]     FCC KDB 248227 D01 v01r02, "SAR Measurement Procedures for 802.11 a/b/g Transmitters", May 2007

[6]     FCC KDB 447498 D01 v05r01, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", May 2013

[7]     FCC KDB 941225 D03 v01, "Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE", December 2008

[8]     FCC KDB 941225 D05 v02r03, "SAR Evaluation Considerations for LTE Devices", May 2013

[9]     FCC KDB 865664 D01 v01r02, "SAR Measurement Requirements for 100 MHz to 6 GHz", May 2013.

[10]    FCC KDB 447498 D02 v02, "SAR Measurement Procedures for USB Dongle Transmitters", Nov 2013.

# Appendix A.    Plots of System Performance Check

The plots are shown as follows.

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# System Check_Body_835MHz_131210

## DUT: D835V2-SN:4d162

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1
Medium: MSL_850_131210 Medium parameters used: f = 835 MHz; σ = 0.977 S/m; ε$_r$ = 53.183; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 3.09 W/kg

**Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 56.037 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 3.62 W/kg
**SAR(1 g) = 2.45 W/kg; SAR(10 g) = 1.62 W/kg**
Maximum value of SAR (measured) = 3.07 W/kg
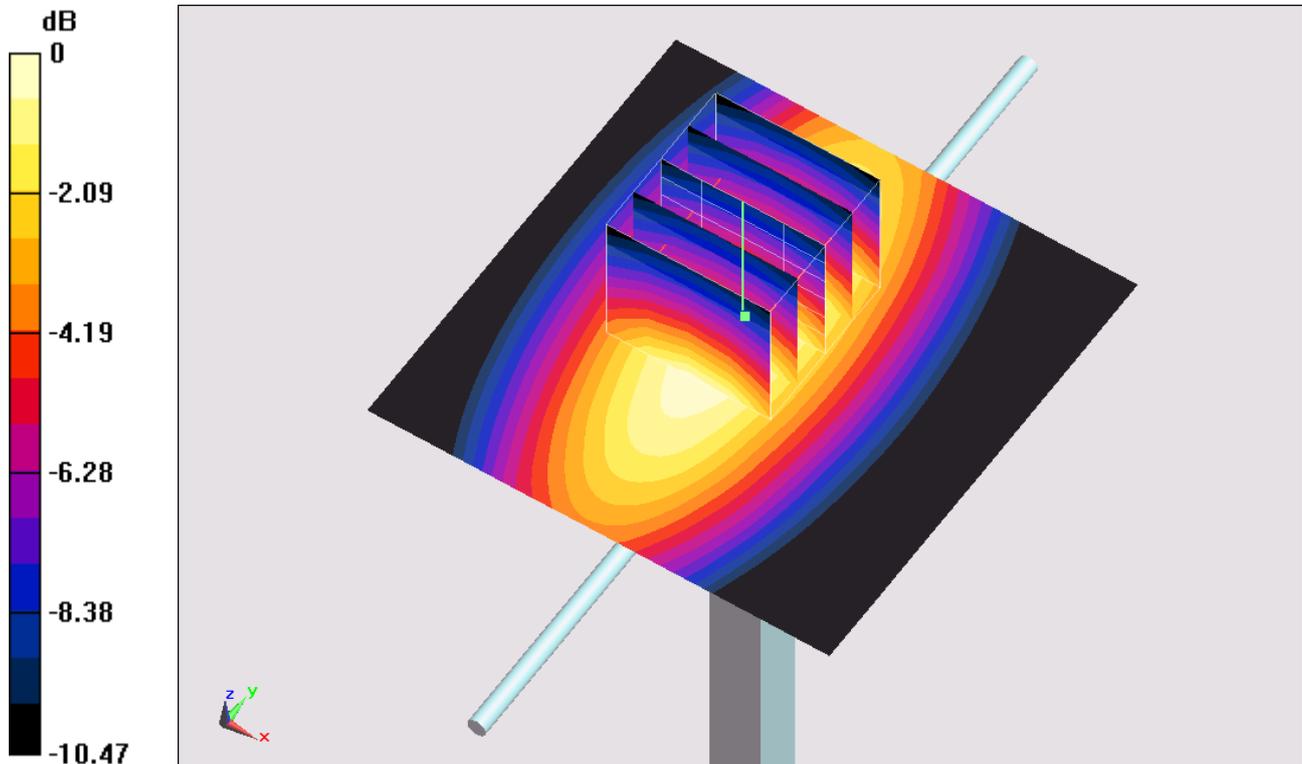


0 dB = 3.07 W/kg = 4.87 dBW/kg

## System Check_Body_1900MHz_131210

### DUT: D1900V2-SN:5d182

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium: MSL_1900_131210 Medium parameters used: f = 1900 MHz; σ = 1.544 S/m; $ε_r$ = 51.591; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

### Configuration/Pin=250mW/Area Scan (61x61x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 15.5 W/kg

### Configuration/Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 98.537 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 19.0 W/kg
**SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.39 W/kg**
Maximum value of SAR (measured) = 14.5 W/kg
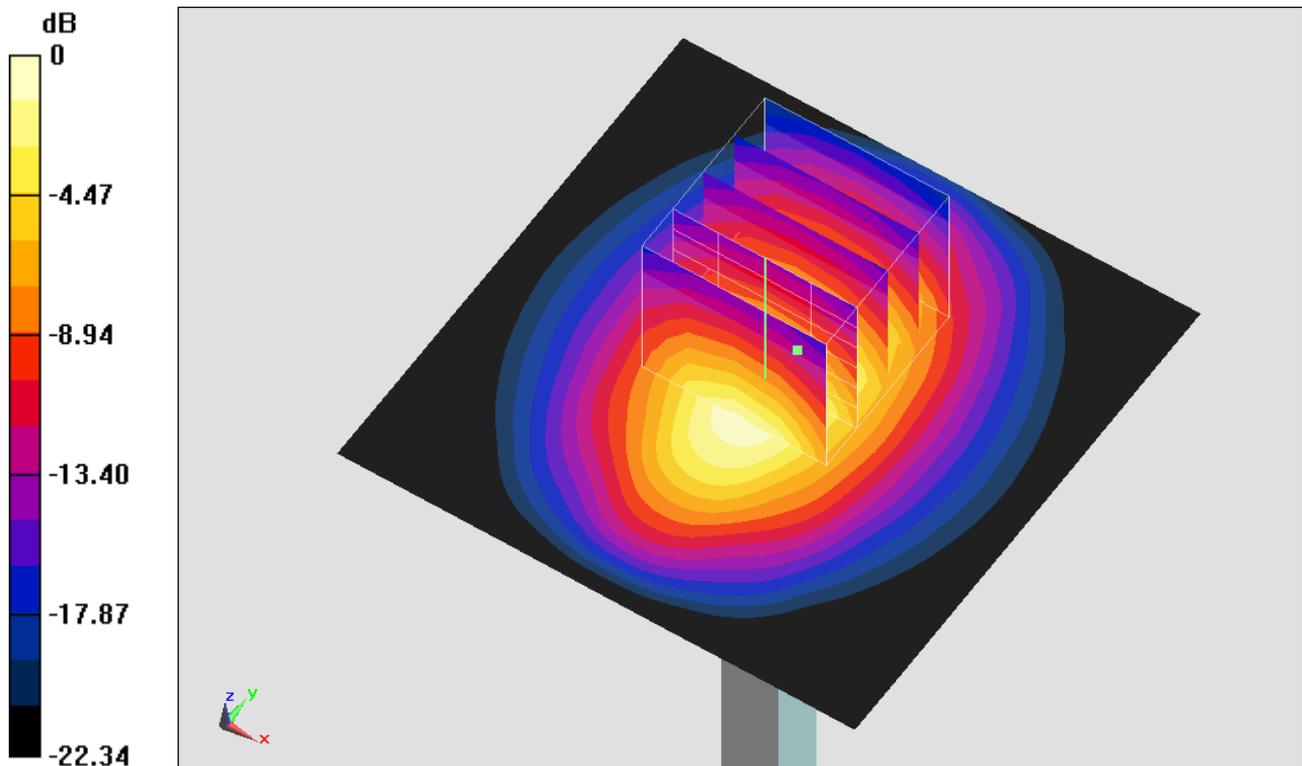


0 dB = 14.5 W/kg = 11.61 dBW/kg

## System Check_Body_2450MHz_131207

### DUT: D2450V2-SN:924

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2450 MHz; $\sigma$ = 2.015 S/m; $\varepsilon_r$ = 53.957; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)


**Configuration/Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 19.1 W/kg

**Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.352 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 25.4 W/kg
**SAR(1 g) = 12.4 W/kg; SAR(10 g) = 5.79 W/kg**
Maximum value of SAR (measured) = 18.8 W/kg
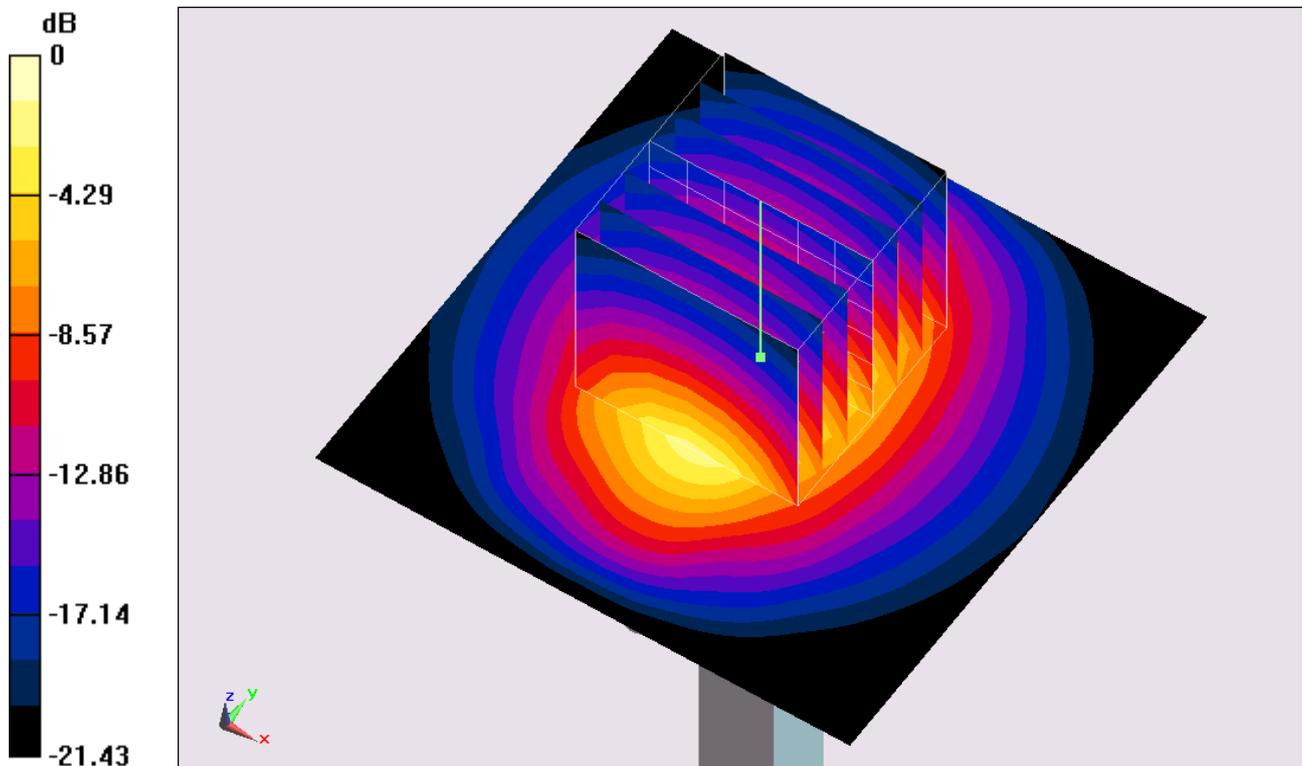


0 dB = 18.8 W/kg = 12.74 dBW/kg

## System Check_Body_2600MHz-131210

**DUT: D2600V2-SN:1070**

Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2600 MHz; σ = 2.201 S/m; $\varepsilon_r$ = 52.823; ρ
= 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Pin=250mW/Area Scan (61x61x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 15.6 W/kg

**Configuration/Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 84.607 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 21.0 W/kg
**SAR(1 g) = 14.2 W/kg; SAR(10 g) = 6.4 W/kg**
Maximum value of SAR (measured) = 15.6 W/kg
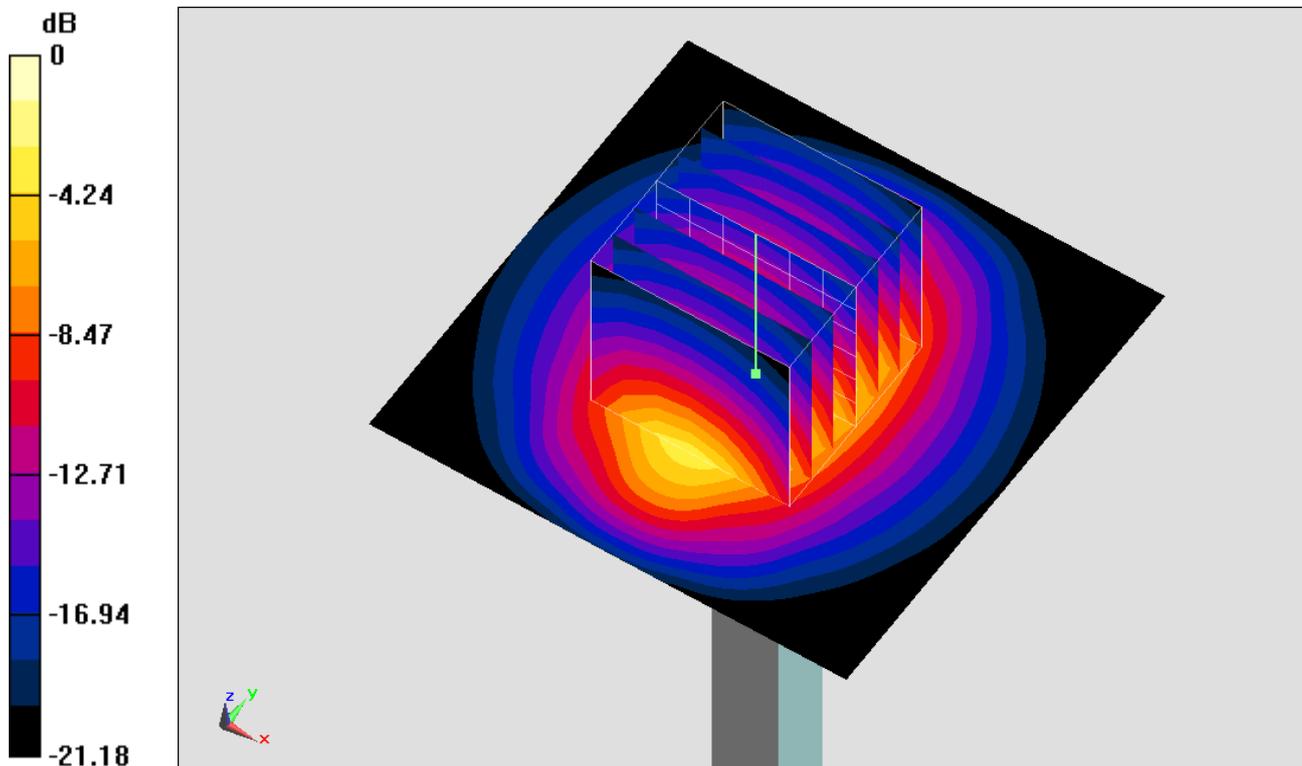


0 dB = 15.6 W/kg = 11.93 dBW/kg

# *Appendix B.    Plots of SAR Measurement*

The plots are shown as follows.

## #12_GSM850_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; σ = 0.979 S/m; $\varepsilon_r$ = 53.172; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
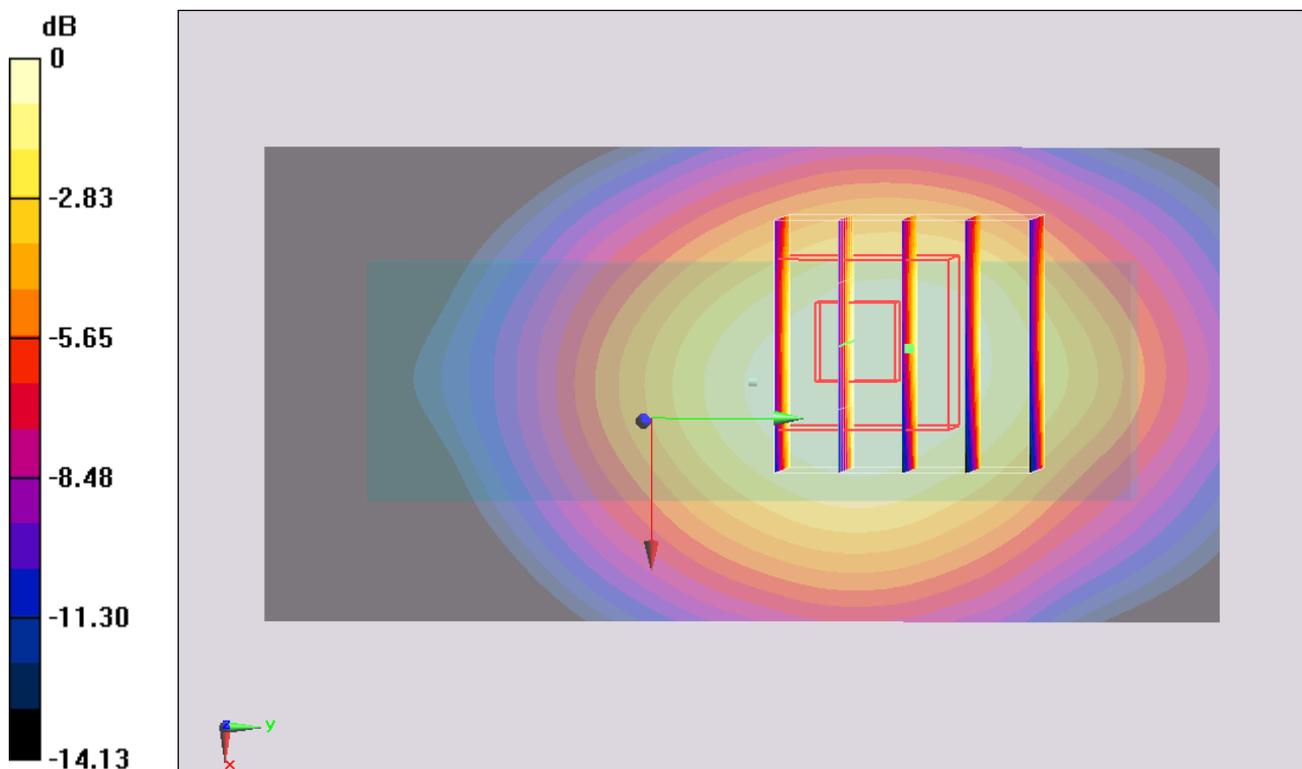Maximum value of SAR (interpolated) = 0.866 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.180 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 1.07 W/kg
**SAR(1 g) = 0.702 W/kg; SAR(10 g) = 0.444 W/kg**
Maximum value of SAR (measured) = 0.900 W/kg
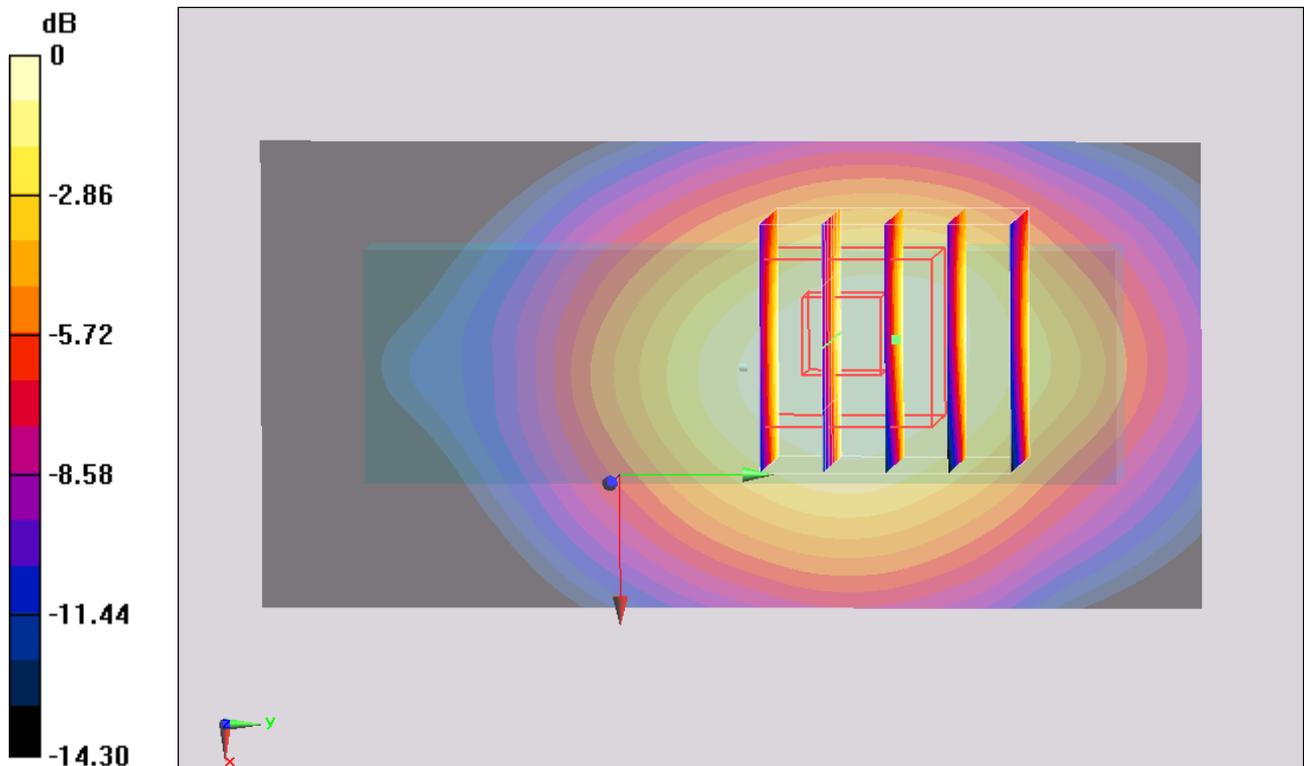


0 dB = 0.900 W/kg = -0.46 dBW/kg

## #13_GSM850_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch189;Flip 90

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; $\sigma$ = 0.979 S/m; $\varepsilon_r$ = 53.172; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.110 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.443 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.129 W/kg
**SAR(1 g) = 0.076 W/kg; SAR(10 g) = 0.045 W/kg**
Maximum value of SAR (measured) = 0.104 W/kg
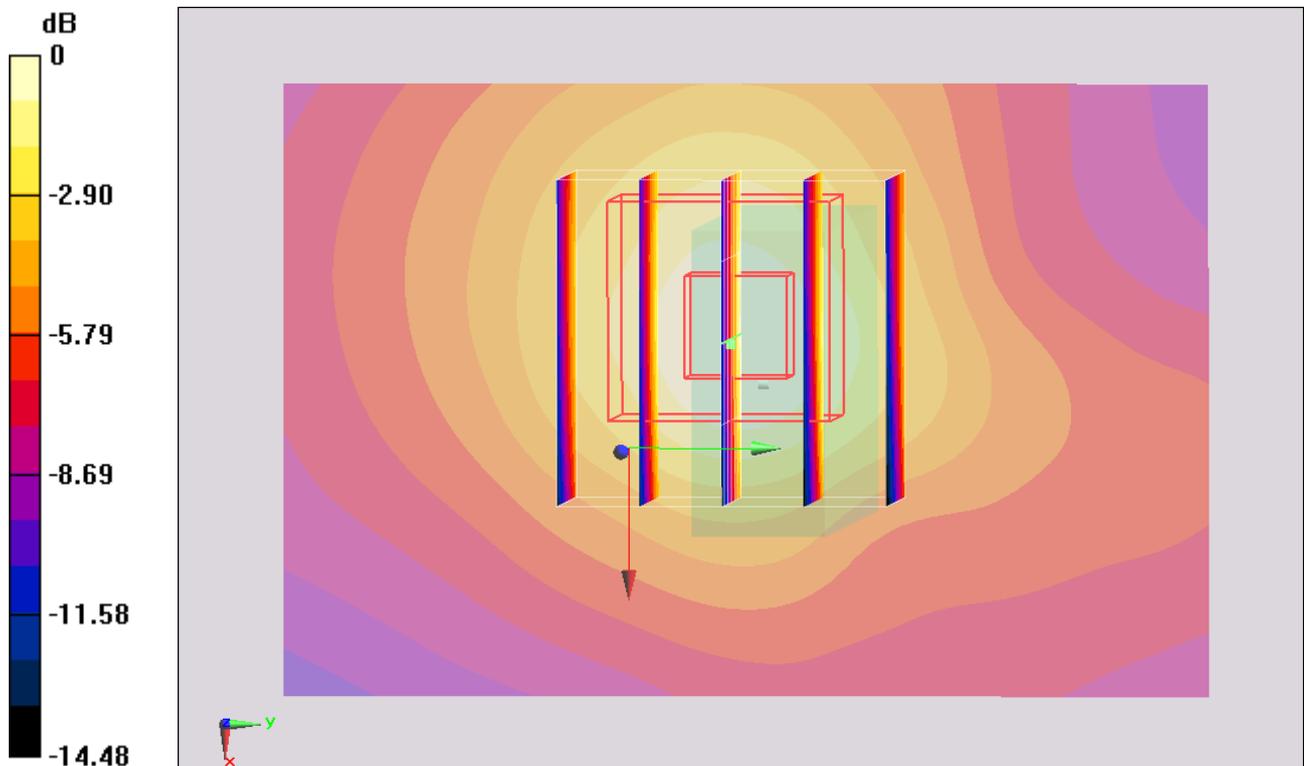


0 dB = 0.104 W/kg = -9.83 dBW/kg

## #14_GSM850_GPRS (2 Tx slots)_Horizontal Down_0.5cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; σ = 0.979 S/m; $\varepsilon_r$ = 53.172; ρ = 1000 kg/m³
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
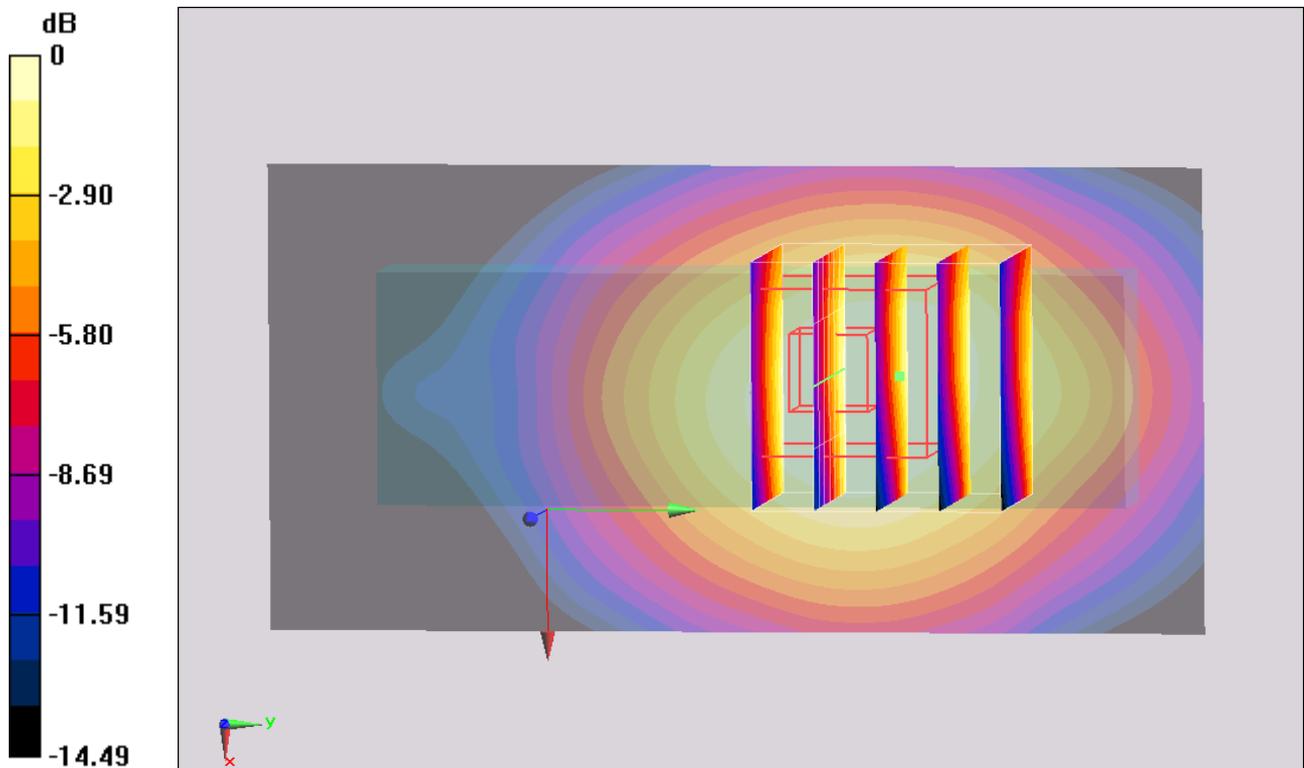Maximum value of SAR (interpolated) = 0.768 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.197 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 0.870 W/kg
**SAR(1 g) = 0.599 W/kg; SAR(10 g) = 0.391 W/kg**
Maximum value of SAR (measured) = 0.749 W/kg
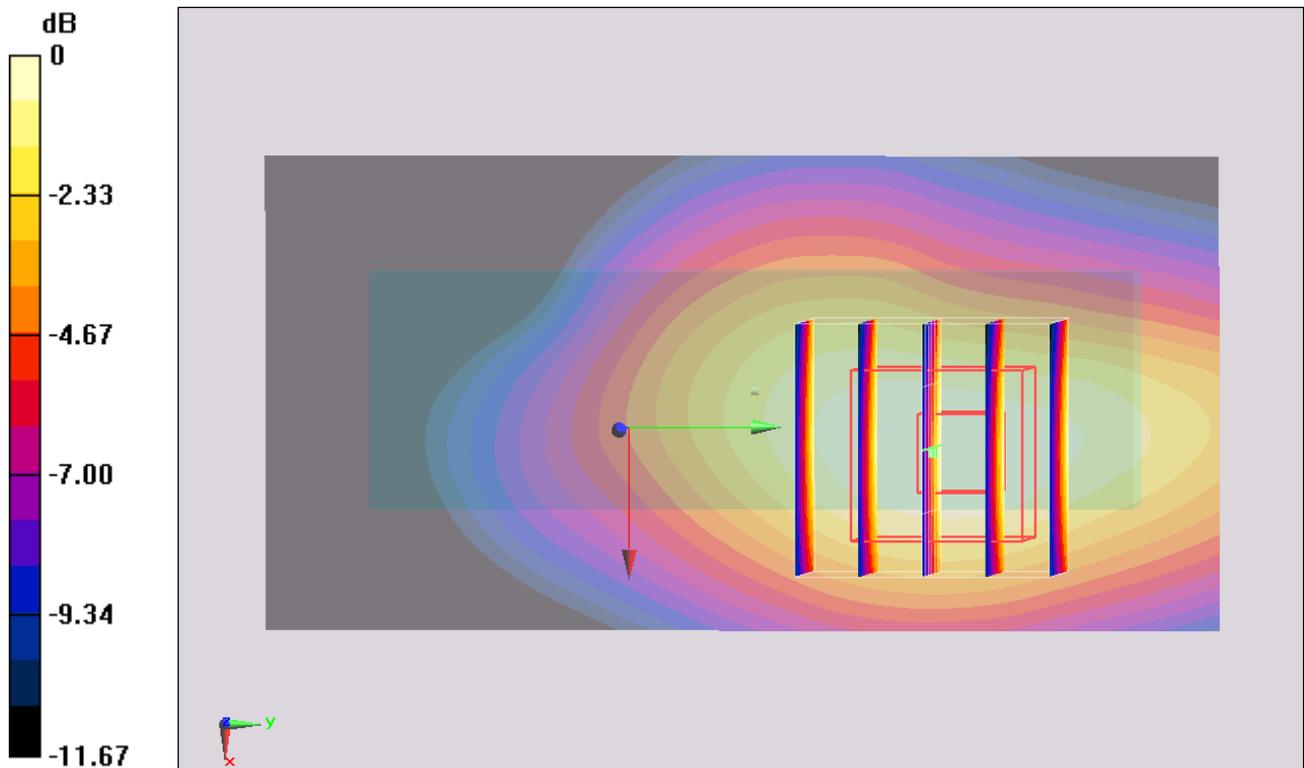


0 dB = 0.749 W/kg = -1.26 dBW/kg

## #15_GSM850_GPRS (2 Tx slots)_Vertical Front_0.5cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; σ = 0.979 S/m; $\varepsilon_r$ = 53.172; ρ = 1000 kg/m³
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
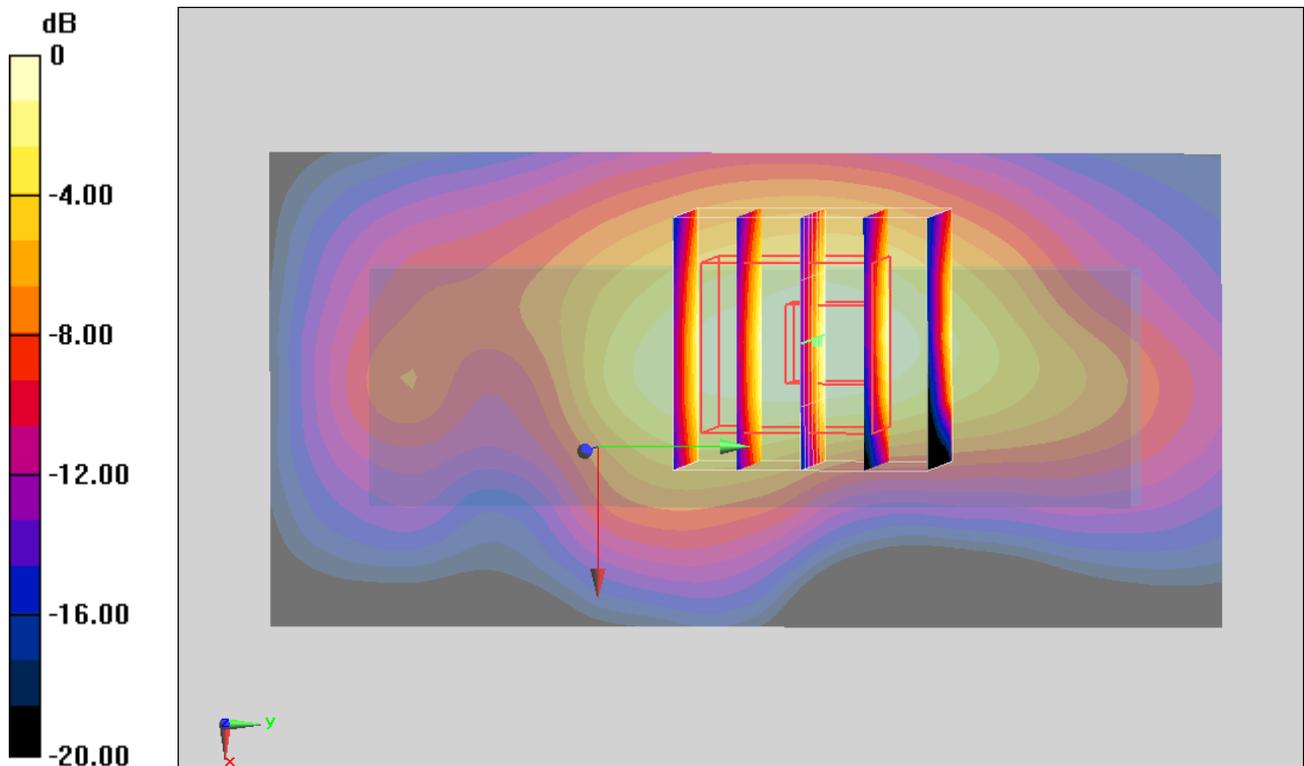Maximum value of SAR (interpolated) = 0.252 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.329 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.339 W/kg
**SAR(1 g) = 0.185 W/kg; SAR(10 g) = 0.111 W/kg**
Maximum value of SAR (measured) = 0.254 W/kg
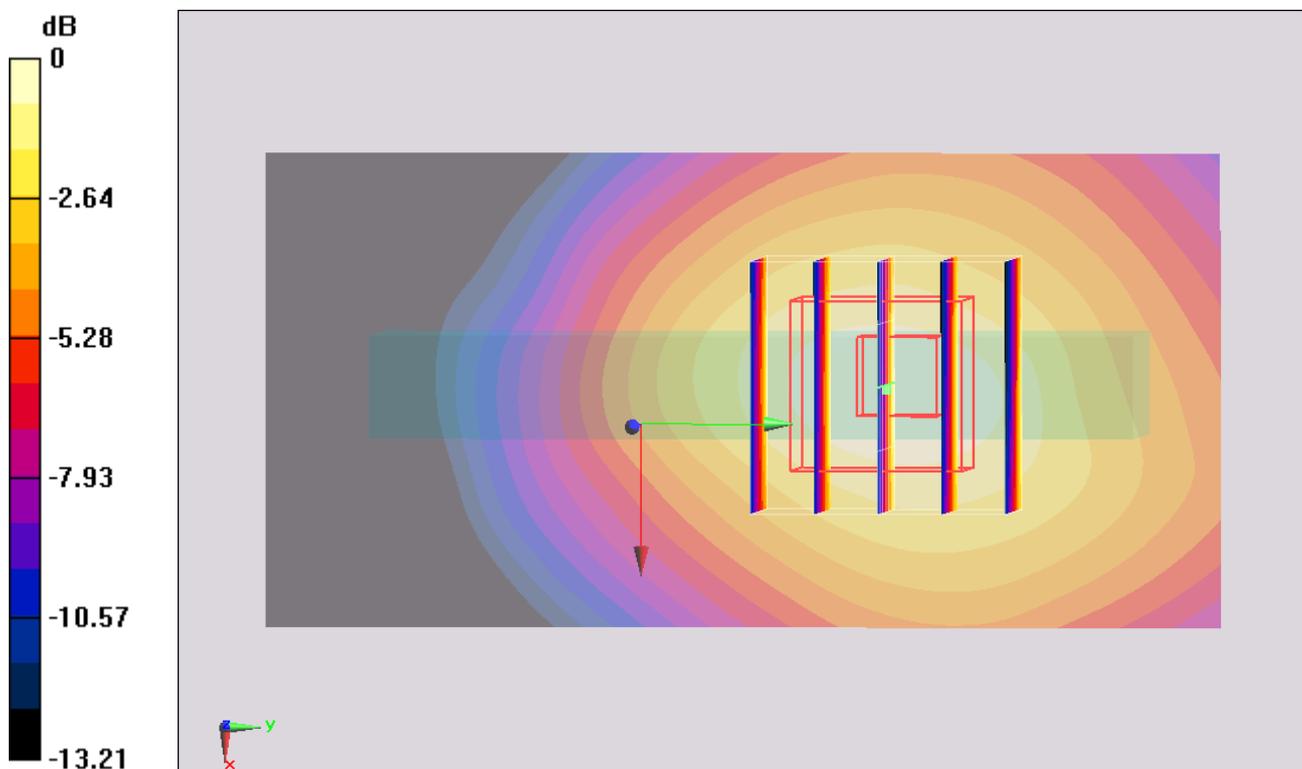


0 dB = 0.254 W/kg = -5.95 dBW/kg

## #16_GSM850_GPRS (2 Tx slots)_Vertical Back_0.5cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; σ = 0.979 S/m; $\varepsilon_r$ = 53.172; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.427 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.567 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.511 W/kg
**SAR(1 g) = 0.340 W/kg; SAR(10 g) = 0.216 W/kg**
Maximum value of SAR (measured) = 0.434 W/kg
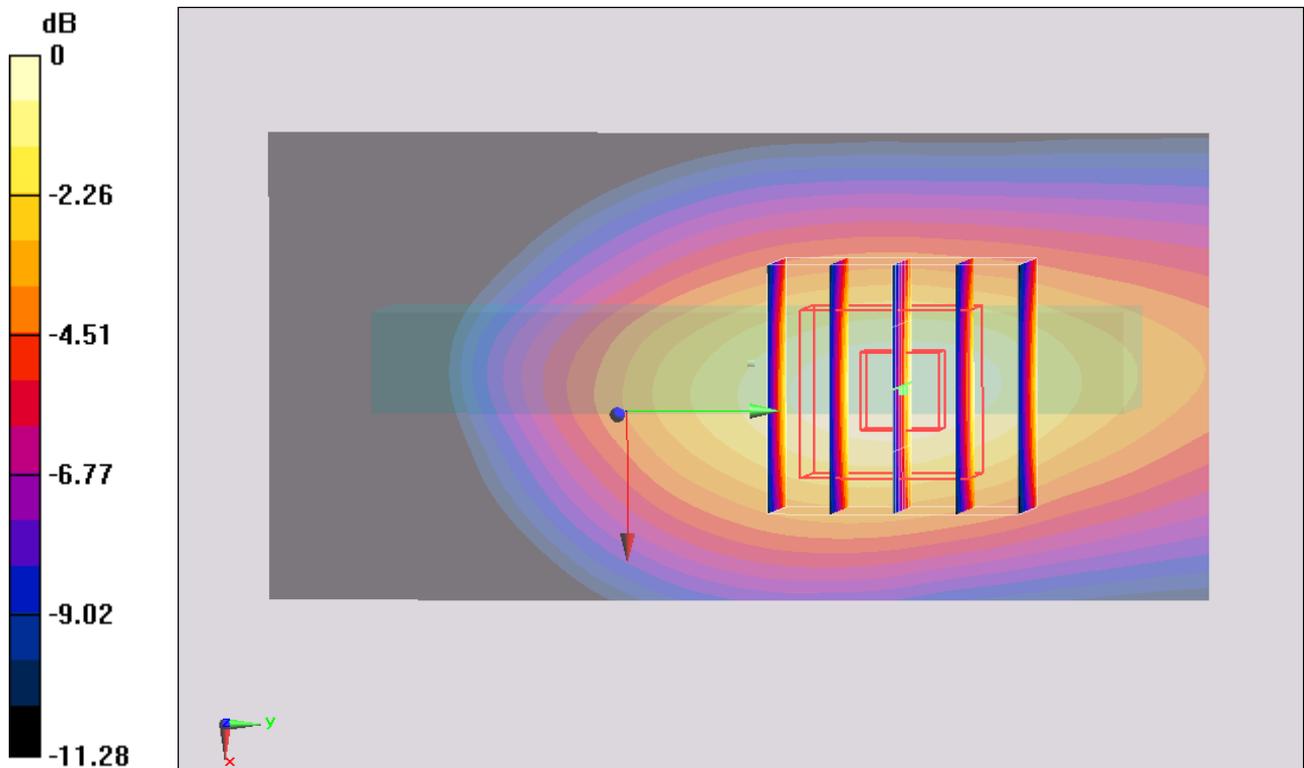


0 dB = 0.434 W/kg = -3.63 dBW/kg

## #17_GSM850_GPRS (2 Tx slots)_Tip Mode_0.5cm_Ch189

Communication System: GSM850; Frequency: 836.4 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 836.4 MHz; σ = 0.979 S/m; $\varepsilon_r$ = 53.172; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch189/Area Scan (41x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0106 W/kg

**Configuration/Ch189/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.176 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.0320 W/kg
**SAR(1 g) = 0.00753 W/kg; SAR(10 g) = 0.00502 W/kg**
Maximum value of SAR (measured) = 0.00982 W/kg
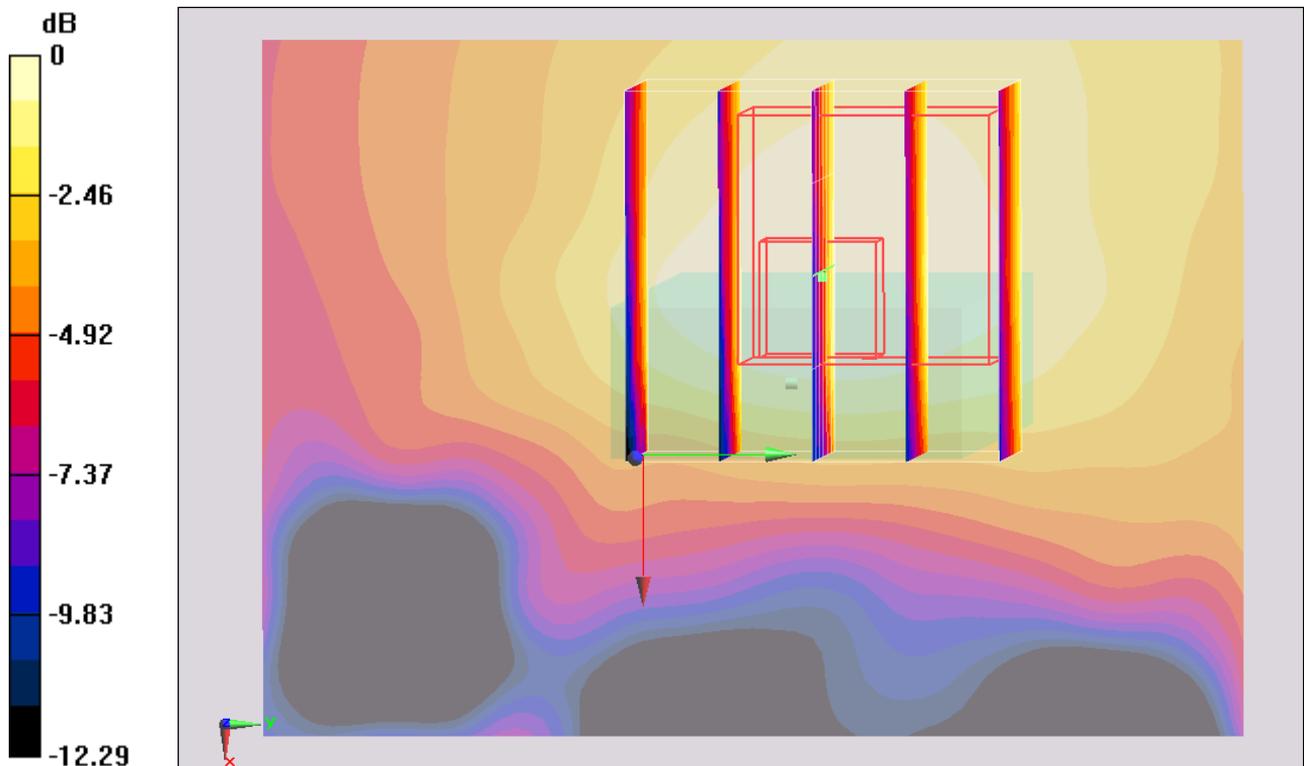


0 dB = 0.00982 W/kg = -20.08 dBW/kg

## #18_GSM850_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch128

Communication System: GSM850; Frequency: 824.2 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 824.2 MHz; σ = 0.965 S/m; $\varepsilon_r$ = 53.328; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch128/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.850 W/kg

**Configuration/Ch128/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.872 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 1.02 W/kg
**SAR(1 g) = 0.685 W/kg; SAR(10 g) = 0.436 W/kg**
Maximum value of SAR (measured) = 0.866 W/kg



0 dB = 0.866 W/kg = -0.62 dBW/kg

## #19_GSM850_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch251

Communication System: GSM850; Frequency: 848.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_850_131210 Medium parameters used: f = 849 MHz; σ = 0.991 S/m; $\varepsilon_r$ = 53.022; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(9.66, 9.66, 9.66); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch251/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.909 W/kg

**Configuration/Ch251/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 29.715 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.11 W/kg
**SAR(1 g) = 0.727 W/kg; SAR(10 g) = 0.459 W/kg**
Maximum value of SAR (measured) = 0.930 W/kg



0 dB = 0.930 W/kg = -0.32 dBW/kg

## #06_GSM1900_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $\varepsilon_r$ = 51.552; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.773 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.886 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.910 W/kg
**SAR(1 g) = 0.528 W/kg; SAR(10 g) = 0.285 W/kg**
Maximum value of SAR (measured) = 0.711 W/kg



0 dB = 0.711 W/kg = -1.48 dBW/kg

## #07_GSM1900_GPRS (2 Tx slots)_Horizontal Up_0.5cm_Ch810;Flip 90

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $ε_r$ = 51.552; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃; Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)


**Configuration/Ch810/Area Scan (41x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.123 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.722 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 0.143 W/kg
**SAR(1 g) = 0.078 W/kg; SAR(10 g) = 0.040 W/kg**
Maximum value of SAR (measured) = 0.111 W/kg
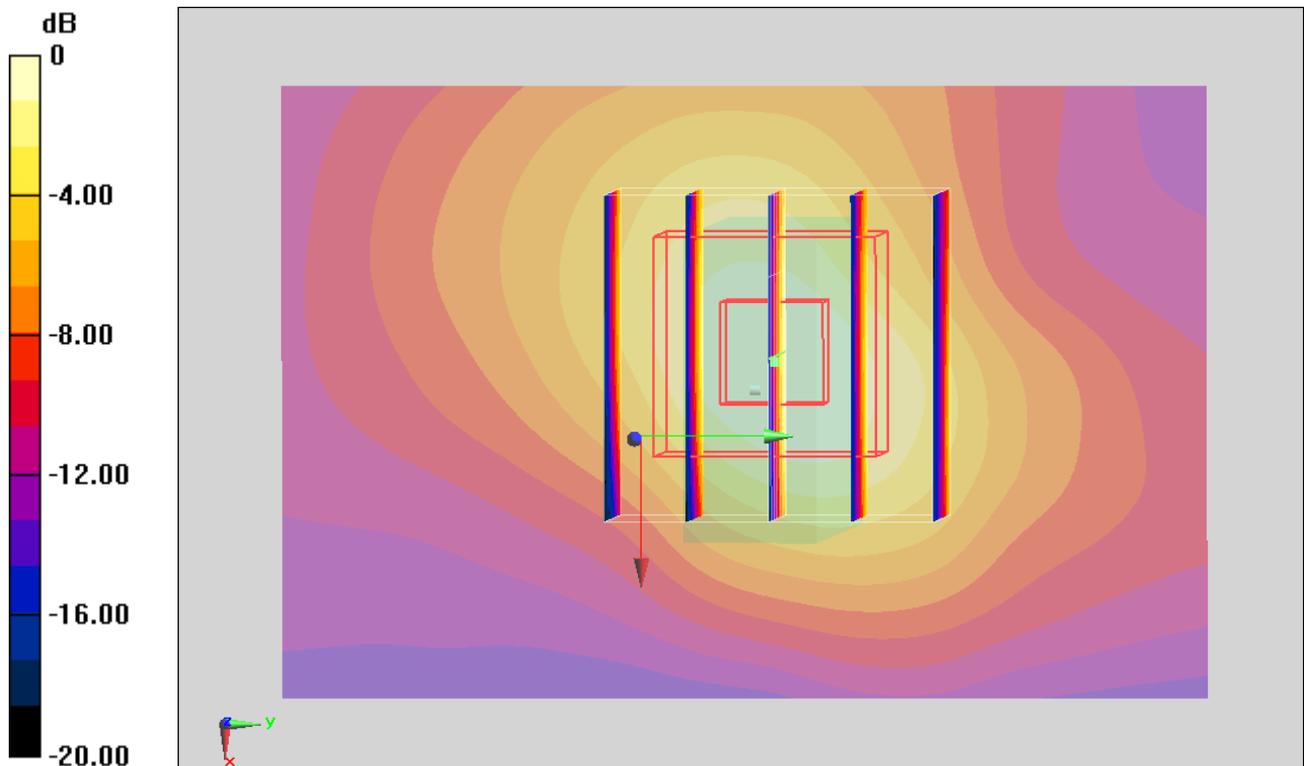


0 dB = 0.111 W/kg = -9.55 dBW/kg

## #08_GSM1900_GPRS (2 Tx slots)_Horizontal Down_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $\varepsilon_r$ = 51.552; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.474 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 17.052 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.546 W/kg
**SAR(1 g) = 0.322 W/kg; SAR(10 g) = 0.174 W/kg**
Maximum value of SAR (measured) = 0.438 W/kg
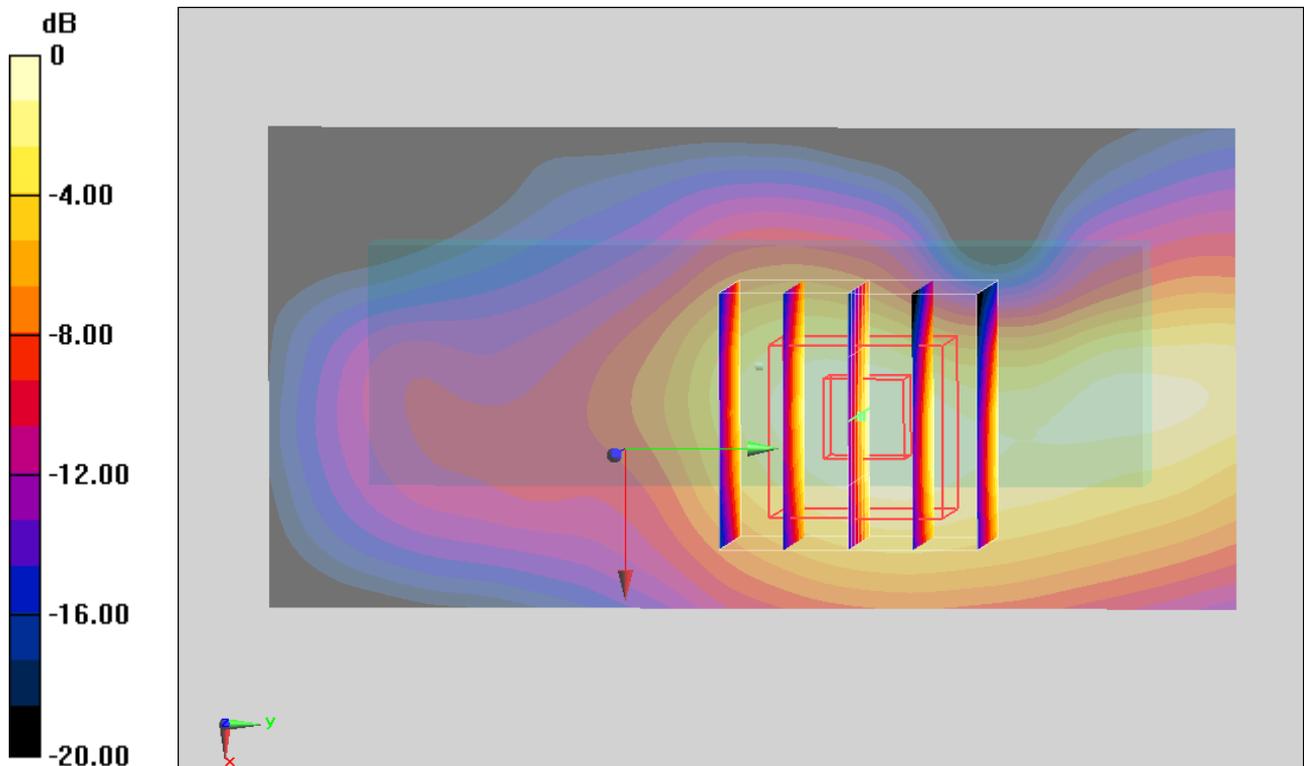


0 dB = 0.438 W/kg = -3.59 dBW/kg

## #09_GSM1900_GPRS (2 Tx slots)_Vertical Front_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $ε_r$ = 51.552; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃; Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.0595 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.171 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.0720 W/kg
**SAR(1 g) = 0.042 W/kg; SAR(10 g) = 0.024 W/kg**
Maximum value of SAR (measured) = 0.0581 W/kg
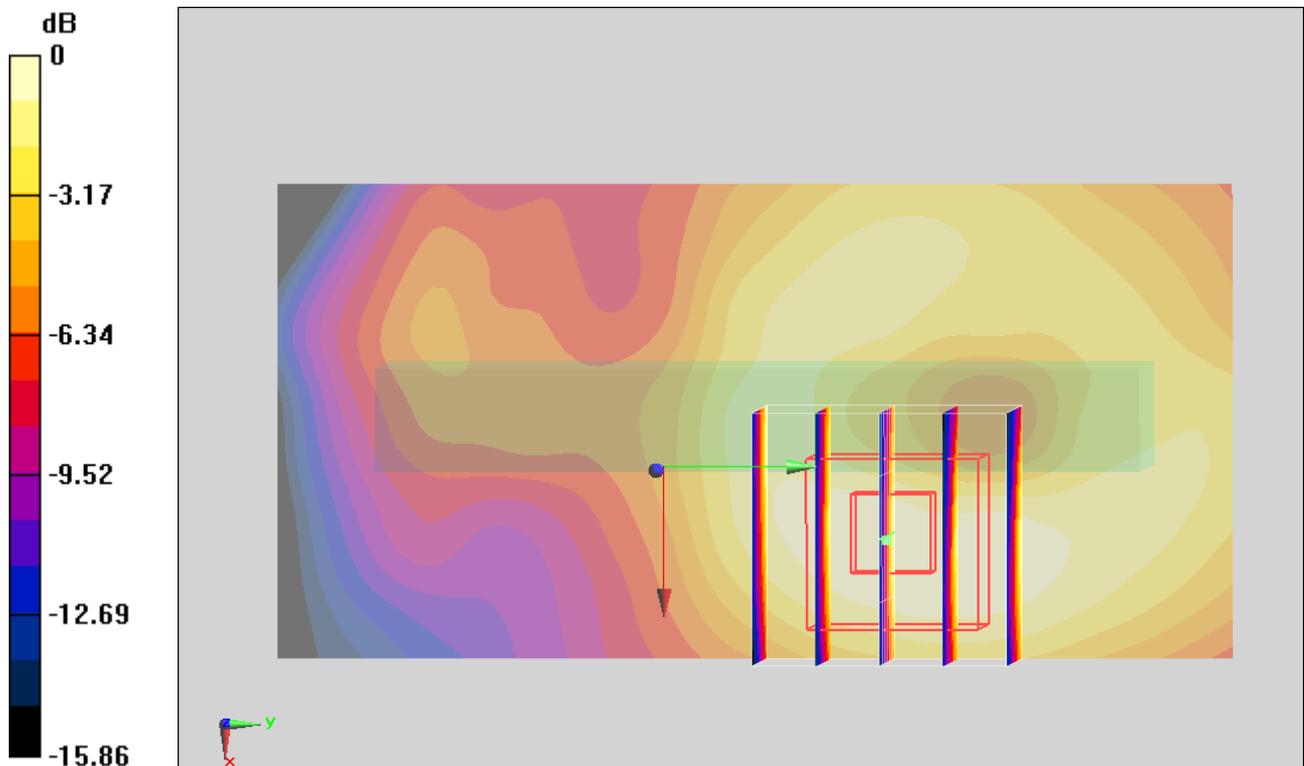


0 dB = 0.0581 W/kg = -12.36 dBW/kg

# #10_GSM1900_GPRS (2 Tx slots)_Vertical Back_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $\varepsilon_r$ = 51.552; ρ
= 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x81x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.447 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm,
dz=5mm
Reference Value = 17.100 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.546 W/kg
**SAR(1 g) = 0.317 W/kg; SAR(10 g) = 0.172 W/kg**
Maximum value of SAR (measured) = 0.439 W/kg
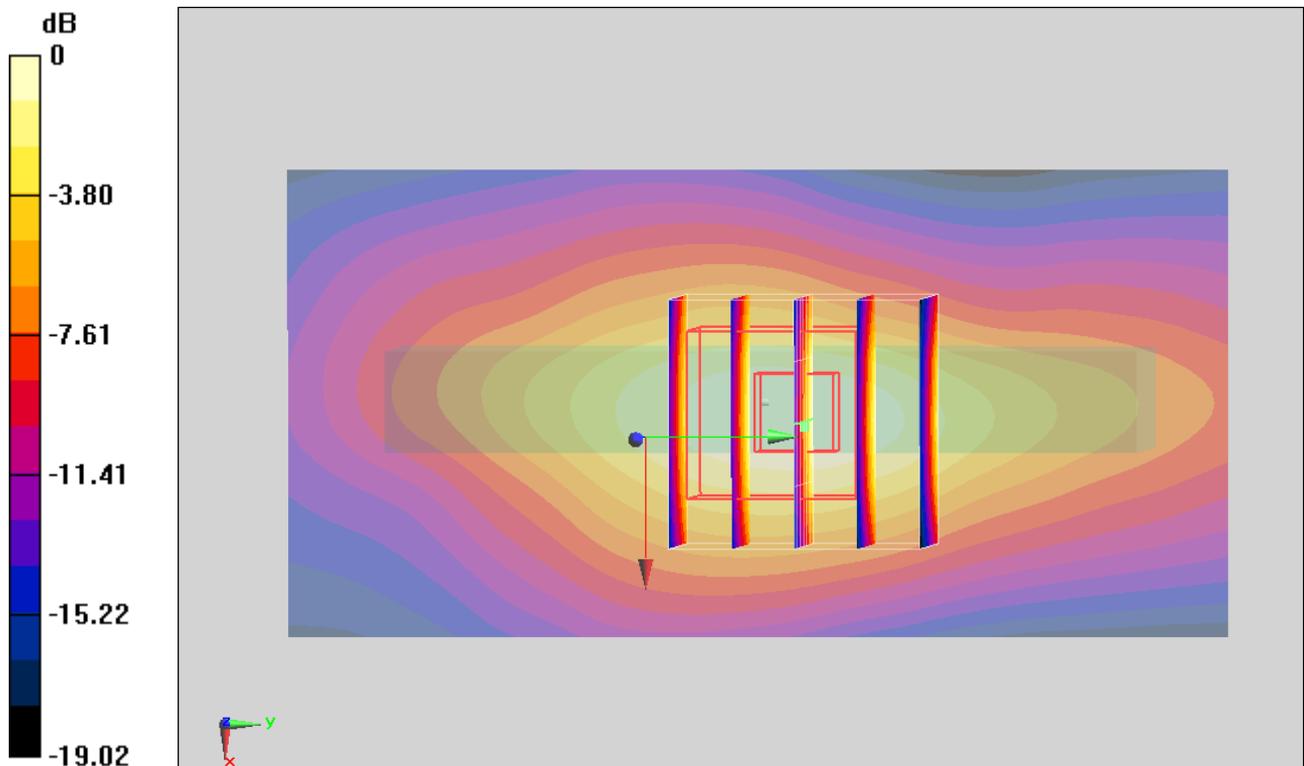


0 dB = 0.439 W/kg = -3.58 dBW/kg

## #11_GSM1900_GPRS (2 Tx slots)_Tip Mode_0.5cm_Ch810

Communication System: PCS; Frequency: 1909.8 MHz;Duty Cycle: 1:4.15
Medium: MSL_1900_131210 Medium parameters used: f = 1910 MHz; σ = 1.554 S/m; $\varepsilon_r$ = 51.552; ρ = 1000 kg/m$^3$
Ambient Temperature：23.1 ℃；Liquid Temperature：22.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3931; ConvF(7.61, 7.61, 7.61); Calibrated: 2013/9/10;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn577; Calibrated: 2013/5/8
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch810/Area Scan (41x61x1):** Interpolated grid: dx=1.500 mm, dy=1.500 mm
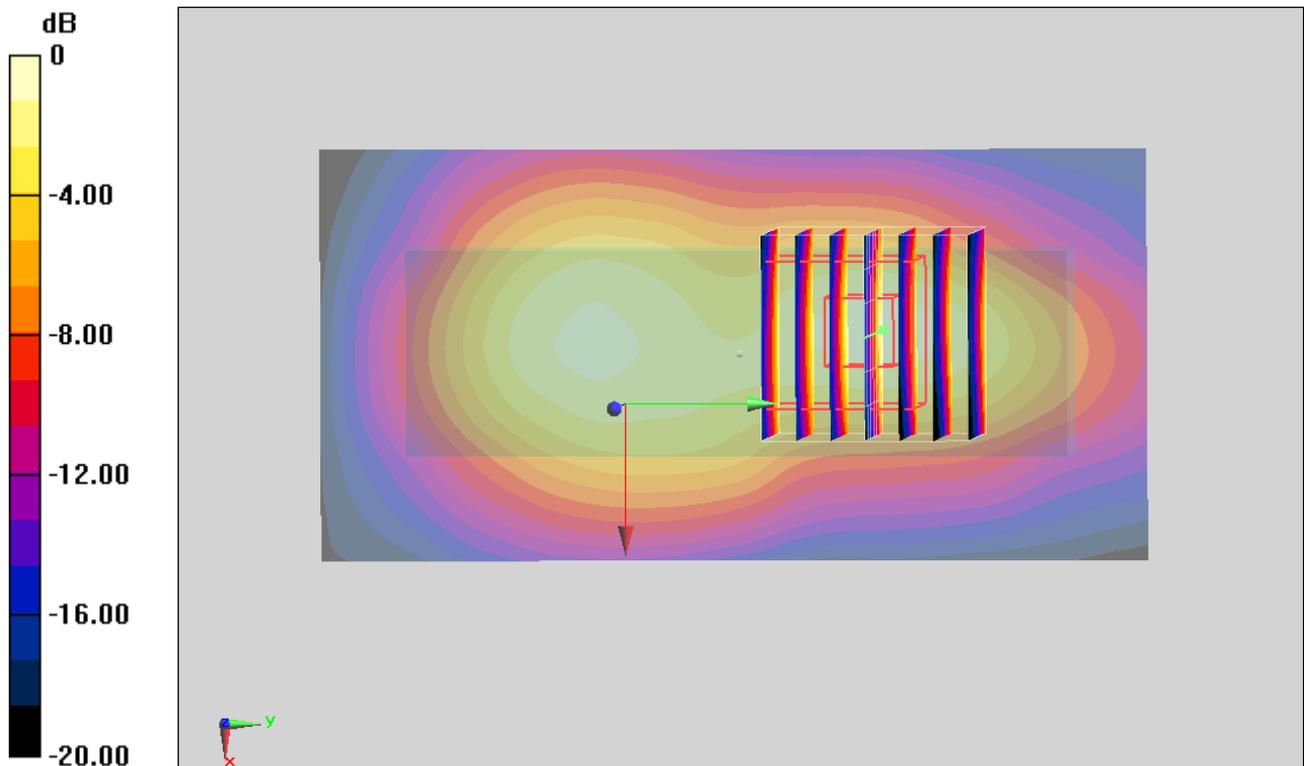Maximum value of SAR (interpolated) = 0.0361 W/kg

**Configuration/Ch810/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.976 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 0.0470 W/kg
**SAR(1 g) = 0.026 W/kg; SAR(10 g) = 0.014 W/kg**
Maximum value of SAR (measured) = 0.0354 W/kg
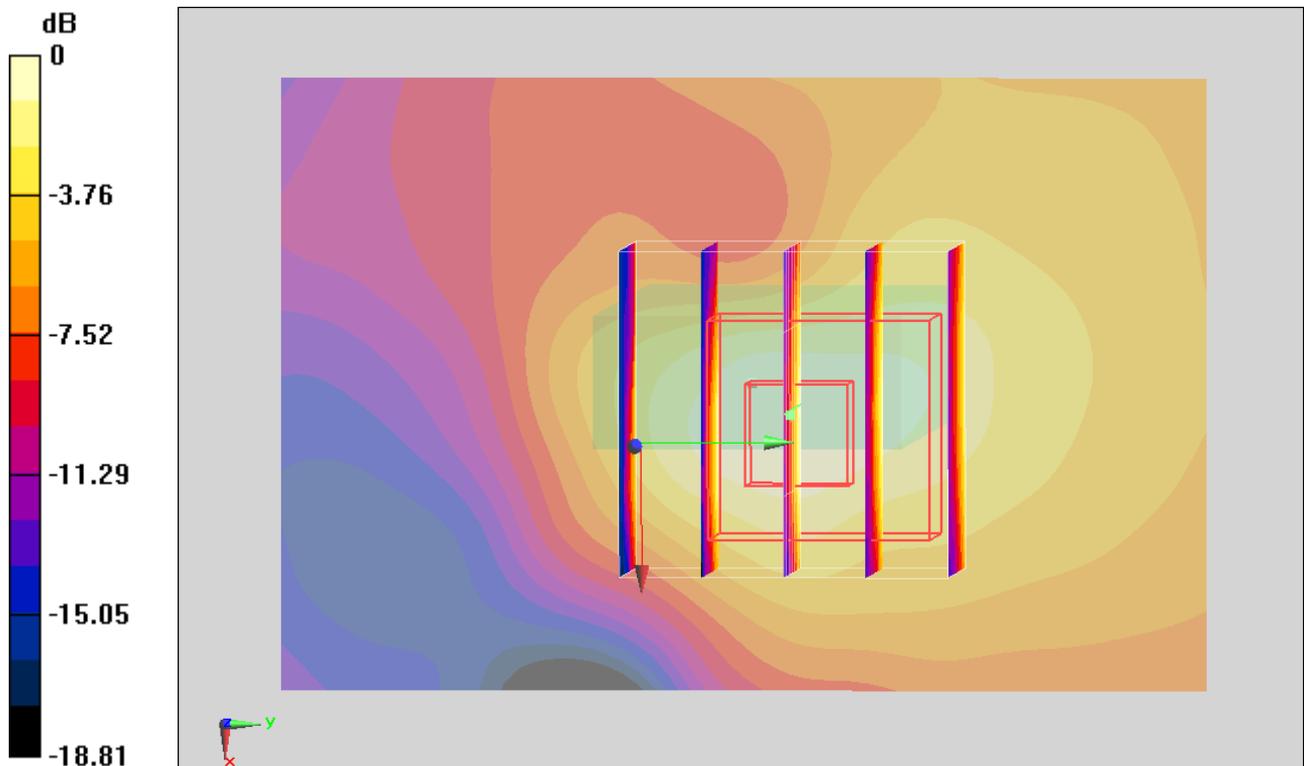


0 dB = 0.0354 W/kg = -14.51 dBW/kg

## #23_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.18 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.876 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 1.73 W/kg
**SAR(1 g) = 0.830 W/kg; SAR(10 g) = 0.392 W/kg**
Maximum value of SAR (measured) = 1.28 W/kg
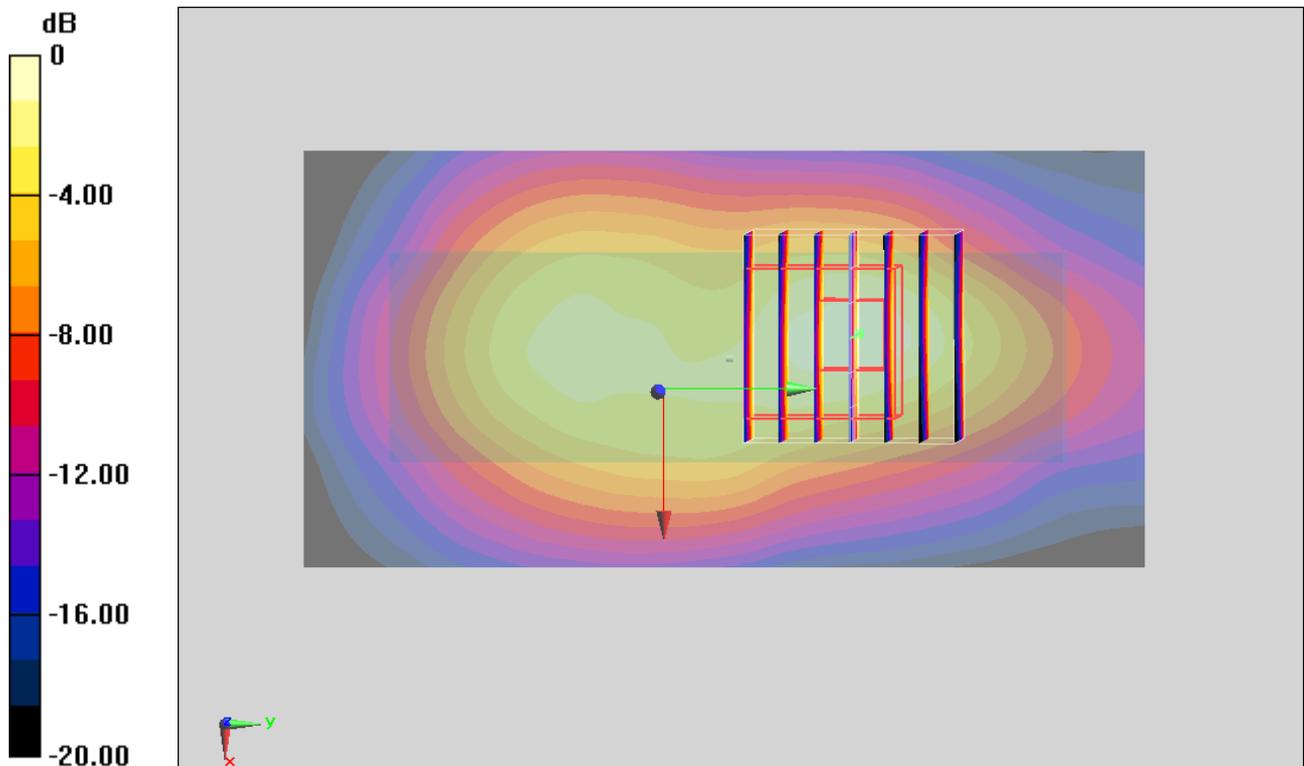


0 dB = 1.28 W/kg = 1.07 dBW/kg

# #38_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch20850;Repeat

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; ε_r = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
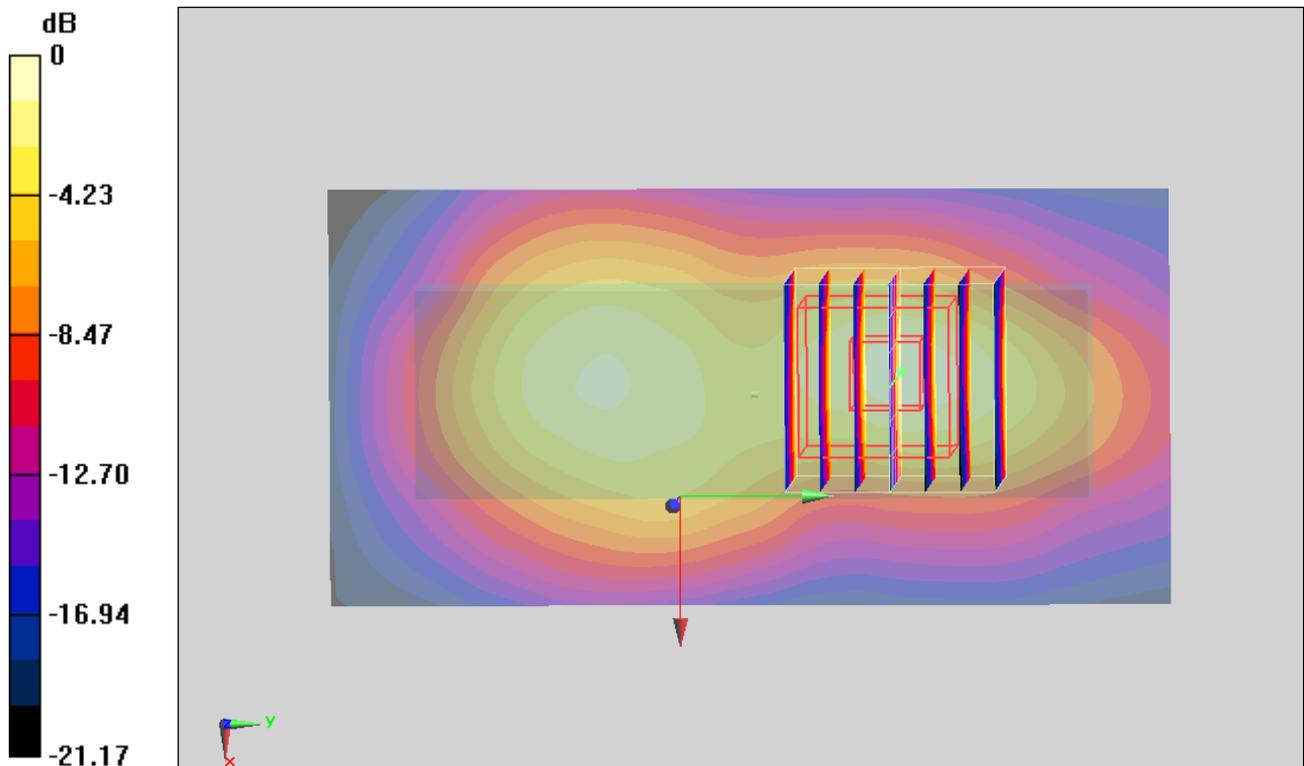Maximum value of SAR (interpolated) = 1.34 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 26.096 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 1.87 W/kg
**SAR(1 g) = 0.814 W/kg; SAR(10 g) = 0.411 W/kg**
Maximum value of SAR (measured) = 1.37 W/kg
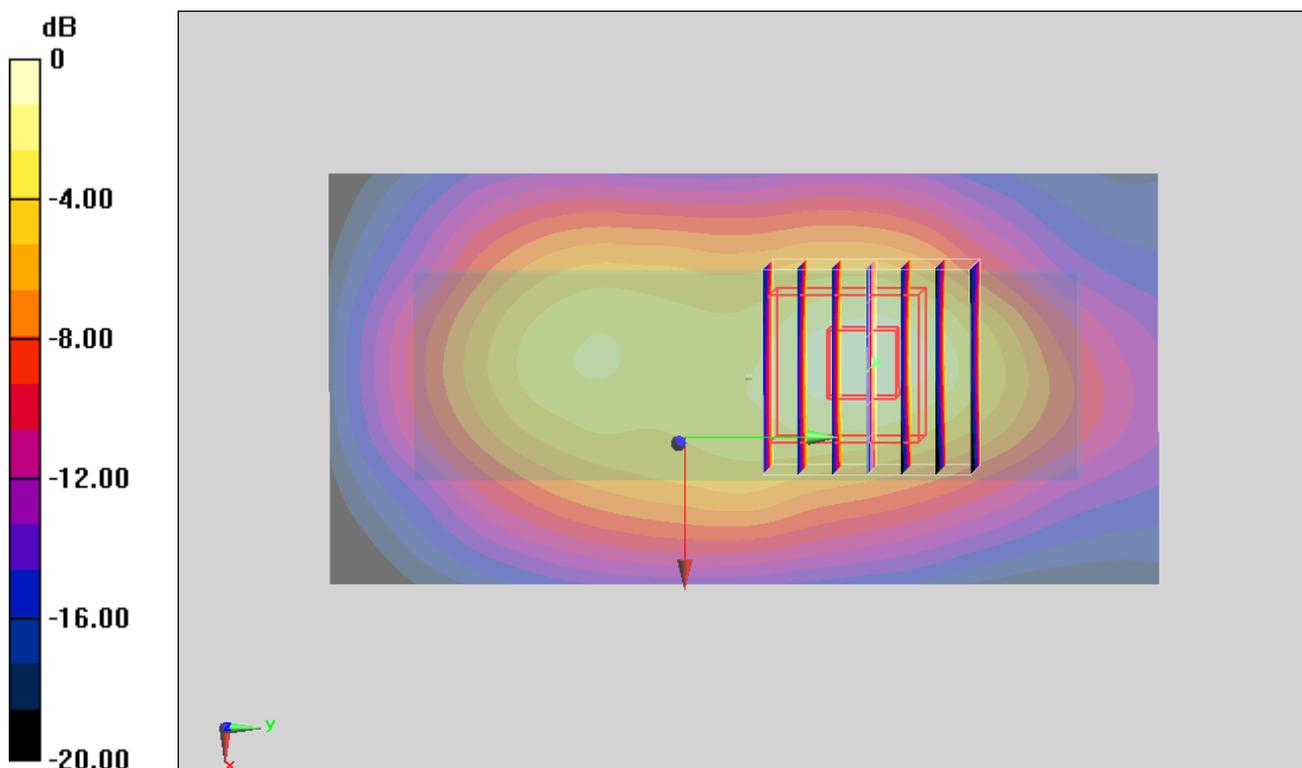


0 dB = 1.37 W/kg = 1.37 dBW/kg

## #24_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch21100

Communication System: LTE; Frequency: 2535 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2535 MHz; σ = 2.126 S/m; $ε_r$ = 52.894; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch21100/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.888 W/kg

**Configuration/Ch21100/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.247 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 1.32 W/kg
**SAR(1 g) = 0.612 W/kg; SAR(10 g) = 0.275 W/kg**
Maximum value of SAR (measured) = 0.942 W/kg



0 dB = 0.942 W/kg = -0.26 dBW/kg

## #25_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch21350

Communication System: LTE; Frequency: 2560 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2560 MHz; σ = 2.149 S/m; $ε_r$ = 52.782; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch21350/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
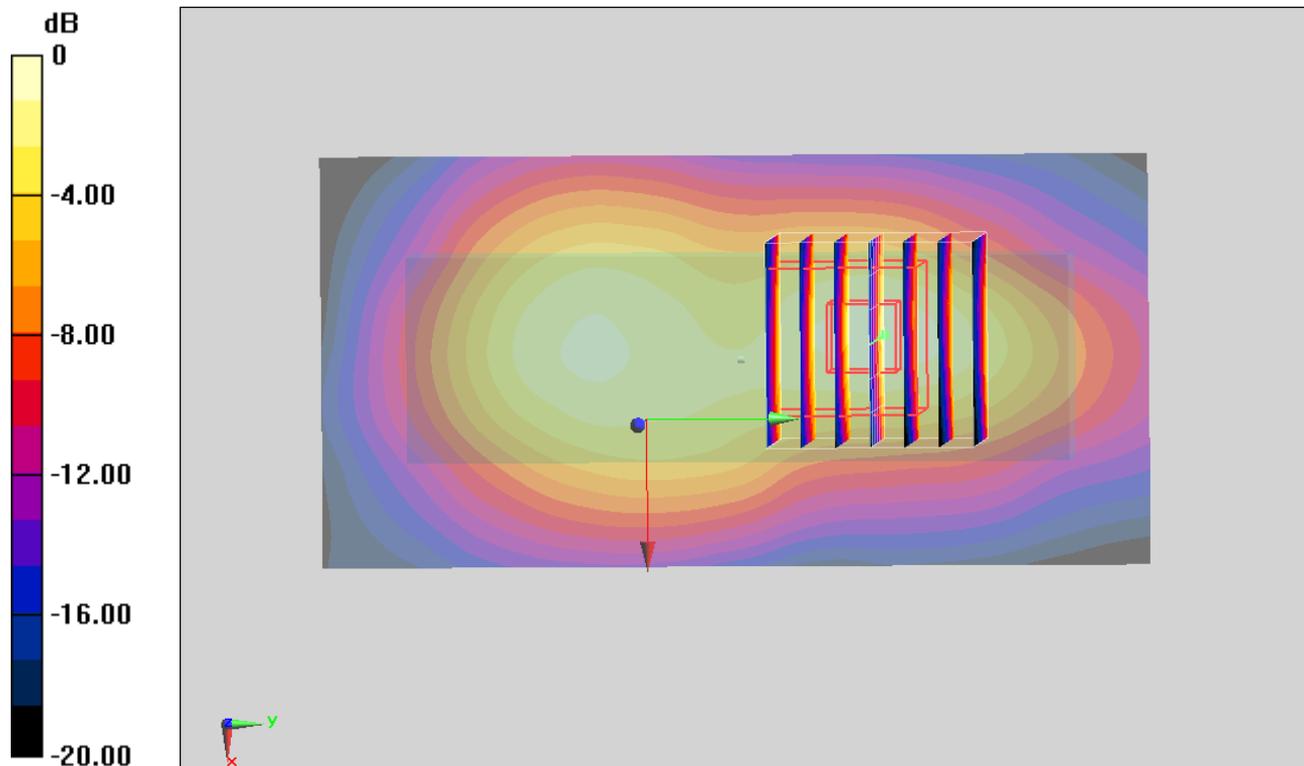Maximum value of SAR (interpolated) = 0.919 W/kg

**Configuration/Ch21350/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.918 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 1.43 W/kg
**SAR(1 g) = 0.652 W/kg; SAR(10 g) = 0.282 W/kg**
Maximum value of SAR (measured) = 1.03 W/kg



0 dB = 1.03 W/kg = 0.13 dBW/kg

## #26_LTE Band 7_20M_QPSK_50RB_24Offset_Horizontal Up_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.13 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 24.268 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.64 W/kg
**SAR(1 g) = 0.780 W/kg; SAR(10 g) = 0.367 W/kg**
Maximum value of SAR (measured) = 1.21 W/kg
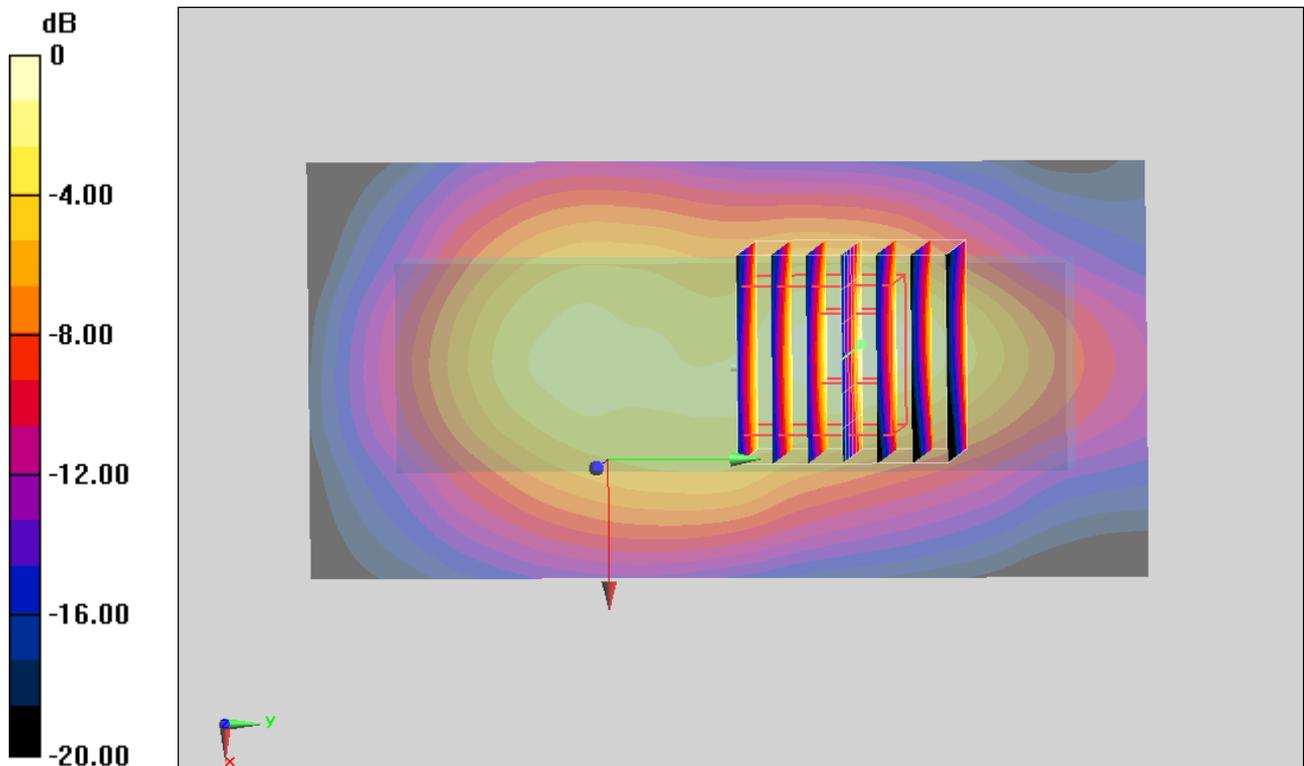


0 dB = 1.21 W/kg = 0.83 dBW/kg

## #27_LTE Band 7_20M_QPSK_50RB_24Offset_Horizontal Up_0.5cm_Ch21100

Communication System: LTE; Frequency: 2535 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2535 MHz; σ = 2.126 S/m; $ε_r$ = 52.894; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch21100/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.843 W/kg

**Configuration/Ch21100/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 20.781 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 1.26 W/kg
**SAR(1 g) = 0.582 W/kg; SAR(10 g) = 0.260 W/kg**
Maximum value of SAR (measured) = 0.900 W/kg



0 dB = 0.900 W/kg = -0.46 dBW/kg

## #28_LTE Band 7_20M_QPSK_50RB_24Offset_Horizontal Up_0.5cm_Ch21350

Communication System: LTE; Frequency: 2560 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2560 MHz; σ = 2.149 S/m; ε$_r$ = 52.782; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch21350/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.925 W/kg

**Configuration/Ch21350/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 21.992 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.45 W/kg
**SAR(1 g) = 0.652 W/kg; SAR(10 g) = 0.280 W/kg**
Maximum value of SAR (measured) = 1.04 W/kg
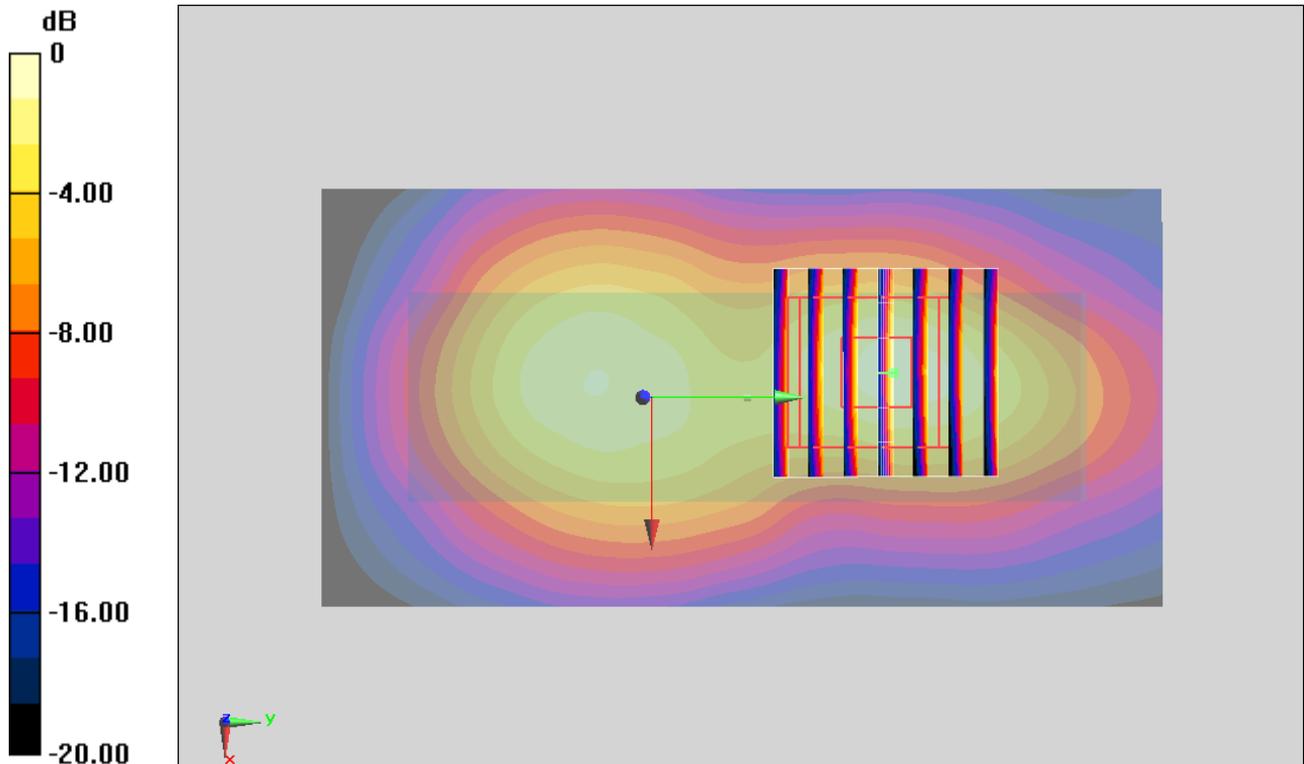


0 dB = 1.04 W/kg = 0.17 dBW/kg

## #29_LTE Band 7_20M_QPSK_100RB_0Offset_Horizontal Up_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.08 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 23.828 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 1.62 W/kg
**SAR(1 g) = 0.768 W/kg; SAR(10 g) = 0.364 W/kg**
Maximum value of SAR (measured) = 1.20 W/kg
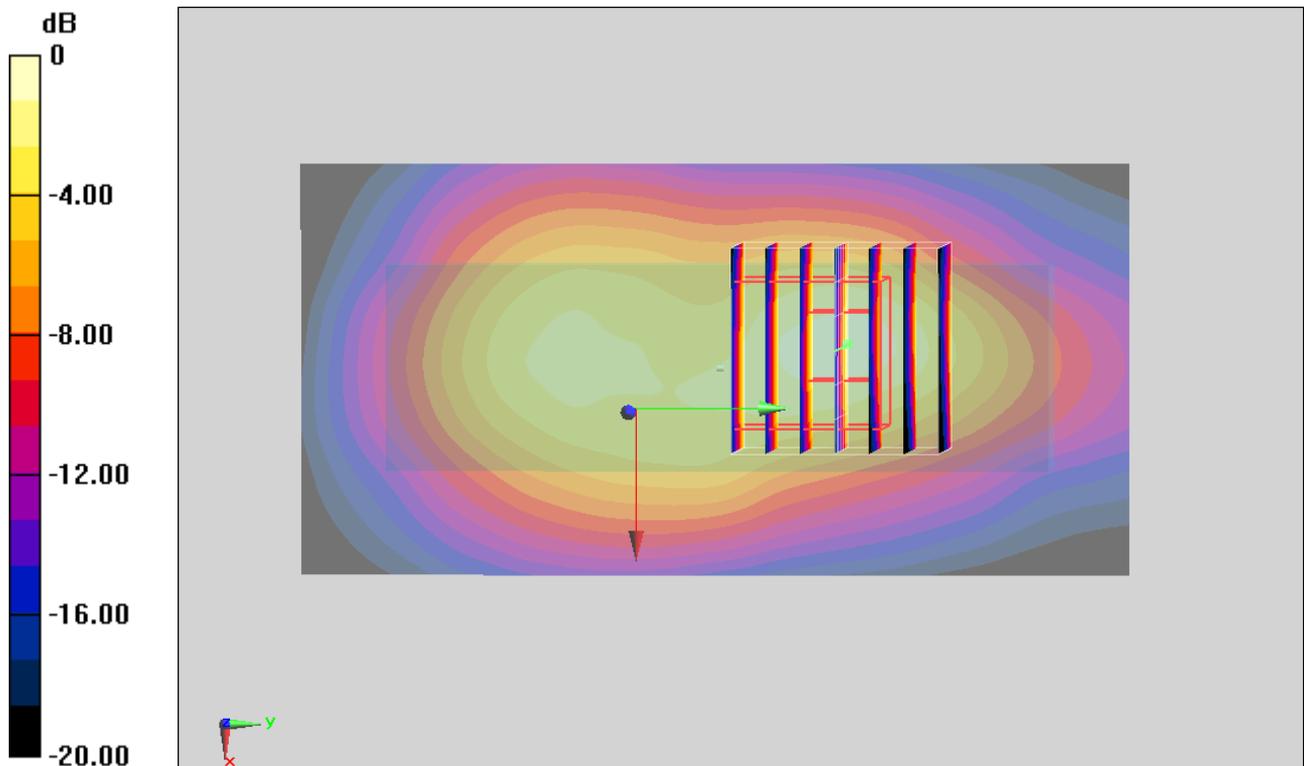


0 dB = 1.20 W/kg = 0.79 dBW/kg

# #21_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Up_0.5cm_Ch20850;Flip 90

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x51x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.384 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.839 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 0.495 W/kg
**SAR(1 g) = 0.239 W/kg; SAR(10 g) = 0.117 W/kg**
Maximum value of SAR (measured) = 0.349 W/kg
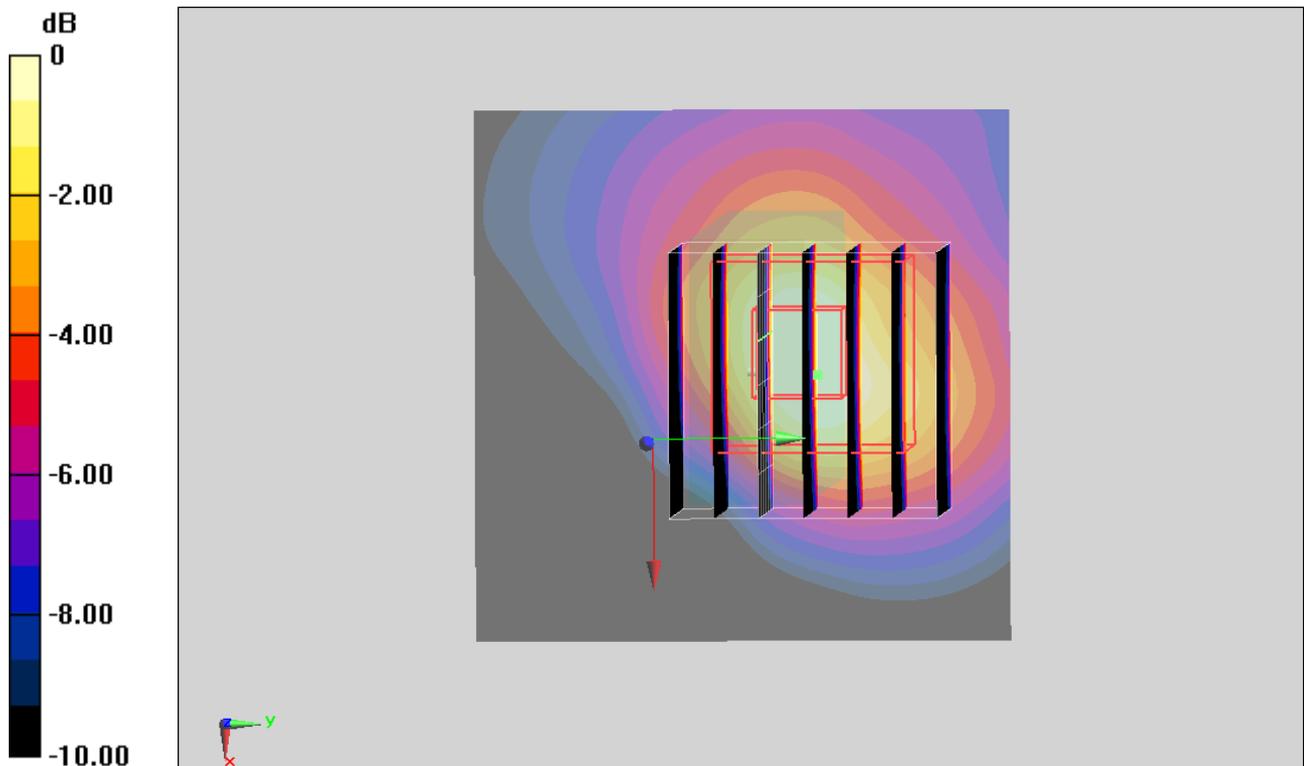


0 dB = 0.349 W/kg = -4.57 dBW/kg

## #22_LTE Band 7_20M_QPSK_50RB_24Offset_Horizontal Up_0.5cm_Ch20850;Flip 90

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x51x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.360 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.469 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.474 W/kg
**SAR(1 g) = 0.227 W/kg; SAR(10 g) = 0.110 W/kg**
Maximum value of SAR (measured) = 0.332 W/kg
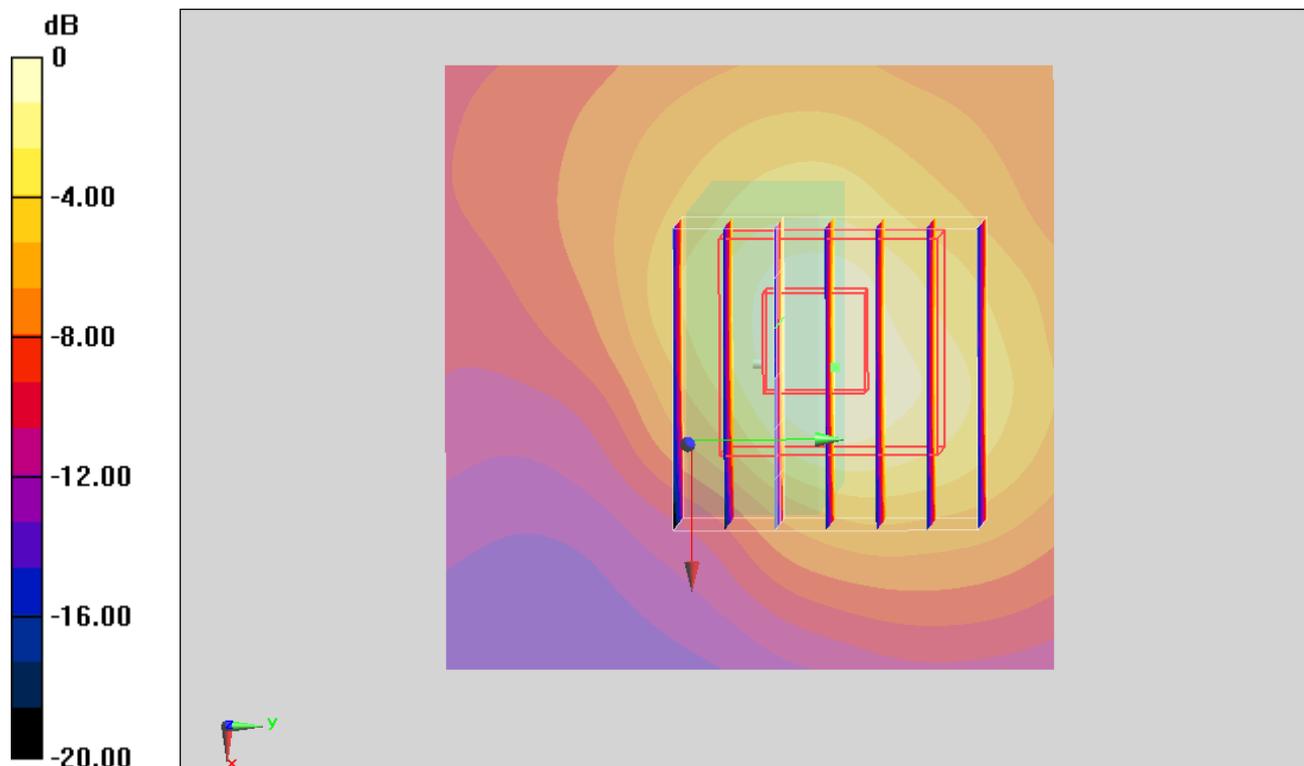


0 dB = 0.332 W/kg = -4.79 dBW/kg

## #30_LTE Band 7_20M_QPSK_1RB_49Offset_Horizontal Down_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.582 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 16.627 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.900 W/kg
**SAR(1 g) = 0.504 W/kg; SAR(10 g) = 0.277 W/kg**
Maximum value of SAR (measured) = 0.698 W/kg
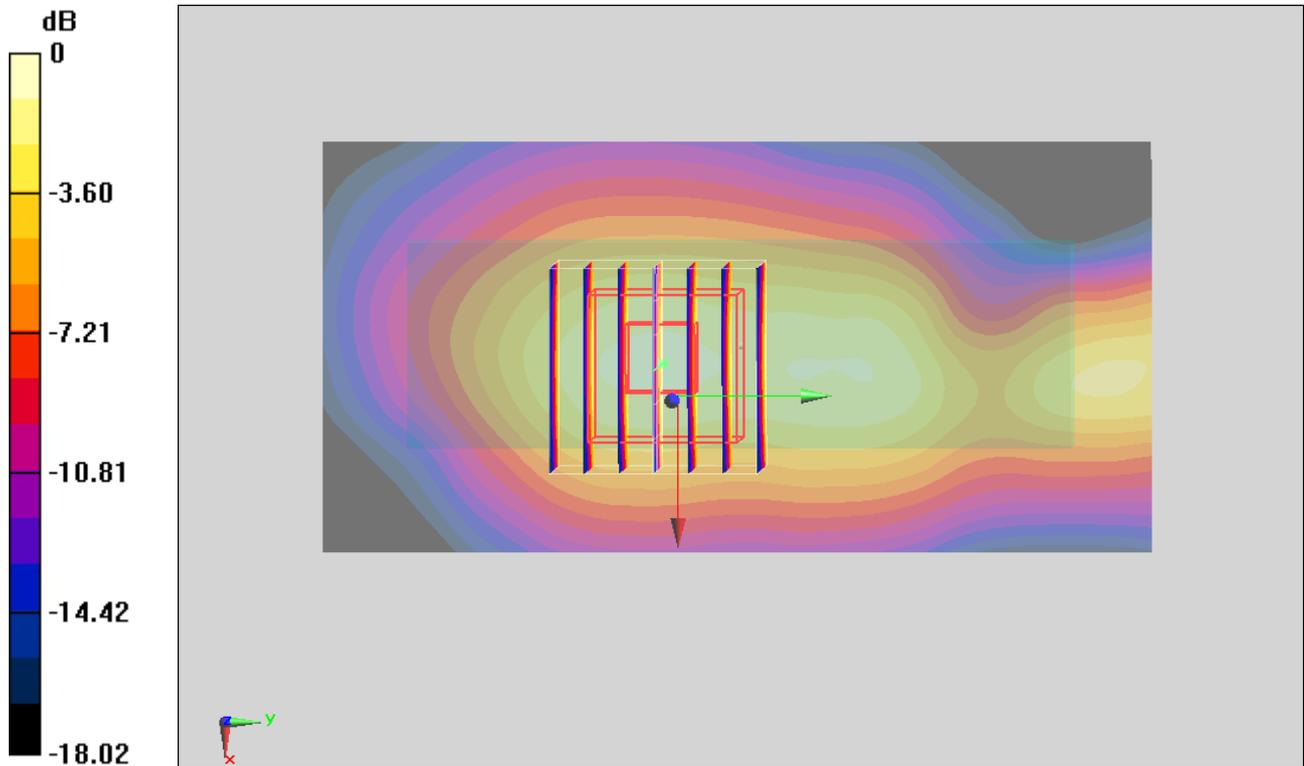


0 dB = 0.698 W/kg = -1.56 dBW/kg

## #31_LTE Band 7_20M_QPSK_50RB_24Offset_Horizontal Down_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; ε_r = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.647 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.612 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.843 W/kg
**SAR(1 g) = 0.474 W/kg; SAR(10 g) = 0.260 W/kg**
Maximum value of SAR (measured) = 0.654 W/kg
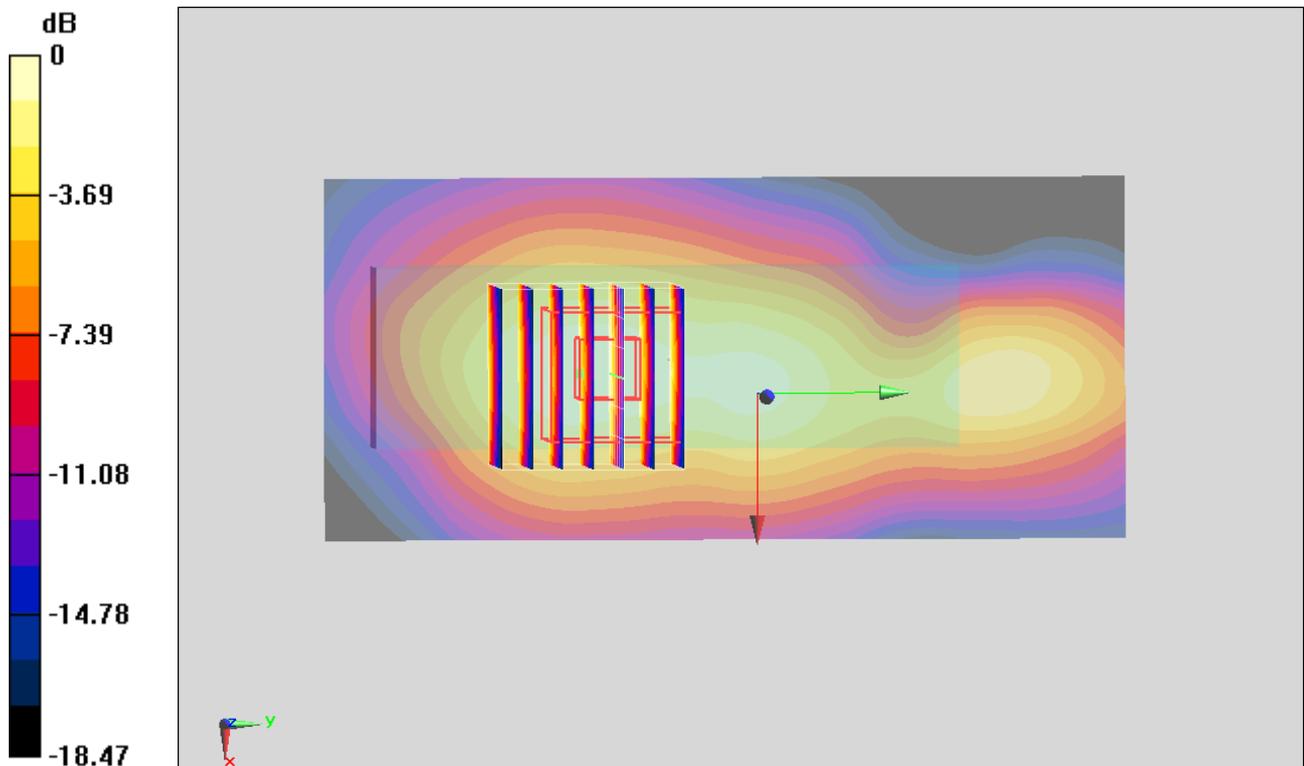


0 dB = 0.654 W/kg = -1.84 dBW/kg

## #34_LTE Band 7_20M_QPSK_1RB_49Offset_Vertical Front_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1

Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $ε_r$ = 52.993; ρ = 1000 kg/m$^3$

Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

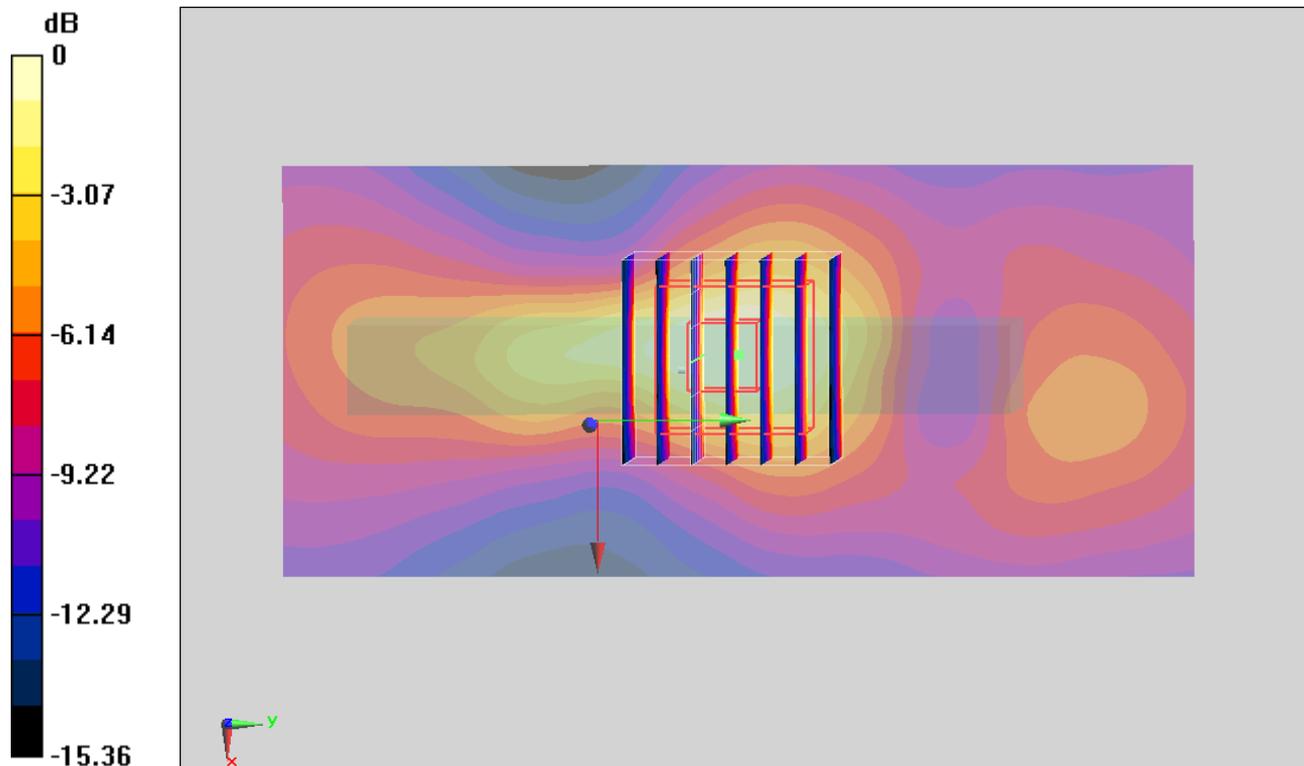Maximum value of SAR (interpolated) = 0.207 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.839 V/m; Power Drift = -0.16 dB

Peak SAR (extrapolated) = 0.264 W/kg

**SAR(1 g) = 0.123 W/kg; SAR(10 g) = 0.059 W/kg**

Maximum value of SAR (measured) = 0.186 W/kg



0 dB = 0.186 W/kg = -7.30 dBW/kg

## #35_LTE Band 7_20M_QPSK_50RB_24Offset_Vertical Front_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
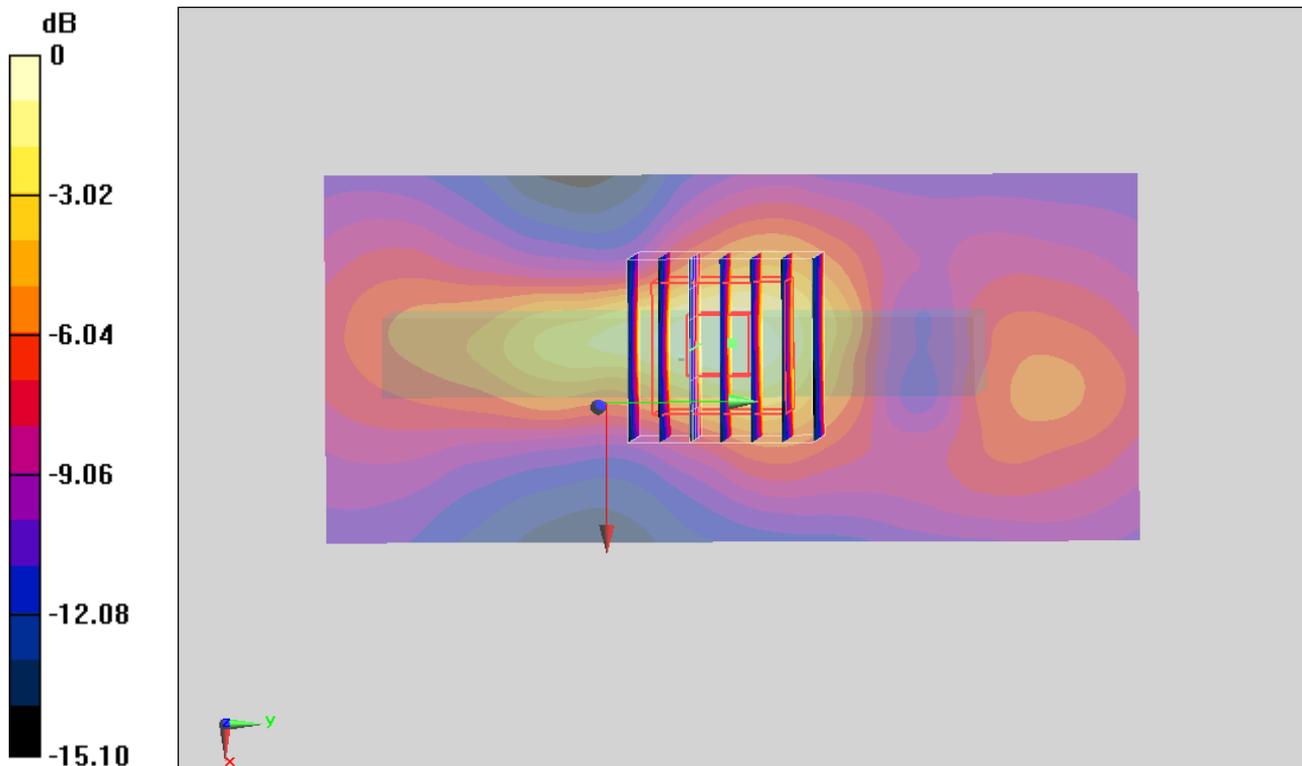Maximum value of SAR (interpolated) = 0.178 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.205 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 0.247 W/kg
**SAR(1 g) = 0.115 W/kg; SAR(10 g) = 0.056 W/kg**
Maximum value of SAR (measured) = 0.174 W/kg



0 dB = 0.174 W/kg = -7.59 dBW/kg

## #32_LTE Band 7_20M_QPSK_1RB_49Offset_Vertical Back_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
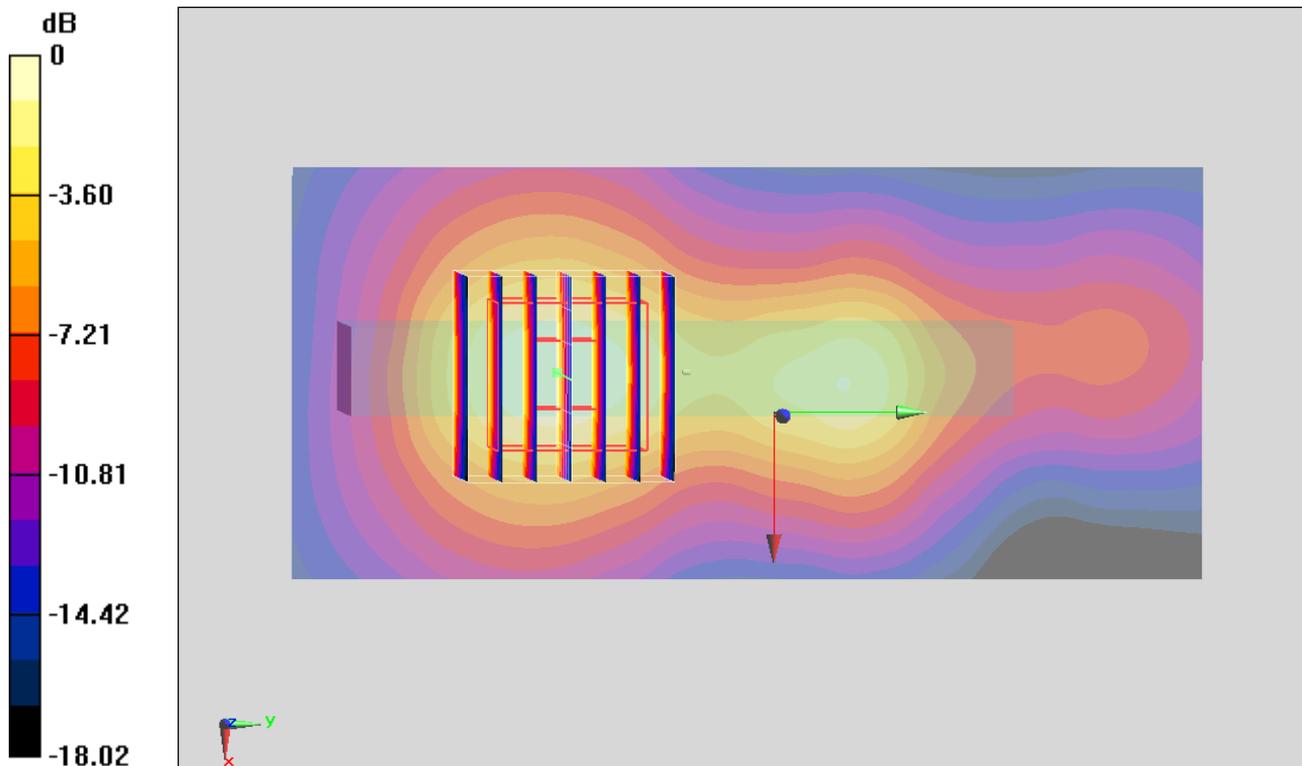Maximum value of SAR (interpolated) = 0.636 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 17.171 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.810 W/kg
**SAR(1 g) = 0.411 W/kg; SAR(10 g) = 0.208 W/kg**
Maximum value of SAR (measured) = 0.605 W/kg



0 dB = 0.605 W/kg = -2.18 dBW/kg

## #33_LTE Band 7_20M_QPSK_50RB_24Offset_Vertical Back_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m³
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (51x111x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
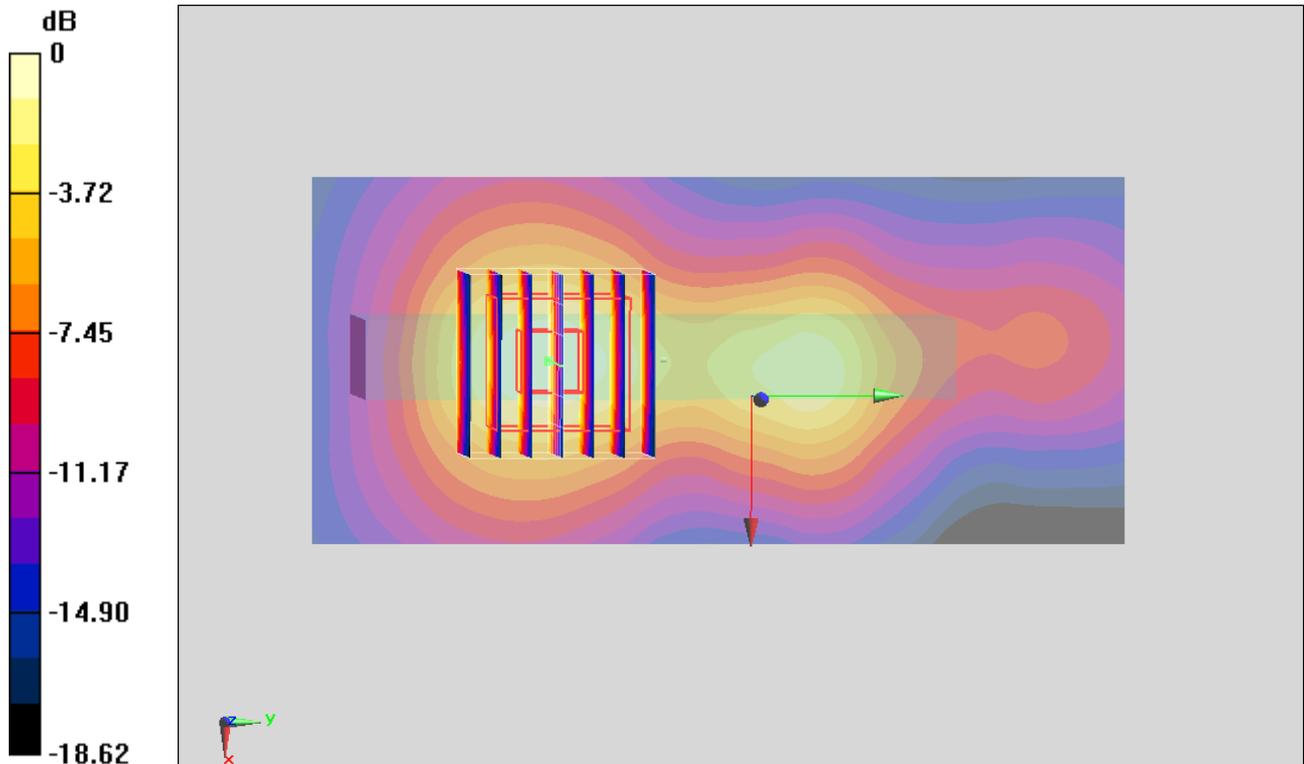Maximum value of SAR (interpolated) = 0.701 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 18.383 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.937 W/kg
**SAR(1 g) = 0.471 W/kg; SAR(10 g) = 0.237 W/kg**
Maximum value of SAR (measured) = 0.697 W/kg



0 dB = 0.697 W/kg = -1.57 dBW/kg

## #36_LTE Band 7_20M_QPSK_1RB_49Offset_Tip Mode_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; ε$_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃; Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (61x61x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
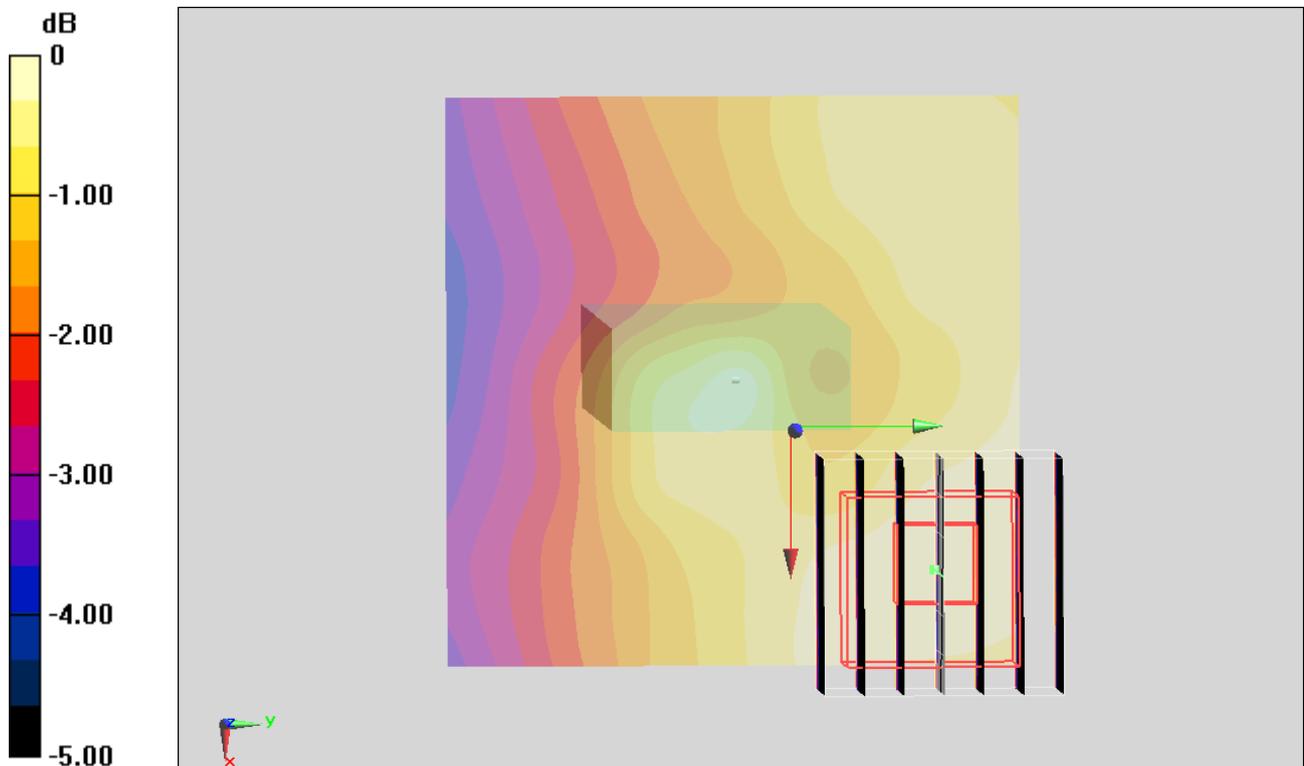Maximum value of SAR (interpolated) = 0.0706 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.715 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 0.0920 W/kg
**SAR(1 g) = 0.052 W/kg; SAR(10 g) = 0.033 W/kg**
Maximum value of SAR (measured) = 0.0699 W/kg



0 dB = 0.0699 W/kg = -11.56 dBW/kg

## #37_LTE Band 7_20M_QPSK_50RB_24Offset_Tip Mode_0.5cm_Ch20850

Communication System: LTE; Frequency: 2510 MHz;Duty Cycle: 1:1
Medium: MSL_2600_131210 Medium parameters used: f = 2510 MHz; σ = 2.085 S/m; $\varepsilon_r$ = 52.993; ρ = 1000 kg/m$^3$
Ambient Temperature：23.3 ℃；Liquid Temperature：22.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(6.99, 6.99, 6.99); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1279; Calibrated: 2013/1/28
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1127
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch20850/Area Scan (61x61x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
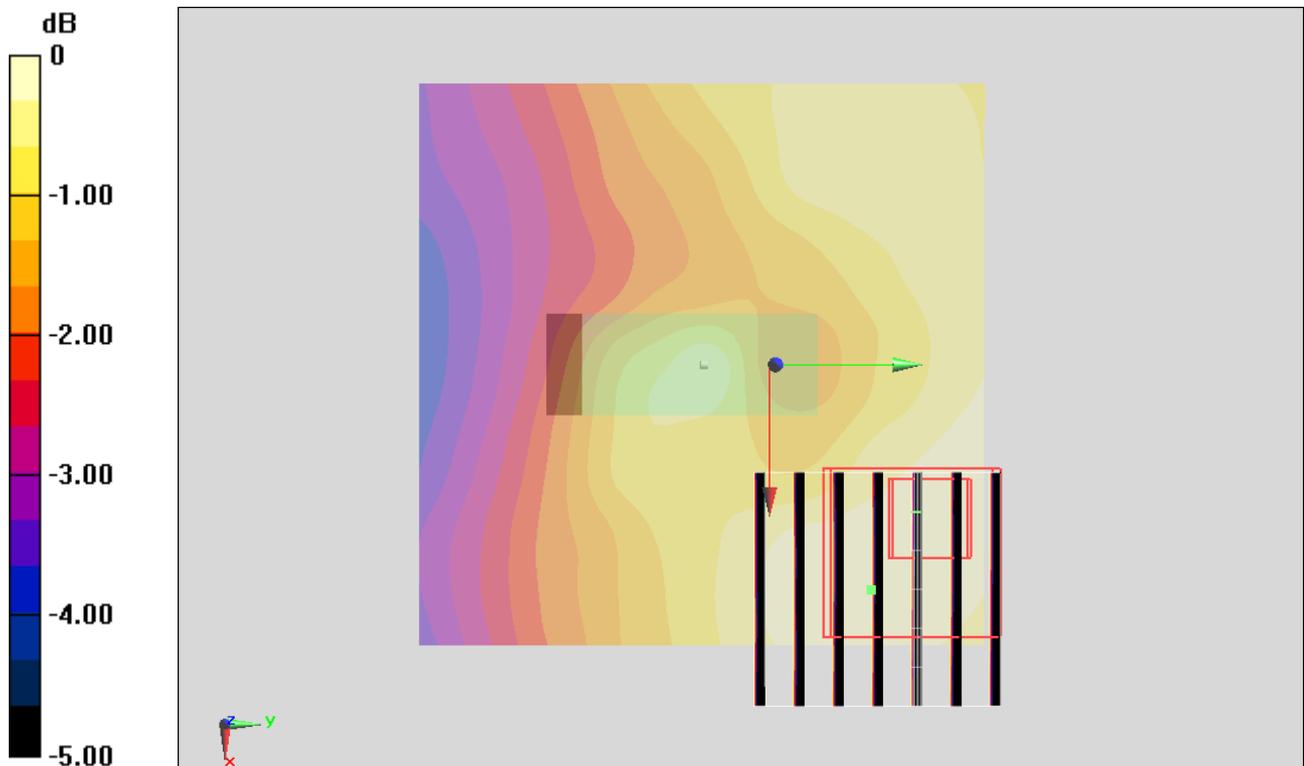Maximum value of SAR (interpolated) = 0.0657 W/kg

**Configuration/Ch20850/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 5.517 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 0.0840 W/kg
**SAR(1 g) = 0.049 W/kg; SAR(10 g) = 0.031 W/kg**
Maximum value of SAR (measured) = 0.0654 W/kg



0 dB = 0.0654 W/kg = -11.84 dBW/kg

## #01_WLAN2.4GHz_802.11b 1Mbps_Horizontal Up_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; σ = 1.996 S/m; $ε_r$ = 53.979; ρ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.191 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 9.684 V/m; Power Drift = 0.15 dB
Peak SAR (extrapolated) = 0.267 W/kg
**SAR(1 g) = 0.122 W/kg; SAR(10 g) = 0.057 W/kg**
Maximum value of SAR (measured) = 0.192 W/kg
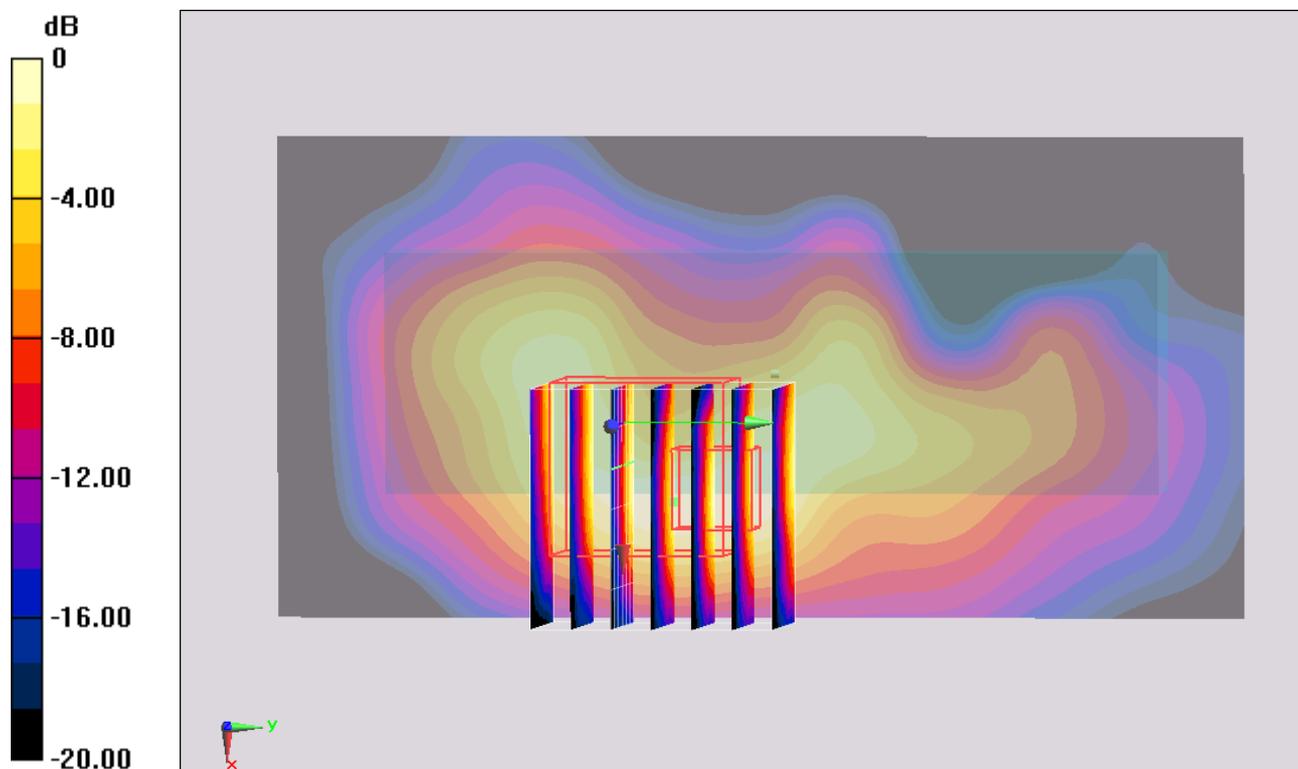


0 dB = 0.192 W/kg = -7.17 dBW/kg

## #20_WLAN2.4GHz_802.11b 1Mbps_Horizontal Up_0.5cm_Ch6;Flip 90

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; σ = 1.996 S/m; $\varepsilon_r$ = 53.979; ρ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0380 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.748 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.0550 W/kg
**SAR(1 g) = 0.029 W/kg; SAR(10 g) = 0.012 W/kg**
Maximum value of SAR (measured) = 0.0465 W/kg
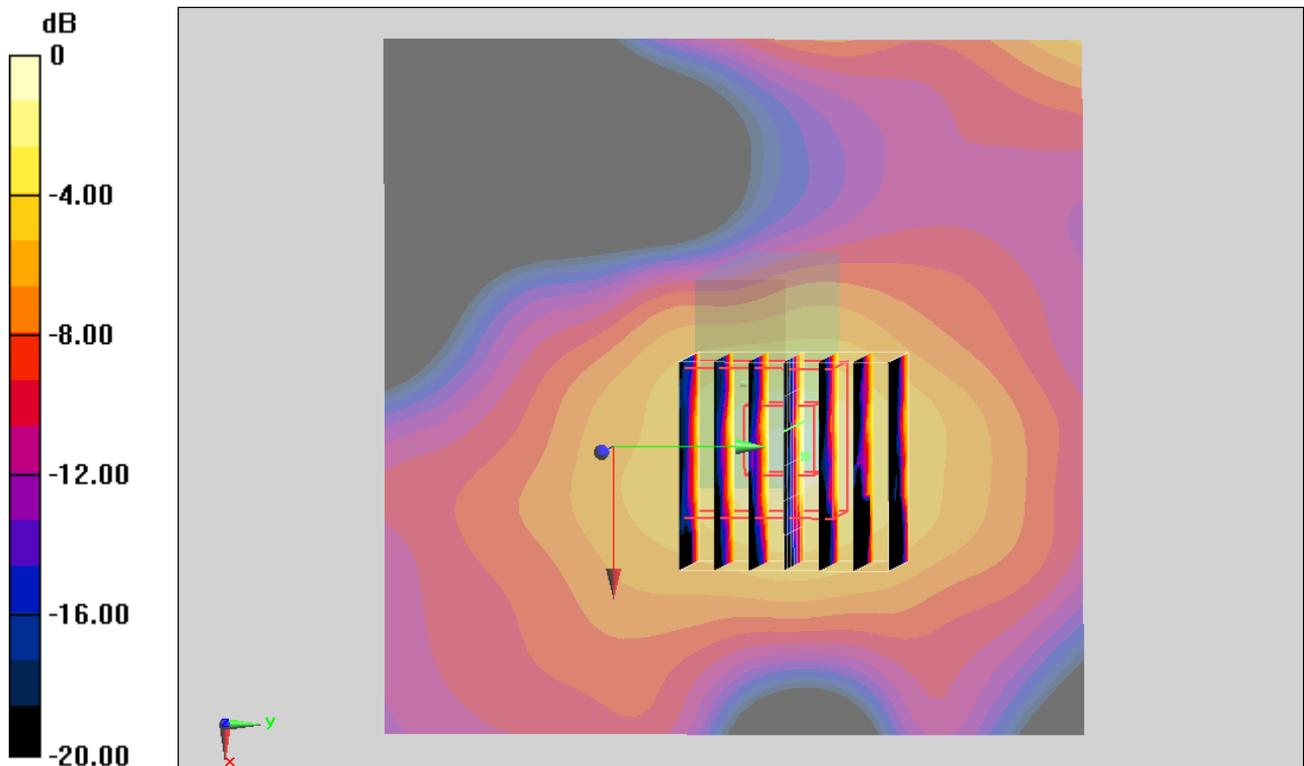


0 dB = 0.0465 W/kg = -13.33 dBW/kg

# #02_WLAN2.4GHz_802.11b 1Mbps_Horizontal Down_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; $\sigma$ = 1.996 S/m; $\varepsilon_r$ = 53.979; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
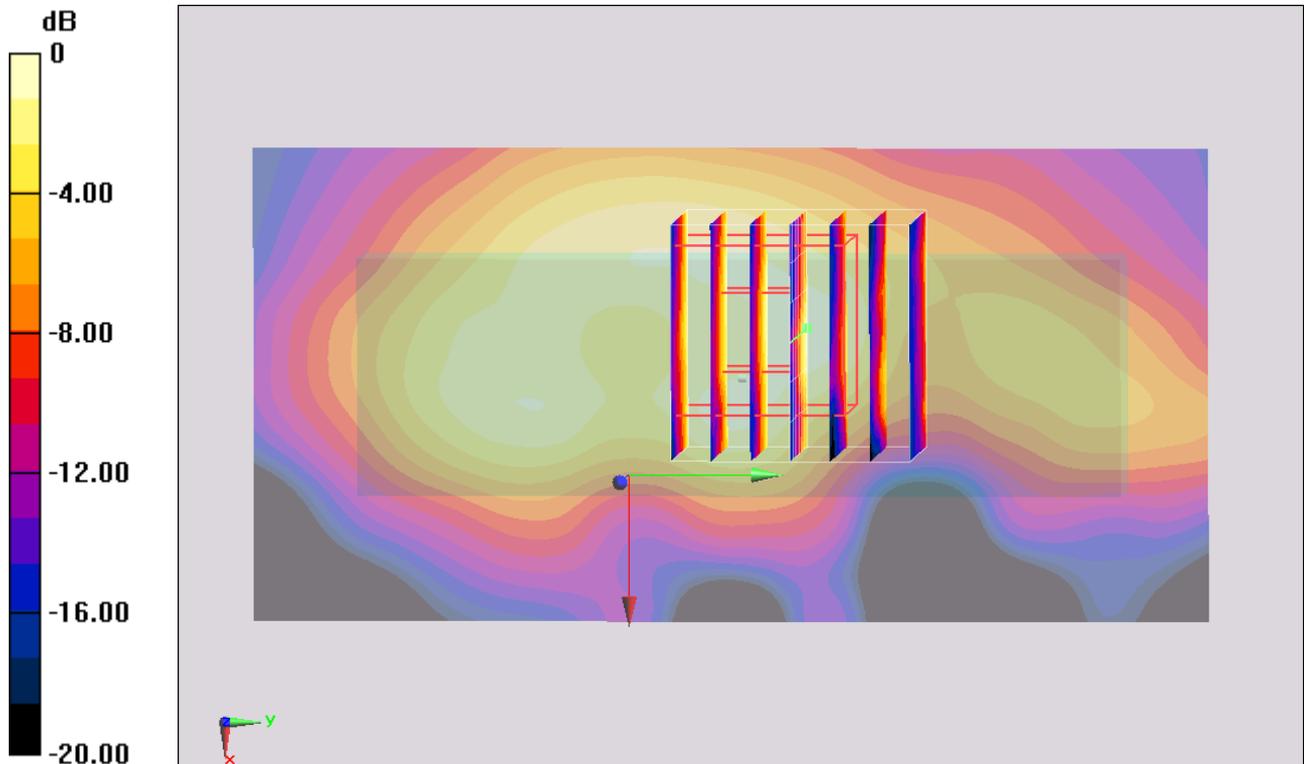Maximum value of SAR (interpolated) = 0.0755 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.622 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 0.107 W/kg
**SAR(1 g) = 0.055 W/kg; SAR(10 g) = 0.026 W/kg**
Maximum value of SAR (measured) = 0.0818 W/kg



0 dB = 0.0818 W/kg = -10.87 dBW/kg

## #03_WLAN2.4GHz_802.11b 1Mbps_Vertical Front_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; σ = 1.996 S/m; $\varepsilon_r$ = 53.979; ρ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.269 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.311 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.353 W/kg
**SAR(1 g) = 0.160 W/kg; SAR(10 g) = 0.077 W/kg**
Maximum value of SAR (measured) = 0.245 W/kg



0 dB = 0.245 W/kg = -6.11 dBW/kg

## #04_WLAN2.4GHz_802.11b 1Mbps_Vertical Back_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; σ = 1.996 S/m; $ε_r$ = 53.979; ρ
= 1000 kg/m$^3$
Ambient Temperature：23.5 ℃；Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
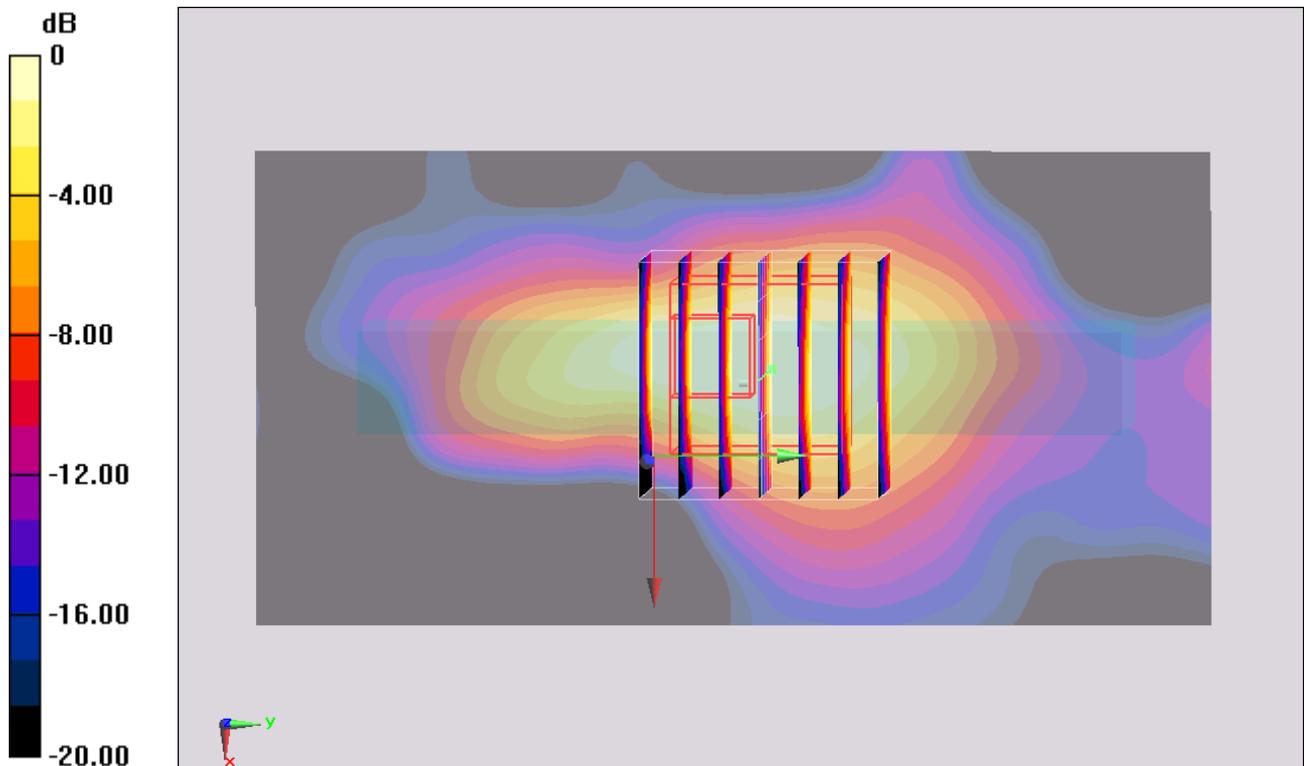Maximum value of SAR (interpolated) = 0.0192 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.711 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.0570 W/kg
**SAR(1 g) = 0.00888 W/kg; SAR(10 g) = 0.00328 W/kg**
Maximum value of SAR (measured) = 0.0406 W/kg
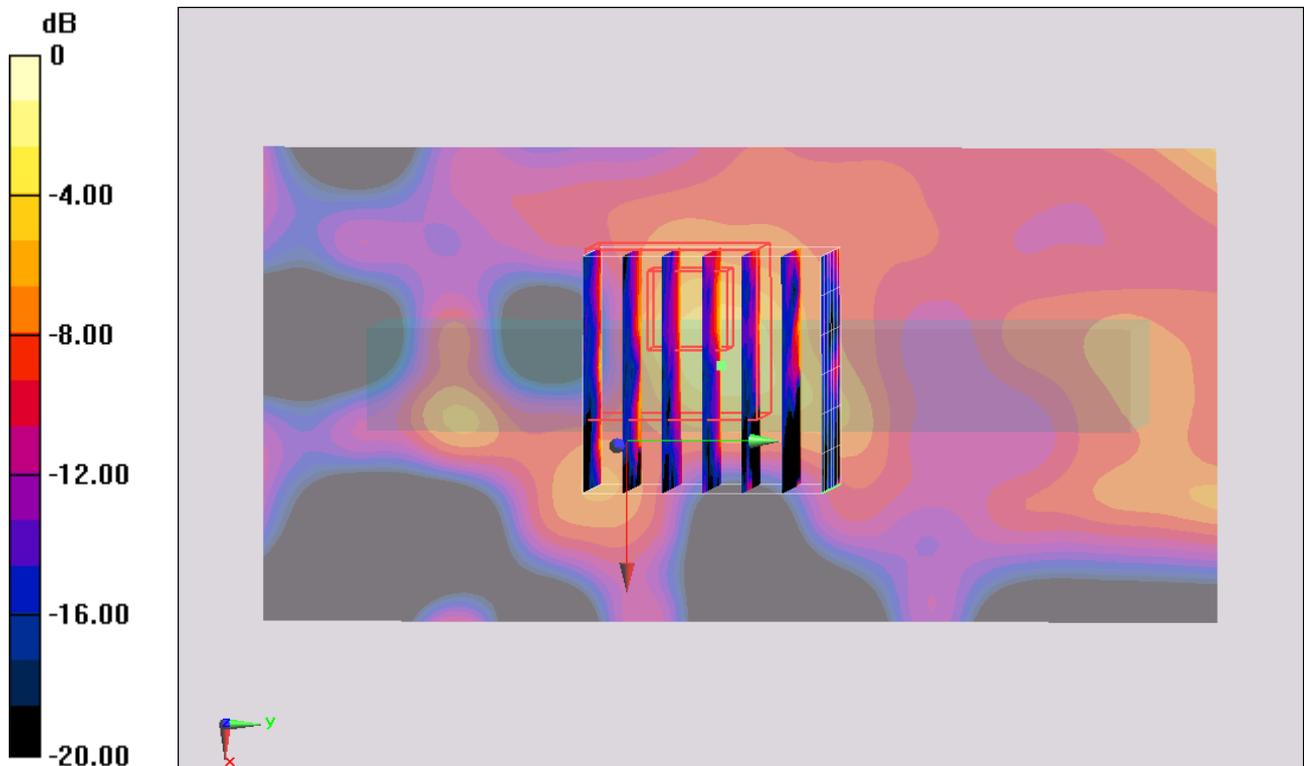


0 dB = 0.0406 W/kg = -13.91 dBW/kg

## #05_WLAN2.4GHz_802.11b 1Mbps_Tip Mode_0.5cm_Ch6

Communication System: 802.11b; Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450_131207 Medium parameters used: f = 2437 MHz; σ = 1.996 S/m; $\varepsilon_r$ = 53.979; ρ = 1000 kg/m$^3$
Ambient Temperature：23.5 ℃; Liquid Temperature：22.5 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3898; ConvF(7.17, 7.17, 7.17); Calibrated: 2013/1/14;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1399; Calibrated: 2013/11/7
- Phantom: ELI v5.0 Left; Type: QDOVA002AA; Serial: TP:1131
- Measurement SW: DASY52, Version 52.8 (6); SEMCAD X Version 14.6.9 (7117)

**Configuration/Ch6/Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.0156 W/kg

**Configuration/Ch6/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.981 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 0.0150 W/kg
**SAR(1 g) = 0.00624 W/kg; SAR(10 g) = 0.00223 W/kg**
Maximum value of SAR (measured) = 0.0101 W/kg
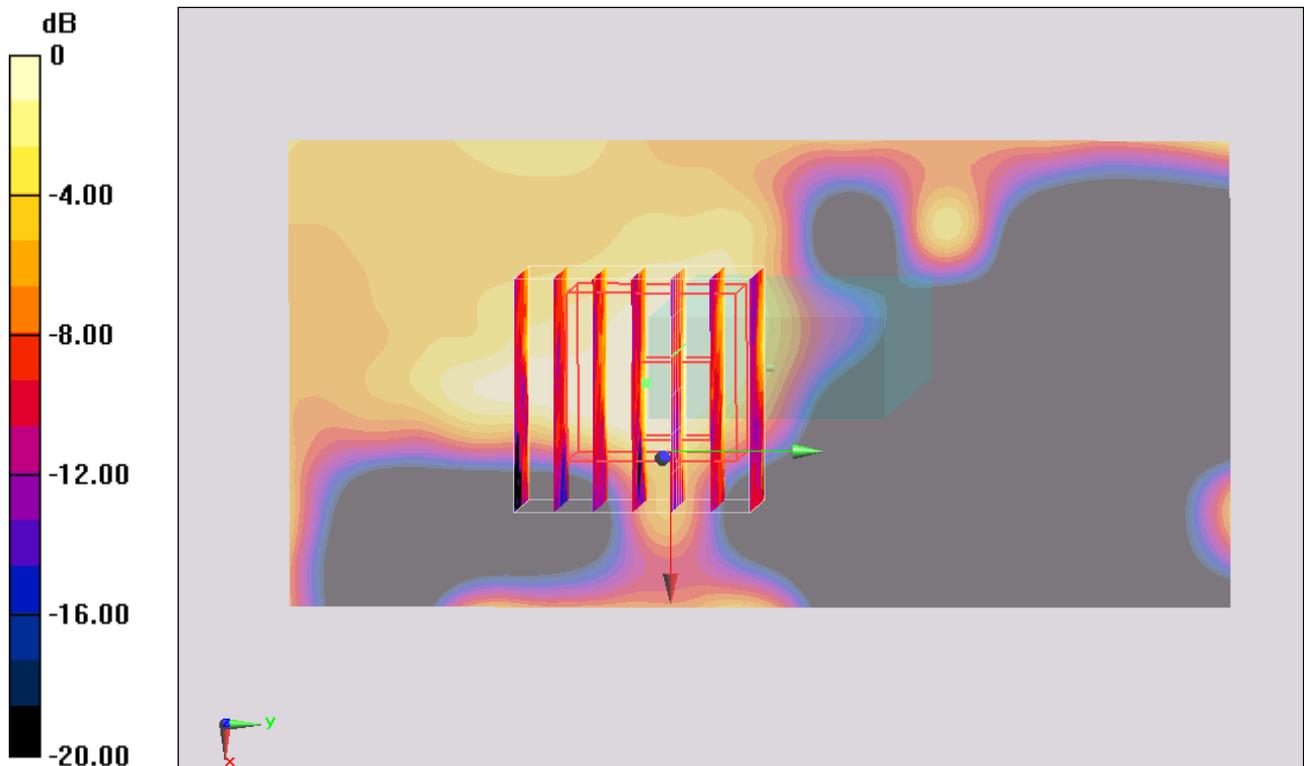


0 dB = 0.0101 W/kg = -19.96 dBW/kg

# Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

**SPORTON INTERNATIONAL INC.**
TEL : 886-3-327-3456
FAX : 886-3-328-4978
FCC ID : QISW5101

Page Number : C1 of C1
Report Issued Date : Jan. 14, 2014
Report Version : Rev. 02

**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 | **Sporton-TW (Auden)** | Certificate No: **D835V2-4d162_Nov13** |
|---|---|---|

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN: 4d162 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | November 11, 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 EPM-442A | GB37480704 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | US37292783 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | MY41092317 | 09-Oct-13 (No. 217-01828) | Oct-14 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 04-Apr-13 (No. 217-01736) | Apr-14 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 04-Apr-13 (No. 217-01739) | Apr-14 |
| Reference Probe ES3DV3 | SN: 3205 | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13 |
| DAE4 | SN: 601 | 25-Apr-13 (No. DAE4-601_Apr13) | Apr-14 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-15 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-13) | In house check: Oct-14 |

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

Issued: November 12, 2013

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

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

d) 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.

---

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%.

---

## Measurement Conditions

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

| DASY Version | DASY5 | V52.8.7 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 15 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 41.5 | 0.90 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 40.8 ± 6 % | 0.94 mho/m ± 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 | 250 mW input power | 2.47 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.53 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.59 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.18 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 55.2 | 0.97 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 54.7 ± 6 % | 1.01 mho/m ± 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 | 250 mW input power | 2.39 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.28 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.56 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.09 W/kg ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 52.5 Ω - 3.3 jΩ |
|---|---|
| Return Loss | - 27.8 dB |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 47.1 Ω - 5.9 jΩ |
|---|---|
| Return Loss | - 23.4 dB |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.425 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 | December 28, 2012 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162**

Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.94 S/m; $\varepsilon_r$ = 40.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.05, 6.05, 6.05); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)


**Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.399 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 3.76 W/kg
**SAR(1 g) = 2.47 W/kg; SAR(10 g) = 1.59 W/kg**
Maximum value of SAR (measured) = 2.88 W/kg
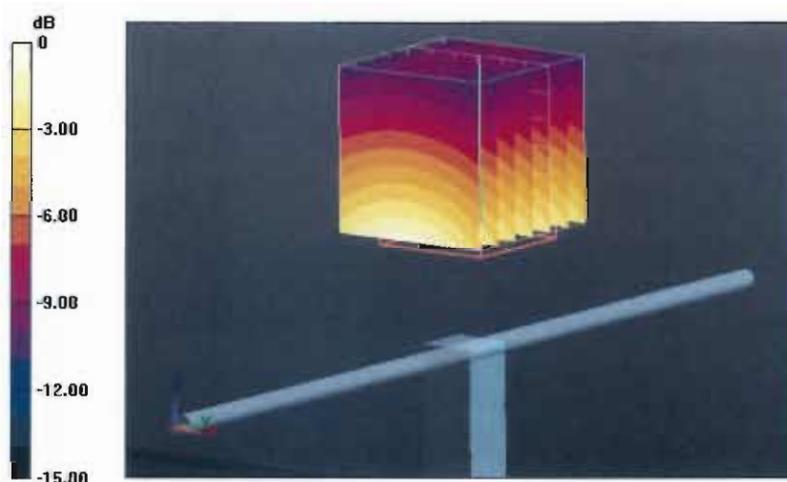


0 dB = 2.88 W/kg = 4.59 dBW/kg
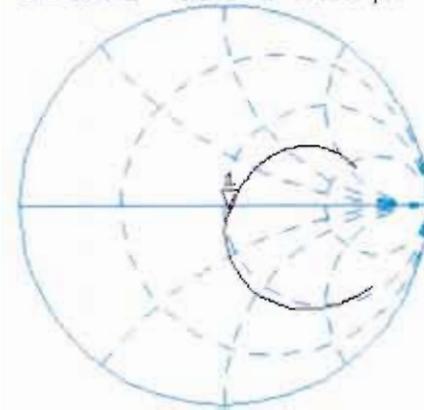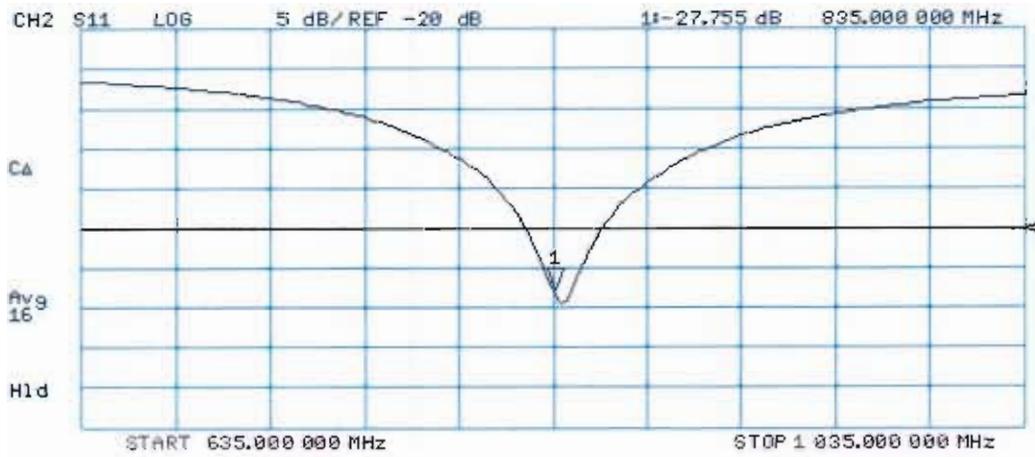
# Impedance Measurement Plot for Head TSL

Date: 11.11.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d162**

Communication System: UID 0 - CW ; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 1.007 S/m; $\varepsilon_r$ = 54.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)


**Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 54.559 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.53 W/kg
**SAR(1 g) = 2.39 W/kg; SAR(10 g) = 1.56 W/kg**
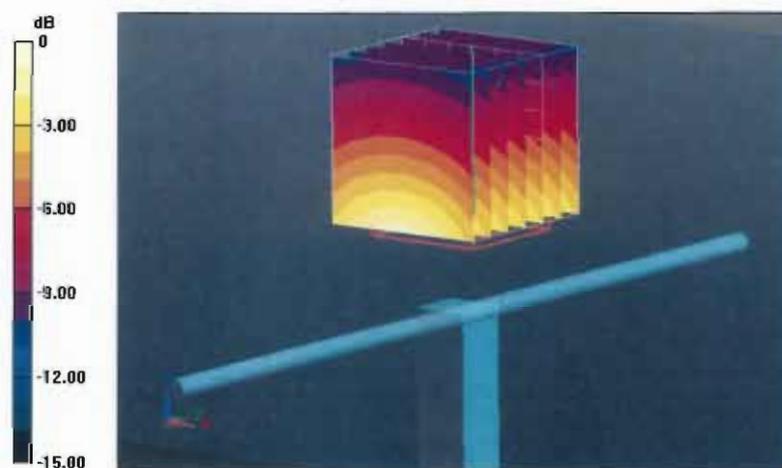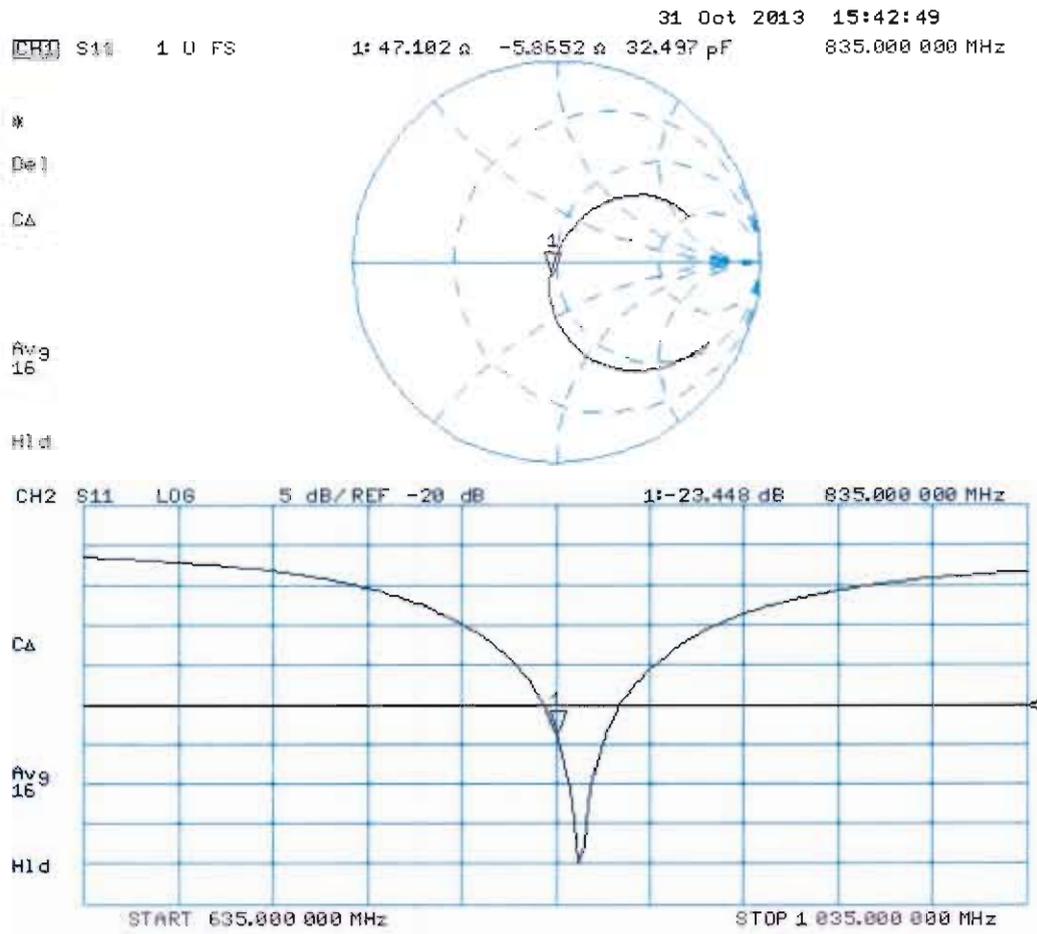Maximum value of SAR (measured) = 2.79 W/kg



0 dB = 2.79 W/kg = 4.46 dBW/kg

# Impedance Measurement Plot for Body TSL

**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    **Sporton-TW (Auden)**

Certificate No: **D1900V2-5d182_Nov13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d182 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | November 12, 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 EPM-442A | GB37480704 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | US37292783 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | MY41092317 | 09-Oct-13 (No. 217-01828) | Oct-14 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 04-Apr-13 (No. 217-01736) | Apr-14 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 04-Apr-13 (No. 217-01739) | Apr-14 |
| Reference Probe ES3DV3 | SN: 3205 | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13 |
| DAE4 | SN: 601 | 25-Apr-13 (No. DAE4-601_Apr13) | Apr-14 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-15 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-13) | In house check: Oct-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Leif Klysner | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: November 12, 2013

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

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**

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

d) 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.

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%.

## Measurement Conditions

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

| DASY Version | DASY5 | V52.8.7 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 1900 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 40.0 | 1.40 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 39.8 ± 6 % | 1.39 mho/m ± 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 | 250 mW input power | 10.0 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **40.1 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.25 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.0 W/kg ± 16.5 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 53.3 | 1.52 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 53.4 ± 6 % | 1.51 mho/m ± 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 | 250 mW input power | 9.82 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **39.5 W/kg ± 17.0 % (k=2)** |

| SAR averaged over 10 cm$^3$ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.23 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.0 W/kg ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.8 Ω + 4.7 jΩ |
|---|---|
| Return Loss | - 24.7 dB |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 49.4 Ω + 5.3 jΩ |
|---|---|
| Return Loss | - 25.5 dB |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.201 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 | August 23, 2013 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182**

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.39 S/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

# Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.302 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 18.3 W/kg
**SAR(1 g) = 10 W/kg; SAR(10 g) = 5.25 W/kg**
Maximum value of SAR (measured) = 12.3 W/kg



0 dB = 12.3 W/kg = 10.90 dBW/kg

# Impedance Measurement Plot for Head TSL
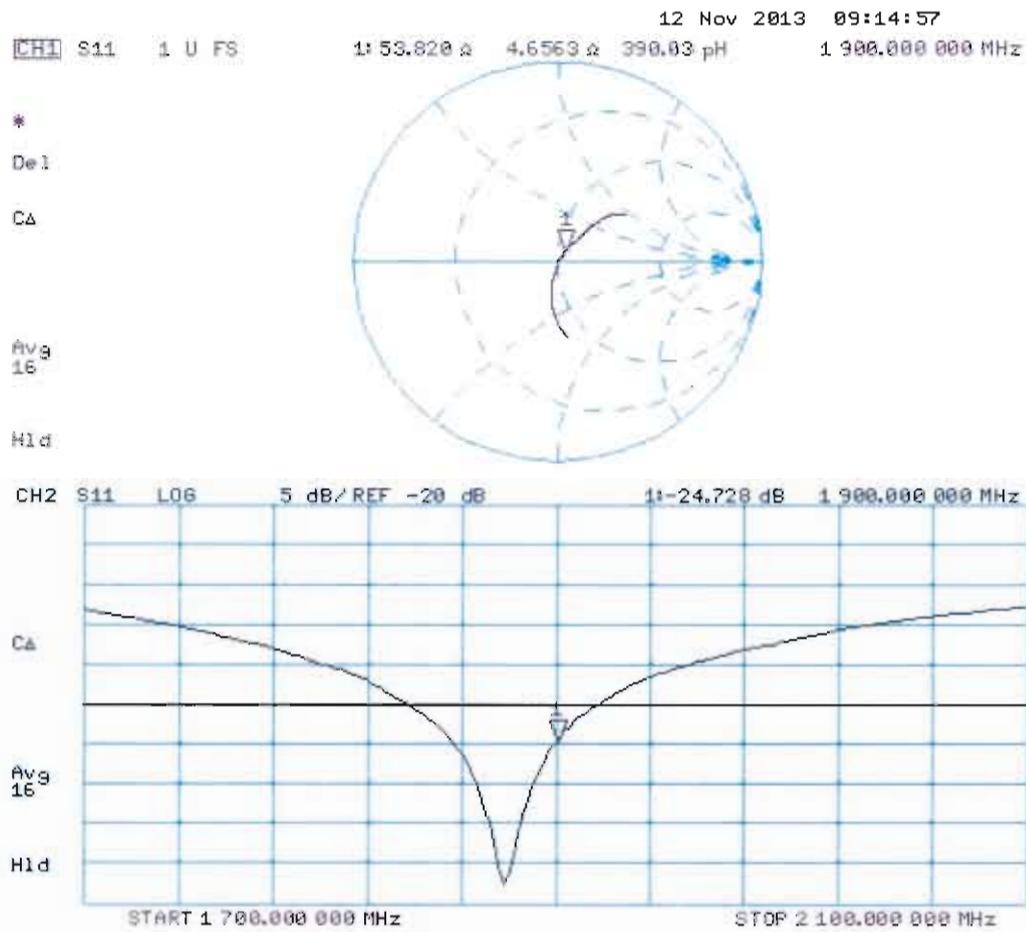
## DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d182**

Communication System: UID 0 - CW ; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.51 S/m; $\varepsilon_r$ = 53.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.302 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 16.8 W/kg
**SAR(1 g) = 9.82 W/kg; SAR(10 g) = 5.23 W/kg**
Maximum value of SAR (measured) = 12.2 W/kg
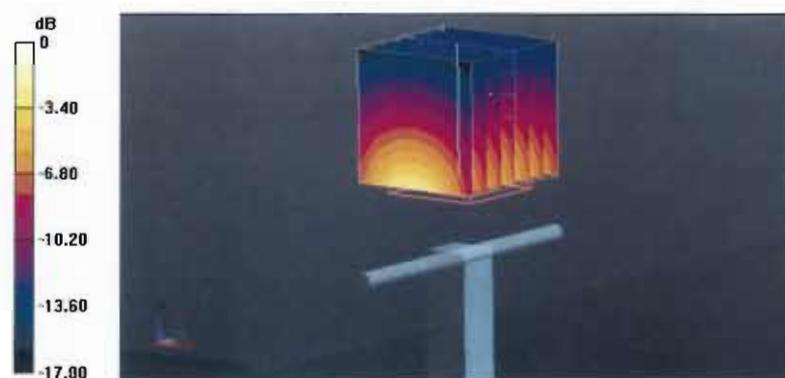


0 dB = 12.2 W/kg = 10.86 dBW/kg

# Impedance Measurement Plot for Body TSL



12 Nov 2013  09:13:26

CH1  S11    1 U FS        1: 49.426 Ω    5.2617 Ω   440.75 pH        1 900.000 000 MHz

Del

CΔ

Avg
16

Hld

CH2  S11    LOG      5 dB/ REF  -20 dB        1: -25.486 dB   1 900.000 000 MHz

CΔ

Avg
16

Hld

START 1 700.000 000 MHz                STOP 2 100.000 000 MHz

---

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Accreditation No.: **SCS 108**

Client **Sporton-TW (Auden)**

Certificate No: **D2450V2-924_Nov13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 924 |
| Calibration procedure(s) | **QA CAL-05.v9**<br>**Calibration procedure for dipole validation kits above 700 MHz** |
| Calibration date: | **November 13, 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)

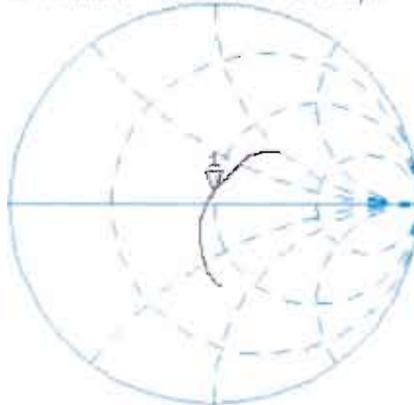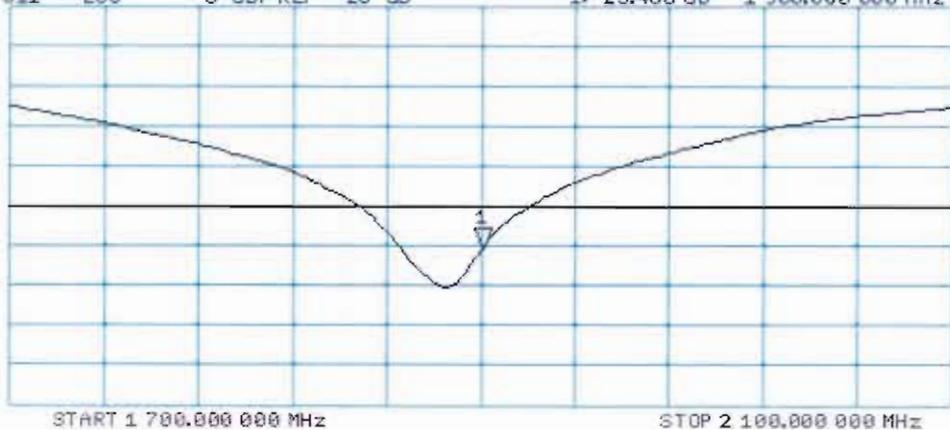| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | US37292783 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | MY41092317 | 09-Oct-13 (No. 217-01828) | Oct-14 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 04-Apr-13 (No. 217-01736) | Apr-14 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 04-Apr-13 (No. 217-01739) | Apr-14 |
| Reference Probe ES3DV3 | SN: 3205 | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13 |
| DAE4 | SN: 601 | 25-Apr-13 (No. DAE4-601_Apr13) | Apr-14 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-15 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-13) | In house check: Oct-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Israe El-Naouq | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: November 13, 2013

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Multilateral Agreement for the recognition of calibration certificates

**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:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

d) 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.

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%.

## Measurement Conditions

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

| DASY Version | DASY5 | V52.8.7 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 39.2 | 1.80 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 39.7 ± 6 % | 1.84 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 13.2 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 52.4 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.08 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 24.2 W/kg ± 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 52.7 | 1.95 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 52.1 ± 6 % | 2.02 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 12.8 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 50.2 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.92 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 23.4 W/kg ± 16.5 % (k=2) |

## Appendix

### Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 53.1 Ω + 2.6 jΩ |
|---|---|
| Return Loss | - 28.2 dB |

### Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 49.6 Ω + 4.3 jΩ |
|---|---|
| Return Loss | - 27.3 dB |

### General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.154 ns |
|---|---|

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. 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 | September 26, 2013 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.84 S/m; $\varepsilon_r$ = 39.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)


**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 98.75 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 27.5 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg**
Maximum value of SAR (measured) = 16.7 W/kg



0 dB = 16.7 W/kg = 12.23 dBW/kg

# Impedance Measurement Plot for Head TSL
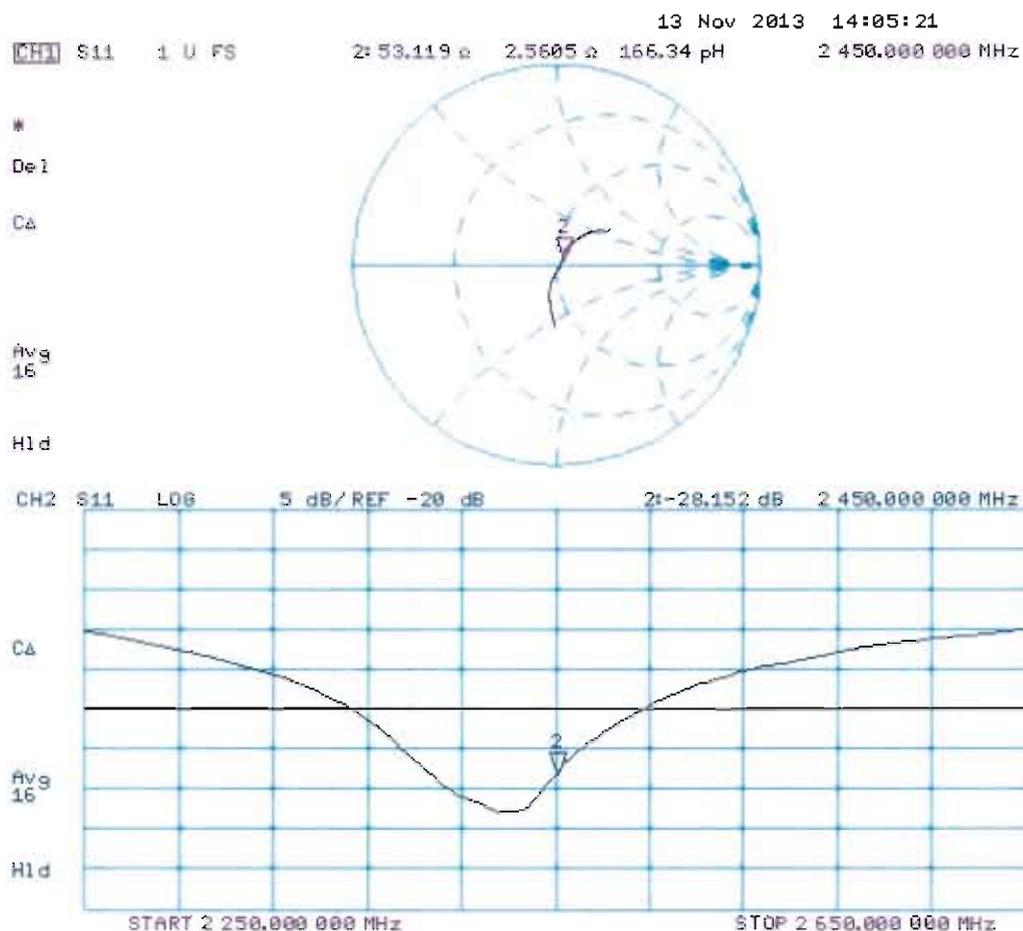
Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 924**

Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 S/m; $\varepsilon_r$ = 52.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.726 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 26.8 W/kg
**SAR(1 g) = 12.8 W/kg; SAR(10 g) = 5.92 W/kg**
Maximum value of SAR (measured) = 16.8 W/kg
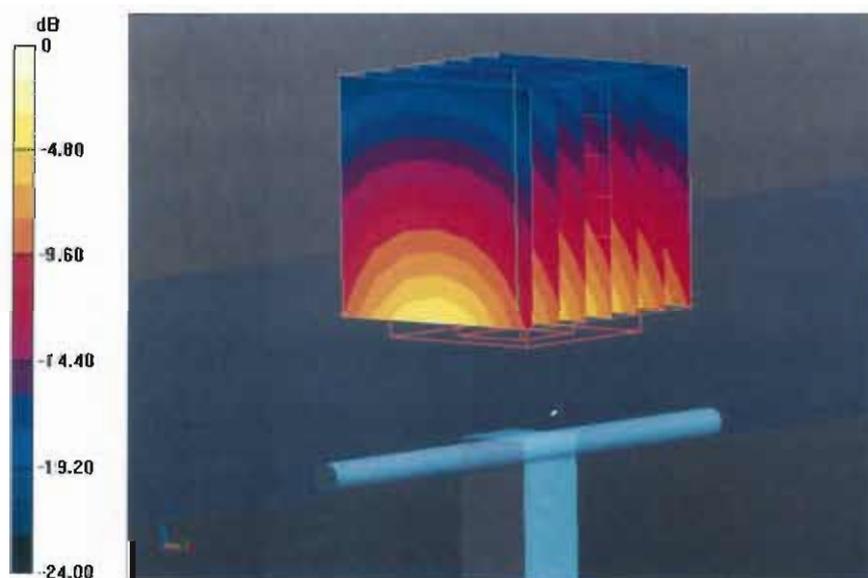


0 dB = 16.8 W/kg = 12.25 dBW/kg

# Impedance Measurement Plot for Body TSL
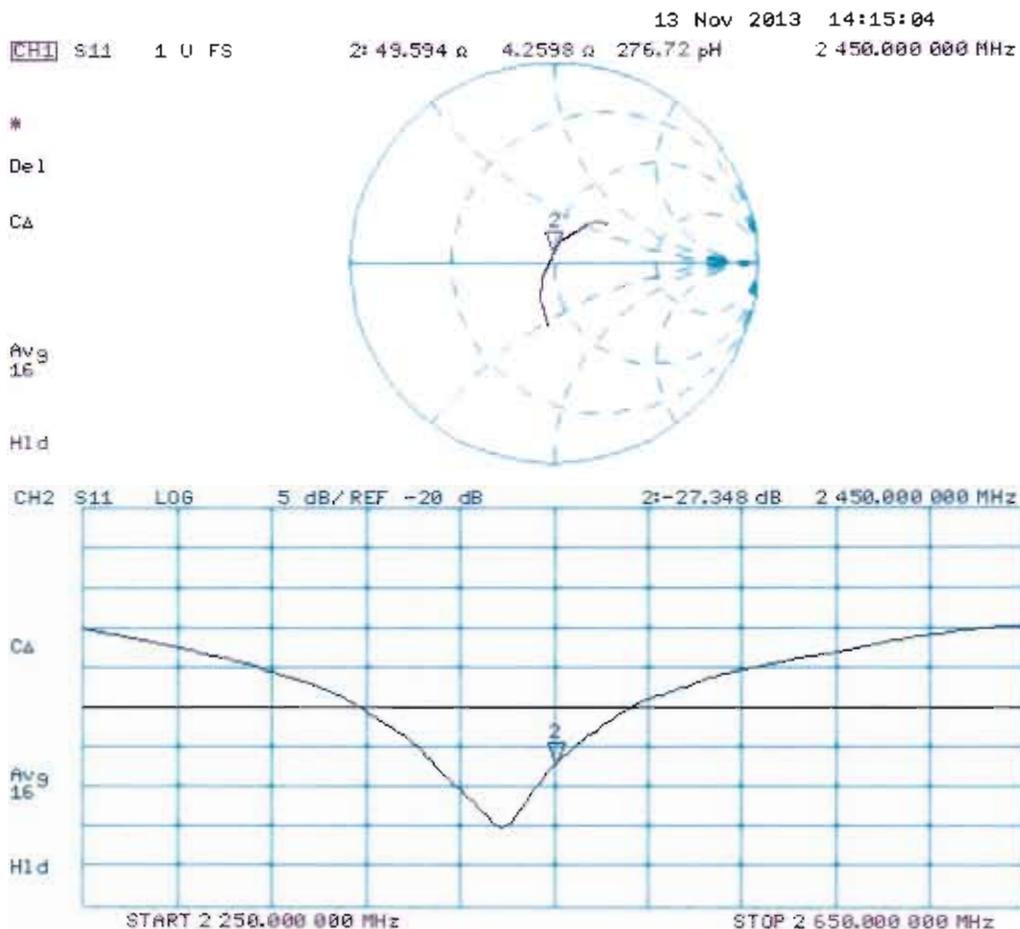
CH1  S11   1 U FS        2: 49.594 Ω   4.2598 Ω  276.72 pH      2 450.000 000 MHz

*

Del

CΔ

Avg
16

Hld

CH2  S11   LOG     5 dB/ REF  -20 dB              2:-27.348 dB   2 450.000 000 MHz

CΔ

Avg
16

Hld

START 2 250.000 000 MHz                    STOP 2 650.000 000 MHz

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Accreditation No.: **SCS 108**

Client    **Sporton-TW (Auden)**

Certificate No: **D2600V2-1070_Nov13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2600V2 - SN: 1070 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | November 13, 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 EPM-442A | GB37480704 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | US37292783 | 09-Oct-13 (No. 217-01827) | Oct-14 |
| Power sensor HP 8481A | MY41092317 | 09-Oct-13 (No. 217-01828) | Oct-14 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 04-Apr-13 (No. 217-01736) | Apr-14 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 04-Apr-13 (No. 217-01739) | Apr-14 |
| Reference Probe ES3DV3 | SN: 3205 | 28-Dec-12 (No. ES3-3205_Dec12) | Dec-13 |
| DAE4 | SN: 601 | 25-Apr-13 (No. DAE4-601_Apr13) | Apr-14 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-13) | In house check: Oct-15 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-13) | In house check: Oct-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Israe El-Naouq | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: November 13, 2013

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

## Glossary:

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

## Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

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) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

## Additional Documentation:

d) 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.

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%.

## Measurement Conditions

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

| DASY Version | DASY5 | V52.8.7 |
|---|---|---|
| Extrapolation | Advanced Extrapolation | |
| Phantom | Modular Flat Phantom | |
| Distance Dipole Center - TSL | 10 mm | with Spacer |
| Zoom Scan Resolution | dx, dy, dz = 5 mm | |
| Frequency | 2600 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Head TSL parameters | 22.0 °C | 39.0 | 1.96 mho/m |
| Measured Head TSL parameters | (22.0 ± 0.2) °C | 39.1 ± 6 % | 2.01 mho/m ± 6 % |
| Head TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL

| SAR averaged over 1 cm³ (1 g) of Head TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 14.3 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 56.6 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (10 g) of Head TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.33 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | 25.2 W/kg ± 16.5 % (k=2) |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| Nominal Body TSL parameters | 22.0 °C | 52.5 | 2.16 mho/m |
| Measured Body TSL parameters | (22.0 ± 0.2) °C | 51.7 ± 6 % | 2.20 mho/m ± 6 % |
| Body TSL temperature change during test | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL

| SAR averaged over 1 cm³ (1 g) of Body TSL | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 14.1 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 55.7 W/kg ± 17.0 % (k=2) |

| SAR averaged over 10 cm³ (10 g) of Body TSL | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.22 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | 24.7 W/kg ± 16.5 % (k=2) |

## Appendix

## Antenna Parameters with Head TSL

| Impedance, transformed to feed point | 48.3 Ω - 5.0 jΩ |
|---|---|
| Return Loss | - 25.4 dB |

## Antenna Parameters with Body TSL

| Impedance, transformed to feed point | 44.5 Ω - 4.0 jΩ |
|---|---|
| Return Loss | - 22.9 dB |

## General Antenna Parameters and Design

| Electrical Delay (one direction) | 1.147 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 | July 17, 2013 |

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070**

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; $\sigma$ = 2.01 S/m; $\varepsilon_r$ = 39.1; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)


**Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 99.401 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 31.0 W/kg
**SAR(1 g) = 14.3 W/kg; SAR(10 g) = 6.33 W/kg**
Maximum value of SAR (measured) = 18.4 W/kg



0 dB = 18.4 W/kg = 12.65 dBW/kg

# Impedance Measurement Plot for Head TSL
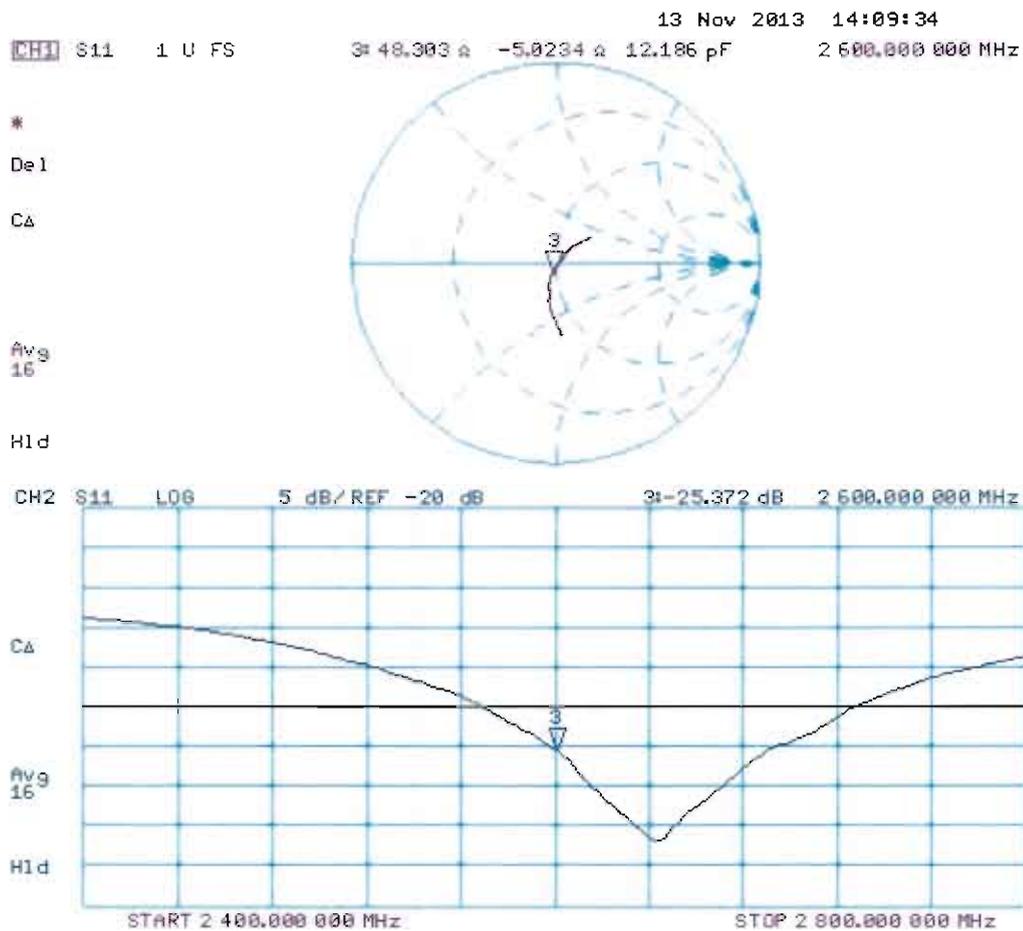
Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1070**

Communication System: UID 0 - CW; Frequency: 2600 MHz
Medium parameters used: f = 2600 MHz; $\sigma$ = 2.2 S/m; $\varepsilon_r$ = 51.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.32, 4.32, 4.32); Calibrated: 28.12.2012;

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 25.04.2013

- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002

- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 95.096 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 30.7 W/kg
**SAR(1 g) = 14.1 W/kg; SAR(10 g) = 6.22 W/kg**
Maximum value of SAR (measured) = 18.7 W/kg
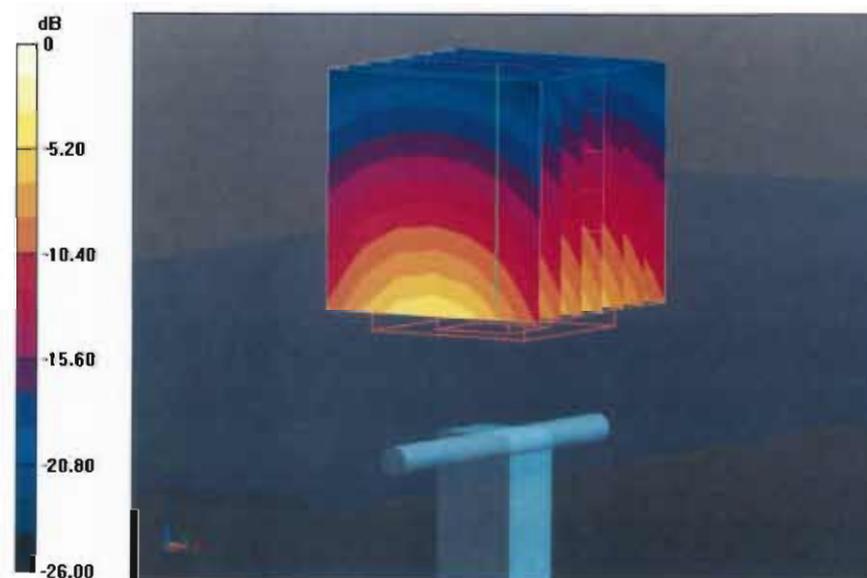


0 dB = 18.7 W/kg = 12.72 dBW/kg

# Impedance Measurement Plot for Body TSL



13 Nov 2013  14:31:36

CH1 S11  1 U FS      3: 44.531 Ω  −4.0020 Ω  15.296 pF     2 600.000 000 MHz

CH2 S11  LOG      5 dB/REF −20 dB      3:−22.904 dB  2 600.000 000 MHz

START 2 400.000 000 MHz                STOP 2 600.000 000 MHz

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

| Client | **Sporton-TW (Auden)** | Certificate No: **DAE3-577_May13** |
|---|---|---|

# CALIBRATION CERTIFICATE

| Object | DAE3 - SD 000 D03 AA - SN: 577 |
|---|---|

| Calibration procedure(s) | QA CAL-06.v26<br>Calibration procedure for the data acquisition electronics (DAE) |
|---|---|

| Calibration date: | May 08, 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 |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 02-Oct-12 (No:12728) | Oct-13 |

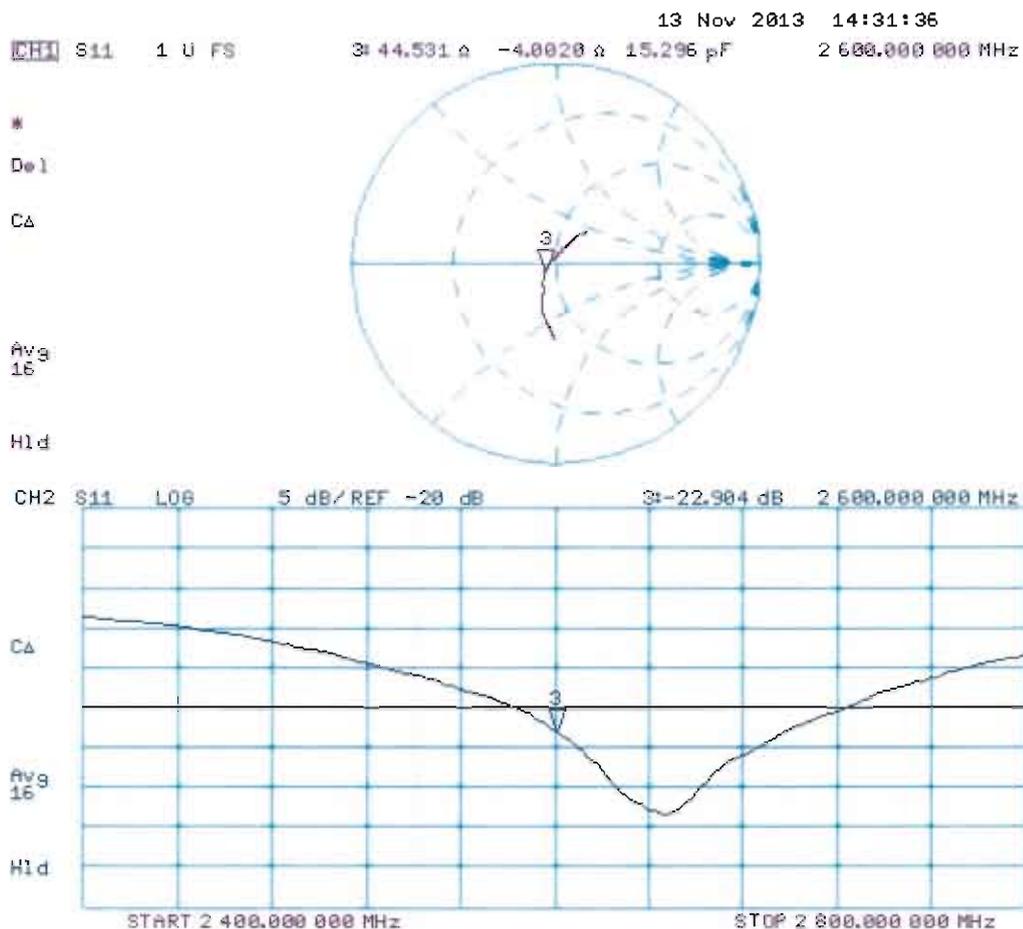| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Auto DAE Calibration Unit | SE UWS 053 AA 1001 | 07-Jan-13 (in house check) | In house check: Jan-14 |
| Calibrator Box V2.1 | SE UMS 006 AA 1002 | 07-Jan-13 (in house check) | In house check: Jan-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | R.Mayoraz | Technician | |
| Approved by: | Fin Bomholt | Deputy Technical Manager | |

Issued: May 8, 2013

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Multilateral Agreement for the recognition of calibration certificates

## Glossary

DAE                        data acquisition electronics
Connector angle            information used in DASY system to align probe sensor X to the robot
                           coordinate system.

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.

  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.

  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.

  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.

  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage

  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.

  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.

  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.

  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.

  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

| | | | | |
|---|---|---|---|---|
| High Range: | 1LSB = | 6.1μV , | full range = | -100...+300 mV |
| Low Range: | 1LSB = | 61nV , | full range = | -1.......+3mV |

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 403.397 ± 0.02% (k=2) | 403.388 ± 0.02% (k=2) | 403.687 ± 0.02% (k=2) |
| **Low Range** | 3.91124 ± 1.50% (k=2) | 3.94923 ± 1.50% (k=2) | 3.96280 ± 1.50% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 152.0 ° ± 1 ° |

## Appendix

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199992.97 | -2.03 | -0.00 |
| Channel X | + Input | 20006.56 | 6.78 | 0.03 |
| Channel X | - Input | -19997.08 | 4.29 | -0.02 |
| Channel Y | + Input | 199993.74 | -1.19 | -0.00 |
| Channel Y | + Input | 20001.32 | 1.47 | 0.01 |
| Channel Y | - Input | -20001.58 | -0.26 | 0.00 |
| Channel Z | + Input | 199992.72 | -2.44 | -0.00 |
| Channel Z | + Input | 19999.97 | 0.17 | 0.00 |
| Channel Z | - Input | -20000.51 | 0.84 | -0.00 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2000.20 | 0.15 | 0.01 |
| Channel X | + Input | 200.85 | 0.32 | 0.16 |
| Channel X | - Input | -198.93 | 0.44 | -0.22 |
| Channel Y | + Input | 1999.33 | -0.71 | -0.04 |
| Channel Y | + Input | 200.17 | -0.49 | -0.25 |
| Channel Y | - Input | -200.58 | -1.19 | 0.60 |
| Channel Z | + Input | 1999.86 | -0.07 | -0.00 |
| Channel Z | + Input | 199.59 | -0.87 | -0.43 |
| Channel Z | - Input | -199.83 | -0.36 | 0.18 |

### 2. Common mode sensitivity
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | -2.45 | -3.91 |
| | - 200 | 5.25 | 3.89 |
| Channel Y | 200 | -15.26 | -14.77 |
| | - 200 | 14.00 | 12.70 |
| Channel Z | 200 | 3.50 | 3.05 |
| | - 200 | -5.18 | -4.77 |

### 3. Channel separation
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | -0.78 | -2.21 |
| Channel Y | 200 | 9.32 | - | 1.71 |
| Channel Z | 200 | 6.44 | 5.54 | - |

## 4. AD-Converter Values with inputs shorted

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

|  | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| Channel X | 16138 | 16187 |
| Channel Y | 16101 | 15933 |
| Channel Z | 16163 | 16267 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

|  | Average (µV) | min. Offset (µV) | max. Offset (µV) | Std. Deviation (µV) |
|---|---|---|---|---|
| Channel X | -2.00 | -2.93 | -1.19 | 0.34 |
| Channel Y | 1.39 | 0.04 | 2.26 | 0.46 |
| Channel Z | -0.90 | -1.82 | -0.10 | 0.37 |

## 6. Input Offset Current

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

## 7. Input Resistance (Typical values for information)

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

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

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

## 9. Power Consumption (Typical values for information)

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

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Multilateral Agreement for the recognition of calibration certificates

| Client | **Sporton (Auden)** | Certificate No: **DAE4-1279_Jan13** |
|---|---|---|

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BJ - SN: 1279 |
| Calibration procedure(s) | QA CAL-06.v25<br>Calibration procedure for the data acquisition electronics (DAE) |
| Calibration date: | January 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 |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 02-Oct-12 (No:12728) | Oct-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Auto DAE Calibration Unit | SE UWS 053 AA 1001 | 07-Jan-13 (in house check) | In house check: Jan-14 |
| Calibrator Box V2.1 | SE UMS 006 AA 1002 | 07-Jan-13 (in house check) | In house check: Jan-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | R.Mayoraz | Technician | |
| Approved by: | Fin Bomholt | Deputy Technical Manager | |

Issued: January 28, 2013

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## Glossary
DAE                    data acquisition electronics
Connector angle        information used in DASY system to align probe sensor X to the robot
                       coordinate system.

## Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.

- *Connector angle:* The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.

- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.

  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.

  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.

  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.

  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage

  - *Input Offset Measurement:* Output voltage and statistical results over a large number of zero voltage measurements.

  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.

  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.

  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.

  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range:      1LSB =      6.1μV ,      full range =    -100...+300 mV

Low Range:      1LSB =      61nV ,      full range =    -1.......+3mV

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 405.158 ± 0.02% (k=2) | 404.952 ± 0.02% (k=2) | 404.290 ± 0.02% (k=2) |
| Low Range | 3.98094 ± 1.55% (k=2) | 3.97626 ± 1.55% (k=2) | 4.00118 ± 1.55% (k=2) |

## Connector Angle

| Connector Angle to be used in DASY system | 333.5 ° ± 1 ° |
|---|---|

## Appendix

### 1. DC Voltage Linearity

| High Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199996.47 | 1.09 | 0.00 |
| Channel X | + Input | 20003.76 | 2.93 | 0.01 |
| Channel X | - Input | -19999.36 | 0.88 | -0.00 |
| Channel Y | + Input | 199994.58 | -0.65 | -0.00 |
| Channel Y | + Input | 20001.07 | 0.39 | 0.00 |
| Channel Y | - Input | -20001.20 | -0.68 | 0.00 |
| Channel Z | + Input | 199998.63 | 3.51 | 0.00 |
| Channel Z | + Input | 20002.19 | 1.53 | 0.01 |
| Channel Z | - Input | -20001.69 | -1.19 | 0.01 |

| Low Range | | Reading (μV) | Difference (μV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2001.94 | 0.86 | 0.04 |
| Channel X | + Input | 200.87 | -0.55 | -0.27 |
| Channel X | - Input | -198.32 | 0.30 | -0.15 |
| Channel Y | + Input | 2001.04 | 0.08 | 0.00 |
| Channel Y | + Input | 201.54 | 0.20 | 0.10 |
| Channel Y | - Input | -198.41 | 0.21 | -0.10 |
| Channel Z | + Input | 2000.79 | -0.09 | -0.00 |
| Channel Z | + Input | 200.22 | -0.99 | -0.49 |
| Channel Z | - Input | -199.65 | -0.88 | 0.44 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (μV) | Low Range Average Reading (μV) |
|---|---|---|---|
| Channel X | 200 | 18.03 | 16.81 |
| | - 200 | -15.22 | -17.01 |
| Channel Y | 200 | 8.11 | 8.20 |
| | - 200 | -9.46 | -9.57 |
| Channel Z | 200 | -1.17 | -1.31 |
| | - 200 | -0.74 | -0.94 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (μV) | Channel Y (μV) | Channel Z (μV) |
|---|---|---|---|---|
| Channel X | 200 | - | 2.26 | -3.75 |
| Channel Y | 200 | 8.26 | - | 3.07 |
| Channel Z | 200 | 9.62 | 5.76 | - |

## 4. AD-Converter Values with inputs shorted

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

|  | High Range (LSB) | Low Range (LSB) |
|---|---|---|
| **Channel X** | 15672 | 15869 |
| **Channel Y** | 16456 | 16271 |
| **Channel Z** | 15940 | 17304 |

## 5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

|  | Average (µV) | min. Offset (µV) | max. Offset (µV) | Std. Deviation (µV) |
|---|---|---|---|---|
| **Channel X** | 3.57 | 2.24 | 4.78 | 0.51 |
| **Channel Y** | -1.43 | -3.30 | 0.43 | 0.71 |
| **Channel Z** | 0.74 | -0.47 | 2.10 | 0.53 |

## 6. Input Offset Current

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

## 7. Input Resistance (Typical values for information)

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

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

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

## 9. Power Consumption (Typical values for information)

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

# IMPORTANT NOTICE

## USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

**Battery Exchange**: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

**Shipping of the DAE**: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

**E-Stop Failures**: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

**Repair**: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

**DASY Configuration Files:** Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

**Important Note:**
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

**Important Note:**
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

**Important Note:**
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

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| S | Swiss Calibration Service |

| Client | **Sporton - TW (Auden)** | Certificate No: **DAE4-1399_Nov13** |

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SD 000 D04 BM - SN: 1399 |
| Calibration procedure(s) | **QA CAL-06.v26**<br>**Calibration procedure for the data acquisition electronics (DAE)** |
| Calibration date: | **November 07, 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 |
|---|---|---|---|
| Keithley Multimeter Type 2001 | SN: 0810278 | 01-Oct-13 (No:13976) | Oct-14 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Auto DAE Calibration Unit | SE UWS 053 AA 1001 | 07-Jan-13 (in house check) | In house check: Jan-14 |
| Calibrator Box V2.1 | SE UMS 006 AA 1002 | 07-Jan-13 (in house check) | In house check: Jan-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Eric Hainfeld | Technician | |
| Approved by: | Fin Bomholt | Deputy Technical Manager | i.V. |

Issued: November 7, 2013

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  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.

  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.

  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

## DC Voltage Measurement

A/D - Converter Resolution nominal

| | | | | |
|---|---|---|---|---|
| High Range: | 1LSB = | 6.1µV , | full range = | -100...+300 mV |
| Low Range: | 1LSB = | 61nV , | full range = | -1.......+3mV |

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

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| **High Range** | 403.576 ± 0.02% (k=2) | 403.837 ± 0.02% (k=2) | 403.694 ± 0.02% (k=2) |
| **Low Range** | 3.99338 ± 1.50% (k=2) | 3.98864 ± 1.50% (k=2) | 3.95341 ± 1.50% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 303.0 ° ± 1 ° |

## Appendix

### 1. DC Voltage Linearity

| High Range | | Reading (µV) | Difference (µV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 199997.26 | -0.61 | -0.00 |
| Channel X | + Input | 20001.91 | 1.03 | 0.01 |
| Channel X | - Input | -19999.07 | 1.82 | -0.01 |
| Channel Y | + Input | 199998.80 | 1.10 | 0.00 |
| Channel Y | + Input | 19999.34 | -1.47 | -0.01 |
| Channel Y | - Input | -20001.19 | -0.12 | 0.00 |
| Channel Z | + Input | 199998.69 | 1.55 | 0.00 |
| Channel Z | + Input | 19998.02 | -2.80 | -0.01 |
| Channel Z | - Input | -20002.75 | -1.69 | 0.01 |

| Low Range | | Reading (µV) | Difference (µV) | Error (%) |
|---|---|---|---|---|
| Channel X | + Input | 2002.09 | 1.09 | 0.05 |
| Channel X | + Input | 201.25 | -0.05 | -0.02 |
| Channel X | - Input | -198.06 | 0.36 | -0.18 |
| Channel Y | + Input | 2001.83 | 0.90 | 0.04 |
| Channel Y | + Input | 200.93 | -0.36 | -0.18 |
| Channel Y | - Input | -198.96 | -0.48 | 0.24 |
| Channel Z | + Input | 2001.86 | 1.03 | 0.05 |
| Channel Z | + Input | 200.25 | -0.93 | -0.46 |
| Channel Z | - Input | -199.87 | -1.30 | 0.65 |

### 2. Common mode sensitivity

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

| | Common mode Input Voltage (mV) | High Range Average Reading (µV) | Low Range Average Reading (µV) |
|---|---|---|---|
| Channel X | 200 | -4.61 | -6.77 |
| | - 200 | 8.22 | 6.43 |
| Channel Y | 200 | -5.41 | -6.04 |
| | - 200 | 5.24 | 4.85 |
| Channel Z | 200 | -7.82 | -7.62 |
| | - 200 | 5.24 | 5.18 |

### 3. Channel separation

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

| | Input Voltage (mV) | Channel X (µV) | Channel Y (µV) | Channel Z (µV) |
|---|---|---|---|---|
| Channel X | 200 | - | 5.08 | -1.79 |
| Channel Y | 200 | 9.74 | - | 6.74 |
| Channel Z | 200 | 8.83 | 7.35 | - |

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client      **Sporton-TW (Auden)**

Certificate No: **EX3-3931_Sep13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3931 |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | September 10, 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 | 4-Sep-13 (No. DAE4-660_Sep13) | Apr-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: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: September 10, 2013

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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 |
| 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, 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., ϑ = 0 is normal to probe axis |

## Calibration is Performed According to the Following Standards:

a)  IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b)  IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not 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; Dx,y,z; VRx,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 ≤ 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 EX3DV4

## SN:3931

Manufactured:     July 24, 2013
Calibrated:          September 10, 2013

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

## Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu$V/(V/m)$^2$)$^A$ | 0.42 | 0.58 | 0.50 | ± 10.1 % |
| DCP (mV)$^B$ | 102.4 | 97.7 | 100.7 | |

## Modulation Calibration Parameters

| UID | Communication System Name |  | A<br>dB | B<br>dB√$\mu$V | C | D<br>dB | VR<br>mV | Unc$^E$<br>(k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 146.7 | ±2.5 % |
|  |  | Y | 0.0 | 0.0 | 1.0 |  | 133.5 |  |
|  |  | Z | 0.0 | 0.0 | 1.0 |  | 120.4 |  |

> 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.
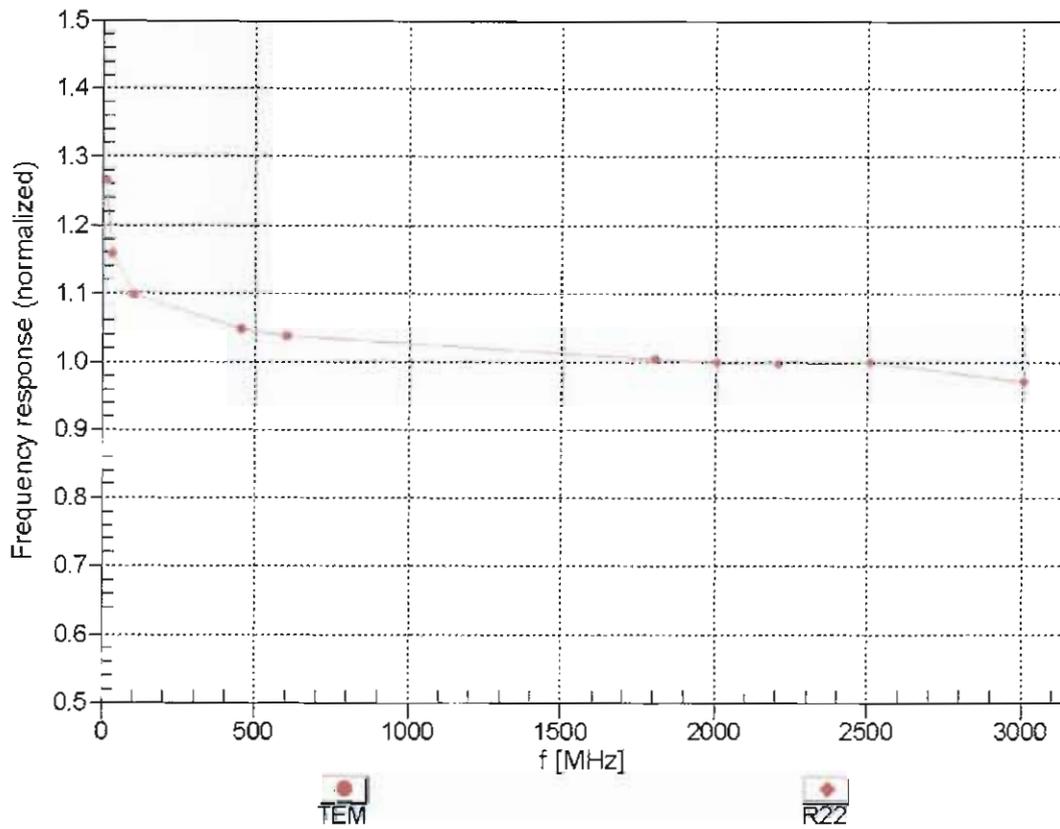
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 835 | 41.5 | 0.90 | 9.87 | 9.87 | 9.87 | 0.18 | 1.43 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.59 | 9.59 | 9.59 | 0.18 | 1.46 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 8.82 | 8.82 | 8.82 | 0.30 | 0.99 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.40 | 8.40 | 8.40 | 0.59 | 0.69 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.41 | 8.41 | 8.41 | 0.46 | 0.78 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.59 | 7.59 | 7.59 | 0.35 | 0.91 | ± 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
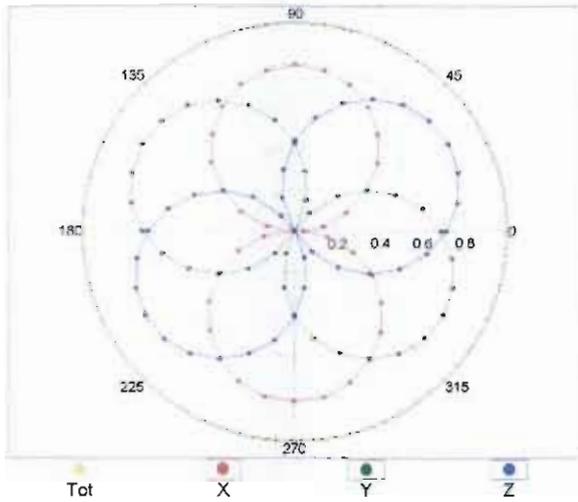
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3931

## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [c] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 835 | 55.2 | 0.97 | 9.66 | 9.66 | 9.66 | 0.32 | 0.99 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.35 | 9.35 | 9.35 | 0.22 | 1.40 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 7.99 | 7.99 | 7.99 | 0.46 | 0.78 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.61 | 7.61 | 7.61 | 0.44 | 0.84 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 7.83 | 7.83 | 7.83 | 0.38 | 0.87 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.24 | 7.24 | 7.24 | 0.75 | 0.57 | ± 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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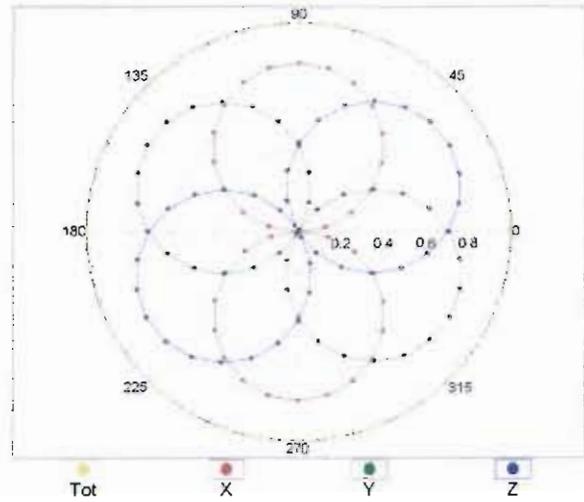## (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

# Receiving Pattern (φ), ϑ = 0°

## f=600 MHz,TEM                                    f=1800 MHz,R22



| Tot | X | Y | Z |

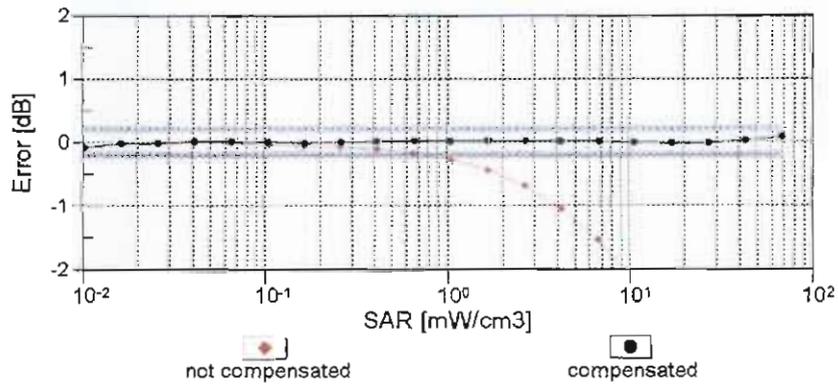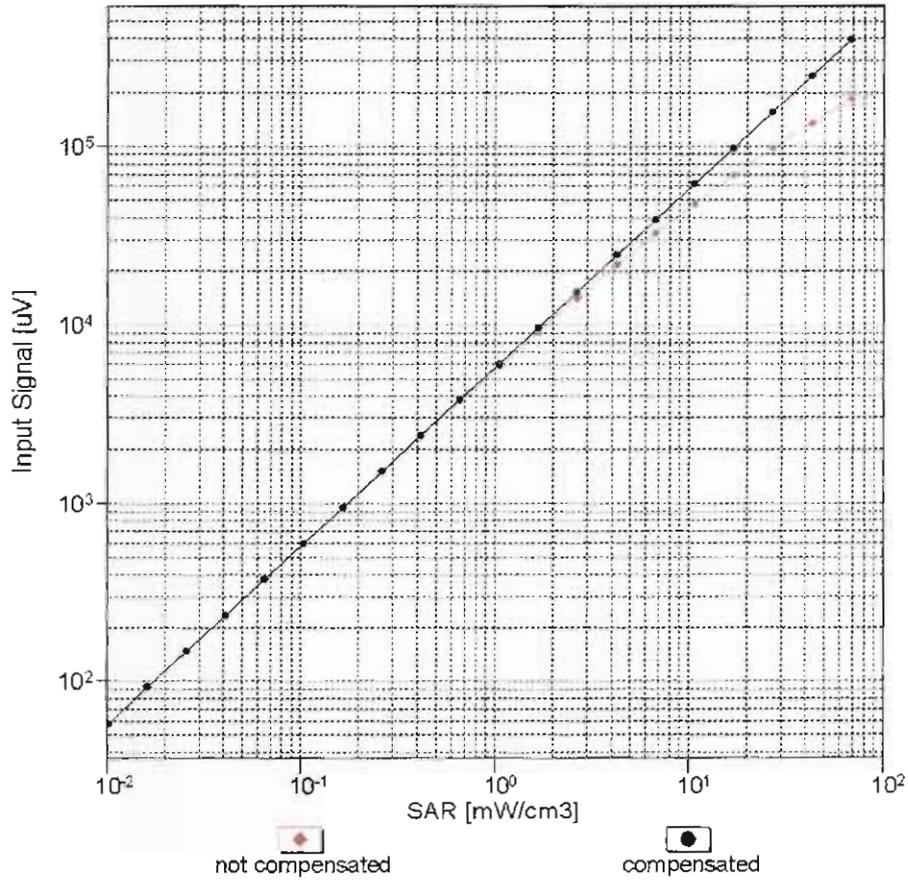

| Tot | X | Y | Z |



| 100 MHz | 600 MHz | 1800 MHz | 2500 MHz |

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

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



Input Signal [uV] vs SAR [mW/cm3]

not compensated          compensated



Error [dB] vs SAR [mW/cm3]

not compensated          compensated

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

# Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

f = 1900 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: EX3DV4 - SN:3931

## Other Probe Parameters

| Sensor Arrangement | | Triangular |
|---|---|---|
| Connector Angle (°) | | -12.3 |
| Mechanical Surface Detection Mode | | enabled |
| Optical Surface Detection Mode | | disabled |
| Probe Overall Length | | 337 mm |
| Probe Body Diameter | | 10 mm |
| Tip Length | | 9 mm |
| Tip Diameter | | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | | 1 mm |
| Probe Tip to Sensor Y Calibration Point | | 1 mm |
| Probe Tip to Sensor Z Calibration Point | | 1 mm |
| Recommended Measurement Distance from Surface | | 2 mm |

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Auden**

Certificate No: **EX3-3898_Jan13**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3898 |
| Calibration procedure(s) | QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | January 14, 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 | 29-Mar-12 (No. 217-01508) | Apr-13 |
| Power sensor E4412A | MY41498087 | 29-Mar-12 (No. 217-01508) | Apr-13 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 27-Mar-12 (No. 217-01531) | Apr-13 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 27-Mar-12 (No. 217-01529) | Apr-13 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 27-Mar-12 (No. 217-01532) | Apr-13 |
| Reference Probe ES3DV2 | SN: 3013 | 28-Dec-12 (No. ES3-3013_Dec12) | Dec-13 |
| DAE4 | SN: 660 | 20-Jun-12 (No. DAE4-660_Jun12) | Jun-13 |
| | | | |
| Secondary Standards | ID | Check Date (in house) | Scheduled Check |
| RF generator HP 8648C | US3642U01700 | 4-Aug-99 (in house check Apr-11) | 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: January 14, 2013

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

## 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, 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., ϑ = 0 is normal to probe axis |

## Calibration is Performed According to the Following Standards:

a)  IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003

b)  IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

## Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not 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; Dx,y,z; VRx,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 ≤ 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  EX3DV4

# SN:3898

Manufactured:     October 9, 2012
Calibrated:          January 14, 2013

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3898

## Basic Calibration Parameters

|  | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm $(\mu V/(V/m)^2)^A$ | 0.54 | 0.54 | 0.50 | ± 10.1 % |
| DCP $(mV)^B$ | 102.3 | 99.7 | 98.7 |  |

## Modulation Calibration Parameters

| UID | Communication System Name |  | A dB | B dB√µV | C | D dB | VR mV | Unc$^E$ (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 173.3 | ±3.3 % |
|  |  | Y | 0.0 | 0.0 | 1.0 |  | 173.6 |  |
|  |  | Z | 0.0 | 0.0 | 1.0 |  | 165.0 |  |

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

$^A$ The uncertainties of NormX,Y,Z do not affect the $E^2$-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: EX3DV4 - SN:3898

## Calibration Parameter Determined in Head Tissue Simulating Media

| f (MHz) [c] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 10.23 | 10.23 | 10.23 | 0.33 | 0.94 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 9.70 | 9.70 | 9.70 | 0.25 | 1.01 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.67 | 9.67 | 9.67 | 0.33 | 0.94 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 8.19 | 8.19 | 8.19 | 0.56 | 0.74 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.94 | 7.94 | 7.94 | 0.62 | 0.69 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 7.87 | 7.87 | 7.87 | 0.46 | 0.73 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.25 | 7.25 | 7.25 | 0.33 | 0.95 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.16 | 7.16 | 7.16 | 0.41 | 0.88 | ± 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
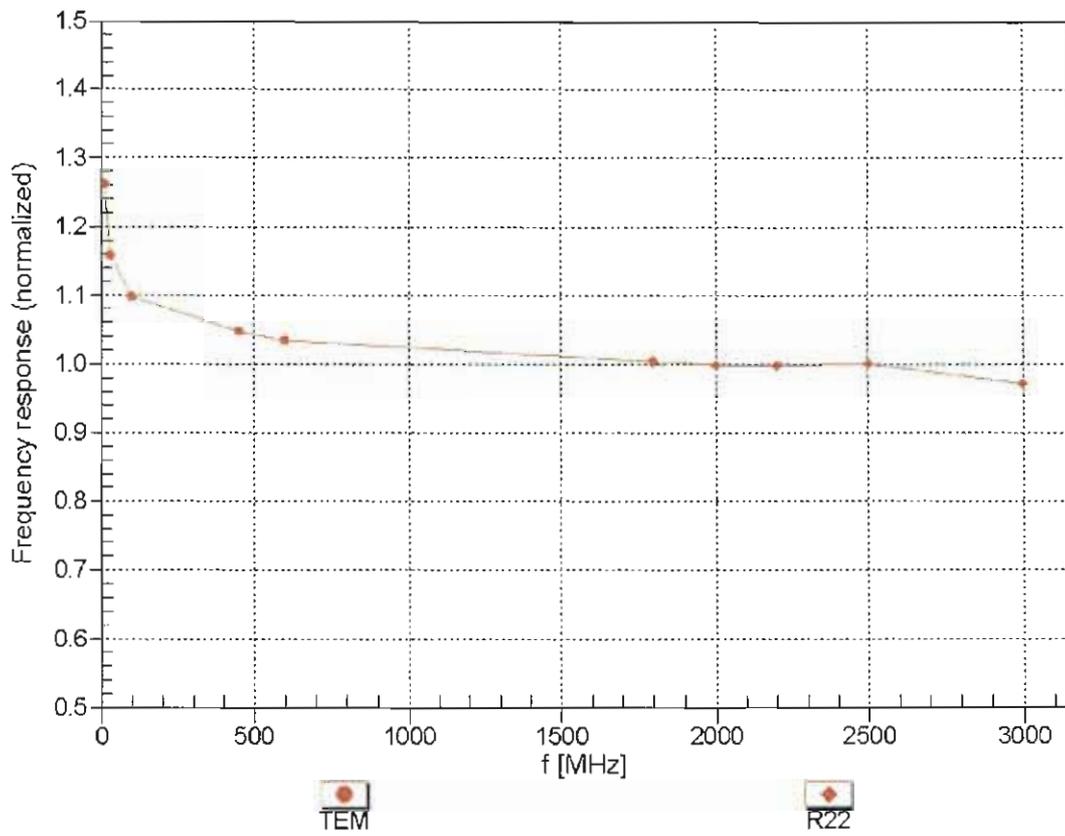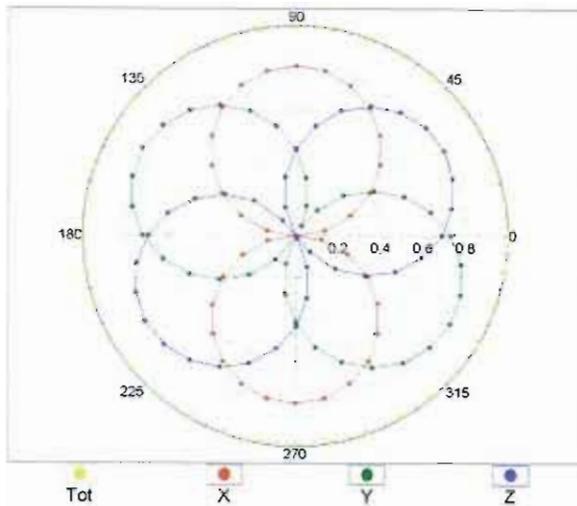
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3898

## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) $^C$ | Relative Permittivity $^F$ | Conductivity (S/m) $^F$ | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 9.87 | 9.87 | 9.87 | 0.52 | 0.80 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 9.58 | 9.58 | 9.58 | 0.35 | 1.02 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.52 | 9.52 | 9.52 | 0.44 | 0.89 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.04 | 8.04 | 8.04 | 0.40 | 0.84 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.52 | 7.52 | 7.52 | 0.41 | 0.87 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 7.65 | 7.65 | 7.65 | 0.40 | 0.89 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.17 | 7.17 | 7.17 | 0.75 | 0.57 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 6.99 | 6.99 | 6.99 | 0.80 | 0.50 | ± 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 ($\varepsilon$ and $\sigma$) 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 ($\varepsilon$ and $\sigma$) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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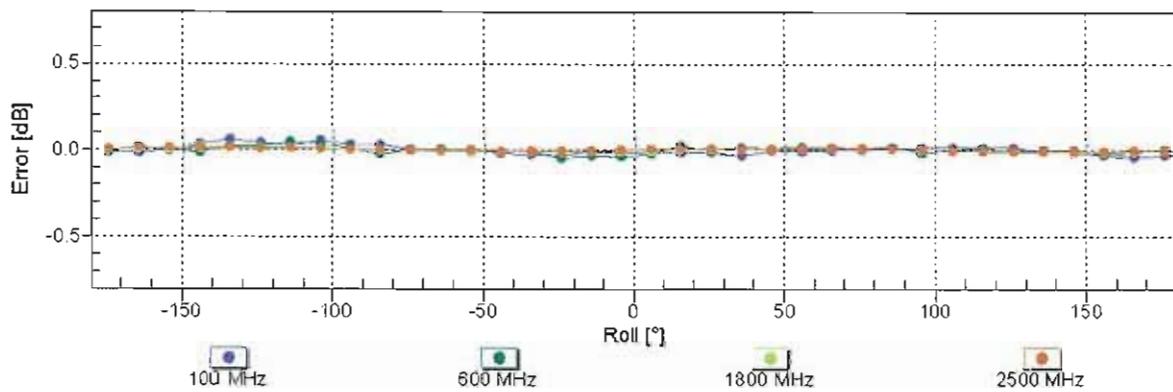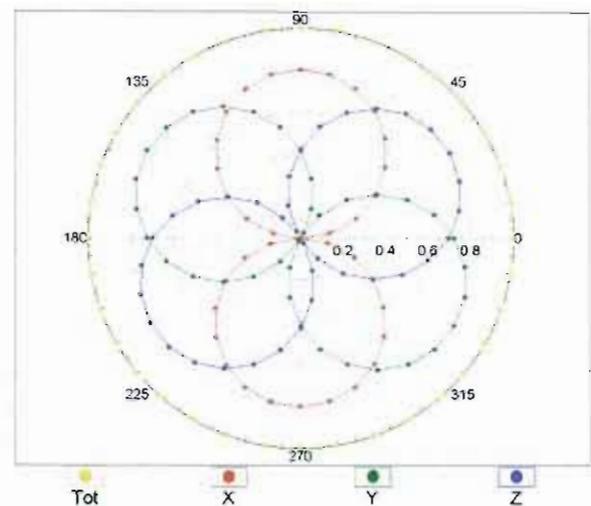## (TEM-Cell:ifi110 EXX, Waveguide: R22)



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

# Receiving Pattern (φ), θ = 0°

## f=600 MHz,TEM

## f=1800 MHz,R22



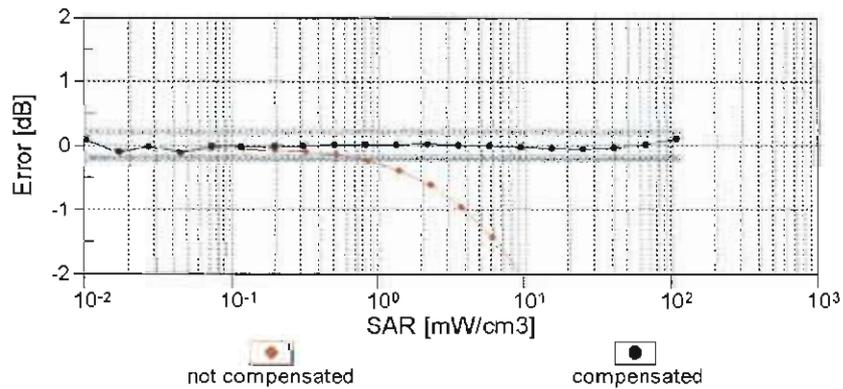| Tot | X | Y | Z |

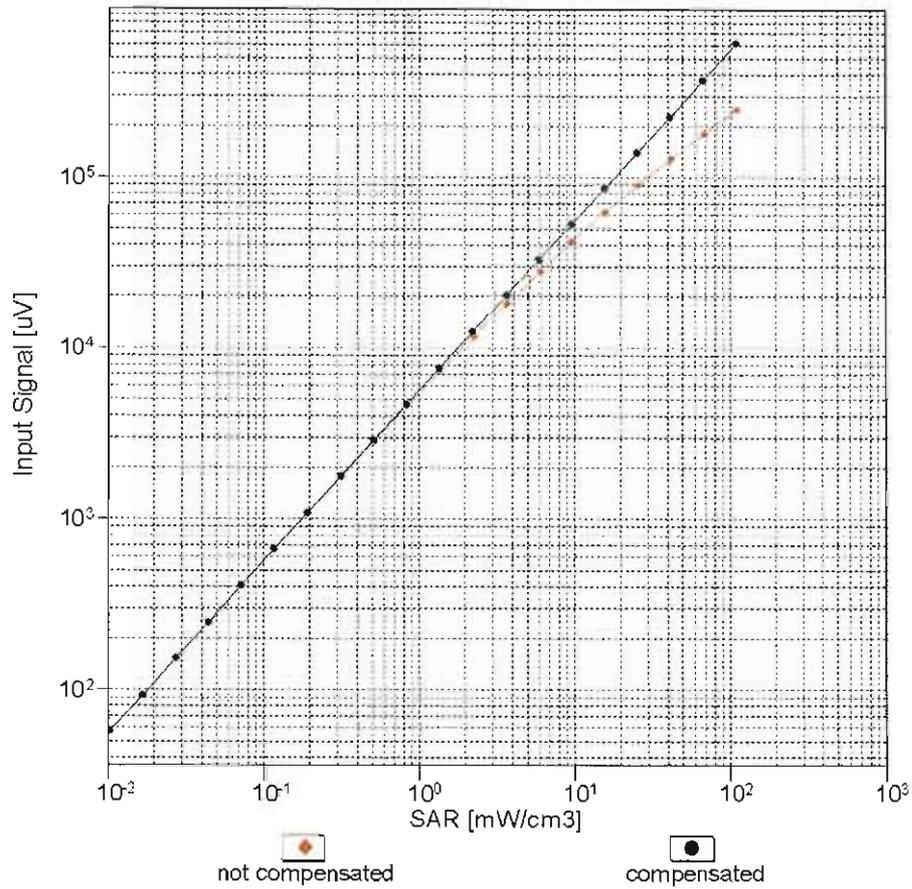

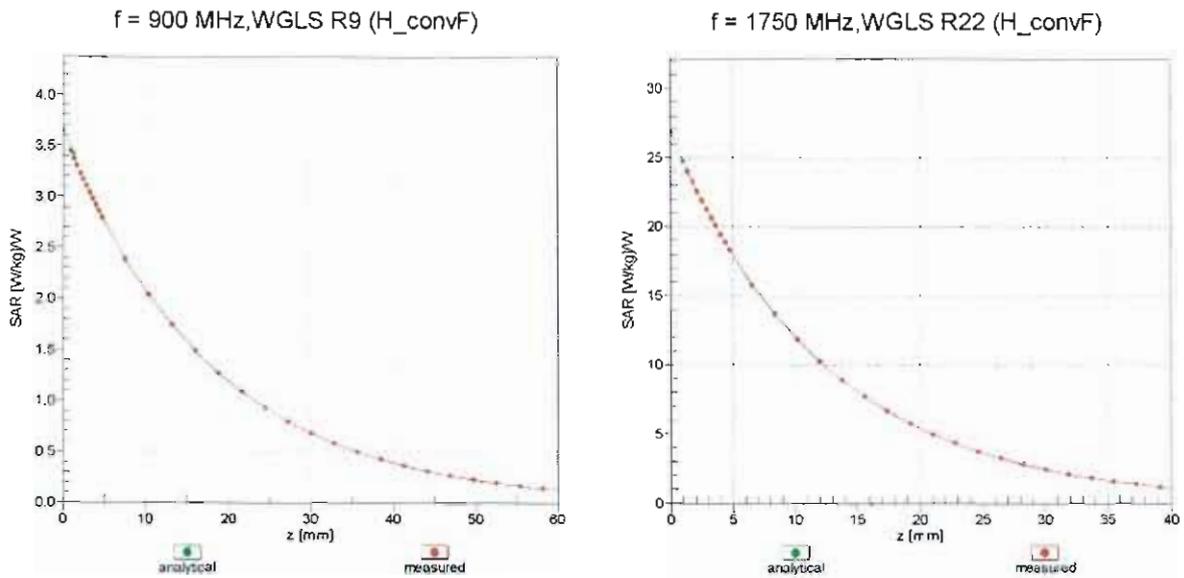| Tot | X | Y | Z |



| 100 MHz | 600 MHz | 1800 MHz | 2500 MHz |

**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)**

# Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)                              f = 1750 MHz,WGLS R22 (H_convF)



# Deviation from Isotropy in Liquid
## Error ($\phi$, $\vartheta$), f = 900 MHz



**Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)**
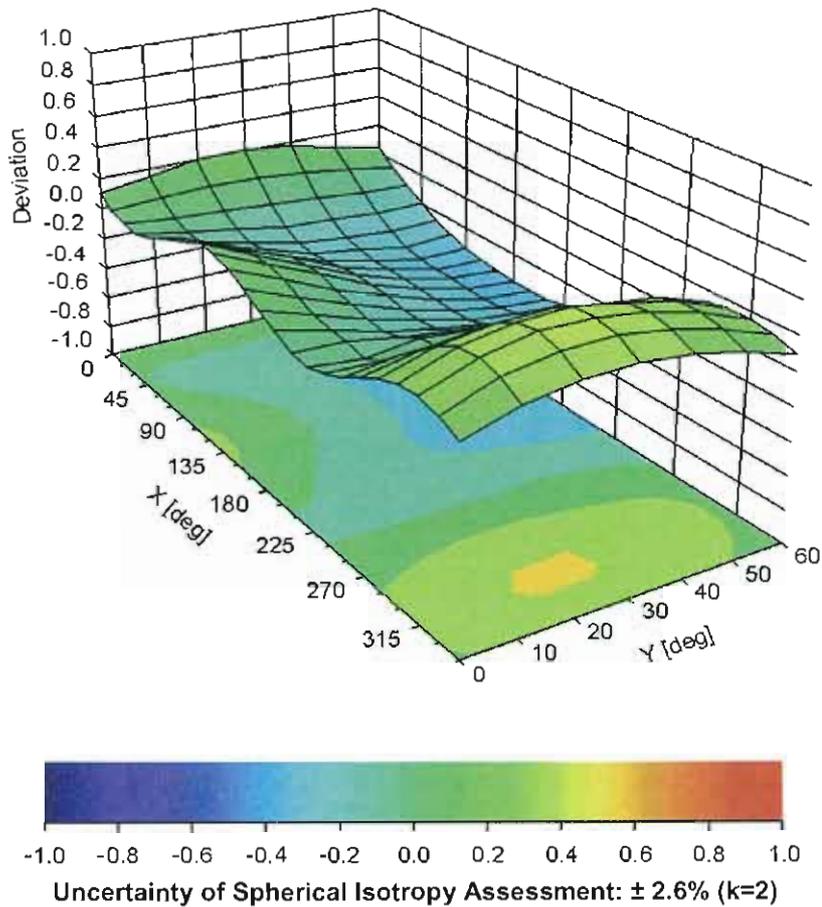
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3898

## Other Probe Parameters

| | |
|---|---:|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -104.5 |
| 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 |

# Appendix D.   SAR Test Setup Photos



**Plug-in for USB Configuration 1**
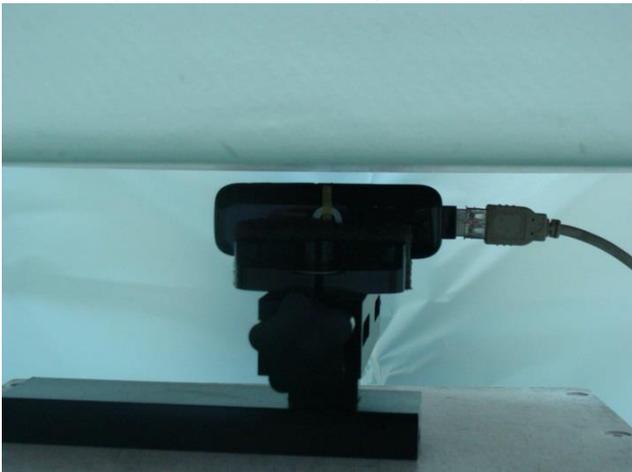**(Horizontal Up, Test Separation 5 mm)**



**Plug-in for USB Configuration 1**
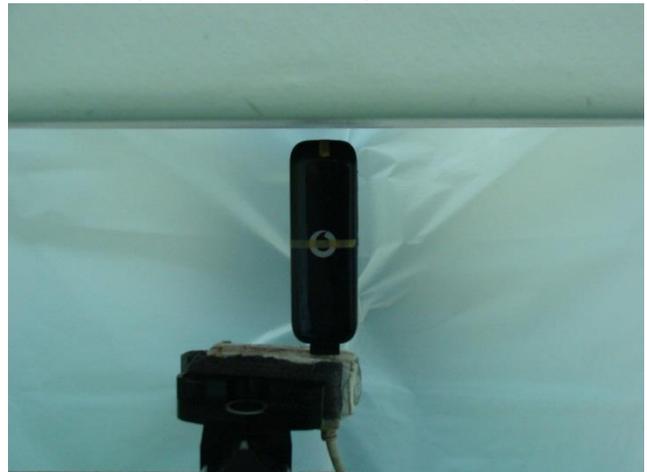**(Horizontal Up, Test Separation 5 mm with Flip 90 degree)**



**Plug-in for USB Configuration 2**
**(Horizontal Down, Test Separation 5 mm)**



**Plug-in for USB Configuration 3**
**(Vertical Front, Test Separation 5 mm)**



**Plug-in USB Configuration 4**
**(Vertical Back, Test Separation 5 mm)**



**Plug-in for USB Configuration 5**
**(Tip Mode, Test Separation 5 mm)**

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