# FCC SAR Test Report

| | | |
|---|---|---|
| **Report No.** | : | **SA150115D03** |
| **Applicant** | : | **Proxim Wireless Corporation** |
| **Address** | : | **47633 Westinghouse Drive Fremont CA 94539 US** |
| **Product** | : | **ORiNOCO 802.11 a/b/g/n/ac USB Adapter** |
| **FCC ID** | : | **HZB-USB9100** |
| **Brand** | : | **ORiNOCO** |
| **Model No.** | : | **USB-9100-xx (XX should be US, WD, or JP)** |
| **Standards** | : | **FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1992 / IEEE 1528:2003<br>IEEE 1528a-2005 / KDB 865664 D01 v01r03 / KDB 248227 D01 v01r02<br>KDB 447498 D01 v05r02 / KDB 447498 D02 v02** |
| **Sample Received Date** | : | **Jan. 15, 2015** |
| **Date of Testing** | : | **Jan. 23, 2015 ~ Jan. 26, 2015** |

**CERTIFICATION:** The above equipment have been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch – Lin Kou Laboratories**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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2021

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# Release Control Record

| Report No. | Reason for Change | Date Issued |
|---|---|---|
| SA150115D03 | Initial release | Feb. 13, 2015 |
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# 1. Summary of Maximum SAR Value

| Equipment Class | Mode | Highest Reported Body $SAR_{1g}$ (0.5 cm Gap) (W/kg) |
|---|---|---|
| DTS | 2.4G WLAN | 0.73 |
| NII | 5.2G WLAN | 0.74 |
| | 5.3G WLAN | 0.60 |
| | 5.6G WLAN | 0.44 |
| | 5.8G WLAN | 0.40 |

**Note:**

1. The SAR limit **(Head & Body: $SAR_{1g}$ 1.6 W/kg)** for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.

## 2. Description of Equipment Under Test

| | |
|---|---|
| **EUT Type** | ORiNOCO 802.11 a/b/g/n/ac USB Adapter |
| **FCC ID** | HZB-USB9100 |
| **Brand Name** | ORiNOCO |
| **Model Name** | USB-9100-xx (XX should be US, WD, or JP) |
| **Tx Frequency Bands (Unit: MHz)** | 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 |
| **Uplink Modulations** | 802.11b : DSSS<br>802.11a/g/n/ac : OFDM |
| **Maximum Tune-up Conducted Power (Unit: dBm)** | WLAN 2.4G : 18.5<br>WLAN 5.2G : 17.5<br>WLAN 5.3G : 17.5<br>WLAN 5.6G : 17.5<br>WLAN 5.8G : 17.5 |
| **Antenna Type** | Printed Antenna |
| **EUT Stage** | Identical Prototype |

**Note:**

1. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

# 3. SAR Measurement System

## 3.1 Definition of Specific Absorption Rate (SAR)

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.

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:

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

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

SAR measurement can be related to the electrical field in the tissue by

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

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

## 3.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4/5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

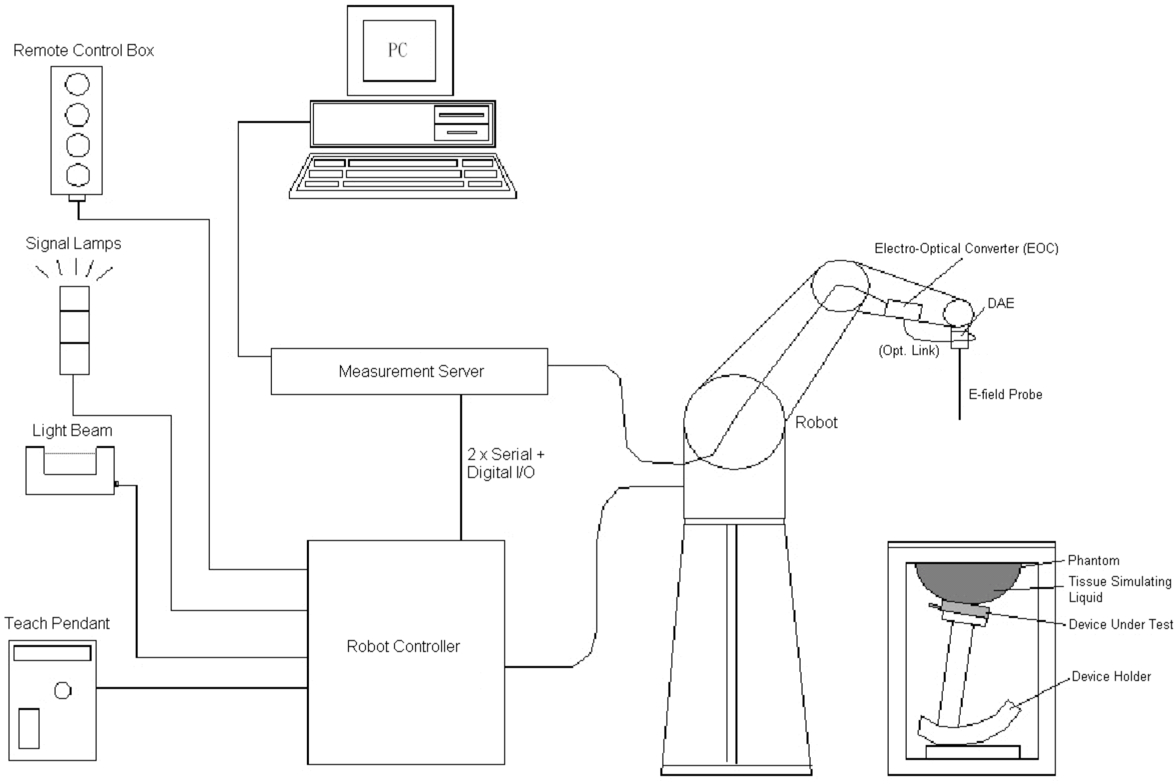



**Fig-3.1 DASY System Setup**

### 3.2.1 Robot

The DASY system uses the high precision robots 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)

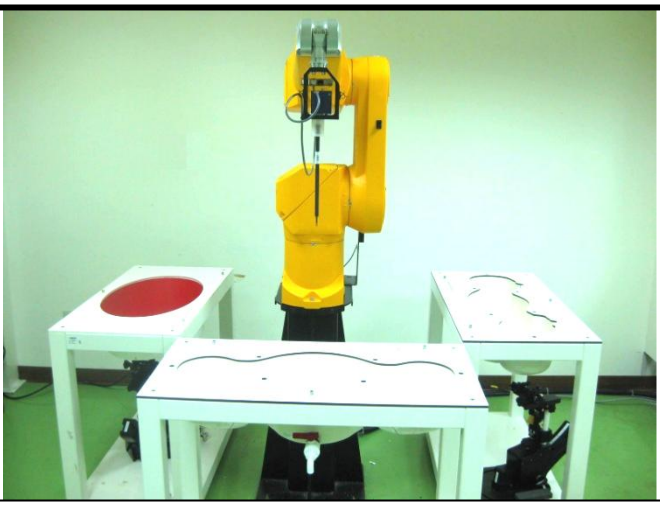


**Fig-3.2 DASY4**

**Fig-3.3 DASY5**

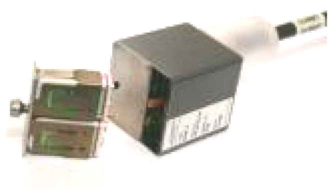
### 3.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. 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.

| | | |
|---|---|---|
| **Model** | EX3DV4 |  |
| **Construction** | Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE). | |
| **Frequency** | 10 MHz to 6 GHz<br>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<br>Linearity: ± 0.2 dB (noise: typically < 1 µW/g) | |
| **Dimensions** | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 2.5 mm (Body: 12 mm)<br>Typical distance from probe tip to dipole centers: 1 mm | |

| | | |
|---|---|---|
| **Model** | ES3DV3 |  |
| **Construction** | Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE). | |
| **Frequency** | 10 MHz to 4 GHz<br>Linearity: ± 0.2 dB | |
| **Directivity** | ± 0.2 dB in HSL (rotation around probe axis)<br>± 0.3 dB in tissue material (rotation normal to probe axis) | |
| **Dynamic Range** | 5 µW/g to 100 mW/g<br>Linearity: ± 0.2 dB | |
| **Dimensions** | Overall length: 337 mm (Tip: 20 mm)<br>Tip diameter: 3.9 mm (Body: 12 mm)<br>Distance from probe tip to dipole centers: 2.0 mm | |

### 3.2.3 Data Acquisition Electronics (DAE)

| | | |
|---|---|---|
| **Model** | DAE3, DAE4 |  |
| **Construction** | Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop. | |
| **Measurement Range** | -100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV) | |
| **Input Offset Voltage** | < 5µV (with auto zero) | |
| **Input Bias Current** | < 50 fA | |
| **Dimensions** | 60 x 60 x 68 mm | |

### 3.2.4 Phantoms

| | | |
|---|---|---|
| **Model** | Twin SAM |  |
| **Construction** | The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot. | |
| **Material** | Vinylester, glass fiber reinforced (VE-GF) | |
| **Shell Thickness** | 2 ± 0.2 mm (6 ± 0.2 mm at ear point) | |
| **Dimensions** | Length: 1000 mm<br>Width: 500 mm<br>Height: adjustable feet | |
| **Filling Volume** | approx. 25 liters | |

| | | |
|---|---|---|
| **Model** | ELI |  |
| **Construction** | Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles. | |
| **Material** | Vinylester, glass fiber reinforced (VE-GF) | |
| **Shell Thickness** | 2.0 ± 0.2 mm (bottom plate) | |
| **Dimensions** | Major axis: 600 mm<br>Minor axis: 400 mm | |
| **Filling Volume** | approx. 30 liters | |

### 3.2.5 Device Holder

| Model | Mounting Device |
|---|---|
| Construction | In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat). |
| Material | POM |

| Model | Laptop Extensions Kit |
|---|---|
| Construction | Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner. |
| Material | POM, Acrylic glass, Foam |

### 3.2.6 System Validation Dipoles

| Model | D-Serial |
|---|---|
| Construction | Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions. |
| Frequency | 750 MHz to 5800 MHz |
| Return Loss | > 20 dB |
| Power Capability | > 100 W (f < 1GHz), > 40 W (f > 1GHz) |

### 3.2.7 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. 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. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.

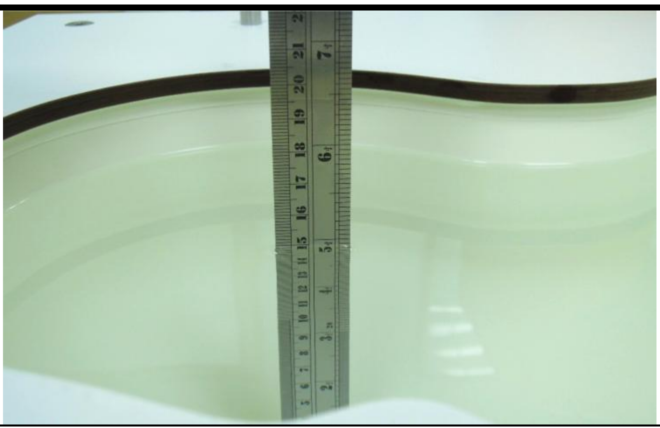


Photo of Liquid Height for Head Position

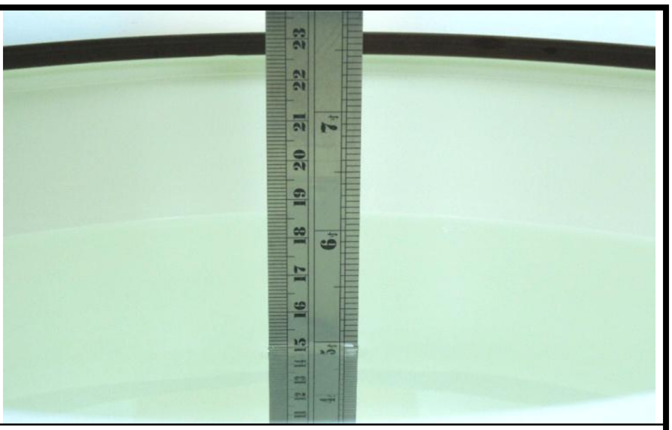


Photo of Liquid Height for Body Position

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using a dielectric assessment kit and a network analyzer.

**Table-3.1 Targets of Tissue Simulating Liquid**

| Frequency (MHz) | Target Permittivity | Range of ±5% | Target Conductivity | Range of ±5% |
|---|---|---|---|---|
| **For Head** | | | | |
| 750 | 41.9 | 39.8 ~ 44.0 | 0.89 | 0.85 ~ 0.93 |
| 835 | 41.5 | 39.4 ~ 43.6 | 0.90 | 0.86 ~ 0.95 |
| 900 | 41.5 | 39.4 ~ 43.6 | 0.97 | 0.92 ~ 1.02 |
| 1450 | 40.5 | 38.5 ~ 42.5 | 1.20 | 1.14 ~ 1.26 |
| 1640 | 40.3 | 38.3 ~ 42.3 | 1.29 | 1.23 ~ 1.35 |
| 1750 | 40.1 | 38.1 ~ 42.1 | 1.37 | 1.30 ~ 1.44 |
| 1800 | 40.0 | 38.0 ~ 42.0 | 1.40 | 1.33 ~ 1.47 |
| 1900 | 40.0 | 38.0 ~ 42.0 | 1.40 | 1.33 ~ 1.47 |
| 2000 | 40.0 | 38.0 ~ 42.0 | 1.40 | 1.33 ~ 1.47 |
| 2300 | 39.5 | 37.5 ~ 41.5 | 1.67 | 1.59 ~ 1.75 |
| 2450 | 39.2 | 37.2 ~ 41.2 | 1.80 | 1.71 ~ 1.89 |
| 2600 | 39.0 | 37.1 ~ 41.0 | 1.96 | 1.86 ~ 2.06 |
| 3500 | 37.9 | 36.0 ~ 39.8 | 2.91 | 2.76 ~ 3.06 |
| 5200 | 36.0 | 34.2 ~ 37.8 | 4.66 | 4.43 ~ 4.89 |
| 5300 | 35.9 | 34.1 ~ 37.7 | 4.76 | 4.52 ~ 5.00 |
| 5500 | 35.6 | 33.8 ~ 37.4 | 4.96 | 4.71 ~ 5.21 |
| 5600 | 35.5 | 33.7 ~ 37.3 | 5.07 | 4.82 ~ 5.32 |
| 5800 | 35.3 | 33.5 ~ 37.1 | 5.27 | 5.01 ~ 5.53 |
| **For Body** | | | | |
| 750 | 55.5 | 52.7 ~ 58.3 | 0.96 | 0.91 ~ 1.01 |
| 835 | 55.2 | 52.4 ~ 58.0 | 0.97 | 0.92 ~ 1.02 |
| 900 | 55.0 | 52.3 ~ 57.8 | 1.05 | 1.00 ~ 1.10 |
| 1450 | 54.0 | 51.3 ~ 56.7 | 1.30 | 1.24 ~ 1.37 |
| 1640 | 53.8 | 51.1 ~ 56.5 | 1.40 | 1.33 ~ 1.47 |
| 1750 | 53.4 | 50.7 ~ 56.1 | 1.49 | 1.42 ~ 1.56 |
| 1800 | 53.3 | 50.6 ~ 56.0 | 1.52 | 1.44 ~ 1.60 |
| 1900 | 53.3 | 50.6 ~ 56.0 | 1.52 | 1.44 ~ 1.60 |
| 2000 | 53.3 | 50.6 ~ 56.0 | 1.52 | 1.44 ~ 1.60 |
| 2300 | 52.9 | 50.3 ~ 55.5 | 1.81 | 1.72 ~ 1.90 |
| 2450 | 52.7 | 50.1 ~ 55.3 | 1.95 | 1.85 ~ 2.05 |
| 2600 | 52.5 | 49.9 ~ 55.1 | 2.16 | 2.05 ~ 2.27 |
| 3500 | 51.3 | 48.7 ~ 53.9 | 3.31 | 3.14 ~ 3.48 |
| 5200 | 49.0 | 46.6 ~ 51.5 | 5.30 | 5.04 ~ 5.57 |
| 5300 | 48.9 | 46.5 ~ 51.3 | 5.42 | 5.15 ~ 5.69 |
| 5500 | 48.6 | 46.2 ~ 51.0 | 5.65 | 5.37 ~ 5.93 |
| 5600 | 48.5 | 46.1 ~ 50.9 | 5.77 | 5.48 ~ 6.06 |
| 5800 | 48.2 | 45.8 ~ 50.6 | 6.00 | 5.70 ~ 6.30 |

The following table gives the recipes for tissue simulating liquids.

**Table-3.2 Recipes of Tissue Simulating Liquid**

| Tissue Type | Bactericide | DGBE | HEC | NaCl | Sucrose | Triton X-100 | Water | Diethylene Glycol Mono-hexylether |
|---|---|---|---|---|---|---|---|---|
| H750 | 0.2 | - | 0.2 | 1.5 | 56.0 | - | 42.1 | - |
| H835 | 0.2 | - | 0.2 | 1.5 | 57.0 | - | 41.1 | - |
| H900 | 0.2 | - | 0.2 | 1.4 | 58.0 | - | 40.2 | - |
| H1450 | - | 43.3 | - | 0.6 | - | - | 56.1 | - |
| H1640 | - | 45.8 | - | 0.5 | - | - | 53.7 | - |
| H1750 | - | 47.0 | - | 0.4 | - | - | 52.6 | - |
| H1800 | - | 44.5 | - | 0.3 | - | - | 55.2 | - |
| H1900 | - | 44.5 | - | 0.2 | - | - | 55.3 | - |
| H2000 | - | 44.5 | - | 0.1 | - | - | 55.4 | - |
| H2300 | - | 44.9 | - | 0.1 | - | - | 55.0 | - |
| H2450 | - | 45.0 | - | 0.1 | - | - | 54.9 | - |
| H2600 | - | 45.1 | - | 0.1 | - | - | 54.8 | - |
| H3500 | - | 8.0 | - | 0.2 | - | 20.0 | 71.8 | - |
| H5G | - | - | - | - | - | 17.2 | 65.5 | 17.3 |
| B750 | 0.2 | - | 0.2 | 0.8 | 48.8 | - | 50.0 | - |
| B835 | 0.2 | - | 0.2 | 0.9 | 48.5 | - | 50.2 | - |
| B900 | 0.2 | - | 0.2 | 0.9 | 48.2 | - | 50.5 | - |
| B1450 | - | 34.0 | - | 0.3 | - | - | 65.7 | - |
| B1640 | - | 32.5 | - | 0.3 | - | - | 67.2 | - |
| B1750 | - | 31.0 | - | 0.2 | - | - | 68.8 | - |
| B1800 | - | 29.5 | - | 0.4 | - | - | 70.1 | - |
| B1900 | - | 29.5 | - | 0.3 | - | - | 70.2 | - |
| B2000 | - | 30.0 | - | 0.2 | - | - | 69.8 | - |
| B2300 | - | 31.0 | - | 0.1 | - | - | 68.9 | - |
| B2450 | - | 31.4 | - | 0.1 | - | - | 68.5 | - |
| B2600 | - | 31.8 | - | 0.1 | - | - | 68.1 | - |
| B3500 | - | 28.8 | - | 0.1 | - | - | 71.1 | - |
| B5G | - | - | - | - | - | 10.7 | 78.6 | 10.7 |

## 3.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

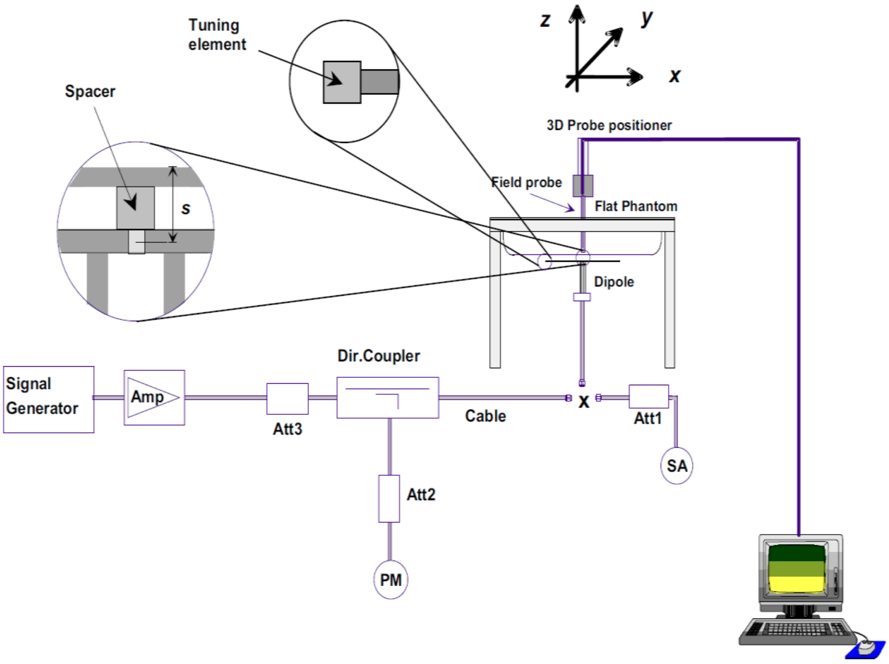



**Fig-3.4 System Verification Setup**

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The spectrum analyzer measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

## 3.4 SAR Measurement Procedure

According to the SAR 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

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

### 3.4.1 Area & Zoom Scan Procedure

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. According to KDB 865664 D01, the resolution for Area and Zoom scan is specified in the table below.

| Items | <= 2 GHz | 2-3 GHz | 3-4 GHz | 4-5 GHz | 5-6 GHz |
|---|---|---|---|---|---|
| Area Scan (Δx, Δy) | <= 15 mm | <= 12 mm | <= 12 mm | <= 10 mm | <= 10 mm |
| Zoom Scan (Δx, Δy) | <= 8 mm | <= 5 mm | <= 5 mm | <= 4 mm | <= 4 mm |
| Zoom Scan (Δz) | <= 5 mm | <= 5 mm | <= 4 mm | <= 3 mm | <= 2 mm |
| Zoom Scan Volume | >= 30 mm | >= 30 mm | >= 28 mm | >= 25 mm | >= 22 mm |

**Note:**

When zoom scan is required and report SAR is <= 1.4 W/kg, the zoom scan resolution of Δx / Δy (2-3GHz: <= 8 mm, 3-4GHz: <= 7 mm, 4-6GHz: <= 5 mm) may be applied.

### 3.4.2 Volume Scan Procedure

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.

### 3.4.3 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 drift more than 5%, the SAR will be retested.

### 3.4.4 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

### 3.4.5 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.

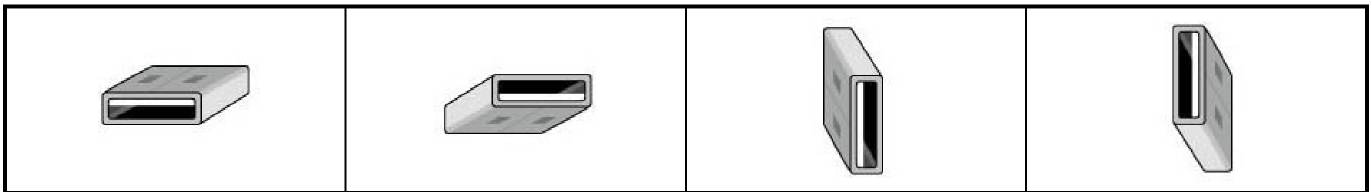
# 4. SAR Measurement Evaluation

## 4.1 EUT Configuration and Setting

For WLAN SAR testing, the EUT has installed WLAN engineering testing software which can provide continuous transmitting RF signal. According to KDB 248227 D01, WLAN SAR should tested at the lowest data rate, and testing at higher data rate is not required when the maximum average output power is less than 1/4 dB higher than those measured at the lowest data rate. Since the WLAN power at lowest data rate has highest output power, WLAN SAR for this device was performed at the lowest data rate.

## 4.2 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 “direct laptop plug-in for EUT Tip Mode” shown as below. Both direct laptop plug-in and USB cable plug-in test configurations are tested with 5 mm separation between the particular dongle orientation and the flat phantom.



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

**Fig-4.1 Illustration for USB Connector Orientations**

## 4.3 Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

| Test Date | Tissue Type | Frequency (MHz) | Liquid Temp. (℃) | Measured Conductivity (σ) | Measured Permittivity ($\varepsilon_r$) | Target Conductivity (σ) | Target Permittivity ($\varepsilon_r$) | Conductivity Deviation (%) | Permittivity Deviation (%) |
|---|---|---|---|---|---|---|---|---|---|
| Jan. 23, 2015 | Body | 2450 | 21.1 | 1.972 | 51.360 | 1.95 | 52.7 | 1.13 | -2.54 |
| Jan. 23, 2015 | Body | 5200 | 21.1 | 5.347 | 47.581 | 5.30 | 49.0 | 0.89 | -2.90 |
| Jan. 26, 2015 | Body | 5300 | 21.2 | 5.462 | 47.107 | 5.42 | 48.9 | 0.77 | -3.67 |
| Jan. 23, 2015 | Body | 5600 | 21.1 | 5.912 | 46.863 | 5.77 | 48.5 | 2.46 | -3.38 |
| Jan. 23, 2015 | Body | 5800 | 21.1 | 6.202 | 46.480 | 6.00 | 48.2 | 3.37 | -3.57 |

**Note:**

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2 ℃.

## 4.4 System Validation

The SAR measurement system was validated according to procedures in KDB 865664 D01. The validation status in tabulated summary is as below.

| Test Date | Probe S/N | Calibration Point | | Measured Conductivity (σ) | Measured Permittivity ($\varepsilon_r$) | Validation for CW | | | Validation for Modulation | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Sensitivity Range | Probe Linearity | Probe Isotropy | Modulation Type | Duty Factor | PAR |
| Jan. 23, 2015 | 3590 | Body | 2450 | 1.972 | 51.360 | Pass | Pass | Pass | OFDM | N/A | Pass |
| Jan. 23, 2015 | 3590 | Body | 5200 | 5.347 | 47.581 | Pass | Pass | Pass | OFDM | N/A | Pass |
| Jan. 26, 2015 | 3590 | Body | 5300 | 5.462 | 47.107 | Pass | Pass | Pass | OFDM | N/A | Pass |
| Jan. 23, 2015 | 3590 | Body | 5600 | 5.912 | 46.863 | Pass | Pass | Pass | OFDM | N/A | Pass |
| Jan. 23, 2015 | 3590 | Body | 5800 | 6.202 | 46.480 | Pass | Pass | Pass | OFDM | N/A | Pass |

## 4.5 System Verification

The measuring result for system verification is tabulated as below.

| Test Date | Mode | Frequency (MHz) | 1W Target SAR-1g (W/kg) | Measured SAR-1g (W/kg) | Normalized to 1W SAR-1g (W/kg) | Deviation (%) | Dipole S/N | Probe S/N | DAE S/N |
|---|---|---|---|---|---|---|---|---|---|
| Jan. 23, 2015 | Body | 2450 | 49.50 | 13.2 | 52.80 | 6.67 | 737 | 3590 | 861 |
| Jan. 23, 2015 | Body | 5200 | 74.70 | 7.08 | 70.80 | -5.22 | 1019 | 3590 | 861 |
| Jan. 26, 2015 | Body | 5300 | 77.10 | 7.29 | 72.90 | -5.45 | 1019 | 3590 | 861 |
| Jan. 23, 2015 | Body | 5600 | 80.80 | 7.67 | 76.70 | -5.07 | 1019 | 3590 | 861 |
| Jan. 23, 2015 | Body | 5800 | 73.90 | 7.00 | 70.00 | -5.28 | 1019 | 3590 | 861 |

**Note:**

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

## 4.6 Maximum Output Power

### 4.6.1 Maximum Conducted Power

The maximum conducted average power (Unit: dBm) including tune-up tolerance is shown as below.

| Mode | 2.4G WLAN | 5.2G WLAN | 5.3G WLAN | 5.6G WLAN | 5.8G WLAN |
|---|---|---|---|---|---|
| 802.11b | 18.5 | N/A | N/A | N/A | N/A |
| 802.11g | 15.5 | N/A | N/A | N/A | N/A |
| 802.11a | N/A | 15.5 | 15.5 | 15.5 | 15.1 |
| 802.11n HT20 | 17.5 | 17.5 | 17.5 | 17.5 | 17.5 |
| 802.11n HT40 | 17.5 | 16.0 | 16.5 | 16.0 | 16.5 |
| 802.11ac VHT80 | N/A | 15.5 | 15.5 | 15.5 | 15.5 |

### 4.6.2 Measured Conducted Power Result

The measuring conducted average power (Unit: dBm) is shown as below.

**<WLAN 2.4G>**

| Mode | 802.11b | | |
|---|---|---|---|
| Channel / Frequency (MHz) | 1 (2412) | 6 (2437) | 11 (2462) |
| Average Power (Ant-0) | **18.14** | 18.07 | 18.12 |
| Mode | 802.11g | | |
| Channel / Frequency (MHz) | 1 (2412) | 6 (2437) | 11 (2462) |
| Average Power (Ant-0) | **15.13** | 15.08 | 15.10 |
| Mode | 802.11n (HT20) | | |
| Channel / Frequency (MHz) | 1 (2412) | 6 (2437) | 11 (2462) |
| Average Power (Ant-0 + Ant-1) | 16.96 | **17.10** | 17.03 |
| Mode | 802.11n (HT40) | | |
| Channel / Frequency (MHz) | 3 (2422) | 6 (2437) | 9 (2452) |
| Average Power (Ant-0 + Ant-1) | **17.06** | 16.94 | 17.03 |

**<WLAN 5.2G>**

| Mode | 802.11a | | | |
|---|---|---|---|---|
| Channel / Frequency (MHz) | 36 (5180) | 40 (5200) | 44 (5220) | 48 (5240) |
| Average Power (Ant-0) | 15.10 | **15.13** | 15.09 | 14.92 |
| Mode | 802.11n (HT20) | | | |
| Channel / Frequency (MHz) | 36 (5180) | 40 (5200) | 44 (5220) | 48 (5240) |
| Average Power (Ant-0 + Ant-1) | 16.99 | 16.88 | 16.90 | **17.03** |
| Mode | 802.11n (HT40) | | | |
| Channel / Frequency (MHz) | 38 (5190) | | 46 (5230) | |
| Average Power (Ant-0 + Ant-1) | 15.94 | | **15.95** | |
| Mode | 802.11ac (VHT80) | | | |
| Channel / Frequency (MHz) | 42 (5210) | | | |
| Average Power (Ant-0 + Ant-1) | **15.09** | | | |

**<WLAN 5.3G>**

| Mode | 802.11a | | | |
|---|---|---|---|---|
| Channel / Frequency (MHz) | 52 (5260) | 56 (5280) | 60 (5300) | 64 (5320) |
| Average Power (Ant-0) | 14.86 | 14.65 | 14.97 | **15.28** |
| Mode | 802.11n (HT20) | | | |
| Channel / Frequency (MHz) | 52 (5260) | 56 (5280) | 60 (5300) | 64 (5320) |
| Average Power (Ant-0 + Ant-1) | 16.99 | 17.00 | 16.94 | **17.01** |
| Mode | 802.11n (HT40) | | | |
| Channel / Frequency (MHz) | 54 (5270) | | 62 (5310) | |
| Average Power (Ant-0 + Ant-1) | 16.01 | | **16.07** | |
| Mode | 802.11ac (VHT80) | | | |
| Channel / Frequency (MHz) | 58 (5290) | | | |
| Average Power (Ant-0 + Ant-1) | **15.12** | | | |

**<WLAN 5.6G>**

| Mode | 802.11a | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Channel / Frequency (MHz)** | 100 (5500) | 104 (5520) | 108 (5540) | 112 (5560) | 116 (5580) | 120 (5600) | 124 (5620) | 128 (5680) | 132 (5660) | 136 (5680) | 140 (5700) |
| Average Power (Ant-0) | 14.77 | 14.79 | 14.81 | 14.85 | 14.95 | 15.05 | 15.00 | 15.01 | 15.12 | 15.04 | **15.17** |
| **Mode** | **802.11n (HT20)** | | | | | | | | | | |
| **Channel / Frequency (MHz)** | 100 (5500) | 104 (5520) | 108 (5540) | 112 (5560) | 116 (5580) | 120 (5600) | 124 (5620) | 128 (5680) | 132 (5660) | 136 (5680) | 140 (5700) |
| Average Power (Ant-0 + Ant-1) | 17.02 | 16.98 | 16.99 | 17.01 | 17.02 | **17.11** | 17.06 | 17.04 | 17.05 | 17.03 | 17.09 |
| **Mode** | **802.11n (HT40)** | | | | | | | | | | |
| **Channel / Frequency (MHz)** | **102 (5510)** | | | | | | **134 (5670)** | | | | |
| Average Power (Ant-0 + Ant-1) | **15.99** | | | | | | **15.99** | | | | |
| **Mode** | **802.11ac (VHT80)** | | | | | | | | | | |
| **Channel / Frequency (MHz)** | **106 (5530)** | | | | | | | | | | |
| Average Power (Ant-0 + Ant-1) | **15.26** | | | | | | | | | | |

**<WLAN 5.8G>**

| Mode | 802.11a | | | | |
|---|---|---|---|---|---|
| **Channel / Frequency (MHz)** | **149 (5745)** | **153 (5765)** | **157 (5785)** | **161 (5805)** | **165 (5825)** |
| Average Power (Ant-0) | 13.24 | 14.98 | **15.02** | 14.91 | 14.93 |
| **Mode** | **802.11n (HT20)** | | | | |
| **Channel / Frequency (MHz)** | **149 (5745)** | **153 (5765)** | **157 (5785)** | **161 (5805)** | **165 (5825)** |
| Average Power (Ant-0 + Ant-1) | 17.04 | 17.08 | **17.09** | 17.05 | 17.01 |
| **Mode** | **802.11n (HT40)** | | | | |
| **Channel / Frequency (MHz)** | **151 (5755)** | | | **159 (5795)** | |
| Average Power (Ant-0 + Ant-1) | 16.03 | | | **16.05** | |
| **Mode** | **802.11ac (VHT80)** | | | | |
| **Channel / Frequency (MHz)** | **155 (5775)** | | | | |
| Average Power (Ant-0 + Ant-1) | **15.16** | | | | |

## 4.7 SAR Testing Results

### 4.7.1 SAR Results for Body (Separation Distance is 0.5 cm Gap)

| Plot No. | Band | Mode | Test Position | Ch. | Tx Antenna | Max. Tune-up Power (dBm) | Measured Conducted Power (dBm) | Scaling Factor | Power Drift (dB) | Measured SAR-1g (W/kg) | Scaled SAR-1g (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 802.11b | - | Horizontal Up | 1 | 0 | 18.5 | 18.14 | 1.09 | 0.17 | 0.674 | 0.73 |
| | 802.11n | HT20 | Horizontal Up | 6 | 0+1 | 17.5 | 17.10 | 1.10 | -0.02 | 0.395 | 0.43 |
| | 802.11b | - | Horizontal Down | 1 | 0 | 18.5 | 18.14 | 1.09 | -0.17 | 0.62 | 0.67 |
| | 802.11n | HT20 | Horizontal Down | 6 | 0+1 | 17.5 | 17.10 | 1.10 | -0.18 | 0.326 | 0.36 |
| | 802.11b | - | Vertical Front | 1 | 0 | 18.5 | 18.14 | 1.09 | 0.01 | 0.552 | 0.60 |
| | 802.11n | HT20 | Vertical Front | 6 | 0+1 | 17.5 | 17.10 | 1.10 | -0.03 | 0.172 | 0.19 |
| | 802.11b | - | Vertical Back | 1 | 0 | 18.5 | 18.14 | 1.09 | -0.12 | 0.09 | 0.10 |
| | 802.11n | HT20 | Vertical Back | 6 | 0+1 | 17.5 | 17.10 | 1.10 | -0.11 | 0.176 | 0.19 |
| | 802.11b | - | Tip Mode | 1 | 0 | 18.5 | 18.14 | 1.09 | -0.09 | 0.094 | 0.10 |
| | 802.11n | HT20 | Tip Mode | 6 | 0+1 | 17.5 | 17.10 | 1.10 | -0.12 | 0.061 | 0.07 |
| | 802.11a | - | Horizontal Up | 40 | 0 | 15.5 | 15.13 | 1.09 | 0.14 | 0.388 | 0.42 |
| | 802.11n | HT20 | Horizontal Up | 48 | 0+1 | 17.5 | 17.03 | 1.11 | 0.13 | 0.118 | 0.13 |
| | 802.11a | - | Horizontal Down | 40 | 0 | 15.5 | 15.13 | 1.09 | -0.02 | 0.242 | 0.26 |
| | 802.11n | HT20 | Horizontal Down | 48 | 0+1 | 17.5 | 17.03 | 1.11 | -0.12 | 0.104 | 0.12 |
| 02 | 802.11a | - | Vertical Front | 40 | 0 | 15.5 | 15.13 | 1.09 | 0.10 | 0.679 | 0.74 |
| | 802.11n | HT20 | Vertical Front | 48 | 0+1 | 17.5 | 17.03 | 1.11 | -0.15 | 0.128 | 0.14 |
| | 802.11a | - | Vertical Back | 40 | 0 | 15.5 | 15.13 | 1.09 | 0.06 | 0.047 | 0.05 |
| | 802.11n | HT20 | Vertical Back | 48 | 0+1 | 17.5 | 17.03 | 1.11 | -0.16 | 0.125 | 0.14 |
| | 802.11a | - | Tip Mode | 40 | 0 | 15.5 | 15.13 | 1.09 | 0.19 | 0.201 | 0.22 |
| | 802.11n | HT20 | Tip Mode | 48 | 0+1 | 17.5 | 17.03 | 1.11 | -0.11 | 0.05 | 0.06 |
| | 802.11ac | VH80 | Vertical Front | 42 | 0+1 | 15.5 | 15.09 | 1.10 | 0.18 | 0.068 | 0.07 |
| | 802.11a | - | Horizontal Up | 64 | 0 | 15.5 | 15.28 | 1.05 | 0.13 | 0.278 | 0.29 |
| | 802.11n | HT20 | Horizontal Up | 64 | 0+1 | 17.5 | 17.01 | 1.12 | -0.12 | 0.211 | 0.24 |
| | 802.11a | - | Horizontal Down | 64 | 0 | 15.5 | 15.28 | 1.05 | -0.17 | 0.193 | 0.20 |
| | 802.11n | HT20 | Horizontal Down | 64 | 0+1 | 17.5 | 17.01 | 1.12 | -0.08 | 0.159 | 0.18 |
| 03 | 802.11a | - | Vertical Front | 64 | 0 | 15.5 | 15.28 | 1.05 | -0.09 | 0.573 | 0.60 |
| | 802.11n | HT20 | Vertical Front | 64 | 0+1 | 17.5 | 17.01 | 1.12 | -0.10 | 0.215 | 0.24 |
| | 802.11a | - | Vertical Back | 64 | 0 | 15.5 | 15.28 | 1.05 | 0.12 | 0.036 | 0.04 |
| | 802.11n | HT20 | Vertical Back | 64 | 0+1 | 17.5 | 17.01 | 1.12 | 0.11 | 0.139 | 0.16 |
| | 802.11a | - | Tip Mode | 64 | 0 | 15.5 | 15.28 | 1.05 | -0.15 | 0.159 | 0.17 |
| | 802.11n | HT20 | Tip Mode | 64 | 0+1 | 17.5 | 17.01 | 1.12 | -0.10 | 0.072 | 0.08 |
| | 802.11ac | VH80 | Vertical Front | 58 | 0+1 | 15.5 | 15.12 | 1.09 | -0.06 | 0.105 | 0.11 |
| | 802.11a | - | Horizontal Up | 140 | 0 | 15.5 | 15.17 | 1.08 | -0.01 | 0.254 | 0.27 |
| | 802.11n | HT20 | Horizontal Up | 120 | 0+1 | 17.5 | 17.11 | 1.09 | 0.11 | 0.164 | 0.18 |
| | 802.11a | - | Horizontal Down | 140 | 0 | 15.5 | 15.17 | 1.08 | 0.13 | 0.223 | 0.24 |
| | 802.11n | HT20 | Horizontal Down | 120 | 0+1 | 17.5 | 17.11 | 1.09 | -0.10 | 0.12 | 0.13 |
| 04 | 802.11a | - | Vertical Front | 140 | 0 | 15.5 | 15.17 | 1.08 | 0.17 | 0.405 | 0.44 |
| | 802.11n | HT20 | Vertical Front | 120 | 0+1 | 17.5 | 17.11 | 1.09 | 0.11 | 0.166 | 0.18 |
| | 802.11a | - | Vertical Back | 140 | 0 | 15.5 | 15.17 | 1.08 | -0.06 | 0.035 | 0.04 |
| | 802.11n | HT20 | Vertical Back | 120 | 0+1 | 17.5 | 17.11 | 1.09 | -0.01 | 0.11 | 0.12 |
| | 802.11a | - | Tip Mode | 140 | 0 | 15.5 | 15.17 | 1.08 | -0.07 | 0.105 | 0.11 |
| | 802.11n | HT20 | Tip Mode | 120 | 0+1 | 17.5 | 17.11 | 1.09 | -0.05 | 0.062 | 0.07 |
| | 802.11ac | VH80 | Vertical Front | 106 | 0+1 | 15.5 | 15.26 | 1.06 | 0.03 | 0.089 | 0.09 |
| | 802.11a | - | Horizontal Up | 157 | 0 | 15.1 | 15.02 | 1.02 | 0.09 | 0.234 | 0.24 |
| | 802.11n | HT20 | Horizontal Up | 157 | 0+1 | 17.5 | 17.09 | 1.10 | 0.01 | 0.126 | 0.14 |
| | 802.11a | - | Horizontal Down | 157 | 0 | 15.1 | 15.02 | 1.02 | 0.00 | 0.159 | 0.16 |
| | 802.11n | HT20 | Horizontal Down | 157 | 0+1 | 17.5 | 17.09 | 1.10 | -0.02 | 0.103 | 0.11 |
| 05 | 802.11a | - | Vertical Front | 157 | 0 | 15.1 | 15.02 | 1.02 | -0.06 | 0.389 | 0.40 |
| | 802.11n | HT20 | Vertical Front | 157 | 0+1 | 17.5 | 17.09 | 1.10 | -0.09 | 0.158 | 0.17 |
| | 802.11a | - | Vertical Back | 157 | 0 | 15.1 | 15.02 | 1.02 | 0.00 | 0.03 | 0.03 |
| | 802.11n | HT20 | Vertical Back | 157 | 0+1 | 17.5 | 17.09 | 1.10 | -0.12 | 0.15 | 0.16 |
| | 802.11a | - | Tip Mode | 157 | 0 | 15.1 | 15.02 | 1.02 | 0.10 | 0.086 | 0.09 |
| | 802.11n | HT20 | Tip Mode | 157 | 0+1 | 17.5 | 17.09 | 1.10 | -0.02 | 0.087 | 0.10 |
| | 802.11ac | VH80 | Vertical Front | 155 | 0+1 | 15.5 | 15.16 | 1.08 | 0.09 | 0.087 | 0.09 |

**Note:**

1. According to KDB 248227, when the extrapolated maximum peak SAR for the maximum output power channel is <= 1.6 W/kg and the 1g averaged SAR is <= 0.8 W/kg, WLAN SAR testing for other channels is not required.
2. SAR testing for 802.11g/n is not required when its maximum power is less than 1/4 dB higher than 802.11b.
3. SAR testing for 802.11n is not required when its maximum power is less than 1/4 dB higher than 802.11a.
4. According to April 2013 TCB Workshop, 802.11ac SAR testing is not required when its maximum power is less than 1/4 dB higher than 802.11a. 802.11ac SAR is required for the highest 802.11a configuration in each 5 GHz band and each exposure condition.

### 4.7.2 SAR Measurement Variability

According to KDB 865664 D01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are ≤ 1.45 W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is ≤ 1.10, the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

Since all the measured SAR are less than 0.8 W/kg, the repeated measurement is not required.

**Test Engineer：** Raymond Wu, and Mars Chang

# 5. Calibration of Test Equipment

| Equipment | Manufacturer | Model | SN | Cal. Date | Cal. Interval |
|---|---|---|---|---|---|
| System Validation Dipole | SPEAG | D2450V2 | 737 | Aug. 21, 2014 | 2 Years |
| System Validation Dipole | SPEAG | D5GHzV2 | 1019 | Aug. 25, 2014 | 2 Years |
| Dosimetric E-Field Probe | SPEAG | EX3DV4 | 3590 | Mar. 04, 2014 | 1 Year |
| Data Acquisition Electronics | SPEAG | DAE4 | 861 | Apr. 23, 2014 | 1 Year |
| ENA Series Network Analyzer | Agilent | E5071C | MY46214281 | Jun. 13, 2014 | 1 Year |
| EXA Spectrum Analyzer | Agilent | N9010A | MY53470455 | Feb. 22, 2014 | 1 Year |
| MXG Analong Signal Generator | Agilent | N5181A | MY50143868 | Jun. 26, 2014 | 1 Year |
| Power Meter | Anritsu | ML2495A | 1218009 | Jun. 26, 2014 | 1 Year |
| Power Sensor | Anritsu | MA2411B | 1207252 | Jun. 26, 2014 | 1 Year |
| Thermometer | YFE | YF-160A | 130504579 | Aug. 21, 2014 | 1 Year |

# 6. Measurement Uncertainty

| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (1g) | Standard Uncertainty (1g) | Vi |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | 6.0 | Normal | 1 | 1 | ± 6.0 % | ∞ |
| Axial Isotropy | 4.7 | Rectangular | √3 | 0.7 | ± 1.9 % | ∞ |
| Hemispherical Isotropy | 9.6 | Rectangular | √3 | 0.7 | ± 3.9 % | ∞ |
| Boundary Effects | 1.0 | Rectangular | √3 | 1 | ± 0.6 % | ∞ |
| Linearity | 4.7 | Rectangular | √3 | 1 | ± 2.7 % | ∞ |
| System Detection Limits | 1.0 | Rectangular | √3 | 1 | ± 0.6 % | ∞ |
| Readout Electronics | 0.6 | Normal | 1 | 1 | ± 0.6 % | ∞ |
| Response Time | 0.0 | Rectangular | √3 | 1 | ± 0.0 % | ∞ |
| Integration Time | 1.7 | Rectangular | √3 | 1 | ± 1.0 % | ∞ |
| RF Ambient Noise | 3.0 | Rectangular | √3 | 1 | ± 1.7 % | ∞ |
| RF Ambient Reflections | 3.0 | Rectangular | √3 | 1 | ± 1.7 % | ∞ |
| Probe Positioner | 0.5 | Rectangular | √3 | 1 | ± 0.3 % | ∞ |
| Probe Positioning | 2.9 | Rectangular | √3 | 1 | ± 1.7 % | ∞ |
| Max. SAR Eval. | 2.3 | Rectangular | √3 | 1 | ± 1.3 % | ∞ |
| **Test Sample Related** | | | | | | |
| Device Positioning | 3.9 | Normal | 1 | 1 | ± 3.9 % | 31 |
| Device Holder | 2.7 | Normal | 1 | 1 | ± 2.7 % | 19 |
| Power Drift | 5.0 | Rectangular | √3 | 1 | ± 2.9 % | ∞ |
| **Phantom and Setup** | | | | | | |
| Phantom Uncertainty | 4.0 | Rectangular | √3 | 1 | ± 2.3 % | ∞ |
| Liquid Conductivity (Target) | 5.0 | Rectangular | √3 | 0.64 | ± 1.8 % | ∞ |
| Liquid Conductivity (Meas.) | 5.0 | Normal | 1 | 0.64 | ± 3.2 % | 29 |
| Liquid Permittivity (Target) | 5.0 | Rectangular | √3 | 0.6 | ± 1.7 % | ∞ |
| Liquid Permittivity (Meas.) | 5.0 | Normal | 1 | 0.6 | ± 3.0 % | 29 |
| **Combined Standard Uncertainty** | | | | | ± 11.7 % | |
| **Expanded Uncertainty (K=2)** | | | | | **± 23.4 %** | |

**Uncertainty budget for frequency range 300 MHz to 3 GHz**

| Error Description | Uncertainty Value (±%) | Probability Distribution | Divisor | Ci (1g) | Standard Uncertainty (1g) | Vi |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | 6.55 | Normal | 1 | 1 | ± 6.55 % | ∞ |
| Axial Isotropy | 4.7 | Rectangular | √3 | 0.7 | ± 1.9 % | ∞ |
| Hemispherical Isotropy | 9.6 | Rectangular | √3 | 0.7 | ± 3.9 % | ∞ |
| Boundary Effects | 2.0 | Rectangular | √3 | 1 | ± 1.2 % | ∞ |
| Linearity | 4.7 | Rectangular | √3 | 1 | ± 2.7 % | ∞ |
| System Detection Limits | 1.0 | Rectangular | √3 | 1 | ± 0.6 % | ∞ |
| Readout Electronics | 0.3 | Normal | 1 | 1 | ± 0.3 % | ∞ |
| Response Time | 0.8 | Rectangular | √3 | 1 | ± 0.5 % | ∞ |
| Integration Time | 2.6 | Rectangular | √3 | 1 | ± 1.5 % | ∞ |
| RF Ambient Noise | 3.0 | Rectangular | √3 | 1 | ± 1.7 % | ∞ |
| RF Ambient Reflections | 3.0 | Rectangular | √3 | 1 | ± 1.7 % | ∞ |
| Probe Positioner | 0.8 | Rectangular | √3 | 1 | ± 0.5 % | ∞ |
| Probe Positioning | 9.9 | Rectangular | √3 | 1 | ± 5.7 % | ∞ |
| Max. SAR Eval. | 4.0 | Rectangular | √3 | 1 | ± 2.3 % | ∞ |
| **Test Sample Related** | | | | | | |
| Device Positioning | 3.9 | Normal | 1 | 1 | ± 3.9 % | 31 |
| Device Holder | 2.7 | Normal | 1 | 1 | ± 2.7 % | 19 |
| Power Drift | 5.0 | Rectangular | √3 | 1 | ± 2.9 % | ∞ |
| **Phantom and Setup** | | | | | | |
| Phantom Uncertainty | 4.0 | Rectangular | √3 | 1 | ± 2.3 % | ∞ |
| Liquid Conductivity (Target) | 5.0 | Rectangular | √3 | 0.64 | ± 1.8 % | ∞ |
| Liquid Conductivity (Meas.) | 5.0 | Normal | 1 | 0.64 | ± 3.2 % | 30 |
| Liquid Permittivity (Target) | 5.0 | Rectangular | √3 | 0.6 | ± 1.7 % | ∞ |
| Liquid Permittivity (Meas.) | 5.0 | Normal | 1 | 0.6 | ± 3.0 % | 30 |
| **Combined Standard Uncertainty** | | | | | ± 13.4 % | |
| **Expanded Uncertainty (K=2)** | | | | | **± 26.8 %** | |

**Uncertainty budget for frequency range 3 GHz to 6 GHz**

# 7. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

**Taiwan HwaYa EMC/RF/Safety/Telecom Lab:**
Add: No. 19, Hwa Ya 2nd Rd, Wen Hwa Vil., Kwei Shan Hsiang, Taoyuan Hsien 333, Taiwan, R.O.C.
Tel: 886-3-318-3232
Fax: 886-3-327-0892

**Taiwan LinKo EMC/RF Lab:**
Add: No. 47-2, 14th Ling, Chia Pau Vil., Linkou Dist., New Taipei City 244, Taiwan, R.O.C.
Tel: 886-2-2605-2180
Fax: 886-2-2605-1924

**Taiwan HsinChu EMC/RF Lab:**
Add: No. 81-1, Lu Liao Keng, 9th Ling, Wu Lung Vil., Chiung Lin Township, Hsinchu County 307, Taiwan, R.O.C.
Tel: 886-3-593-5343
Fax: 886-3-593-5342

**Email:** service.adt@tw.bureauveritas.com
**Web Site:** www.adt.com.tw

The road map of all our labs can be found in our web site also.

**---END---**

# Appendix A. SAR Plots of System Verification

The plots for system verification with largest deviation for each SAR system combination are shown as follows.

# System Check_B2450_150123

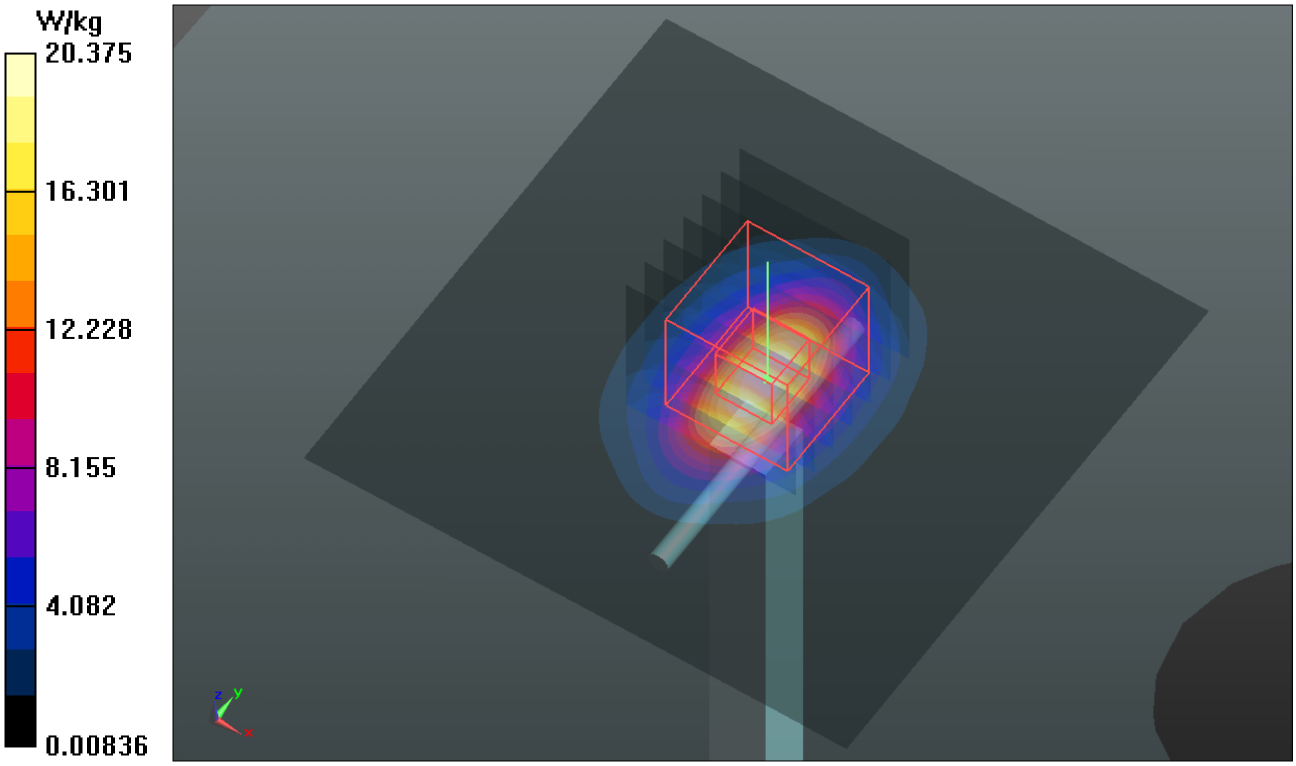
## DUT: Dipole 2450 MHz; Type: D2450V2; SN: 737

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: B24T25N2_0123 Medium parameters used: f = 2450 MHz; $\sigma = 1.972$ S/m; $\varepsilon_r = 51.36$; $\rho = 1000$ $kg/m^3$
Ambient Temperature：21.6 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(7.72, 7.72, 7.72); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1202; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 20.4 W/kg

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.3 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 28.4 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 5.99 W/kg**
Maximum value of SAR (measured) = 20.6 W/kg



## System Check_B5200_150123

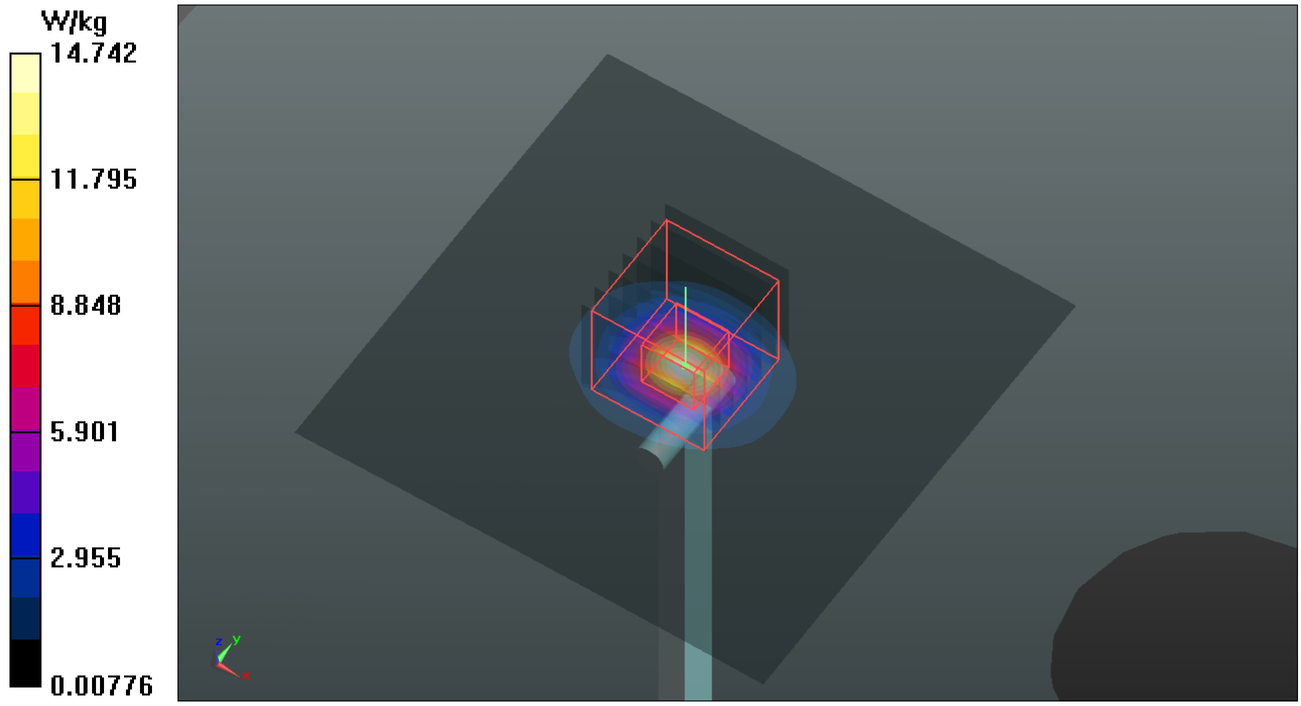
### DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5200 MHz; σ = 5.347 S/m; $\varepsilon_r$ = 47.581; ρ = 1000 kg/$m^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(5.16, 5.16, 5.16); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.7 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 56.81 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 28.7 W/kg
**SAR(1 g) = 7.08 W/kg; SAR(10 g) = 2 W/kg**
Maximum value of SAR (measured) = 14.9 W/kg



Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab Date: 2015/01/26

## System Check_B5300_150126

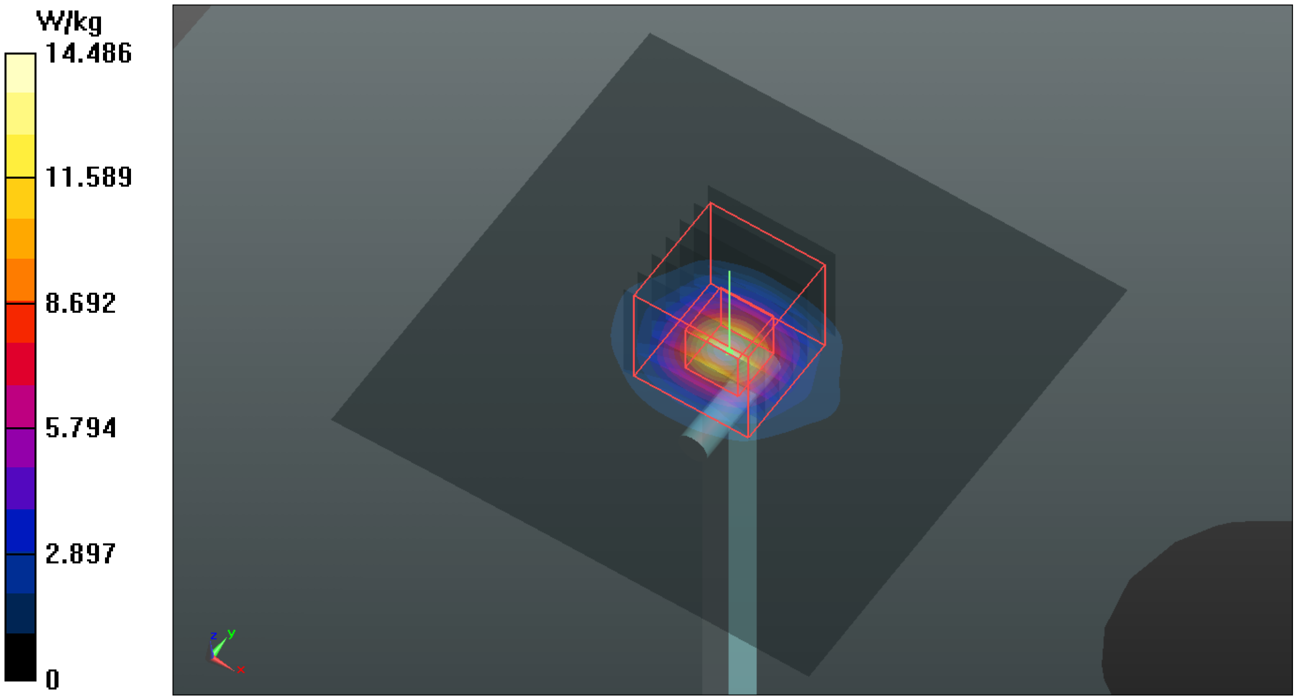
### DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019

Communication System: CW; Frequency: 5300 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0126 Medium parameters used: f = 5300 MHz; σ = 5.462 S/m; $\varepsilon_r$ = 47.107; ρ = 1000 $kg/m^3$
Ambient Temperature：21.6 ℃; Liquid Temperature：21.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.92, 4.92, 4.92); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.5 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 57.19 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 30.8 W/kg
**SAR(1 g) = 7.29 W/kg; SAR(10 g) = 2.03 W/kg**
Maximum value of SAR (measured) = 15.6 W/kg



## System Check_B5600_150123

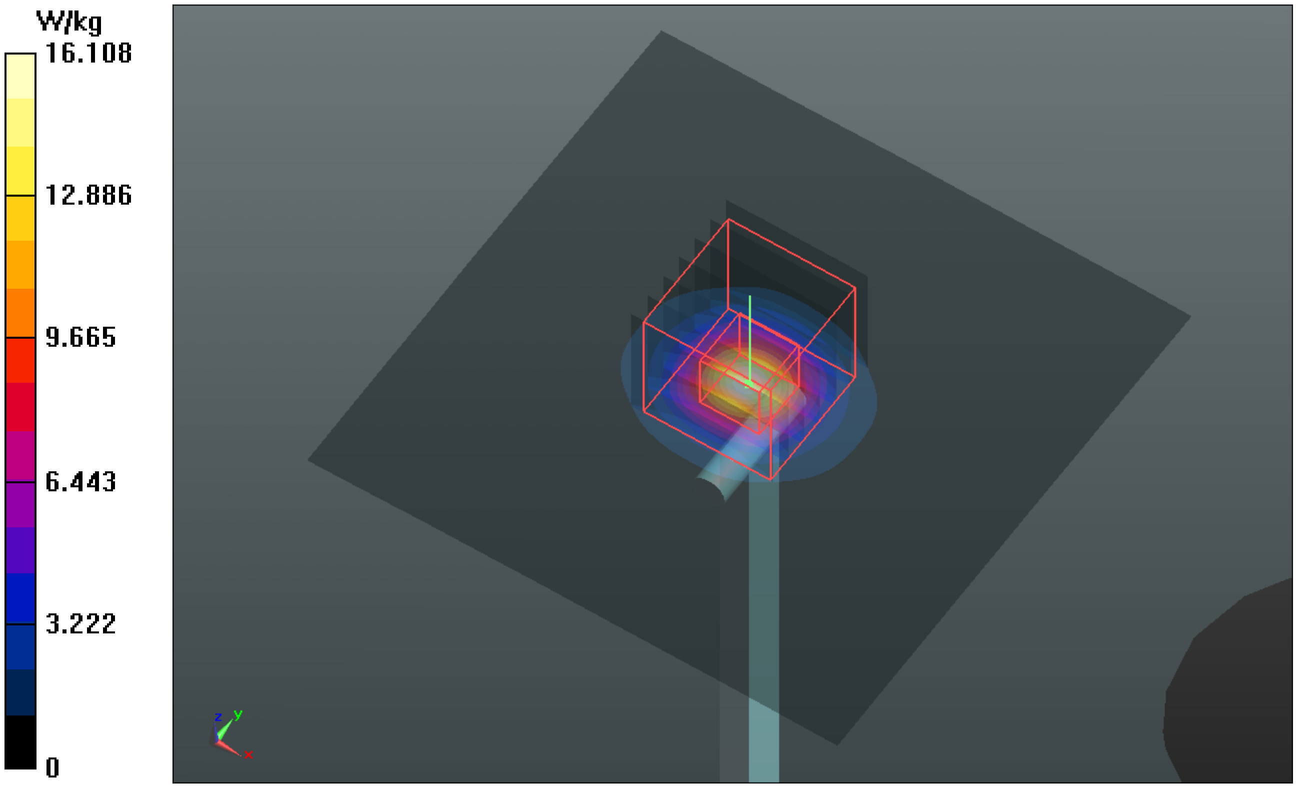
**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019**

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5600 MHz; σ = 5.912 S/m; $\varepsilon_r$ = 46.863; ρ = 1000 kg/m$^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.62, 4.62, 4.62); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 16.1 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 57.20 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 34.3 W/kg
**SAR(1 g) = 7.67 W/kg; SAR(10 g) = 2.14 W/kg**
Maximum value of SAR (measured) = 16.5 W/kg



## System Check_B5800_150123

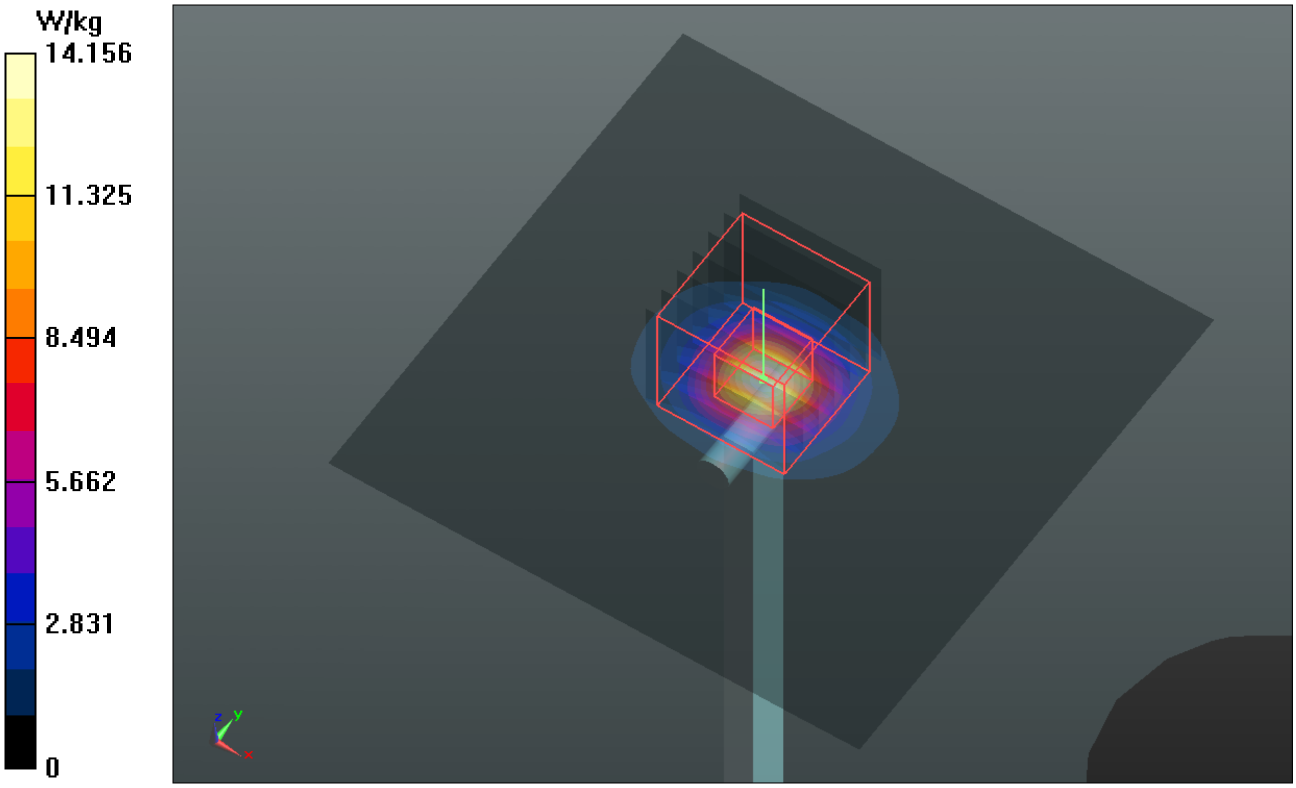
### DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1019

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5800 MHz; $\sigma$ = 6.202 S/m; $\varepsilon_r$ = 46.48; $\rho$ = 1000 kg/$m^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.74, 4.74, 4.74); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.2 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 52.91 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 29.4 W/kg
**SAR(1 g) = 7 W/kg; SAR(10 g) = 1.97 W/kg**
Maximum value of SAR (measured) = 15.1 W/kg



# Appendix B. SAR Plots of SAR Measurement

The SAR plots for highest measured SAR in each exposure configuration, wireless mode and frequency band combination, and measured SAR > 1.5 W/kg are shown as follows.

## P01 802.11b_Horizontal Up_0.5cm_Ch1_Ant0

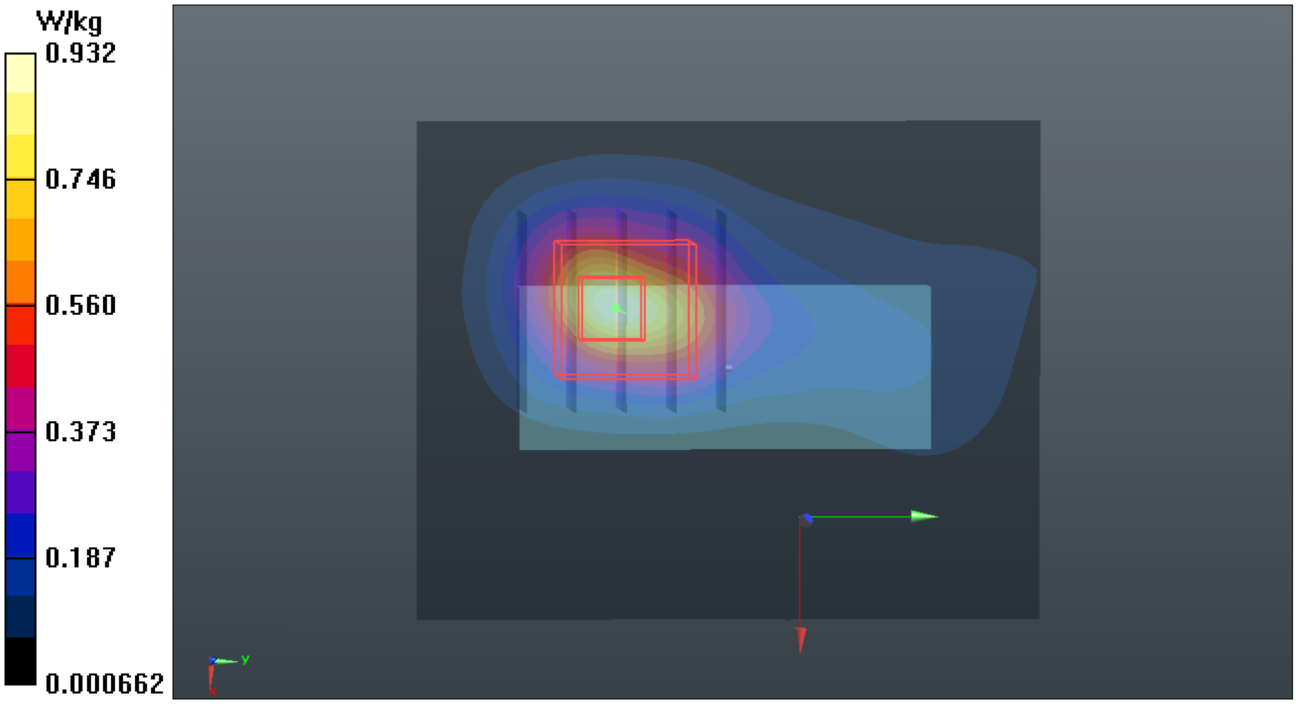
### DUT: 150115D03

Communication System: WLAN_2.4G; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: B24T25N2_0123 Medium parameters used: f = 2412 MHz; σ = 1.923 S/m; $\varepsilon_r$ = 51.517; ρ = 1000 kg/$m^3$
Ambient Temperature：21.6 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(7.72, 7.72, 7.72); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1202; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**- Area Scan (71x91x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.932 W/kg

**- Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.30 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 1.42 W/kg
**SAR(1 g) = 0.674 W/kg; SAR(10 g) = 0.307 W/kg**
Maximum value of SAR (measured) = 1.02 W/kg



Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab Date: 2015/01/23

## P02 802.11a_Vertical Front_0.5cm_Ch40_Ant0

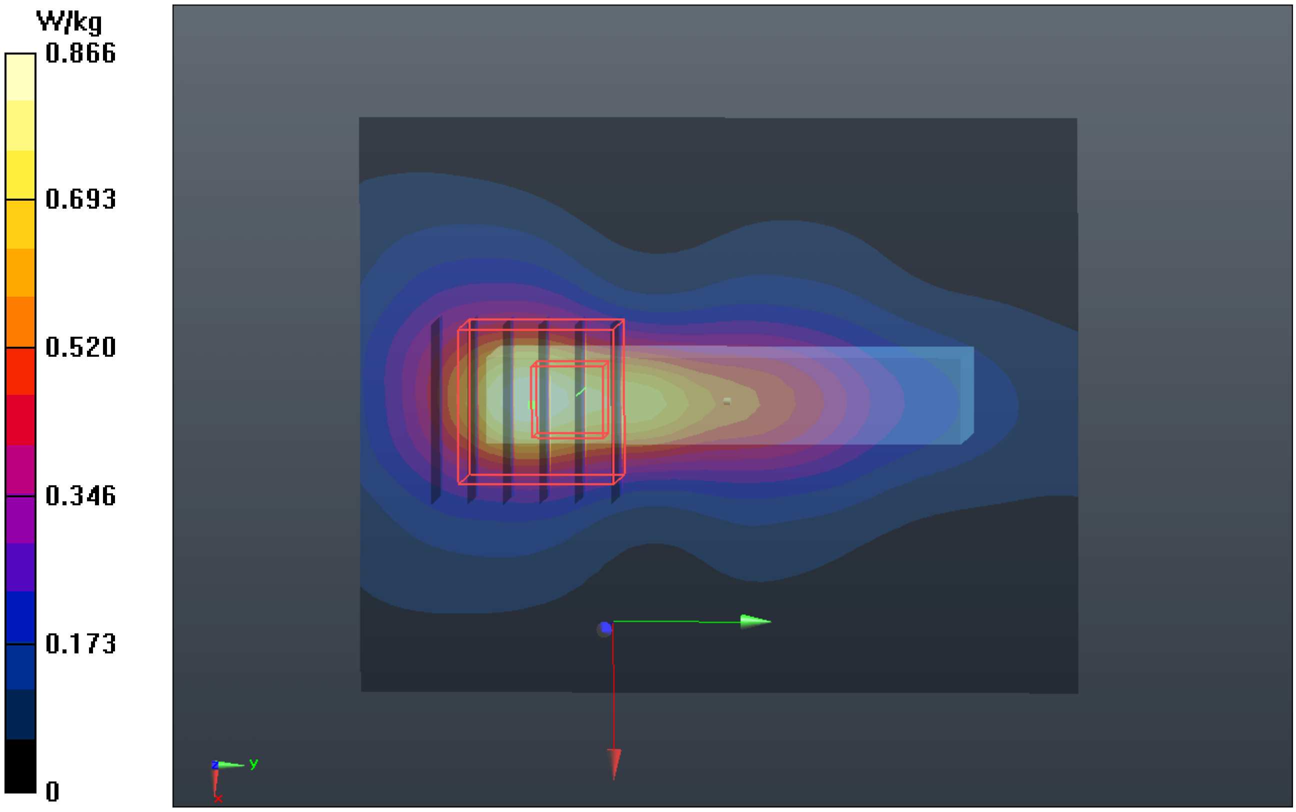
### DUT: 150115D03

Communication System: WLAN_5G; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5200 MHz; $\sigma$ = 5.347 S/m; $\varepsilon_r$ = 47.581; $\rho$ = 1000 kg/m$^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(5.16, 5.16, 5.16); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**- Area Scan (81x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.866 W/kg

**- Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm
Reference Value = 6.622 V/m; Power Drift = 0.10 dB
Peak SAR (extrapolated) = 2.79 W/kg
**SAR(1 g) = 0.679 W/kg; SAR(10 g) = 0.224 W/kg**
Maximum value of SAR (measured) = 1.28 W/kg



Test Laboratory: Bureau Veritas ADT SAR/HAC Testing Lab Date: 2015/01/26

## P03 802.11a_Vertical Front_0.5cm_Ch64_Ant0

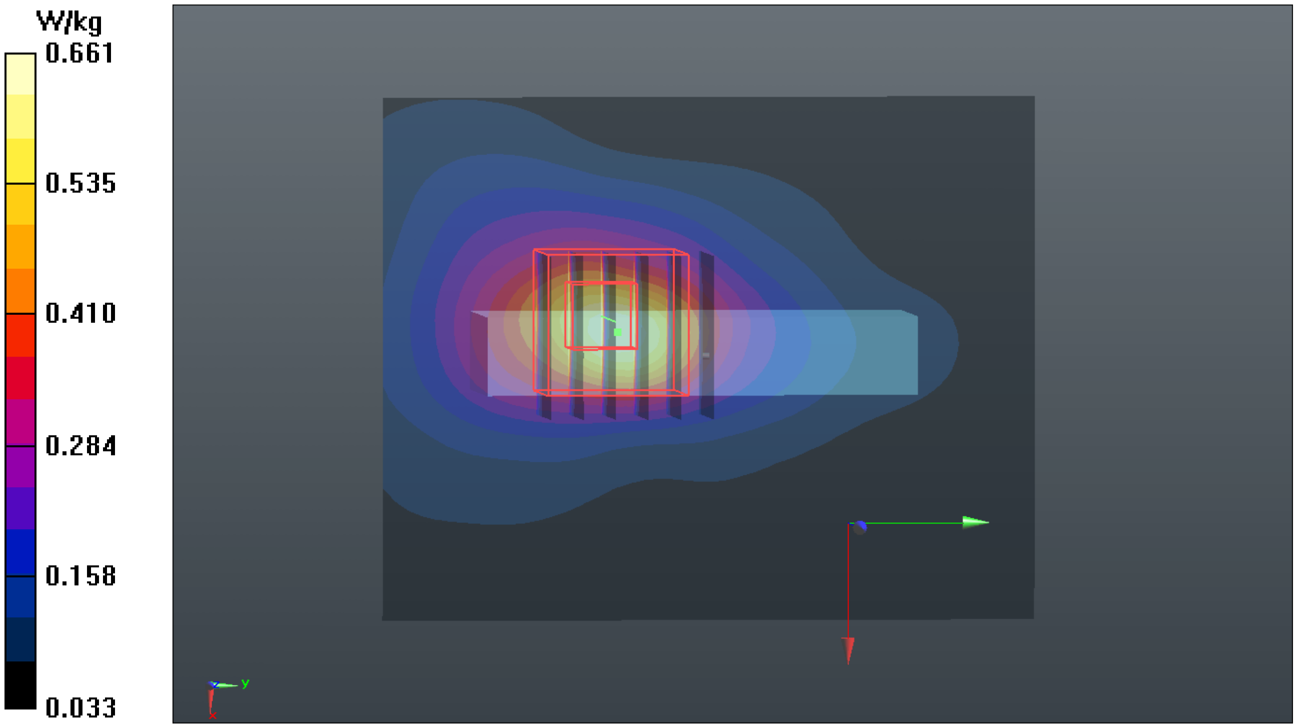
### DUT: 150115D03

Communication System: WLAN_5G; Frequency: 5320 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0126 Medium parameters used: f = 5320 MHz; σ = 5.502 S/m; $\varepsilon_r$ = 47.029; ρ = 1000 kg/m$^3$
Ambient Temperature：21.6 ℃; Liquid Temperature：21.2 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.92, 4.92, 4.92); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**- Area Scan (81x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.661 W/kg

**- Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm
Reference Value = 5.951 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 2.07 W/kg
**SAR(1 g) = 0.573 W/kg; SAR(10 g) = 0.221 W/kg**
Maximum value of SAR (measured) = 1.06 W/kg



## P04 802.11a_Vertical Front_0.5cm_Ch140_Ant0

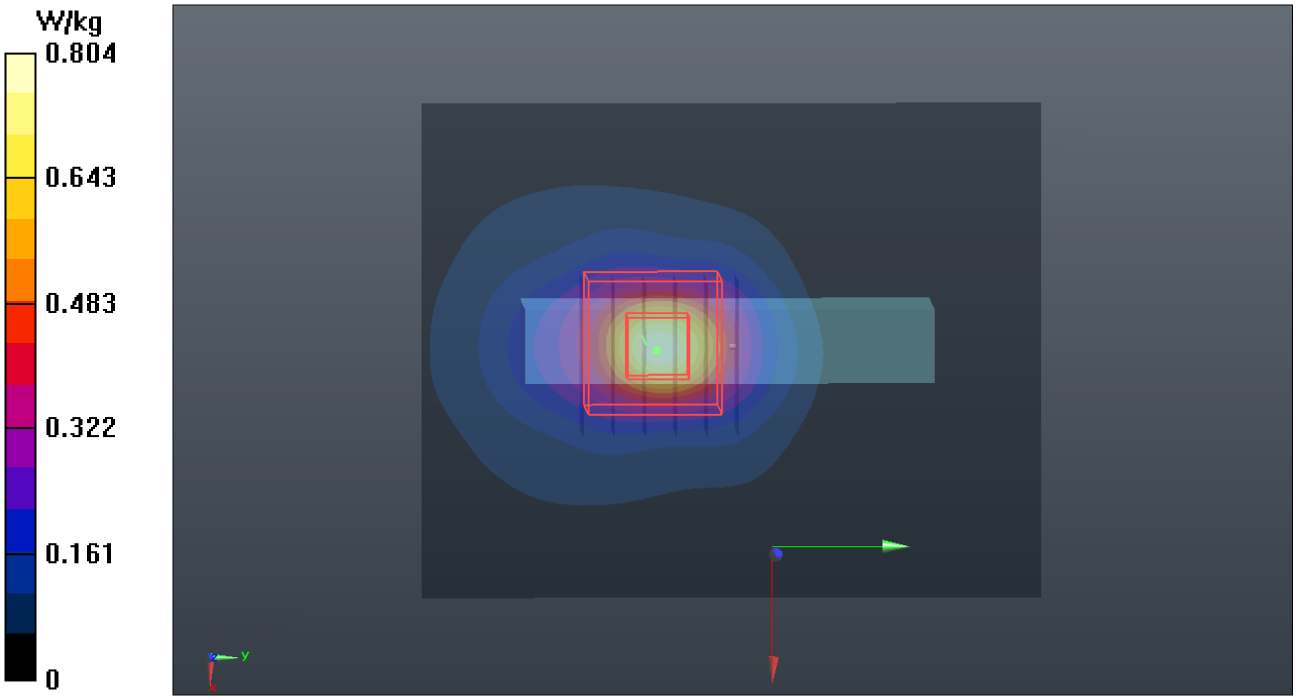
### DUT: 150115D03

Communication System: WLAN_5G; Frequency: 5700 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5700 MHz; $\sigma$ = 6.057 S/m; $\varepsilon_r$ = 46.674; $\rho$ = 1000 kg/$m^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.62, 4.62, 4.62); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**- Area Scan (81x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.804 W/kg

**- Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm
Reference Value = 9.824 V/m; Power Drift = 0.17 dB
Peak SAR (extrapolated) = 1.80 W/kg
**SAR(1 g) = 0.405 W/kg; SAR(10 g) = 0.137 W/kg**
Maximum value of SAR (measured) = 0.778 W/kg



## P05 802.11a_Vertical Front_0.5cm_Ch157_Ant0

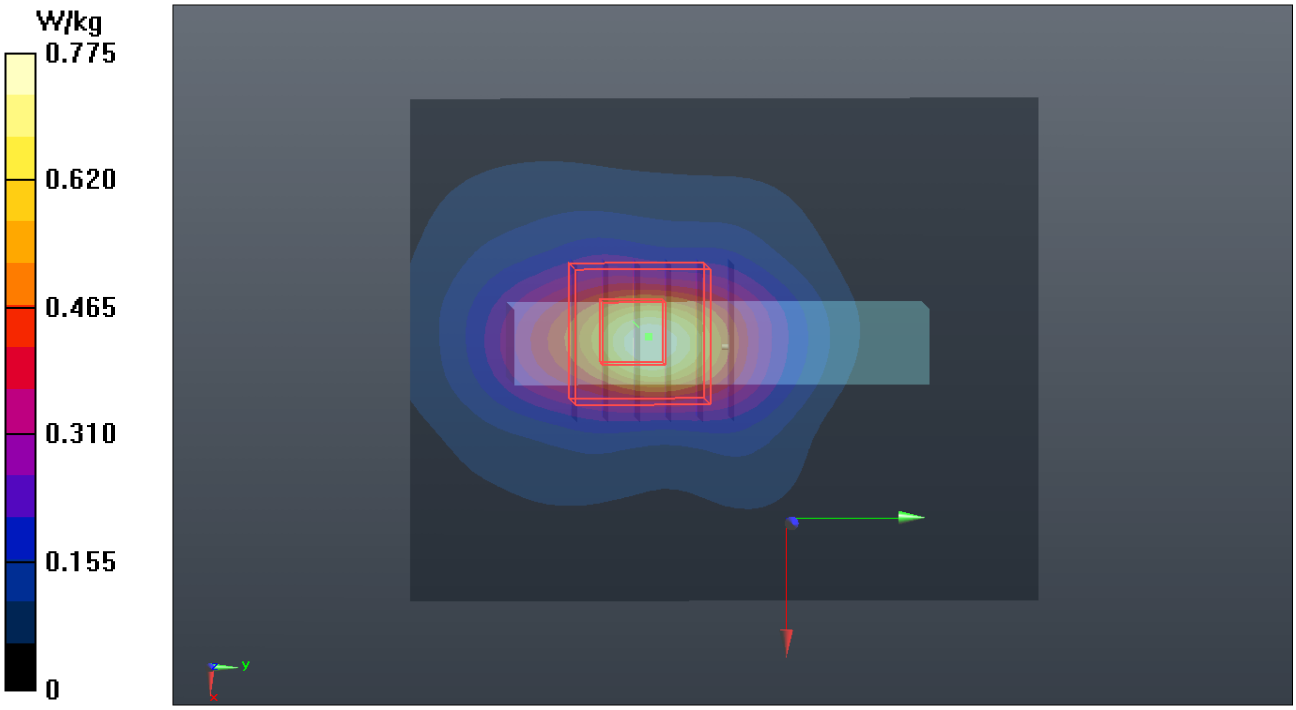
### DUT: 150115D03

Communication System: WLAN_5G; Frequency: 5785 MHz;Duty Cycle: 1:1
Medium: B50T60N2_0123 Medium parameters used: f = 5785 MHz; $\sigma = 6.18$ S/m; $\varepsilon_r = 46.486$; $\rho = 1000$ kg/m$^3$
Ambient Temperature：21.5 ℃; Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.74, 4.74, 4.74); Calibrated: 2014/03/04;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2014/04/23
- Phantom: Twin SAM Phantom_1654; Type: QD000P40;
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

**- Area Scan (81x101x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 0.775 W/kg

**- Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm
Reference Value = 9.875 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 1.59 W/kg
**SAR(1 g) = 0.389 W/kg; SAR(10 g) = 0.130 W/kg**
Maximum value of SAR (measured) = 0.770 W/kg



# Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.

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

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

Accredited by the Swiss 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** **B.V. ADT (Auden)**

**Certificate No: D2450V2-737_Aug14**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 737 |
| Calibration procedure(s) | QA CAL-05.v9<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | August 21, 2014 |

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) | 03-Apr-14 (No. 217-01918) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-13 (No. ES3-3205_Dec13) | Dec-14 |
| DAE4 | SN: 601 | 18-Aug-14 (No. DAE4-601_Aug14) | Aug-15 |

| 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-16 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-13) | In house check: Oct-14 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: August 21, 2014

## 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 | V52.8.8 |
| **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 | 38.0 ± 6 % | 1.82 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 | 12.9 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **51.0 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.97 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.7 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 | 50.5 ± 6 % | 2.02 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 | 12.7 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **49.5 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 5.84 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **23.0 W/kg ± 16.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 54.9 Ω + 3.6 jΩ |
| Return Loss | - 24.7 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 50.6 Ω + 4.8 jΩ |
| Return Loss | - 26.4 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.162 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 26, 2003 |

**DASY5 Validation Report for Head TSL**

Date: 21.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737**

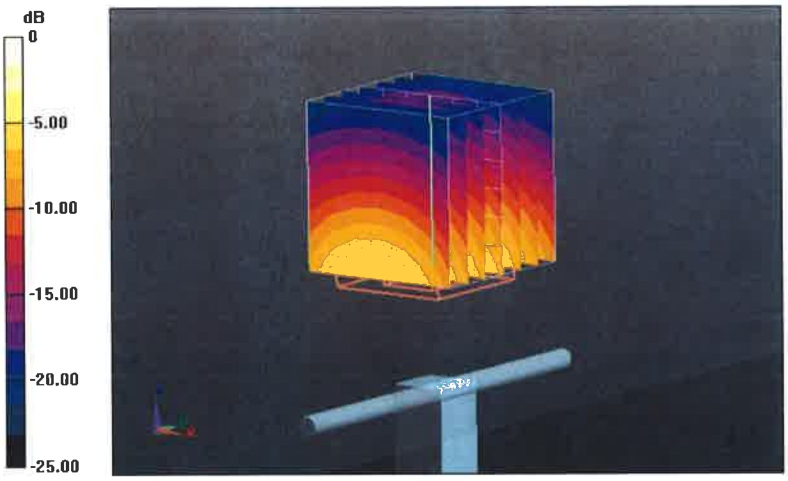
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.82 S/m; $\varepsilon_r$ = 38; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.53, 4.53, 4.53); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

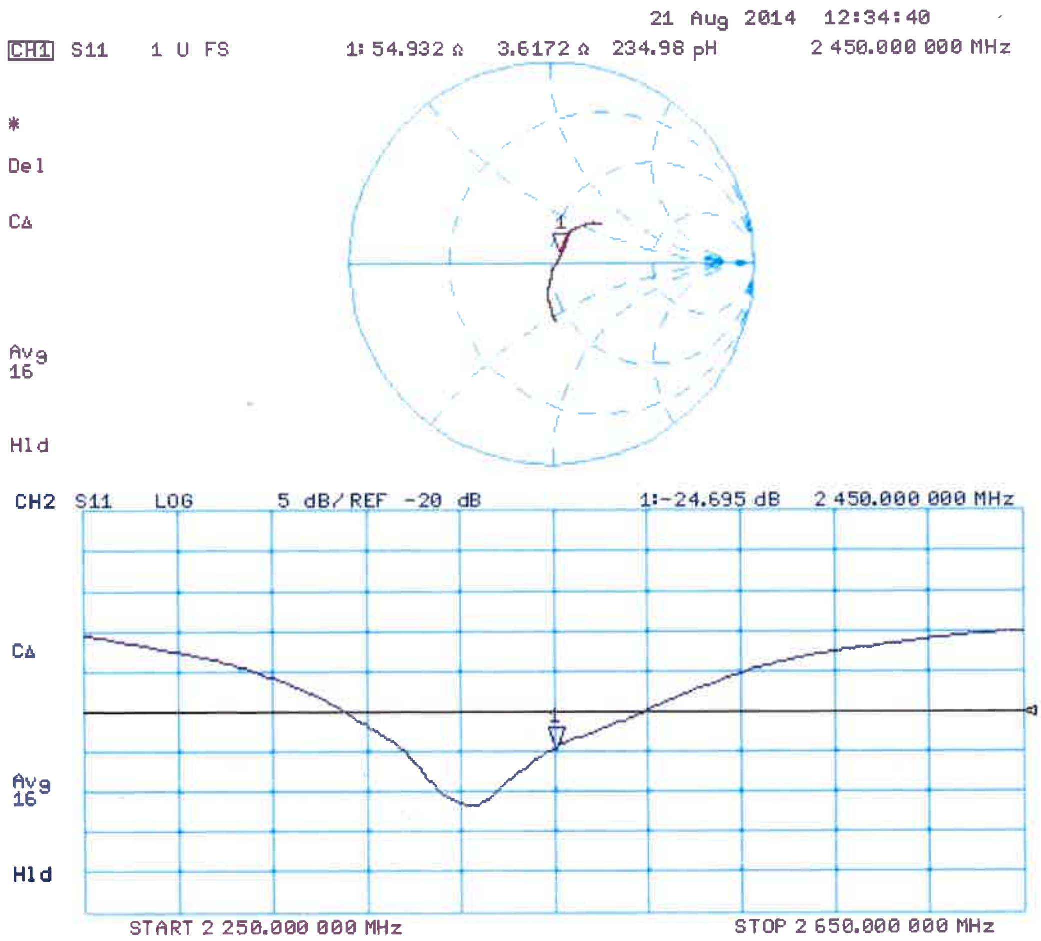
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.7 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 26.7 W/kg
**SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.97 W/kg**
Maximum value of SAR (measured) = 17.1 W/kg




0 dB = 17.1 W/kg = 12.33 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 21.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 737**

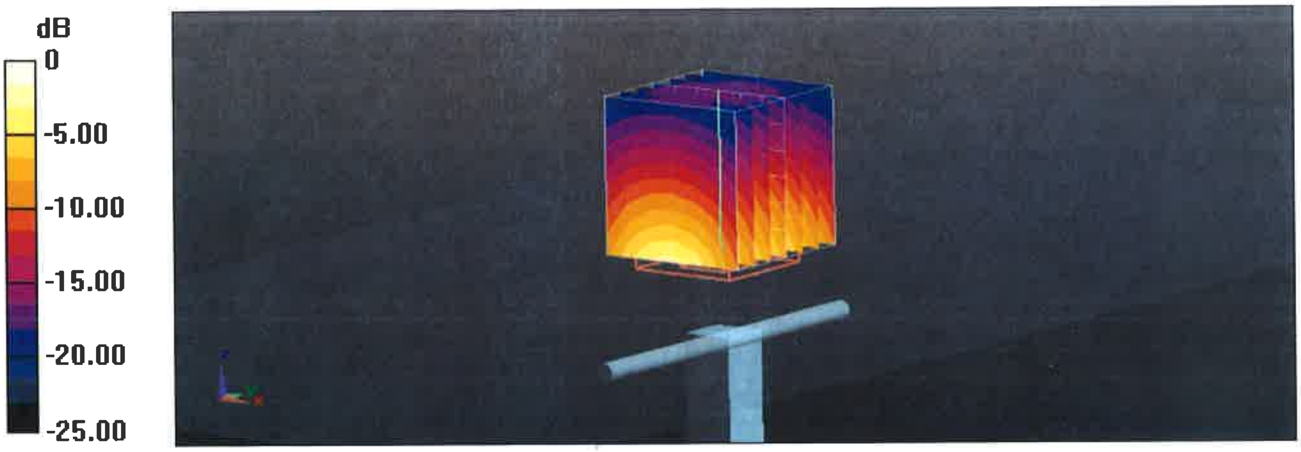
Communication System: UID 0 - CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 S/m; $\varepsilon_r$ = 50.5; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.35, 4.35, 4.35); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

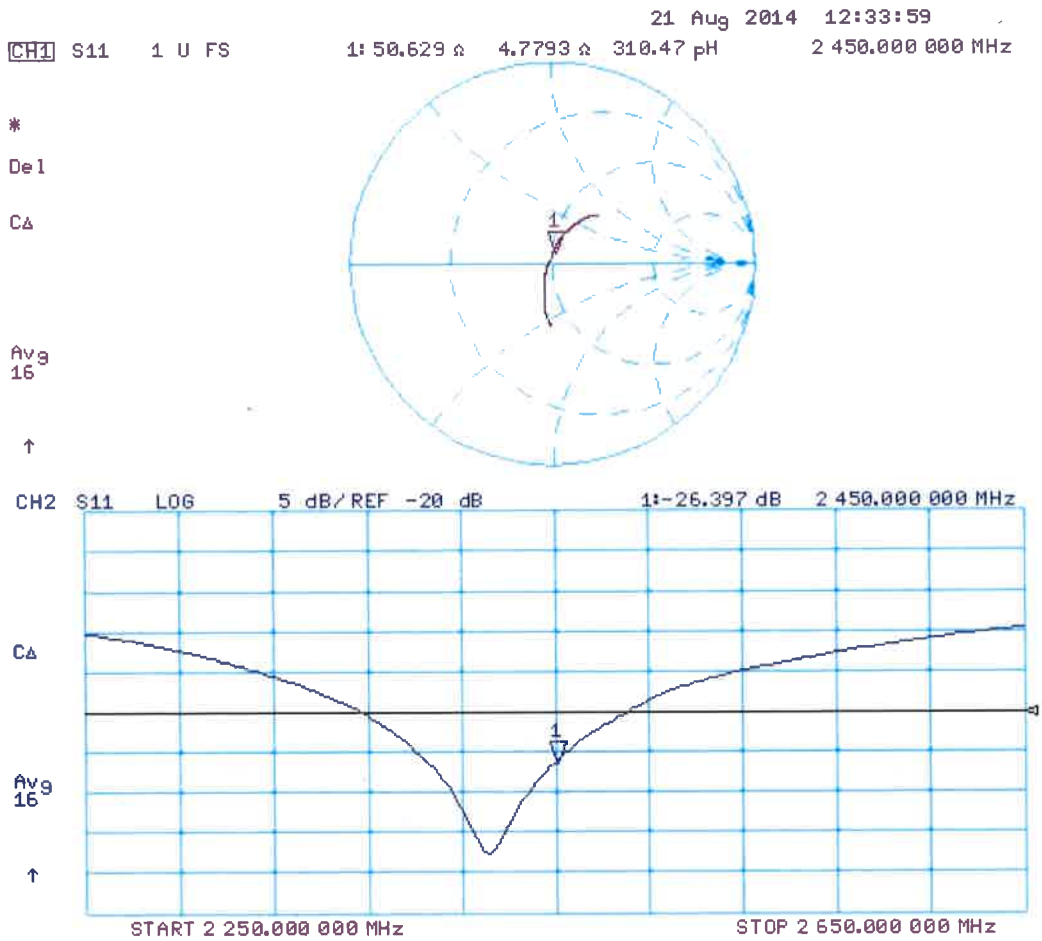
### Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 93.87 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 26.6 W/kg
**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.84 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



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

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

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

**Accreditation No.: SCS 108**

**Client** **B.V. ADT (Auden)**

**Certificate No: D5GHzV2-1019_Aug14**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D5GHzV2 - SN: 1019 |
| Calibration procedure(s) | QA CAL-22.v2<br>Calibration procedure for dipole validation kits between 3-6 GHz |
| Calibration date: | August 25, 2014 |

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) | 03-Apr-14 (No. 217-01918) | Apr-15 |
| Type-N mismatch combination | SN: 5047.2 / 06327 | 03-Apr-14 (No. 217-01921) | Apr-15 |
| Reference Probe EX3DV4 | SN: 3503 | 30-Dec-13 (No. EX3-3503_Dec13) | Dec-14 |
| DAE4 | SN: 601 | 18-Aug-14 (No. DAE4-601_Aug14) | Aug-15 |

| 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-16 |
| 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: August 25, 2014

## 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) IEC 62209-2, "Evaluation of Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices in the Frequency Range of 30 MHz to 6 GHz: Human models, Instrumentation, and Procedures"; Part 2: "Procedure to determine the Specific Absorption Rate (SAR) for including accessories and multiple transmitters", March 2010
b) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"
c) 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

## 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 | V52.8.8 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom V5.0 | |
| **Distance Dipole Center - TSL** | 10 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy = 4.0 mm, dz = 1.4 mm | Graded Ratio = 1.4 (Z direction) |
| **Frequency** | 5200 MHz ± 1 MHz<br>5300 MHz ± 1 MHz<br>5500 MHz ± 1 MHz<br>5600 MHz ± 1 MHz<br>5800 MHz ± 1 MHz | |

## Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 36.0 | 4.66 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 34.7 ± 6 % | 4.48 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5200 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.04 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **79.7 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.30 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **22.7 W/kg ± 19.5 % (k=2)** |

## Head TSL parameters at 5300 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.9 | 4.76 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 34.5 ± 6 % | 4.57 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5300 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.42 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **83.4 W / kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.8 W/kg ± 19.5 % (k=2)** |

## Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.6 | 4.96 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 34.3 ± 6 % | 4.76 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5500 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.54 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **84.6 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.45 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.2 W/kg ± 19.5 % (k=2)** |

## Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.5 | 5.07 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 34.1 ± 6 % | 4.86 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5600 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.47 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **83.8 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.41 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.8 W/kg ± 19.5 % (k=2)** |

## Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 35.3 | 5.27 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 33.9 ± 6 % | 5.06 mho/m ± 6 % |
| **Head TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Head TSL at 5800 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.10 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **80.2 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.30 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **22.7 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 49.0 | 5.30 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 47.0 ± 6 % | 5.32 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5200 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.53 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **74.7 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.11 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.9 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.9 | 5.42 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.8 ± 6 % | 5.45 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5300 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.78 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **77.1 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.16 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.4 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.6 | 5.65 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.5 ± 6 % | 5.71 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5500 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.92 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **78.5 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.21 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.9 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.5 | 5.77 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.3 ± 6 % | 5.84 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5600 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 8.15 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **80.8 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.26 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **22.3 W/kg ± 19.5 % (k=2)** |

## Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 48.2 | 6.00 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 46.0 ± 6 % | 6.12 mho/m ± 6 % |
| **Body TSL temperature change during test** | < 0.5 °C | ---- | ---- |

## SAR result with Body TSL at 5800 MHz

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 100 mW input power | 7.45 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **73.9 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.08 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.6 W/kg ± 19.5 % (k=2)** |

## Appendix (Additional assessments outside the scope of SCS108)

### Antenna Parameters with Head TSL at 5200 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 51.3 Ω - 8.5 jΩ |
| Return Loss | - 21.5 dB |

### Antenna Parameters with Head TSL at 5300 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 53.2 Ω - 1.4 jΩ |
| Return Loss | - 29.4 dB |

### Antenna Parameters with Head TSL at 5500 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 50.8 Ω - 1.6 jΩ |
| Return Loss | - 35.0 dB |

### Antenna Parameters with Head TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.3 Ω - 2.9 jΩ |
| Return Loss | - 23.7 dB |

### Antenna Parameters with Head TSL at 5800 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 55.7 Ω + 1.9 jΩ |
| Return Loss | - 24.8 dB |

### Antenna Parameters with Body TSL at 5200 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 52.2 Ω - 6.6 jΩ |
| Return Loss | - 23.4 dB |

### Antenna Parameters with Body TSL at 5300 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 53.2 Ω - 0.8 jΩ |
| Return Loss | - 29.9 dB |

### Antenna Parameters with Body TSL at 5500 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 51.1 Ω - 0.6 jΩ |
| Return Loss | - 37.8 dB |

## Antenna Parameters with Body TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 57.5 Ω - 0.7 jΩ |
| Return Loss | - 23.1 dB |

## Antenna Parameters with Body TSL at 5800 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.9 Ω + 4.4 jΩ |
| Return Loss | - 22.4 dB |

## General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.205 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 | February 05, 2004 |

## DASY5 Validation Report for Head TSL

Date: 25.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1019**

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 4.48 S/m; $\varepsilon_r$ = 34.7; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5300 MHz; $\sigma$ = 4.57 S/m; $\varepsilon_r$ = 34.5; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5500 MHz; $\sigma$ = 4.76 S/m; $\varepsilon_r$ = 34.3; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 4.86 S/m; $\varepsilon_r$ = 34.1; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 5.06 S/m; $\varepsilon_r$ = 33.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.52, 5.52, 5.52); Calibrated: 30.12.2013, ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2013, ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.86, 4.86, 4.86); Calibrated: 30.12.2013, ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

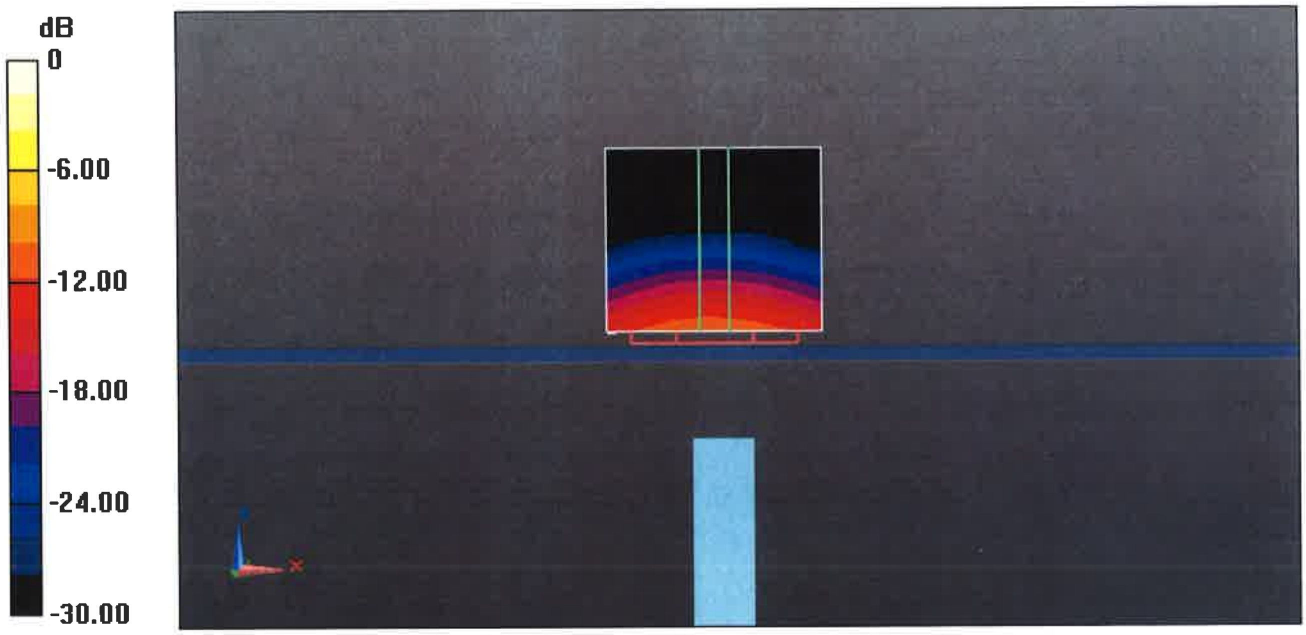
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.25 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 28.8 W/kg
**SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.3 W/kg**
Maximum value of SAR (measured) = 18.4 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.75 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 31.4 W/kg
**SAR(1 g) = 8.42 W/kg; SAR(10 g) = 2.41 W/kg**
Maximum value of SAR (measured) = 19.3 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.08 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 32.8 W/kg
**SAR(1 g) = 8.54 W/kg; SAR(10 g) = 2.45 W/kg**
Maximum value of SAR (measured) = 20.0 W/kg

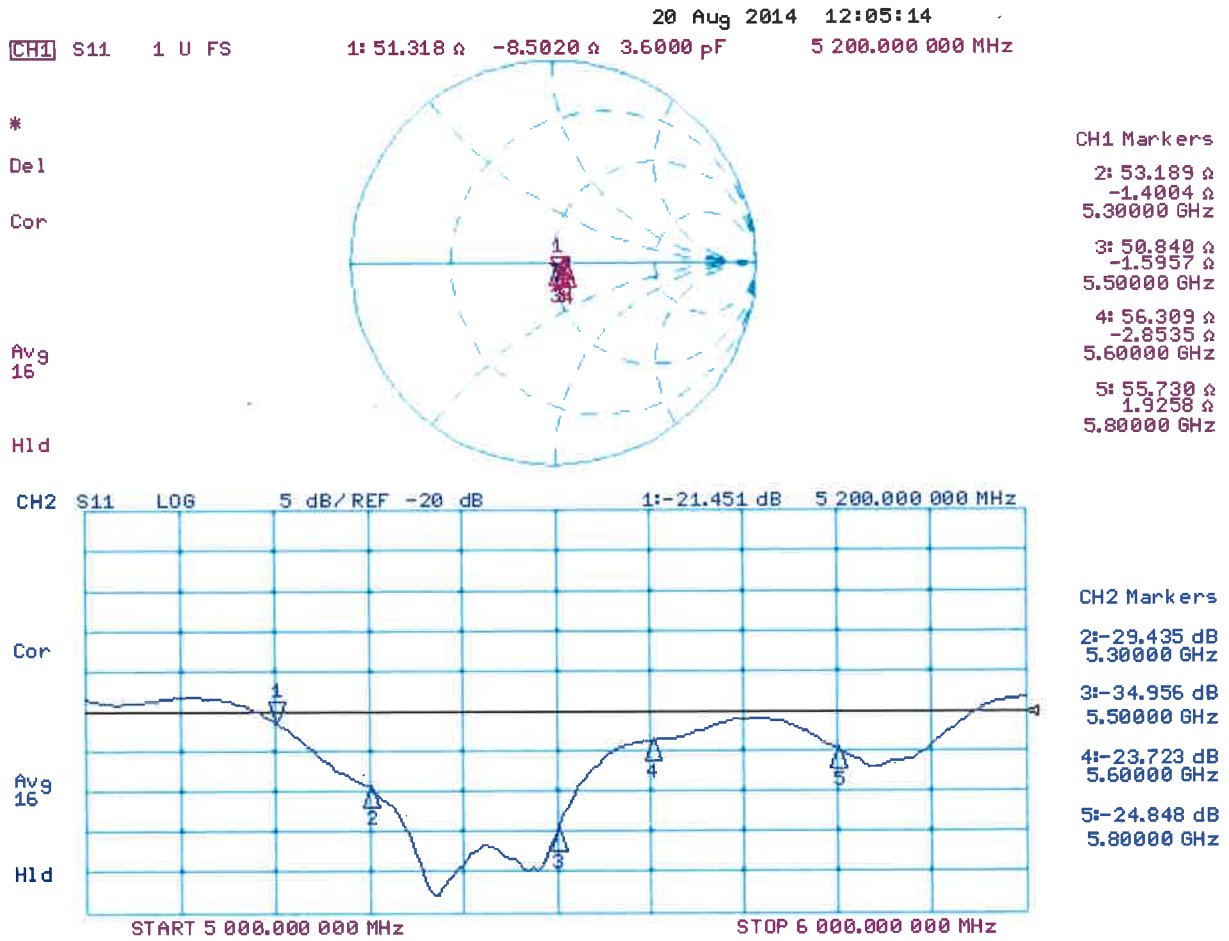
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.30 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 33.1 W/kg
**SAR(1 g) = 8.47 W/kg; SAR(10 g) = 2.41 W/kg**
Maximum value of SAR (measured) = 20.1 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 63.27 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 32.9 W/kg
**SAR(1 g) = 8.1 W/kg; SAR(10 g) = 2.3 W/kg**
Maximum value of SAR (measured) = 19.4 W/kg




0 dB = 19.4 W/kg = 12.88 dBW/kg

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 25.08.2014

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1019**

Communication System: UID 0 - CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5500 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 5.32 S/m; $\varepsilon_r$ = 47; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5300 MHz; $\sigma$ = 5.45 S/m; $\varepsilon_r$ = 46.8; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5500 MHz; $\sigma$ = 5.71 S/m; $\varepsilon_r$ = 46.5; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 5.84 S/m; $\varepsilon_r$ = 46.3; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 6.12 S/m; $\varepsilon_r$ = 46; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2013, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013, ConvF(4.52, 4.52, 4.52); Calibrated: 30.12.2013, ConvF(4.3, 4.3, 4.3); Calibrated: 30.12.2013, ConvF(4.47, 4.47, 4.47); Calibrated: 30.12.2013;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

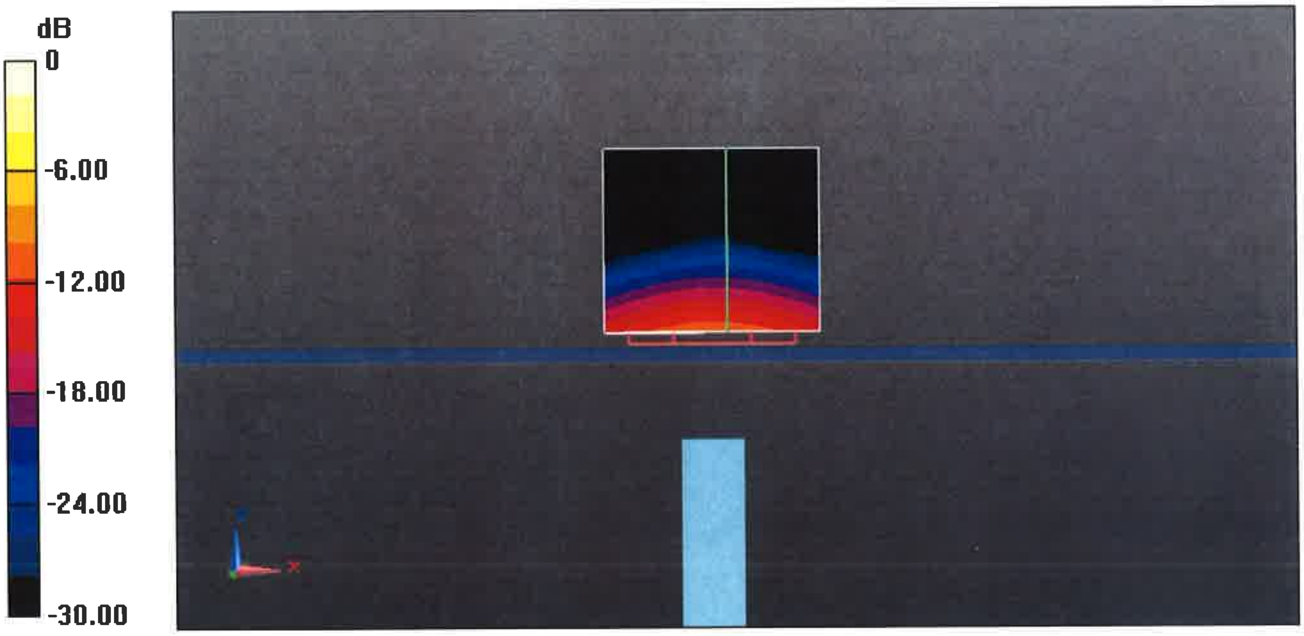
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.85 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 28.7 W/kg
**SAR(1 g) = 7.53 W/kg; SAR(10 g) = 2.11 W/kg**
Maximum value of SAR (measured) = 17.5 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.61 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 30.9 W/kg
**SAR(1 g) = 7.78 W/kg; SAR(10 g) = 2.16 W/kg**
Maximum value of SAR (measured) = 18.7 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5500 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 60.11 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 32.8 W/kg
**SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.21 W/kg**
Maximum value of SAR (measured) = 19.1 W/kg

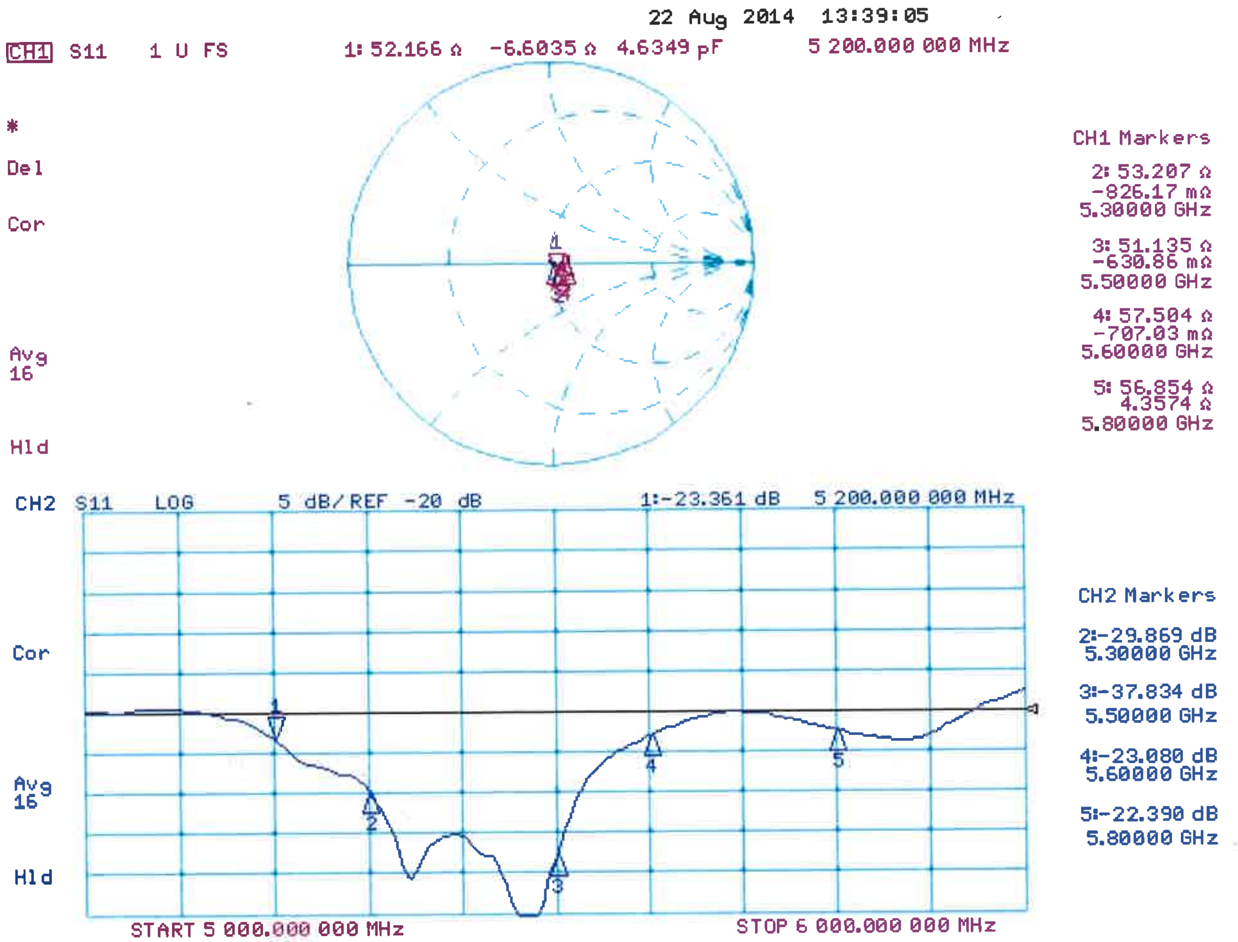
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 59.88 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 34.7 W/kg
**SAR(1 g) = 8.15 W/kg; SAR(10 g) = 2.26 W/kg**
Maximum value of SAR (measured) = 19.8 W/kg

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5800 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 56.48 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 33.2 W/kg
**SAR(1 g) = 7.45 W/kg; SAR(10 g) = 2.08 W/kg**
Maximum value of SAR (measured) = 18.6 W/kg




0 dB = 18.6 W/kg = 12.70 dBW/kg

## Impedance Measurement Plot for Body TSL



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

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

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

**Accreditation No.: SCS 108**

**Client** **B.V.ADT (Auden)**

**Certificate No: EX3-3590_Mar14**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3590 |
| Calibration procedure(s) | QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | March 4, 2014 |

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 | 30-Dec-13 (No. ES3-3013_Dec13) | Dec-14 |
| DAE4 | SN: 660 | 13-Dec-13 (No. DAE4-660_Dec13) | Dec-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-16 |
| Network Analyzer HP 8753E | US37390585 | 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: March 4, 2014

## 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 |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

## 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

## 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.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

# Probe EX3DV4

## SN:3590

Manufactured: March 23, 2009
Calibrated: March 4, 2014

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm (μV/(V/m)$^2$)[A] | 0.50 | 0.47 | 0.50 | ± 10.1 % |
| DCP (mV)[B] | 94.6 | 96.4 | 95.9 | |

## 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 | 146.4 | ±3.5 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 168.7 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 160.8 | |

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:3590

## 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 [G] | Depth [G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 10.89 | 10.89 | 10.89 | 0.25 | 1.15 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 10.52 | 10.52 | 10.52 | 0.62 | 0.67 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 10.53 | 10.53 | 10.53 | 0.61 | 0.63 | ± 12.0 % |
| 1450 | 40.5 | 1.20 | 9.12 | 9.12 | 9.12 | 0.80 | 0.50 | ± 12.0 % |
| 1640 | 40.3 | 1.29 | 8.96 | 8.96 | 8.96 | 0.76 | 0.55 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 8.92 | 8.92 | 8.92 | 0.80 | 0.56 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 8.70 | 8.70 | 8.70 | 0.43 | 0.74 | ± 12.0 % |
| 2000 | 40.0 | 1.40 | 8.61 | 8.61 | 8.61 | 0.39 | 0.79 | ± 12.0 % |
| 2300 | 39.5 | 1.67 | 8.30 | 8.30 | 8.30 | 0.35 | 0.82 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.95 | 7.95 | 7.95 | 0.53 | 0.68 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 7.76 | 7.76 | 7.76 | 0.49 | 0.73 | ± 12.0 % |
| 3500 | 37.9 | 2.91 | 7.88 | 7.88 | 7.88 | 0.88 | 0.57 | ± 13.1 % |
| 5200 | 36.0 | 4.66 | 5.57 | 5.57 | 5.57 | 0.35 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 5.33 | 5.33 | 5.33 | 0.35 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 5.06 | 5.06 | 5.06 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.94 | 4.94 | 4.94 | 0.35 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.89 | 4.89 | 4.89 | 0.40 | 1.80 | ± 13.1 % |

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

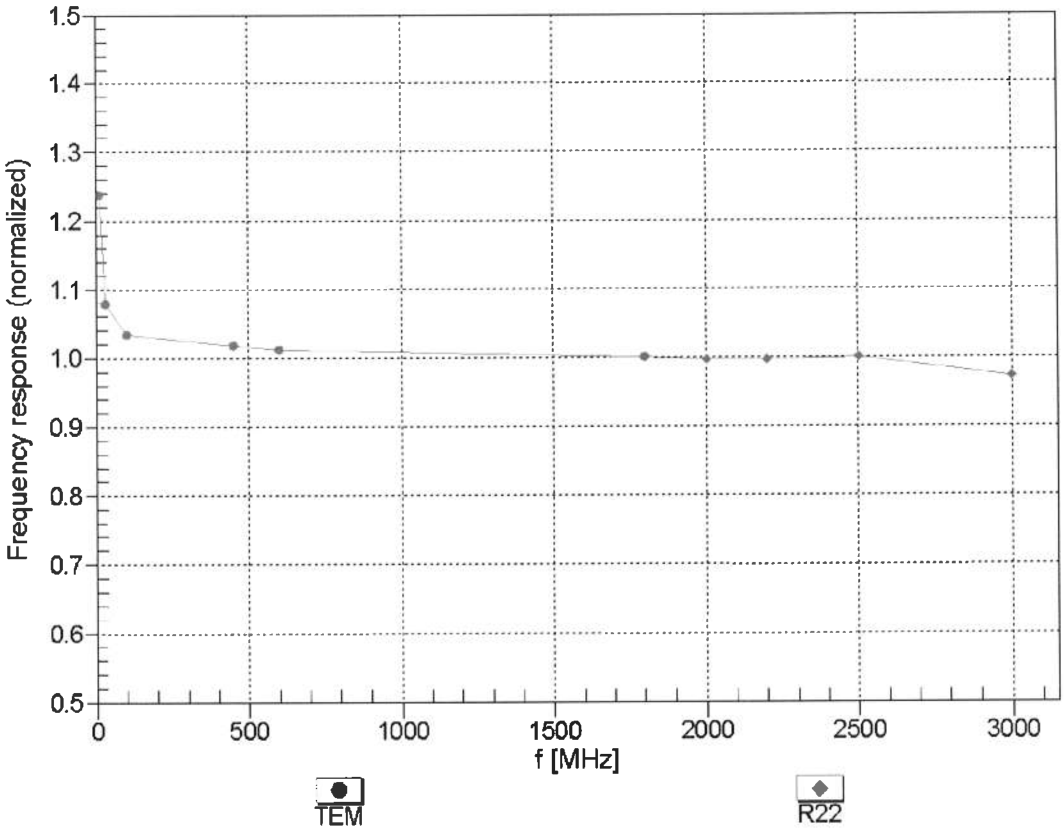
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

## 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 [G] | Depth [G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 10.39 | 10.39 | 10.39 | 0.43 | 0.81 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 10.31 | 10.31 | 10.31 | 0.77 | 0.60 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 10.13 | 10.13 | 10.13 | 0.77 | 0.60 | ± 12.0 % |
| 1450 | 54.0 | 1.30 | 8.83 | 8.83 | 8.83 | 0.34 | 0.94 | ± 12.0 % |
| 1640 | 53.8 | 1.40 | 9.04 | 9.04 | 9.04 | 0.40 | 0.88 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 8.35 | 8.35 | 8.35 | 0.52 | 0.76 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 8.11 | 8.11 | 8.11 | 0.37 | 0.86 | ± 12.0 % |
| 2000 | 53.3 | 1.52 | 8.24 | 8.24 | 8.24 | 0.36 | 0.85 | ± 12.0 % |
| 2300 | 52.9 | 1.81 | 7.96 | 7.96 | 7.96 | 0.59 | 0.65 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.72 | 7.72 | 7.72 | 0.80 | 0.50 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 7.49 | 7.49 | 7.49 | 0.80 | 0.50 | ± 12.0 % |
| 3500 | 51.3 | 3.31 | 7.51 | 7.51 | 7.51 | 0.68 | 0.74 | ± 13.1 % |
| 5200 | 49.0 | 5.30 | 5.16 | 5.16 | 5.16 | 0.40 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.92 | 4.92 | 4.92 | 0.40 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 4.64 | 4.64 | 4.64 | 0.40 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 4.62 | 4.62 | 4.62 | 0.35 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.74 | 4.74 | 4.74 | 0.45 | 1.90 | ± 13.1 % |

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

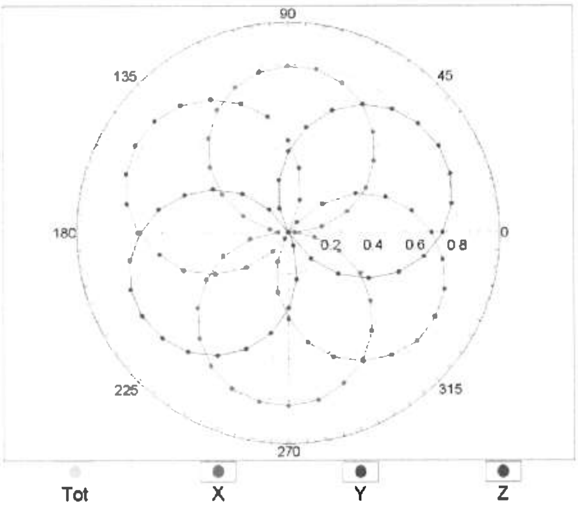
# Frequency Response of E-Field
## (TEM-Cell:ifi110 EXX, Waveguide: R22)



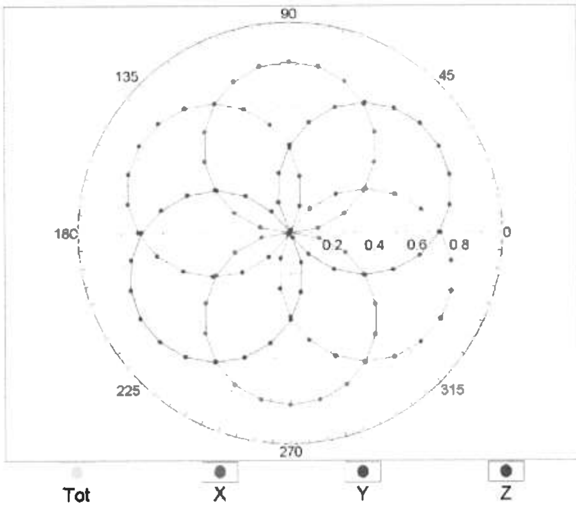

**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

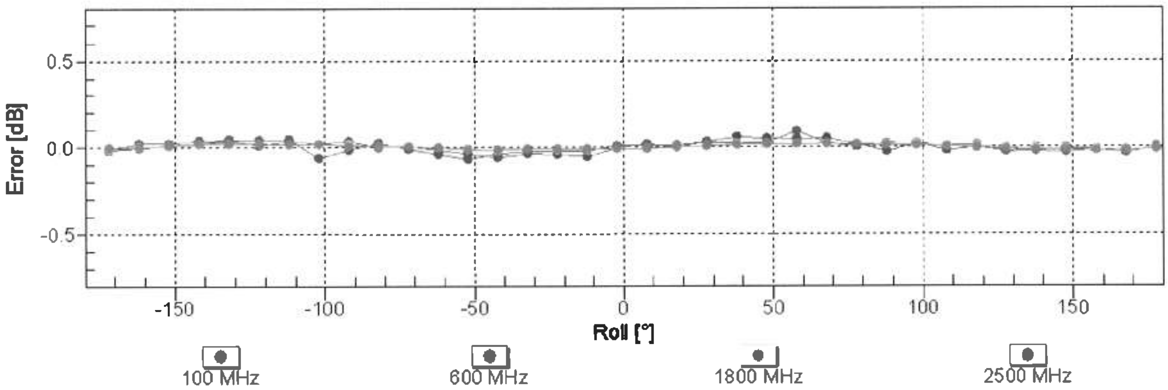
# Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



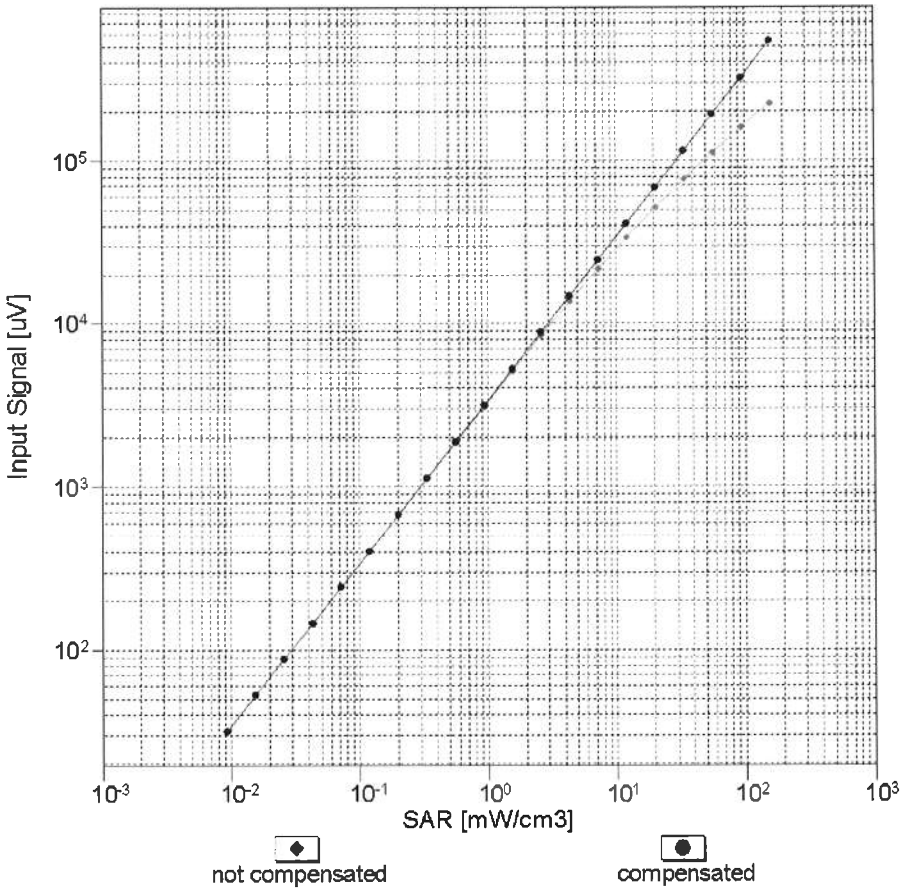

f=1800 MHz,R22

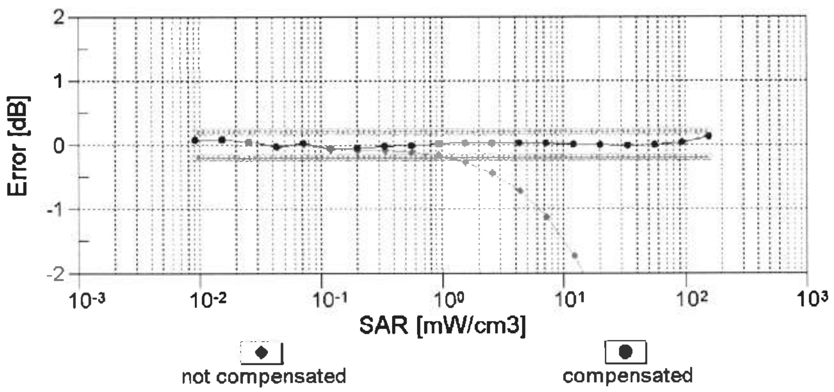



**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

# Dynamic Range f($SAR_{head}$)
**(TEM cell , $f_{eval}$= 1900 MHz)**

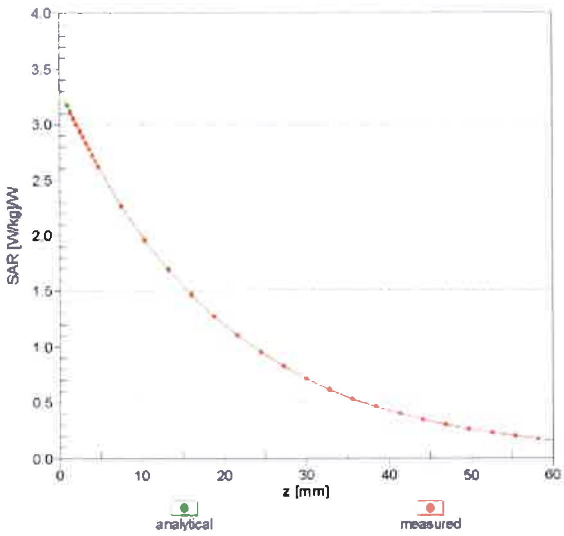


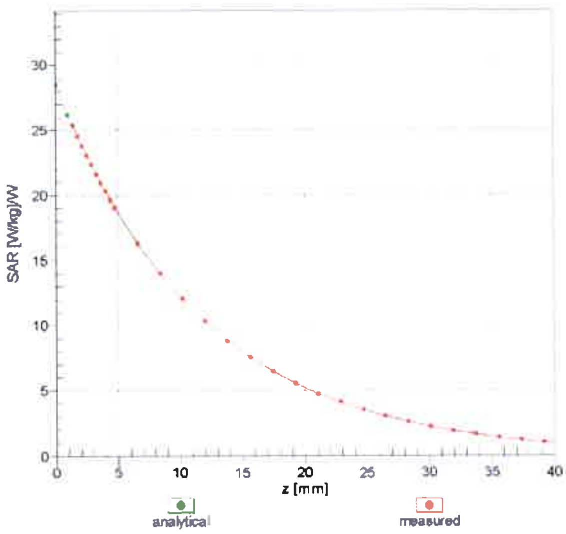

**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

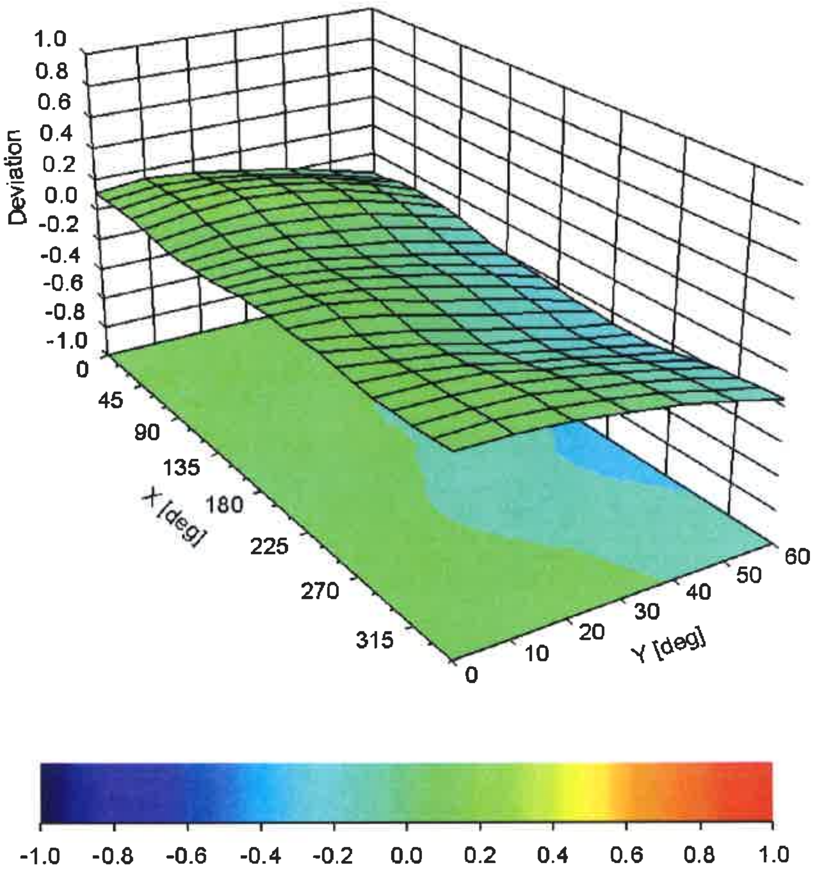



f = 1900 MHz,WGLS R22 (H_convF)




# 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:3590

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -142.1 |
| 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. Photographs of EUT and Setup