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# CERTIFICATE OF COMPLIANCE
# SAR EVALUATION

| | | | |
|---|---|---|---|
| Intel Mobile Communications | | Dates of Test: | August 15-19, 2014 |
| 100 Center Point Circle, Suite 200 | | Test Report Number: | SAR.20140812 |
| Columbia, SC 29210 | | | |

| | |
|---|---|
| FCC ID: | PD917265NG |
| IC Certificate: | 1000M-17265NG |
| Model(s): | 17265NGW, 7265NGW LC |
| Test Sample: | Engineering Unit Same as Production |
| MAC ID Number: | 001500F78D62 |
| Equipment Type: | Wireless Module |
| Classification: | Portable Transmitter Next to Body |
| TX Frequency Range: | 2412 – 2462 MHz; 5180 – 5320 MHz; 5500 – 5700 MHz; 5745 – 5825 MHz |
| Frequency Tolerance: | ± 2.5 ppm |
| Maximum RF Output: | 2450 MHz (b) – 17.50 dB, 2450 MHz (g) – 17.50 dB, 2450 MHz (n20) – 17.50 dB, 2450 MHz (n40) – 16.50 dB, 5250 MHz (a) – 16.00 dB, 5250 MHz (n20) – 16.00 dB, 5250 MHz (n40) – 16.50 dB, 5250 MHz (ac) – 13.50 dB, 5600 MHz (a) – 16.50 dB, 5600 MHz (n20) – 16.50 dB, 5600 MHz (n40) – 16.50 dB, 5600 MHz (ac) – 16.50 dB, 5800 MHz (a) – 16.50 dB, 5800 MHz (n20) – 16.50 dB, 5800 MHz (n40) – 16.50 dB 5800 MHz (ac) – 16.50 dB Conducted |
| Signal Modulation: | DSSS, OFDM |
| Antenna Type: | SkyCross Electronics (Shenzhen) Co., Ltd., PIFA Antenna |
| Application Type: | Certification |
| FCC Rule Parts: | Part 2, 15C, 15E |
| KDB Test Methodology: | KDB 447498 D01 v05r02, KDB 248227 v01r02, KDB 616217 D04 v01r01 |
| Industry Canada: | RSS-102, Safety Code 6 |
| Maximum SAR Value: | 0.76 W/kg Reported |
| Maximum Simultaneous SAR: | 1.48 W/kg Reported |
| Separation Distance: | 8 mm |

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2013 and IEC 62209-2:2010 (See test report).

I attest to the accuracy of the data. All measurements were performed by myself or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RF Exposure Lab, LLC certifies that no party to this application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Jay M. Moulton
Vice President

ACCREDITED
Testing Cert. # 2387.01

# Table of Contents

# 1. Introduction

This measurement report shows compliance of the Intel Mobile Communications Model(s) 17265NGW, 7265NGW LC FCC ID: PD917265NG with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices and IC Certificate: 1000M-17265NG with RSS102 & Safety Code 6. The FCC have adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1], [6]

The test results recorded herein are based on a single type test of Intel Corporation Model 7265NGW and therefore apply only to the tested sample.

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], IEEE Std.1528 – 2013 Recommended Practice [4], and Industry Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz were employed.

The following table indicates all the wireless technologies operating in the 17265NGW, 17265NGW LC wireless modem. The table also shows the tolerance for the power level for each mode tested.

| Band | Technology | 3GPP Nominal Power dBm | Setpoint Nominal Power dBm | Tolerance dBm | Lower Tolerance dBm | Upper Tolerance dBm |
|---|---|---|---|---|---|---|
| WLAN – 2.4 GHz | 802.11b (Ch. 2-10) | N/A | 16 | ±1.5 | 14.5 | 17.5 |
| WLAN – 2.4 GHz | 802.11b (Ch. 1,11) | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 2.4 GHz | 802.11g/n20(Ch. 3-9) | N/A | 16 | ±1.5 | 14.5 | 17.5 |
| WLAN – 2.4 GHz | 802.11g/n20(Ch. 2,10) | N/A | 14 | ±1.5 | 12.5 | 15.5 |
| WLAN – 2.4 GHz | 802.11g/n20(Ch. 1,11) | N/A | 11 | ±1.5 | 9.5 | 12.5 |
| WLAN – 2.4 GHz | n40 SISO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 2.4 GHz | n40 MIMO | N/A | 12 | ±1.5 | 10.5 | 13.5 |
| WLAN – 5 GHz Band I, II | 802.11a/n20 (Ch. 40-60) | N/A | 14.5 | ±1.5 | 13 | 16 |
| WLAN – 5 GHz Band I, II | 802.11a/n20 (Ch. 36-64) | N/A | 12.5 | ±1.5 | 11 | 14 |
| WLAN – 5 GHz Band I, II | 40 MHz SISO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band I, II | 40 MHz MIMO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band I, II | 80 MHz SISO | N/A | 12 | ±1.5 | 10.5 | 13.5 |
| WLAN – 5 GHz Band I, II | 80 MHz MIMO | N/A | 12 | ±1.5 | 10.5 | 13.5 |
| WLAN – 5 GHz Band III | 802.11a/n20 (Ch. 104-136) | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band III | 802.11a/n20 (Ch. 100) | N/A | 12 | ±1.5 | 10.5 | 13.5 |
| WLAN – 5 GHz Band III | 802.11a/n20 (Ch. 140) | N/A | 11.5 | ±1.5 | 10 | 13 |
| WLAN – 5 GHz Band III | 40 MHz SISO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band III | 40 MHz MIMO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band III | 80 MHz SISO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band III | 80 MHz MIMO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band IV | 802.11a/n20 (Ch. 149-165) | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band IV | 40 MHz SISO & MIMO | N/A | 15 | ±1.5 | 13.5 | 16.5 |
| WLAN – 5 GHz Band IV | 80 MHz SISO & MIMO | N/A | 15 | ±1.5 | 13.5 | 16.5 |

## SAR Definition [5]

Specific Absorption Rate is defined as 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 ($\rho$).

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

SAR is expressed in units of watts per kilogram (W/kg). *SAR* can be related to the electric field at a point by

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

where:

$\sigma$ = conductivity of the tissue (S/m)

$\rho$ = mass density of the tissue (kg/m$^3$)

*E* = rms electric field strength (V/m)

# 2. SAR Measurement Setup

## Robotic System

These measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Intel Core2 computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

## System Hardware

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the HP Intel Core2 computer with Windows XP system and SAR Measurement Software DASY52, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot.  A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC).  The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

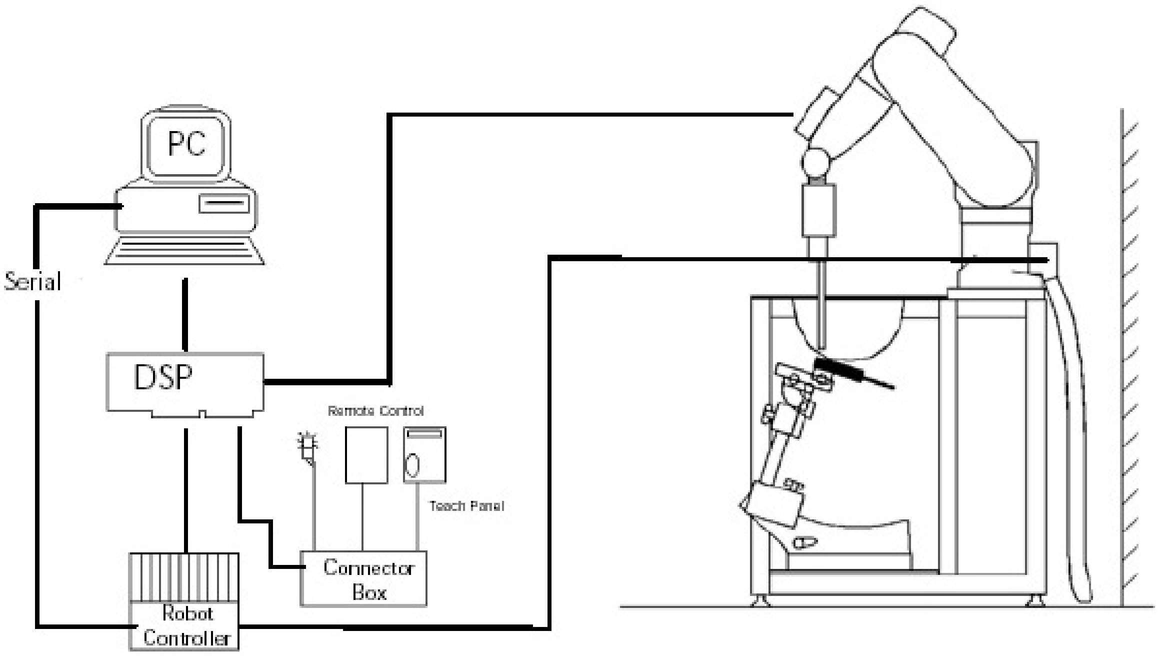



**Figure 2.1 SAR Measurement System Setup**

## System Electronics

The DAE4 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

## Probe Measurement System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 2.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip. (see Fig. 2.3) It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY52 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

**DAE System**

## Probe Specifications

**Calibration:** In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of 450 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

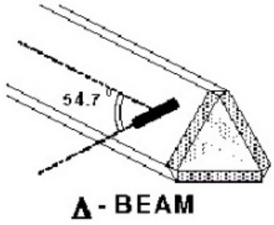



Figure 2.2 Triangular Probe Configurations

**Frequency**: 10 MHz to 6 GHz

**Linearity:** ±0.2dB (30 MHz to 6 GHz)

**Dynamic:** 10 mW/kg to 100 W/kg

**Range:** Linearity: ±0.2dB

**Dimensions:** Overall length: 330 mm

**Tip length:** 20 mm

**Body diameter:** 12 mm

**Tip diameter:** 2.5 mm

**Distance from probe tip to sensor center:** 1 mm

Figure 2.3 Probe Thick-Film Technique

**Application:** SAR Dosimetry Testing
Compliance tests of wireless device

# Probe Calibration Process

## Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

## Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm$^2$.

## Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor based temperature probe is used in conjunction with the E-field probe

$$SAR = C\frac{\Delta T}{\Delta t}$$

where:

$\Delta t$ = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

$\Delta T$ = temperature increase due to RF exposure.

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

where:

$\sigma$ = simulated tissue conductivity,

$\rho$ = Tissue density (1.25 g/cm$^3$ for brain tissue)

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

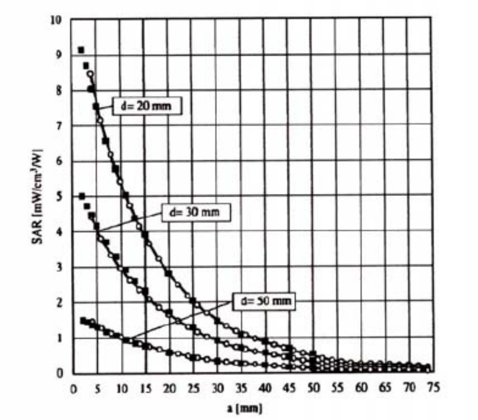



**Figure 2.4 E-Field and Temperature Measurements at 900MHz**

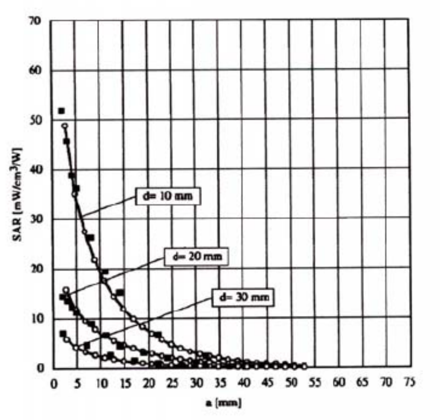



**Figure 2.5 E-Field and Temperature Measurements at 1800MHz**

## Data Extrapolation

The DASY52 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

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

with $V_i$ = compensated signal of channel i (i=x,y,z)
$U_i$ = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
$dcp_i$ = diode compression point (DASY parameter)

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

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with $V_i$ = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
$E_i$ = electric field strength of channel i in V/m

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

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

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

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

with SAR = local specific absorption rate in W/g
$E_{tot}$ = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm³

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with $P_{pwe}$ = equivalent power density of a plane wave in W/cm²
$E_{tot}$ = total electric field strength in V/m

## Scanning procedure

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

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

- The highest integrated SAR value is the main concern in compliance test applications. These values can mostly be found at the inner surface of the phantom and cannot be measured directly due to the sensor offset in the probe. To extrapolate the surface values, the measurement distances to the surface must be known accurately. A distance error of 0.5mm could produce SAR errors of 6% at 1800 MHz. Using predefined locations for measurements is not accurate enough. Any shift of the phantom (e.g., slight deformations after filling it with liquid) would produce high uncertainties. For an automatic and accurate detection of the phantom surface, the DASY5 system uses the mechanical surface detection. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

- The „area scan“ measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The scan uses different grid spacings for different frequency measurements. Standard grid spacing for head measurements in frequency ranges ≤ 2GHz is 15 mm in x - and y-dimension. For higher frequencies a finer resolution is needed, thus for the grid spacing is reduced according the following table:

| **Area scan grid spacing for different frequency ranges** | |
|---|---|
| Frequency range | Grid spacing |
| ≤ 2 GHz | ≤ 15 mm |
| 2 – 4 GHz | ≤ 12 mm |
| 4 – 6 GHz | ≤ 10 mm |

Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation. Results of this coarse scan are shown in annex B.

- A „zoom scan” measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse“ scan. It uses a fine meshed grid where the robot moves the probe in steps along all the 3 axis (x,y and z-axis) starting at the bottom of the Phantom. The grid spacing for the cube measurement is varied according to the measured frequency range, the dimensions are given in the following table:

| **Zoom scan grid spacing and volume for different frequency ranges** | | | |
|---|---|---|---|
| Frequency range | Grid spacing for x, y axis | Grid spacing for z axis | Minimum zoom scan volume |
| ≤ 2 GHz | ≤ 8 mm | ≤ 5 mm | ≥ 30 mm |
| 2 – 3 GHz | ≤ 5 mm | ≤ 5 mm | ≥ 28 mm |
| 3 – 4 GHz | ≤ 5 mm | ≤ 4 mm | ≥ 28 mm |
| 4 – 5 GHz | ≤ 4 mm | ≤ 3 mm | ≥ 25 mm |
| 5 – 6 GHz | ≤ 4 mm | ≤ 2 mm | ≥ 22 mm |

DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex B. Test results relevant for the specified standard (see section 3) are shown in table form in section 7.

## Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of all points in the three directions x, y and z. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 1 to 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

## Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

## Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff ].

## Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

## Advanced Extrapolation

DASY uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

## SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. 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 the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 2.6)

## Phantom Specification

**Phantom:** SAM Twin Phantom (V4.0)
**Shell Material:** Vivac Composite
**Thickness:** 2.0 ± 0.2 mm

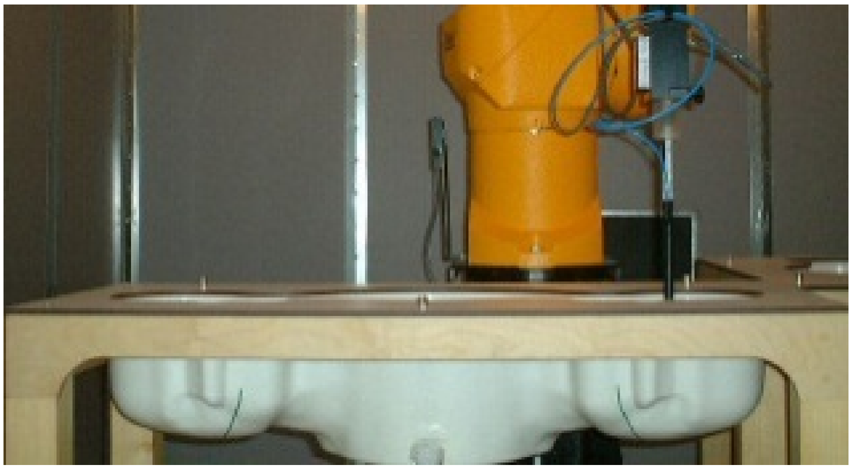


**Figure 2.6 SAM Twin Phantom**

## Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 2.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeat ably be positioned according to the FCC, CENELEC, IEC and IEEE specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

**Figure 2.7 Mounting Device**

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

# 3. Probe and Dipole Calibration

**See Appendix D and E.**

# 4. Phantom & Simulating Tissue Specifications

## Head & Body Simulating Mixture Characterization

The head and body mixtures consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. Body tissue parameters that have not been specified in IEEE1528:2010 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations.

**Table 4.1 Typical Composition of Ingredients for Tissue**

| Ingredients | | Simulating Tissue | | | |
|---|---|---|---|---|---|
| | | 2450 MHz Body | 5250 MHz Body | 5600 MHz Body | 5785 MHz Body |
| Mixing Percentage | | | | | |
| Water | | 73.20 | Proprietary Mixture Purchased from Speag | | |
| Sugar | | 0.00 | | | |
| Salt | | 0.04 | | | |
| HEC | | 0.00 | | | |
| Bactericide | | 0.00 | | | |
| DGBE | | 26.70 | | | |
| Dielectric Constant | Target | 52.70 | 48.96 | 48.47 | 48.25 |
| Conductivity (S/m) | Target | 1.95 | 5.35 | 5.77 | 5.96 |

# 5. ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2]

## Uncontrolled Environment

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

## Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 5.1 Human Exposure Limits**

| | UNCONTROLLED ENVIRONMENT<br>General Population<br>(W/kg) or (mW/g) | CONTROLLED ENVIROMENT<br>Professional Population<br>(W/kg) or (mW/g) |
|---|---|---|
| SPATIAL PEAK SAR[1]<br>Head | 1.60 | 8.00 |
| SPATIAL AVERAGE SAR[2]<br>Whole Body | 0.08 | 0.40 |
| SPATIAL PEAK SAR[3]<br>Hands, Feet, Ankles, Wrists | 4.00 | 20.00 |

[1] The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
[2] The Spatial Average value of the SAR averaged over the whole body.
[3] The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

# 6. Measurement Uncertainty

Measurement uncertainty table is not required per KDB 865664 D01 v01 section 2.8.2 page 12. SAR measurement uncertainty analysis is required in the SAR report only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR. The equivalent ratio (1.5/1.6) should be applied to extremity and occupational exposure conditions. The highest reported value is less than 1.5 W/kg. Therefore, the measurement uncertainty table is not required.

# 7. System Validation

## Tissue Verification

**Table 7.1 Measured Tissue Parameters**

| | | 2450 MHz Body | | 5200 MHz Body | |
|---|---|---|---|---|---|
| Date(s) | | Aug. 19, 2014 | | Aug. 15, 2014 | |
| Liquid Temperature (˚C) | 20.0 | Target | Measured | Target | Measured |
| Dielectric Constant: ε | | 52.70 | 52.57 | 49.01 | 48.92 |
| Conductivity: σ | | 1.95 | 2.00 | 5.30 | 5.41 |
| | | 5600 MHz Body | | 5800 MHz Body | |
| Date(s) | | Aug. 15, 2014 | | Aug. 15, 2014 | |
| Liquid Temperature (˚C) | 20.0 | Target | Measured | Target | Measured |
| Dielectric Constant: ε | | 48.47 | 48.33 | 48.22 | 48.05 |
| Conductivity: σ | | 5.77 | 5.93 | 5.98 | 6.15 |

See Appendix A for data printout.

## Test System Verification

Prior to assessment, the system is verified to the ±10% of the specifications at the test frequency by using the system kit. Power is normalized to 1 watt. (Graphic Plots Attached)

**Table 7.2 System Dipole Validation Target & Measured**

| | Test Frequency | Targeted $SAR_{1g}$ (W/kg) | Measure $SAR_{1g}$ (W/kg) | Tissue Used for Verification | Deviation to Target SAR (%) | Plot Number |
|---|---|---|---|---|---|---|
| 19-Aug-2014 | 2450 MHz | 51.50 | 51.40 | Body | - 0.19 | 1 |
| 15-Aug-2014 | 5200 MHz | 73.40 | 73.90 | Body | + 0.68 | 2 |
| 15-Aug-2014 | 5600 MHz | 79.10 | 80.10 | Body | + 1.26 | 3 |
| 15-Aug-2014 | 5800 MHz | 72.90 | 73.00 | Body | + 0.14 | 4 |

See Appendix A for data plots.

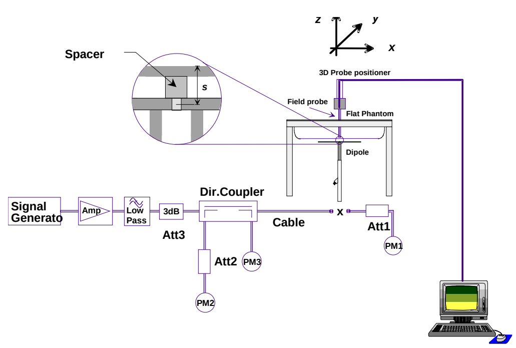



**Figure 7.1 Dipole Validation Test Setup**

# 8. SAR Test Data Summary

## See Measurement Result Data Pages

See Appendix B for SAR Test Data Plots.
See Appendix C for SAR Test Setup Photos.

## Procedures Used To Establish Test Signal

The device was either placed into simulated transmit mode using the manufacturer's test codes or the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

## Device Test Condition

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula ((end/start)-1)*100 and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

The EUT was installed into a computer. The computer was used to configure the EUT to continuously transmit at a maximum output power on the channel specified in the test data.

The data rates used when evaluating the WiFi transmitter were the lowest data rates for each mode. The device was operating at its maximum output power at the lowest data rate for all measurements.

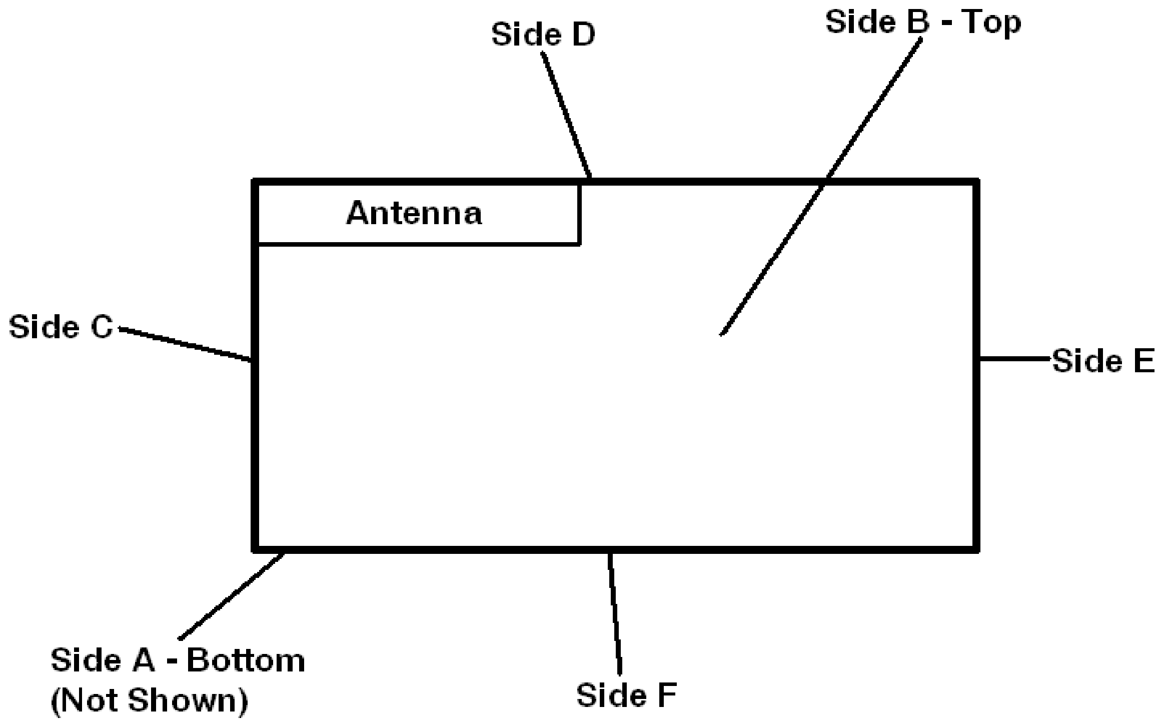
Bluetooth operation was evaluated per RSS102 Draft Issue 5. The Bluetooth transmitter does simultaneously transmit with the WiFi transmitter. When BT and WiFi are transmitting simultaneously, WiFi will transmit on Chain A and BT will transmit on Chain B. The installation guide has instructions to the installer to set the two antennas with a minimum of 50 mm separation. Simultaneous transmission is evaluated on page 38.

The PC was using the Intel test utility DRTU Version 1.7.3-859 and the device driver was version 17.0.0.20.

The EUT antenna is a two-antenna PIFA antenna system – SkyCross Electronics (Shenzhen) Co., Ltd. The antenna connects to the EUT via a non-standard antenna connector.

The antenna was tested on all six sides of the antenna device. During each test, the antenna was on a minimum of 10 cm of Styrofoam during the test. The coaxial cable from the module to the antenna was 500 mm in length. The laptop was set to be >10 cm from the antenna during the test. The following is a pictorial drawing of the locations.

**SAR Location Diagram**



| Band | Mode | Bandwidth (MHz) | Channel | Frequency (MHz) | Data Rate | Antenna | Power (dBm) |
|---|---|---|---|---|---|---|---|
| 2450 MHz | 802.11b | 20 | 1 | 2412 | 1 Mbps | Chain A | 16.49 |
| | | | 6 | 2437 | | | 17.50 |
| | | | 11 | 2462 | | | 16.47 |
| | | | 1 | 2412 | | Chain B | 16.47 |
| | | | 6 | 2437 | | | 17.50 |
| | | | 11 | 2462 | | | 16.45 |
| | 802.11g | 20 | 1 | 2412 | 6 Mbps | Chain A | 13.97 |
| | | | 6 | 2437 | | | 17.49 |
| | | | 11 | 2462 | | | 12.42 |
| | | | 1 | 2412 | | Chain B | 14.43 |
| | | | 6 | 2437 | | | 17.44 |
| | | | 11 | 2462 | | | 12.46 |
| | 802.11n | 20 | 1 | 2412 | HT4 | Chain A | 13.92 |
| | | | 6 | 2437 | | | 17.46 |
| | | | 11 | 2462 | | | 12.44 |
| | | | 1 | 2412 | | Chain B | 14.39 |
| | | | 6 | 2437 | | | 17.42 |
| | | | 11 | 2462 | | | 12.40 |
| | 802.11n | 40 | 3 | 2422 | HT4 | Chain A | 13.42 |
| | | | 6 | 2437 | | | 16.46 |
| | | | 9 | 2452 | | | 12.40 |
| | | | 3 | 2422 | | Chain B | 13.43 |
| | | | 6 | 2437 | | | 16.47 |
| | | | 9 | 2452 | | | 11.42 |
| 5.15-5.25 GHz | 802.11a | 20 | 36 | 5180 | 6 Mbps | Chain A | 13.97 |
| | | | 40 | 5200 | | | 15.92 |
| | | | 44 | 5220 | | | 16.00 |
| | | | 48 | 5240 | | | 15.93 |
| | | | 36 | 5180 | | Chain B | 13.92 |
| | | | 40 | 5200 | | | 15.96 |
| | | | 44 | 5220 | | | 16.00 |
| | | | 48 | 5240 | | | 15.94 |
| | 802.11n | 20 | 36 | 5180 | HT4 | Chain A | 13.92 |
| | | | 40 | 5200 | | | 15.90 |
| | | | 44 | 5220 | | | 16.00 |
| | | | 48 | 5240 | | | 15.95 |
| | | | 36 | 5180 | | Chain B | 13.97 |
| | | | 40 | 5200 | | | 15.94 |
| | | | 44 | 5220 | | | 16.00 |
| | | | 48 | 5240 | | | 15.93 |
| | 802.11n | 40 | 38 | 5190 | HT4 | Chain A | 11.94 |
| | | | 46 | 5230 | | | 16.47 |
| | | | 38 | 5190 | HT4 | Chain B | 13.42 |
| | | | 46 | 5230 | | | 16.49 |
| | 802.11ac | 80 | 42 | 5210 | VHT6 | Chain A | 13.47 |
| | | | | | | Chain B | 13.42 |
| 5.25-5.35 GHz | 802.11a | 20 | 52 | 5260 | 6 Mbps | Chain A | 15.92 |
| | | | 56 | 5280 | | | 15.89 |
| | | | 60 | 5300 | | | 16.00 |
| | | | 64 | 5320 | | | 13.48 |
| | | | 52 | 5260 | | Chain B | 15.92 |
| | | | 56 | 5280 | | | 15.97 |
| | | | 60 | 5300 | | | 16.00 |
| | | | 64 | 5320 | | | 13.46 |
| | 802.11n | 20 | 52 | 5260 | HT4 | Chain A | 15.89 |
| | | | 56 | 5280 | | | 15.87 |
| | | | 60 | 5300 | | | 15.96 |
| | | | 64 | 5320 | | | 13.45 |
| | | | 52 | 5260 | | Chain B | 15.92 |
| | | | 56 | 5280 | | | 15.96 |
| | | | 60 | 5300 | | | 15.98 |
| | | | 64 | 5320 | | | 13.42 |
| | 802.11n | 40 | 54 | 5270 | HT4 | Chain A | 16.47 |
| | | | 62 | 5310 | | | 13.43 |
| | | | 54 | 5270 | HT4 | Chain B | 16.44 |
| | | | 62 | 5310 | | | 13.49 |
| | 802.11ac | 80 | 58 | 5290 | VHT6 | Chain A | 13.42 |
| | | | | | | Chain B | 13.48 |

| Band | Mode | Bandwidth (MHz) | Channel | Frequency (MHz) | Data Rate | Antenna | Power (dBm) |
|---|---|---|---|---|---|---|---|
| 5600 MHz | 802.11a | 20 | 100 | 5500 | 6 Mbps | Chain A | 13.42 |
| 5600 MHz | 802.11a | 20 | 104 | 5520 | 6 Mbps | Chain A | 16.43 |
| 5600 MHz | 802.11a | 20 | 108 | 5540 | 6 Mbps | Chain A | 16.37 |
| 5600 MHz | 802.11a | 20 | 112 | 5560 | 6 Mbps | Chain A | 16.50 |
| 5600 MHz | 802.11a | 20 | 116 | 5580 | 6 Mbps | Chain A | 16.42 |
| 5600 MHz | 802.11a | 20 | 120 | 5600 | 6 Mbps | Chain A | 16.47 |
| 5600 MHz | 802.11a | 20 | 124 | 5620 | 6 Mbps | Chain A | 16.44 |
| 5600 MHz | 802.11a | 20 | 128 | 5640 | 6 Mbps | Chain A | 16.37 |
| 5600 MHz | 802.11a | 20 | 132 | 5660 | 6 Mbps | Chain A | 16.50 |
| 5600 MHz | 802.11a | 20 | 136 | 5680 | 6 Mbps | Chain A | 16.47 |
| 5600 MHz | 802.11a | 20 | 140 | 5700 | 6 Mbps | Chain A | 12.98 |
| 5600 MHz | 802.11a | 20 | 100 | 5500 | 6 Mbps | Chain B | 13.37 |
| 5600 MHz | 802.11a | 20 | 104 | 5520 | 6 Mbps | Chain B | 16.38 |
| 5600 MHz | 802.11a | 20 | 108 | 5540 | 6 Mbps | Chain B | 16.46 |
| 5600 MHz | 802.11a | 20 | 112 | 5560 | 6 Mbps | Chain B | 16.50 |
| 5600 MHz | 802.11a | 20 | 116 | 5580 | 6 Mbps | Chain B | 16.42 |
| 5600 MHz | 802.11a | 20 | 120 | 5600 | 6 Mbps | Chain B | 16.48 |
| 5600 MHz | 802.11a | 20 | 124 | 5620 | 6 Mbps | Chain B | 16.44 |
| 5600 MHz | 802.11a | 20 | 128 | 5640 | 6 Mbps | Chain B | 16.40 |
| 5600 MHz | 802.11a | 20 | 132 | 5660 | 6 Mbps | Chain B | 16.50 |
| 5600 MHz | 802.11a | 20 | 136 | 5680 | 6 Mbps | Chain B | 16.47 |
| 5600 MHz | 802.11a | 20 | 140 | 5700 | 6 Mbps | Chain B | 12.96 |
| 5600 MHz | 802.11n | 20 | 100 | 5500 | HT4 | Chain A | 13.45 |
| 5600 MHz | 802.11n | 20 | 104 | 5520 | HT4 | Chain A | 16.42 |
| 5600 MHz | 802.11n | 20 | 108 | 5540 | HT4 | Chain A | 16.39 |
| 5600 MHz | 802.11n | 20 | 112 | 5560 | HT4 | Chain A | 16.38 |
| 5600 MHz | 802.11n | 20 | 116 | 5580 | HT4 | Chain A | 16.46 |
| 5600 MHz | 802.11n | 20 | 120 | 5600 | HT4 | Chain A | 16.47 |
| 5600 MHz | 802.11n | 20 | 124 | 5620 | HT4 | Chain A | 16.41 |
| 5600 MHz | 802.11n | 20 | 128 | 5640 | HT4 | Chain A | 16.40 |
| 5600 MHz | 802.11n | 20 | 132 | 5660 | HT4 | Chain A | 16.39 |
| 5600 MHz | 802.11n | 20 | 136 | 5680 | HT4 | Chain A | 16.48 |
| 5600 MHz | 802.11n | 20 | 140 | 5700 | HT4 | Chain A | 12.91 |
| 5600 MHz | 802.11n | 20 | 100 | 5500 | HT4 | Chain B | 13.47 |
| 5600 MHz | 802.11n | 20 | 104 | 5520 | HT4 | Chain B | 16.43 |
| 5600 MHz | 802.11n | 20 | 108 | 5540 | HT4 | Chain B | 16.38 |
| 5600 MHz | 802.11n | 20 | 112 | 5560 | HT4 | Chain B | 16.37 |
| 5600 MHz | 802.11n | 20 | 116 | 5580 | HT4 | Chain B | 16.39 |
| 5600 MHz | 802.11n | 20 | 120 | 5600 | HT4 | Chain B | 16.42 |
| 5600 MHz | 802.11n | 20 | 124 | 5620 | HT4 | Chain B | 16.45 |
| 5600 MHz | 802.11n | 20 | 128 | 5640 | HT4 | Chain B | 16.46 |
| 5600 MHz | 802.11n | 20 | 132 | 5660 | HT4 | Chain B | 16.44 |
| 5600 MHz | 802.11n | 20 | 136 | 5680 | HT4 | Chain B | 16.48 |
| 5600 MHz | 802.11n | 20 | 140 | 5700 | HT4 | Chain B | 12.95 |
| 5600 MHz | 802.11n | 40 | 102 | 5510 | HT4 | Chain A | 13.42 |
| 5600 MHz | 802.11n | 40 | 110 | 5550 | HT4 | Chain A | 16.48 |
| 5600 MHz | 802.11n | 40 | 118 | 5580 | HT4 | Chain A | 16.42 |
| 5600 MHz | 802.11n | 40 | 126 | 5610 | HT4 | Chain A | 16.44 |
| 5600 MHz | 802.11n | 40 | 134 | 5670 | HT4 | Chain A | 16.43 |
| 5600 MHz | 802.11n | 40 | 102 | 5510 | HT4 | Chain B | 13.89 |
| 5600 MHz | 802.11n | 40 | 110 | 5550 | HT4 | Chain B | 16.38 |
| 5600 MHz | 802.11n | 40 | 118 | 5580 | HT4 | Chain B | 16.46 |
| 5600 MHz | 802.11n | 40 | 126 | 5610 | HT4 | Chain B | 16.47 |
| 5600 MHz | 802.11n | 40 | 134 | 5670 | HT4 | Chain B | 16.42 |
| 5600 MHz | 802.11ac | 20 | 144 | 5720 | VHT0 | Chain A | 16.42 |
| 5600 MHz | 802.11ac | 20 | 144 | 5720 | VHT0 | Chain B | 16.45 |
| 5600 MHz | 802.11ac | 40 | 142 | 5710 | VHT0 | Chain A | 16.46 |
| 5600 MHz | 802.11ac | 40 | 142 | 5710 | VHT0 | Chain B | 16.47 |
| 5600 MHz | 802.11ac | 80 | 106 | 5530 | VHT6 | Chain A | 13.42 |
| 5600 MHz | 802.11ac | 80 | 122 | 5610 | VHT6 | Chain A | 16.45 |
| 5600 MHz | 802.11ac | 80 | 138 | 5690 | VHT6 | Chain A | 16.48 |
| 5600 MHz | 802.11ac | 80 | 106 | 5530 | VHT6 | Chain B | 13.40 |
| 5600 MHz | 802.11ac | 80 | 122 | 5610 | VHT6 | Chain B | 16.39 |
| 5600 MHz | 802.11ac | 80 | 138 | 5690 | VHT6 | Chain B | 16.46 |

| Band | Mode | Bandwidth (MHz) | Channel | Frequency (MHz) | Data Rate | Antenna | Power (dBm) |
|---|---|---|---|---|---|---|---|
| 5800 MHz | 802.11a | 20 | 149 | 5745 | 6 Mbps | Chain A | 16.42 |
| | | | 153 | 5765 | | | 16.45 |
| | | | 157 | 5785 | | | 16.50 |
| | | | 161 | 5805 | | | 16.43 |
| | | | 165 | 5825 | | | 16.39 |
| | | | 149 | 5745 | | Chain B | 16.47 |
| | | | 153 | 5765 | | | 16.43 |
| | | | 157 | 5785 | | | 16.50 |
| | | | 161 | 5805 | | | 16.42 |
| | | | 165 | 5825 | | | 16.44 |
| | 802.11n | 20 | 149 | 5745 | HT8 | Chain A | 16.43 |
| | | | 153 | 5765 | | | 16.42 |
| | | | 157 | 5785 | | | 16.48 |
| | | | 161 | 5805 | | | 16.43 |
| | | | 165 | 5825 | | | 16.44 |
| | | | 149 | 5745 | | Chain B | 16.40 |
| | | | 153 | 5765 | | | 16.37 |
| | | | 157 | 5785 | | | 16.43 |
| | | | 161 | 5805 | | | 16.42 |
| | | | 165 | 5825 | | | 16.37 |
| | 802.11n | 40 | 151 | 5755 | HT8 | Chain A | 16.46 |
| | | | 159 | 5795 | | | 16.41 |
| | | | 151 | 5755 | | Chain B | 16.43 |
| | | | 159 | 5795 | | | 16.48 |
| | 802.11ac | 80 | 155 | 5775 | VHT6 | Chain A | 16.42 |
| | | | | | | Chain B | 16.44 |

# Figure 8.1 Test Reduction Table – WiFi

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11b | Side A | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side B | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side C | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side D | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side E | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| | Side F | 1 – 2412 MHz | Reduced[1] |
| | | 6 – 2437 MHz | Tested |
| | | 11 – 2462 MHz | Reduced[1] |
| 802.11g | Side A | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side B | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side C | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side D | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side E | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side F | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| 802.11n | Side A | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side B | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side C | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side D | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side E | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |
| | Side F | 1 – 2412 MHz | Reduced[2] |
| | | 6 – 2437 MHz | Reduced[2] |
| | | 11 – 2462 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.

Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

## Test Reduction Table – BT

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| BT | Side A | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |
| | Side B | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |
| | Side C | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |
| | Side D | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |
| | Side E | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |
| | Side F | 1 – 2402 MHz | Reduced[1] |
| | | 39 – 2440 MHz | Tested |
| | | 79 – 2480 MHz | Reduced[1] |

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11a 5150 MHz | Side A | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| | Side B | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| | Side C | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| | Side D | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| | Side E | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| | Side F | 36 – 5180 MHz | Reduced[1] |
| | | 40 – 5200 MHz | Reduced[1] |
| | | 44 – 5220 MHz | Tested |
| | | 48 – 5240 MHz | Reduced[1] |
| 802.11n 5150 MHz | Side A | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| | Side B | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| | Side C | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| | Side D | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| | Side E | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| | Side F | 36 – 5180 MHz | Reduced[2] |
| | | 40 – 5200 MHz | Reduced[2] |
| | | 44 – 5220 MHz | Reduced[2] |
| | | 48 – 5240 MHz | Reduced[2] |
| 802.11ac 5210 MHz | Side A | 42 – 5210 MHz | Reduced[2] |
| | Side B | 42 – 5210 MHz | Tested |
| | Side C | 42 – 5210 MHz | Reduced[2] |
| | Side D | 42 – 5210 MHz | Reduced[2] |
| | Side E | 42 – 5210 MHz | Reduced[2] |
| | Side F | 42 – 5210 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.

Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11a 5250 MHz | Side A | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| | Side B | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| | Side C | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| | Side D | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| | Side E | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| | Side F | 52 – 5260 MHz | Reduced[1] |
| | | 56 – 5280 MHz | Reduced[1] |
| | | 60 – 5300 MHz | Tested |
| | | 64 – 5320 MHz | Reduced[1] |
| 802.11n 5250 MHz | Side A | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| | Side B | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| | Side C | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| | Side D | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| | Side E | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| | Side F | 52 – 5260 MHz | Reduced[2] |
| | | 56 – 5280 MHz | Reduced[2] |
| | | 60 – 5300 MHz | Reduced[2] |
| | | 64 – 5320 MHz | Reduced[2] |
| 802.11ac 5290 MHz | Side A | 58 – 5290 MHz | Reduced[2] |
| | Side B | 58 – 5290 MHz | Reduced[2] |
| | Side C | 58 – 5290 MHz | Tested |
| | Side D | 58 – 5290 MHz | Reduced[2] |
| | Side E | 58 – 5290 MHz | Reduced[2] |
| | Side F | 58 – 5290 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.
Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.
Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11a 5600 MHz | Side A | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |
| | Side B | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |
| | Side C | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |
| | Side D | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |
| | Side E | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |
| | Side F | 100 – 5500 MHz | Reduced[1] |
| | | 104 – 5520 MHz | Reduced[1] |
| | | 108 – 5540 MHz | Reduced[1] |
| | | 112 – 5560 MHz | Tested |
| | | 116 – 5580 MHz | Reduced[1] |
| | | 120 – 5600 MHz | Reduced[1] |
| | | 124 – 5620 MHz | Reduced[1] |
| | | 128 – 5640 MHz | Reduced[1] |
| | | 132 – 5660 MHz | Tested |
| | | 136 – 5680 MHz | Reduced[1] |
| | | 140 – 5700 MHz | Reduced[1] |

Both Chains A and B were tested per these test reduction requirements.

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11n 5600 MHz | Side A | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |
| | Side B | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |
| | Side C | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |
| | Side D | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |
| | Side E | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |
| | Side F | 100 – 5500 MHz | Reduced[2] |
| | | 104 – 5520 MHz | Reduced[2] |
| | | 108 – 5540 MHz | Reduced[2] |
| | | 112 – 5560 MHz | Reduced[2] |
| | | 116 – 5580 MHz | Reduced[2] |
| | | 120 – 5600 MHz | Reduced[2] |
| | | 124 – 5620 MHz | Reduced[2] |
| | | 128 – 5640 MHz | Reduced[2] |
| | | 132 – 5660 MHz | Reduced[2] |
| | | 136 – 5680 MHz | Reduced[2] |
| | | 140 – 5700 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.
Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11ac 5600 MHz | Side A | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Reduced[2] |
| | | 138 – 5690 MHz | Reduced[2] |
| | Side B | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Reduced[2] |
| | | 138 – 5690 MHz | Reduced[2] |
| | Side C | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Tested |
| | | 138 – 5690 MHz | Reduced[2] |
| | Side D | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Reduced[2] |
| | | 138 – 5690 MHz | Reduced[2] |
| | Side E | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Reduced[2] |
| | | 138 – 5690 MHz | Reduced[2] |
| | Side F | 106 – 5530 MHz | Reduced[2] |
| | | 122 – 5610 MHz | Reduced[2] |
| | | 138 – 5690 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.

Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

| Mode | Side | Required Channel | Tested/Reduced |
|---|---|---|---|
| 802.11a 5800 MHz | Side A | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| | Side B | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| | Side C | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| | Side D | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| | Side E | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| | Side F | 149 – 5745 MHz | Reduced[1] |
| | | 153 – 5765 MHz | Reduced[1] |
| | | 157 – 5785 MHz | Tested |
| | | 161 – 5805 MHz | Reduced[1] |
| | | 165 – 5825 MHz | Reduced[1] |
| 802.11n 5800 MHz | Side A | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| | Side B | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| | Side C | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| | Side D | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| | Side E | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| | Side F | 149 – 5745 MHz | Reduced[2] |
| | | 153 – 5765 MHz | Reduced[2] |
| | | 157 – 5785 MHz | Reduced[2] |
| | | 161 – 5805 MHz | Reduced[2] |
| | | 165 – 5825 MHz | Reduced[2] |
| 802.11ac 5775 MHz | Side A | 155 – 5775 MHz | Tested |
| | Side B | 155 – 5775 MHz | Reduced[2] |
| | Side C | 155 – 5775 MHz | Reduced[2] |
| | Side D | 155 – 5775 MHz | Reduced[2] |
| | Side E | 155 – 5775 MHz | Reduced[2] |
| | Side F | 155 – 5775 MHz | Reduced[2] |

Both Chains A and B were tested per these test reduction requirements.

Reduced[1] – When the mid channel is 3 dB below the limit, the remaining channels are not required per KDB 447498 D01 v05r02 section 4.3.3 page 13.

Reduced[2] – When the conducted power in this mode is less than 0.25 dB higher than the b mode, testing is not required per KDB 248227 v01r02 page 5.

## SAR Data Summary – 2450 MHz Body 802.11b & BT

MEASUREMENT RESULTS

| Gap | Plot | Position | Frequency | | Modulation | Antenna | End Power | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | MHz | Ch. | | | (dBm) | | |
| 8 mm | ----- | Side A | 2437 | 6 | DSSS | Chain A | 17.50 | 0.536 | 0.54 |
| | ----- | Side B | 2437 | 6 | DSSS | Chain A | 17.50 | 0.297 | 0.30 |
| | ----- | Side C | 2437 | 6 | DSSS | Chain A | 17.50 | 0.413 | 0.41 |
| | ----- | Side D | 2437 | 6 | DSSS | Chain A | 17.50 | 0.168 | 0.17 |
| | ----- | Side E | 2437 | 6 | DSSS | Chain A | 17.50 | 0.119 | 0.12 |
| | ----- | Side F | 2437 | 6 | DSSS | Chain A | 17.50 | 0.0926 | 0.09 |
| | 1 | Side A | 2437 | 6 | DSSS | Chain B | 17.50 | 0.549 | 0.55 |
| | ----- | Side B | 2437 | 6 | DSSS | Chain B | 17.50 | 0.302 | 0.30 |
| | ----- | Side C | 2437 | 6 | DSSS | Chain B | 17.50 | 0.427 | 0.43 |
| | ----- | Side D | 2437 | 6 | DSSS | Chain B | 17.50 | 0.196 | 0.20 |
| | ----- | Side E | 2437 | 6 | DSSS | Chain B | 17.50 | 0.143 | 0.14 |
| | ----- | Side F | 2437 | 6 | DSSS | Chain B | 17.50 | 0.102 | 0.10 |
| | ----- | Side A | 2440 | 39 | GFSK | Chain B | 10.00 | 0.0062 | 0.01 |
| | ----- | Side B | 2440 | 39 | GFSK | Chain B | 10.00 | 0.0069 | 0.01 |
| | ----- | Side C | 2440 | 39 | GFSK | Chain B | 10.00 | 0.0053 | 0.01 |
| | ----- | Side D | 2440 | 39 | GFSK | Chain B | 10.00 | 0.0059 | 0.01 |
| | ----- | Side E | 2440 | 39 | GFSK | Chain B | 10.00 | 0.005 | 0.01 |
| | ----- | Side F | 2440 | 39 | GFSK | Chain B | 10.00 | 0.0041 | <0.01 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5150 MHz Body 802.11a

### MEASUREMENT RESULTS

| Gap | Plot | Position | Frequency | | Modulation | Antenna | End Power | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | MHz | Ch. | | | (dBm) | | |
| 8 mm | ----- | Side A | 5220 | 44 | OFDM | Chain A | 16.00 | 0.632 | 0.63 |
| | ----- | Side B | 5220 | 44 | OFDM | Chain A | 16.00 | 0.597 | 0.60 |
| | ----- | Side C | 5220 | 44 | OFDM | Chain A | 16.00 | 0.689 | 0.69 |
| | ----- | Side D | 5220 | 44 | OFDM | Chain A | 16.00 | 0.554 | 0.55 |
| | ----- | Side E | 5220 | 44 | OFDM | Chain A | 16.00 | 0.0391 | 0.04 |
| | ----- | Side F | 5220 | 44 | OFDM | Chain A | 16.00 | 0.0236 | 0.02 |
| | ----- | Side A | 5220 | 44 | OFDM | Chain B | 16.00 | 0.609 | 0.61 |
| | ----- | Side B | 5220 | 44 | OFDM | Chain B | 16.00 | 0.527 | 0.53 |
| | 2 | Side C | 5220 | 44 | OFDM | Chain B | 16.00 | 0.719 | 0.72 |
| | ----- | Side D | 5220 | 44 | OFDM | Chain B | 16.00 | 0.567 | 0.57 |
| | ----- | Side E | 5220 | 44 | OFDM | Chain B | 16.00 | 0.0203 | 0.02 |
| | ----- | Side F | 5220 | 44 | OFDM | Chain B | 16.00 | 0.0229 | 0.02 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒ Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5250 MHz Body 802.11a

### MEASUREMENT RESULTS

| Gap | Plot | Position | Frequency | | Modulation | Antenna | End Power | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | MHz | Ch. | | | (dBm) | | |
| 8 mm | ----- | Side A | 5300 | 60 | OFDM | Chain A | 16.00 | 0.701 | 0.70 |
| | ----- | Side B | 5300 | 60 | OFDM | Chain A | 16.00 | 0.697 | 0.70 |
| | ----- | Side C | 5300 | 60 | OFDM | Chain A | 16.00 | 0.723 | 0.72 |
| | ----- | Side D | 5300 | 60 | OFDM | Chain A | 16.00 | 0.635 | 0.64 |
| | ----- | Side E | 5300 | 60 | OFDM | Chain A | 16.00 | 0.0186 | 0.02 |
| | ----- | Side F | 5300 | 60 | OFDM | Chain A | 16.00 | 0.0267 | 0.03 |
| | ----- | Side A | 5300 | 60 | OFDM | Chain B | 16.00 | 0.721 | 0.72 |
| | ----- | Side B | 5300 | 60 | OFDM | Chain B | 16.00 | 0.708 | 0.71 |
| | 3 | Side C | 5300 | 60 | OFDM | Chain B | 16.00 | 0.761 | 0.76 |
| | ----- | Side D | 5300 | 60 | OFDM | Chain B | 16.00 | 0.645 | 0.65 |
| | ----- | Side E | 5300 | 60 | OFDM | Chain B | 16.00 | 0.0177 | 0.02 |
| | ----- | Side F | 5300 | 60 | OFDM | Chain B | 16.00 | 0.0269 | 0.03 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒ Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5600 MHz Low Band Body 802.11a

| MEASUREMENT RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Gap | Plot | Position | Frequency | | Modulation | Antenna | End Power | Measured SAR (W/kg) | Reported SAR (W/kg) |
| | | | MHz | Ch. | | | (dBm) | | |
| 8 mm | ----- | Side A | 5560 | 112 | OFDM | Chain A | 16.50 | 0.385 | 0.39 |
| | ----- | Side B | 5560 | 112 | OFDM | Chain A | 16.50 | 0.326 | 0.33 |
| | ----- | Side C | 5560 | 112 | OFDM | Chain A | 16.50 | 0.401 | 0.40 |
| | ----- | Side D | 5560 | 112 | OFDM | Chain A | 16.50 | 0.332 | 0.33 |
| | ----- | Side E | 5560 | 112 | OFDM | Chain A | 16.50 | 0.0197 | 0.02 |
| | ----- | Side F | 5560 | 112 | OFDM | Chain A | 16.50 | 0.0237 | 0.02 |
| | ----- | Side A | 5560 | 112 | OFDM | Chain B | 16.50 | 0.392 | 0.39 |
| | ----- | Side B | 5560 | 112 | OFDM | Chain B | 16.50 | 0.346 | 0.35 |
| | 4 | Side C | 5560 | 112 | OFDM | Chain B | 16.50 | 0.459 | 0.46 |
| | ----- | Side D | 5560 | 112 | OFDM | Chain B | 16.50 | 0.329 | 0.33 |
| | ----- | Side E | 5560 | 112 | OFDM | Chain B | 16.50 | 0.0267 | 0.03 |
| | ----- | Side F | 5560 | 112 | OFDM | Chain B | 16.50 | 0.0203 | 0.02 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒ Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5600 MHz High Band Body 802.11a

**MEASUREMENT RESULTS**

| Gap | Plot | Position | Frequency | | Modulation | Antenna | End Power | Measured SAR (W/kg) | Reported SAR (W/kg) |
|---|---|---|---|---|---|---|---|---|---|
| | | | MHz | Ch. | | | (dBm) | | |
| 8 mm | ----- | Side A | 5660 | 132 | OFDM | Chain A | 16.50 | 0.463 | 0.46 |
| | ----- | Side B | 5660 | 132 | OFDM | Chain A | 16.50 | 0.387 | 0.39 |
| | ----- | Side C | 5660 | 132 | OFDM | Chain A | 16.50 | 0.503 | 0.50 |
| | ----- | Side D | 5660 | 132 | OFDM | Chain A | 16.50 | 0.366 | 0.37 |
| | ----- | Side E | 5660 | 132 | OFDM | Chain A | 16.50 | 0.0172 | 0.02 |
| | ----- | Side F | 5660 | 132 | OFDM | Chain A | 16.50 | 0.0213 | 0.02 |
| | ----- | Side A | 5660 | 132 | OFDM | Chain B | 16.50 | 0.514 | 0.51 |
| | ----- | Side B | 5660 | 132 | OFDM | Chain B | 16.50 | 0.439 | 0.44 |
| | 5 | Side C | 5660 | 132 | OFDM | Chain B | 16.50 | 0.536 | 0.54 |
| | ----- | Side D | 5660 | 132 | OFDM | Chain B | 16.50 | 0.328 | 0.33 |
| | ----- | Side E | 5660 | 132 | OFDM | Chain B | 16.50 | 0.0108 | 0.01 |
| | ----- | Side F | 5660 | 132 | OFDM | Chain B | 16.50 | 0.0237 | 0.02 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒ Conducted ☐ ERP ☐ EIRP
2. SAR Measurement
   Phantom Configuration ☐ Left Head ☒ Eli4 ☐ Right Head
   SAR Configuration ☐ Head ☒ Body
3. Test Signal Call Mode ☒ Test Code ☐ Base Station Simulator
4. Test Configuration ☐ With Belt Clip ☐ Without Belt Clip ☒ N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5800 MHz Body 802.11a

| MEASUREMENT RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Gap** | **Plot** | **Position** | **Frequency** | | **Modulation** | **Antenna** | **End Power** | **Measured SAR (W/kg)** | **Reported SAR (W/kg)** |
| | | | **MHz** | **Ch.** | | | **(dBm)** | | |
| 8 mm | ----- | Side A | 5785 | 157 | OFDM | Chain A | 16.50 | 0.218 | 0.22 |
| | ----- | Side B | 5785 | 157 | OFDM | Chain A | 16.50 | 0.152 | 0.15 |
| | ----- | Side C | 5785 | 157 | OFDM | Chain A | 16.50 | 0.203 | 0.20 |
| | ----- | Side D | 5785 | 157 | OFDM | Chain A | 16.50 | 0.139 | 0.14 |
| | ----- | Side E | 5785 | 157 | OFDM | Chain A | 16.50 | 0.0098 | 0.01 |
| | ----- | Side F | 5785 | 157 | OFDM | Chain A | 16.50 | 0.0105 | 0.01 |
| | 6 | Side A | 5785 | 157 | OFDM | Chain B | 16.50 | 0.227 | 0.23 |
| | ----- | Side B | 5785 | 157 | OFDM | Chain B | 16.50 | 0.161 | 0.16 |
| | ----- | Side C | 5785 | 157 | OFDM | Chain B | 16.50 | 0.217 | 0.22 |
| | ----- | Side D | 5785 | 157 | OFDM | Chain B | 16.50 | 0.163 | 0.16 |
| | ----- | Side E | 5785 | 157 | OFDM | Chain B | 16.50 | 0.0122 | 0.01 |
| | ----- | Side F | 5785 | 157 | OFDM | Chain B | 16.50 | 0.0117 | 0.01 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒ Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – 5 GHz Body 802.11ac 80 MHz Bandwidth

| MEASUREMENT RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Gap** | **Plot** | **Position** | **Frequency** | | **Modulation** | **Antenna** | **End Power** | **Measured SAR (W/kg)** | **Reported SAR (W/kg)** |
| | | | **MHz** | **Ch.** | | | **(dBm)** | | |
| 8 mm | ----- | Side A | 5210 | 42 | OFDM | Chain B | 13.42 | 0.421 | 0.43 |
| | ----- | Side C | 5290 | 58 | OFDM | Chain B | 13.42 | 0.569 | 0.58 |
| | ----- | Side C | 5610 | 122 | OFDM | Chain B | 16.39 | 0.456 | 0.47 |
| | ----- | Side A | 5775 | 155 | OFDM | Chain B | 16.44 | 0.216 | 0.22 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒ Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

## SAR Data Summary – Simultaneous Evaluation MIMO

| MEASUREMENT RESULTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frequency | | Modulation | Frequency | | Modulation | $SAR_1$ | $SAR_2$ | SAR Total |
| MHz | Ch. | | MHz | Ch. | | | | |
| 2437 | 6 | OFDM | 2437 | 6 | OFDM | 0.54 | 0.55 | 1.09 |
| 5220 | 44 | OFDM | 5220 | 44 | OFDM | 0.69 | 0.72 | 1.41 |
| 5300 | 60 | OFDM | 5300 | 60 | OFDM | 0.72 | 0.76 | 1.48 |
| 5560 | 112 | OFDM | 5560 | 112 | OFDM | 0.40 | 0.46 | 0.86 |
| 5660 | 132 | OFDM | 5660 | 132 | OFDM | 0.50 | 0.54 | 1.04 |
| 5785 | 157 | OFDM | 5785 | 157 | OFDM | 0.22 | 0.23 | 0.45 |

**Body**
**1.6 W/kg (mW/g)**
averaged over 1 gram

MIMO is the worst case simultaneous transmission; therefore, BT was not evaluated.

To calculate the separation ratio the following formula is used:

$(SAR_1 + SAR_2 + SAR_3)^{1.5}/R_i$ where $R_i$ is in mm must be ≤0.04

For each of the pairs, the following calculations show the separation ratio at the 50 mm separation stated in the installation guide.

2.4 GHz Band: $(0.54+0.55)^{1.5}/50 = 0.02$
5.1 GHz Band: $(0.69+0.72)^{1.5}/50 = 0.03$
5.2 GHz Band: $(0.72+0.76)^{1.5}/50 = 0.04$
5.6 GHz Band: $(0.40+0.46)^{1.5}/50 = 0.02$
5.6 GHz Band: $(0.50+0.54)^{1.5}/50 = 0.02$
5.8 GHz Band: $(0.22+0.23)^{1.5}/50 = 0.01$

# 9. Enhanced Energy Coupling

| Worst-case test configuration | Band | Antenna-to-person distance (mm) | | Peak SAR (W/kg) | Percent Change |
|---|---|---|---|---|---|
| Side A | 2450 MHz | Initial | 8 | 1.01 | ----- |
| | | 1 | 13 | 0.74 | -26.9 |
| | | 2 | 18 | 0.47 | -53.3 |
| Side B | 2450 MHz | Initial | 8 | 0.86 | ----- |
| | | 1 | 13 | 0.64 | -25.2 |
| | | 2 | 18 | 0.41 | -52.0 |
| Side C | 2450 MHz | Initial | 8 | 1.12 | ----- |
| | | 1 | 13 | 0.84 | -25.2 |
| | | 2 | 18 | 0.51 | -54.8 |
| Side D | 2450 MHz | Initial | 8 | 0.42 | ----- |
| | | 1 | 13 | 0.31 | -26.0 |
| | | 2 | 18 | 0.21 | -49.8 |
| | | 3 | 23 | 0.12 | -70.9 |
| Side E | 2450 MHz | Initial | 8 | 0.39 | ----- |
| | | 1 | 13 | 0.29 | -24.9 |
| | | 2 | 18 | 0.16 | -58.4 |
| Side F | 2450 MHz | Initial | 8 | 0.11 | ----- |
| | | 1 | 13 | 0.08 | -26.8 |
| | | 2 | 18 | 0.06 | -48.7 |
| | | 3 | 23 | 0.03 | -74.1 |
| Side A | 5250 MHz | Initial | 8 | 2.23 | ----- |
| | | 1 | 13 | 1.52 | -31.7 |
| | | 2 | 18 | 1.01 | -54.8 |
| Side B | 5250 MHz | Initial | 8 | 2.38 | ------ |
| | | 1 | 13 | 1.82 | -23.5 |
| | | 2 | 18 | 1.03 | -56.7 |
| Side C | 5250 MHz | Initial | 8 | 3.52 | ----- |
| | | 1 | 13 | 2.73 | -22.4 |
| | | 2 | 18 | 1.41 | -59.8 |
| Side D | 5250 MHz | Initial | 8 | 2.73 | ----- |
| | | 1 | 13 | 1.91 | -30.0 |
| | | 2 | 18 | 1.22 | -55.4 |
| Side E | 5250 MHz | Initial | 8 | 0.13 | ----- |
| | | 1 | 13 | 0.10 | -26.2 |
| | | 2 | 18 | 0.06 | -57.6 |
| Side F | 5250 MHz | Initial | 8 | 0.18 | ----- |
| | | 1 | 13 | 0.14 | -24.1 |
| | | 2 | 18 | 0.07 | -59.6 |

| Worst-case test configuration | Band | Antenna-to-person distance (mm) | | Peak SAR (W/kg) | Percent Change |
|---|---|---|---|---|---|
| Side A | 5600 MHz | Initial | 8 | 2.21 | ----- |
| | | 1 | 13 | 1.63 | -26.0 |
| | | 2 | 18 | 1.03 | -53.4 |
| Side B | 5600 MHz | Initial | 8 | 2.35 | ----- |
| | | 1 | 13 | 1.80 | -23.2 |
| | | 2 | 18 | 1.11 | -52.6 |
| Side C | 5600 MHz | Initial | 8 | 2.97 | ----- |
| | | 1 | 13 | 2.18 | -26.5 |
| | | 2 | 18 | 1.44 | -51.4 |
| Side D | 5600 MHz | Initial | 8 | 1.83 | ----- |
| | | 1 | 13 | 1.27 | -30.7 |
| | | 2 | 18 | 0.84 | -54.0 |
| Side E | 5600 MHz | Initial | 8 | 0.15 | ----- |
| | | 1 | 13 | 0.11 | -24.3 |
| | | 2 | 18 | 0.08 | -49.7 |
| | | 3 | 23 | 0.04 | -75.3 |
| Side F | 5600 MHz | Initial | 8 | 0.15 | ----- |
| | | 1 | 13 | 0.11 | -23.8 |
| | | 2 | 18 | 0.06 | -58.4 |
| Side A | 5800 MHz | Initial | 8 | 1.59 | ----- |
| | | 1 | 13 | 1.20 | -24.6 |
| | | 2 | 18 | 0.79 | -50.2 |
| Side B | 5800 MHz | Initial | 8 | 1.36 | ----- |
| | | 1 | 13 | 0.93 | -31.8 |
| | | 2 | 18 | 0.68 | -50.2 |
| Side C | 5800 MHz | Initial | 8 | 1.88 | ----- |
| | | 1 | 13 | 1.33 | -29.4 |
| | | 2 | 18 | 0.85 | -55.0 |
| Side D | 5800 MHz | Initial | 8 | 1.42 | ----- |
| | | 1 | 13 | 0.98 | -30.7 |
| | | 2 | 18 | 0.70 | -50.6 |
| Side E | 5800 MHz | Initial | 8 | 0.08 | ----- |
| | | 1 | 13 | 0.06 | -23.0 |
| | | 2 | 18 | 0.04 | -55.3 |
| Side F | 5800 MHz | Initial | 8 | 0.05 | ----- |
| | | 1 | 13 | 0.04 | -22.5 |
| | | 2 | 18 | 0.03 | -49.6 |
| | | 3 | 23 | 0.01 | -74.3 |

# 10. Test Equipment List

**Table 10.1 Equipment Specifications**

| Type | Calibration Due Date | Calibration Done Date | Serial Number |
|---|---|---|---|
| Staubli Robot TX60L | N/A | N/A | F07/55M6A1/A/01 |
| Measurement Controller CS8c | N/A | N/A | 1012 |
| ELI4 Flat Phantom | N/A | N/A | 1065 |
| Device Holder | N/A | N/A | N/A |
| Data Acquisition Electronics 4 | 01/13/2015 | 01/13/2014 | 1416 |
| SPEAG E-Field Probe EX3DV4 | 04/15/2015 | 04/15/2014 | 3662 |
| Speag Validation Dipole D2450V2 | 12/04/2014 | 12/04/2012 | 829 |
| Speag Validation Dipole D5GHzV2 | 12/11/2014 | 12/11/2012 | 1085 |
| Agilent N1911A Power Meter | 03/24/2015 | 03/24/2014 | GB45100254 |
| Advantest R3261A Spectrum Analyzer | 03/24/2015 | 03/24/2014 | 31720068 |
| Agilent (HP) 8350B Signal Generator | 03/24/2015 | 03/24/2014 | 2749A10226 |
| Agilent (HP) 83525A RF Plug-In | 03/24/2015 | 03/24/2014 | 2647A01172 |
| Agilent (HP) 8753C Vector Network Analyzer | 03/25/2015 | 03/25/2014 | 3135A01724 |
| Agilent (HP) 85047A S-Parameter Test Set | 03/25/2015 | 03/25/2014 | 2904A00595 |
| Agilent (HP) 8960 Base Station Sim. | 10/23/2014 | 10/23/2012 | MY48360364 |
| Anritsu MT8820C | 08/03/2014 | 08/03/2012 | 6201176199 |
| Agilent 778D Dual Directional Coupler | N/A | N/A | MY48220184 |
| MiniCircuits BW-N20W5+ Fixed 20 dB Attenuator | N/A | N/A | N/A |
| MiniCircuits SPL-10.7+ Low Pass Filter | N/A | N/A | R8979513746 |
| Aprel Dielectric Probe Assembly | N/A | N/A | 0011 |
| Body Equivalent Matter (2450 MHz) | N/A | N/A | N/A |
| Body Equivalent Matter (5 Ghz) | N/A | N/A | N/A |

# 11. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

# 12. References

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996

[2] ANSI/IEEE C95.1 – 1992, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.

[3] ANSI/IEEE C95.3 – 1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.

[4] IEEE Standard 1528 – 2013, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013.

[5] Industry Canada, RSS – 102e, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2010.

[6] Health Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 2009.

# Appendix A – System Validation Plots and Data

```
***********************************************************
Test Result for UIM Dielectric Parameter
Tue 19/Aug/2014
Freq    Frequency(GHz)
FCC_eH FCC FCC KDB865664 D01 v01r01 Limits for Head Epsilon
FCC_sH FCC FCC KDB865664 D01 v01r01 Limits for Head Sigma
FCC_eB FCC FCC KDB865664 D01 v01r01 Limits for Body Epsilon
FCC_sB FCC FCC KDB865664 D01 v01r01 Limits for Body Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
***********************************************************
```

| Freq | FCC_eB | FCC_sB | Test_e | Test_s |
|---|---|---|---|---|
| 2.4000 | 52.76 | 1.90 | 52.68 | 1.92 |
| 2.4020 | 52.758 | 1.902 | 52.676 | 1.922* |
| 2.4100 | 52.75 | 1.91 | 52.66 | 1.93 |
| 2.4120 | 52.748 | 1.912 | 52.656 | 1.932* |
| 2.4200 | 52.74 | 1.92 | 52.64 | 1.94 |
| 2.4300 | 52.73 | 1.93 | 52.62 | 1.97 |
| 2.4370 | 52.716 | 1.937 | 52.599 | 1.977* |
| 2.4400 | 52.71 | 1.94 | 52.59 | 1.98 |
| 2.4500 | 52.70 | 1.95 | 52.57 | 2.00 |
| 2.4600 | 52.69 | 1.96 | 52.56 | 2.01 |
| 2.4620 | 52.686 | 1.964 | 52.554 | 2.012* |
| 2.4700 | 52.67 | 1.98 | 52.53 | 2.02 |
| 2.4800 | 52.66 | 1.99 | 52.51 | 2.03 |

* value interpolated

************************************************************
Test Result for UIM Dielectric Parameter
Fri 15/Aug/2014
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
************************************************************

| Freq | FCC_eB | FCC_sB | Test_e | Test_s |
|---|---|---|---|---|
| 5.1000 | 49.15 | 5.18 | 49.07 | 5.27 |
| 5.1200 | 49.12 | 5.21 | 49.04 | 5.30 |
| 5.1400 | 49.10 | 5.23 | 49.01 | 5.33 |
| 5.1600 | 49.07 | 5.25 | 48.98 | 5.36 |
| 5.1800 | 49.04 | 5.28 | 48.95 | 5.39 |
| 5.2000 | 49.01 | 5.30 | 48.92 | 5.41 |
| 5.2100 | 49.00 | 5.31 | 48.905 | 5.425* |
| 5.2200 | 48.99 | 5.32 | 48.89 | 5.44 |
| 5.2400 | 48.96 | 5.35 | 48.86 | 5.47 |
| 5.2600 | 48.93 | 5.37 | 48.83 | 5.50 |
| 5.2800 | 48.91 | 5.39 | 48.80 | 5.52 |
| 5.2900 | 48.895 | 5.405 | 48.785 | 5.535* |
| 5.3000 | 48.88 | 5.42 | 48.77 | 5.55 |
| 5.3200 | 48.85 | 5.44 | 48.74 | 5.58 |
| 5.3400 | 48.82 | 5.46 | 48.71 | 5.61 |
| 5.3600 | 48.80 | 5.49 | 48.69 | 5.63 |
| 5.3800 | 48.77 | 5.51 | 48.66 | 5.66 |
| 5.4000 | 48.74 | 5.53 | 48.63 | 5.69 |
| 5.4200 | 48.72 | 5.56 | 48.60 | 5.72 |
| 5.4400 | 48.69 | 5.58 | 48.57 | 5.74 |
| 5.4600 | 48.66 | 5.60 | 48.54 | 5.77 |
| 5.4800 | 48.63 | 5.63 | 48.51 | 5.80 |
| 5.5000 | 48.61 | 5.65 | 48.48 | 5.83 |
| 5.5200 | 48.58 | 5.67 | 48.45 | 5.85 |
| 5.5400 | 48.55 | 5.70 | 48.42 | 5.87 |
| 5.5600 | 48.53 | 5.72 | 48.39 | 5.89 |
| 5.5800 | 48.50 | 5.74 | 48.36 | 5.91 |
| 5.6000 | 48.47 | 5.77 | 48.33 | 5.93 |
| 5.6100 | 48.455 | 5.78 | 48.32 | 5.94* |
| 5.6200 | 48.44 | 5.79 | 48.31 | 5.95 |
| 5.6400 | 48.42 | 5.81 | 48.28 | 5.97 |
| 5.6600 | 48.39 | 5.84 | 48.25 | 5.99 |
| 5.6800 | 48.36 | 5.86 | 48.22 | 6.01 |
| 5.7000 | 48.34 | 5.88 | 48.19 | 6.04 |
| 5.7200 | 48.31 | 5.91 | 48.16 | 6.06 |
| 5.7400 | 48.28 | 5.93 | 48.13 | 6.08 |
| 5.7450 | 48.273 | 5.935 | 48.125 | 6.085* |
| 5.7600 | 48.25 | 5.95 | 48.11 | 6.10 |
| 5.7750 | 48.235 | 5.973 | 48.088 | 6.115* |
| 5.7800 | 48.23 | 5.98 | 48.08 | 6.12 |
| 5.7850 | 48.223 | 5.985 | 48.073 | 6.128* |
| 5.8000 | 48.20 | 6.00 | 48.05 | 6.15 |
| 5.8200 | 48.17 | 6.02 | 48.02 | 6.17 |
| 5.8250 | 48.165 | 6.028 | 48.01 | 6.175* |
| 5.8400 | 48.15 | 6.05 | 47.98 | 6.19 |

* value interpolated

# RF Exposure Lab

## Plot 1

### DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:829

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL2450; Medium parameters used: f = 2450 MHz; $\sigma$ = 2 S/m; $\varepsilon_r$ = 52.57; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

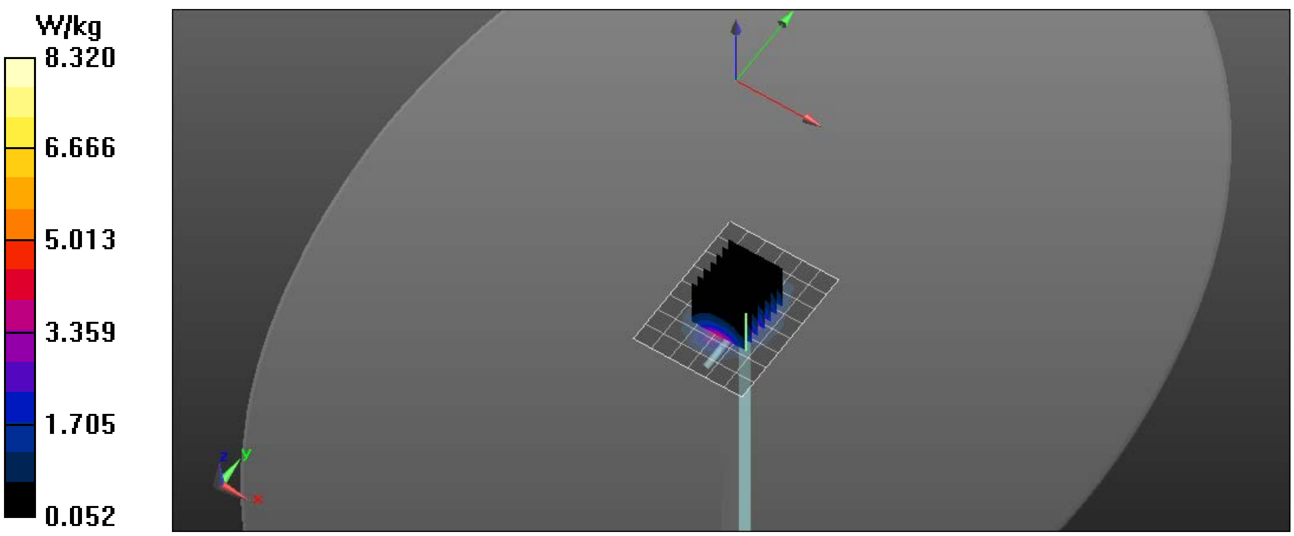
Test Date: Date: 8/19/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

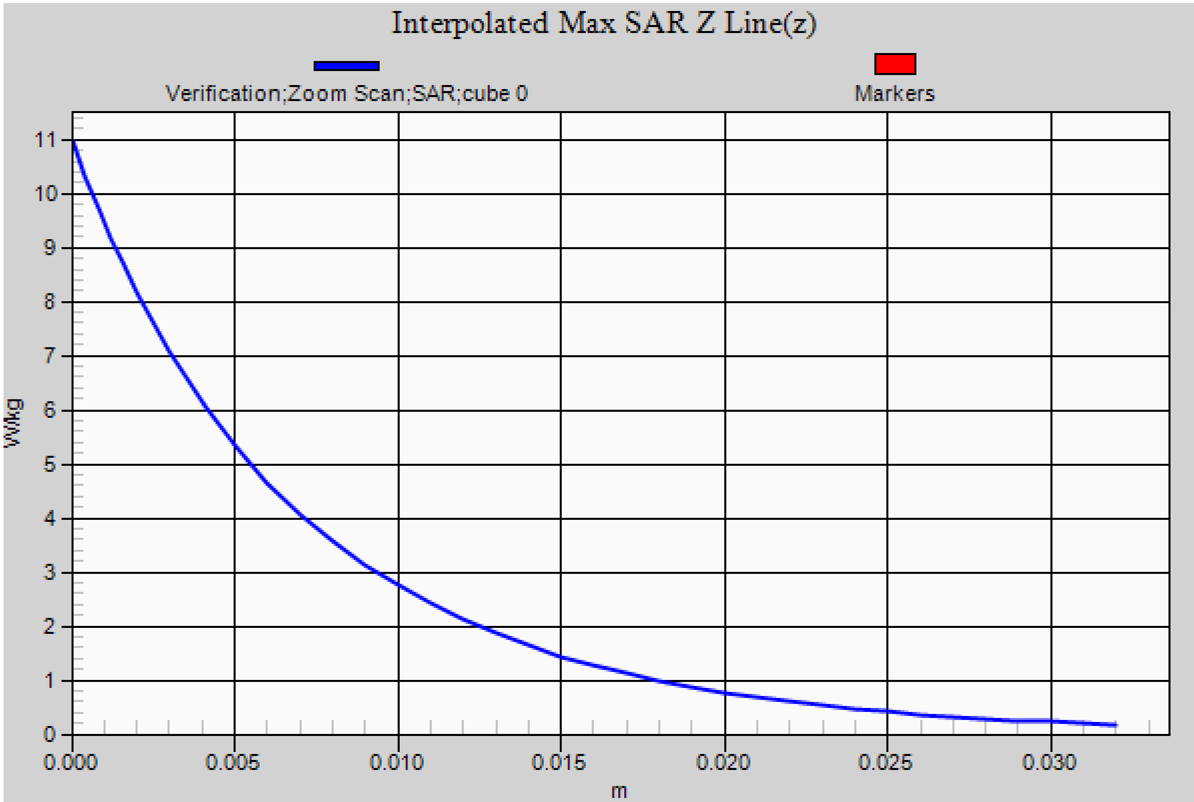
Probe: EX3DV4 - SN3662; ConvF(7.12, 7.12, 7.12); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7164)

### Procedure Notes:

**2450 MHz Body/Verification/Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 8.13 W/kg

**2450 MHz Body/Verification/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 56.438 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 10.91 W/kg
$P_{in}$=100 mW
**SAR(1 g) = 5.14 W/kg; SAR(10 g) = 2.19 W/kg**
Maximum value of SAR (measured) = 8.32 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
11
10
9
8
7
6
5
4
3
2
1
0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

# RF Exposure Lab

## Plot 2

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5200 MHz; $\sigma$ = 5.41 S/m; $\varepsilon_r$ = 48.92; $\rho$ = 1000 kg/$m^3$
Phantom section: Flat Section

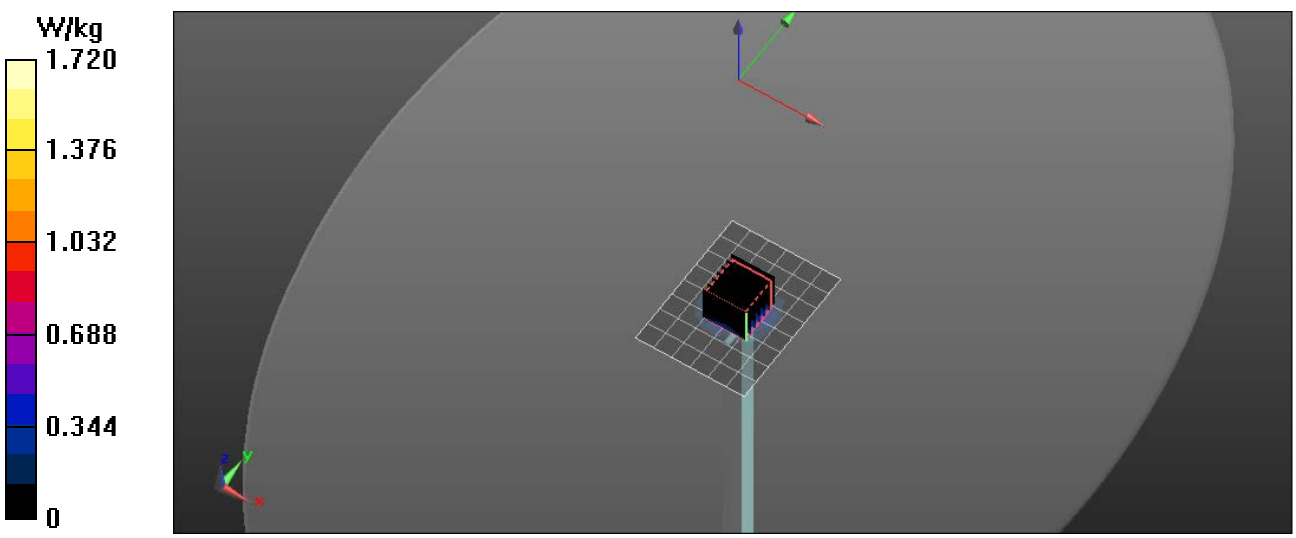
Test Date: Date: 8/15/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

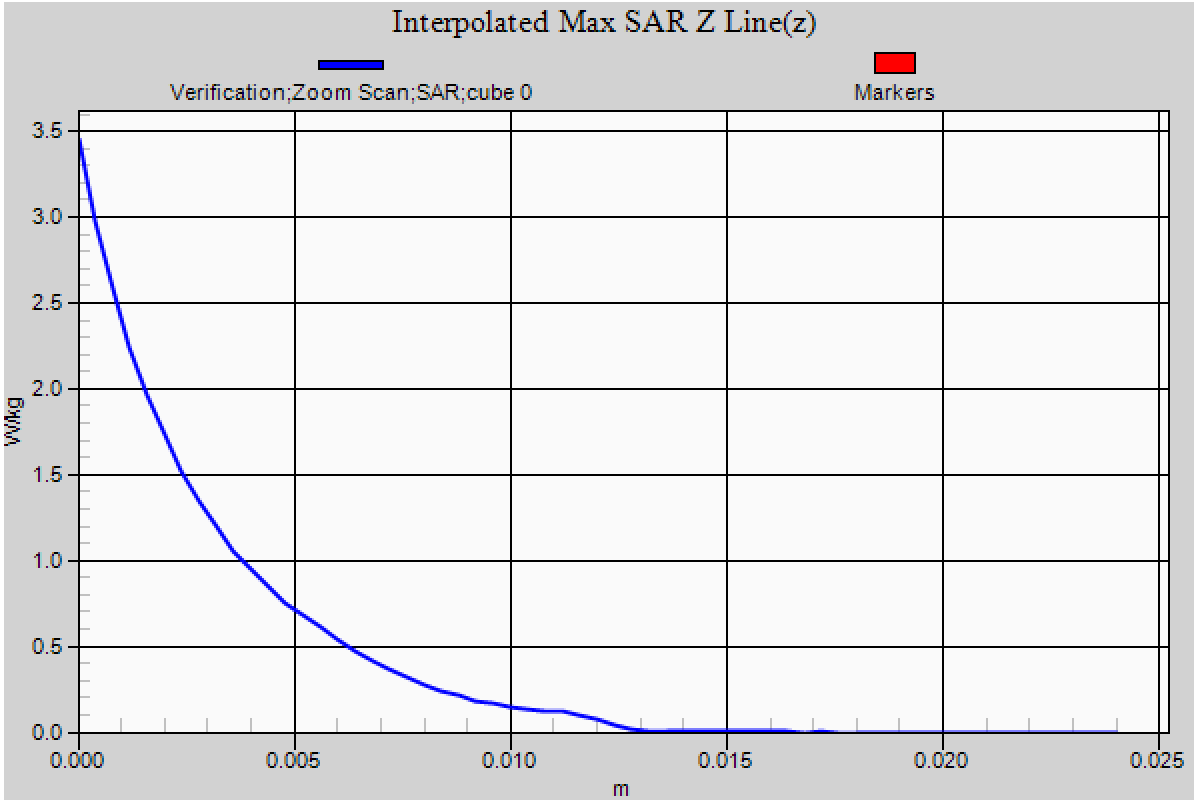
Probe: EX3DV4 - SN3662; ConvF(4.59, 4.59, 4.59); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7164)

### Procedure Notes:

**5200 MHz Body/Verification/Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.73 W/kg

**5200 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 52.846 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.49 W/kg
$P_{in}$=10 mW
**SAR(1 g) = 0.739 W/kg; SAR(10 g) = 0.205 W/kg**
Maximum value of SAR (measured) = 1.69 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
W/kg
0.000
0.005
0.010
0.015
0.020
0.025
m

# RF Exposure Lab

## Plot 3

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5600 MHz; $\sigma$ = 5.93 S/m; $\varepsilon_r$ = 48.33; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

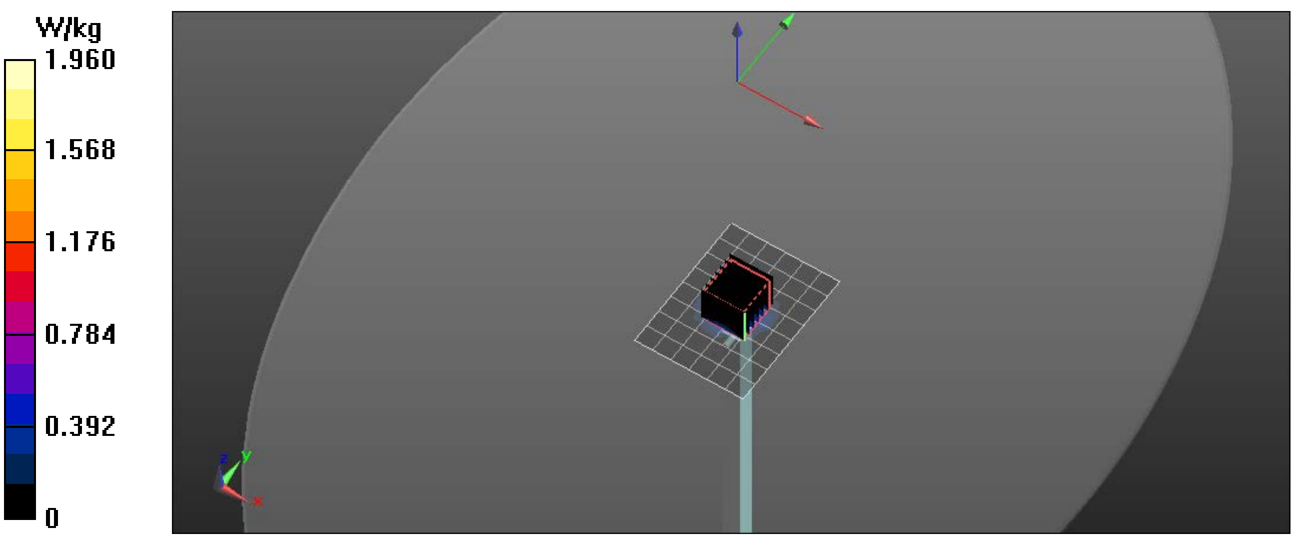
Test Date: Date: 8/19/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

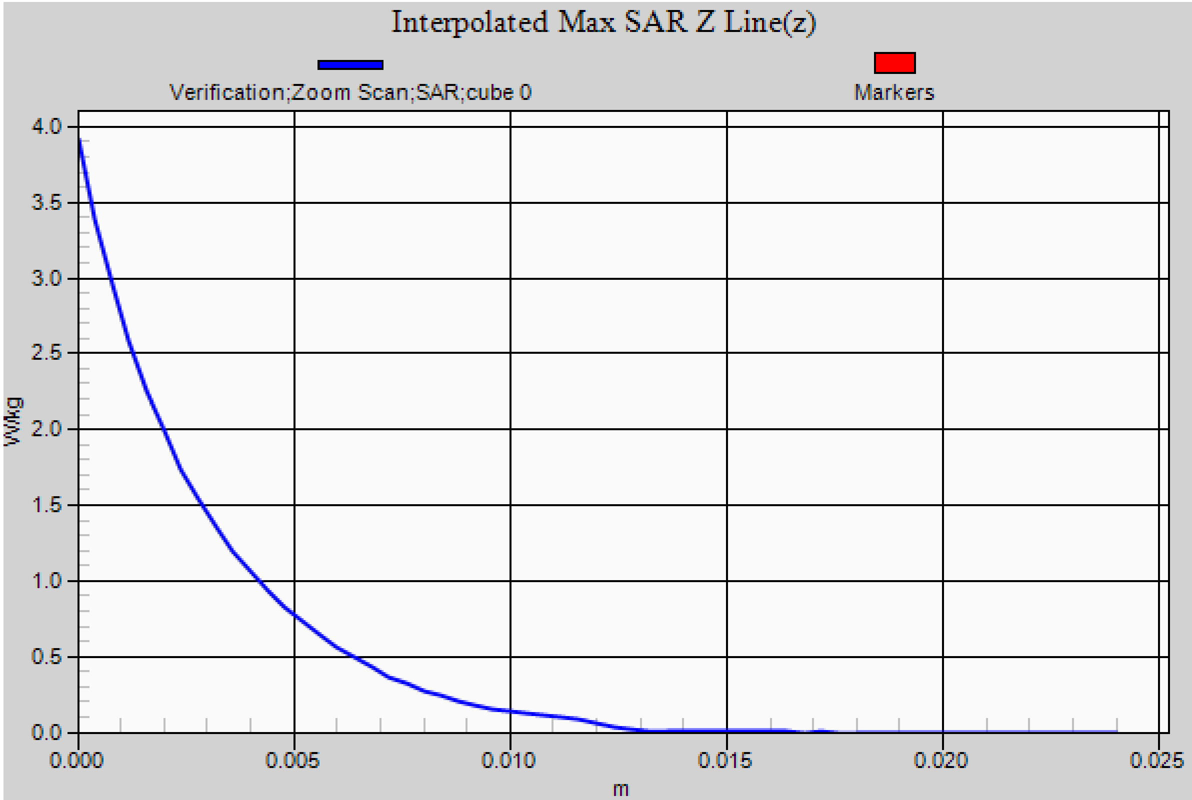
Probe: EX3DV4 - SN3662; ConvF(3.97, 3.97, 3.97); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7164)

### Procedure Notes:

**5600 MHz Body/Verification/Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.92 W/kg

**5600 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 57.026 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.92 W/kg
$P_{in}$=10 mW
**SAR(1 g) = 0.801 W/kg; SAR(10 g) = 0.227 W/kg**
Maximum value of SAR (measured) = 1.97 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
W/kg
0.000
0.005
0.010
0.015
0.020
0.025
m

# RF Exposure Lab

## Plot 4

### DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5800 MHz; $\sigma$ = 6.15 S/m; $\varepsilon_r$ = 48.05; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

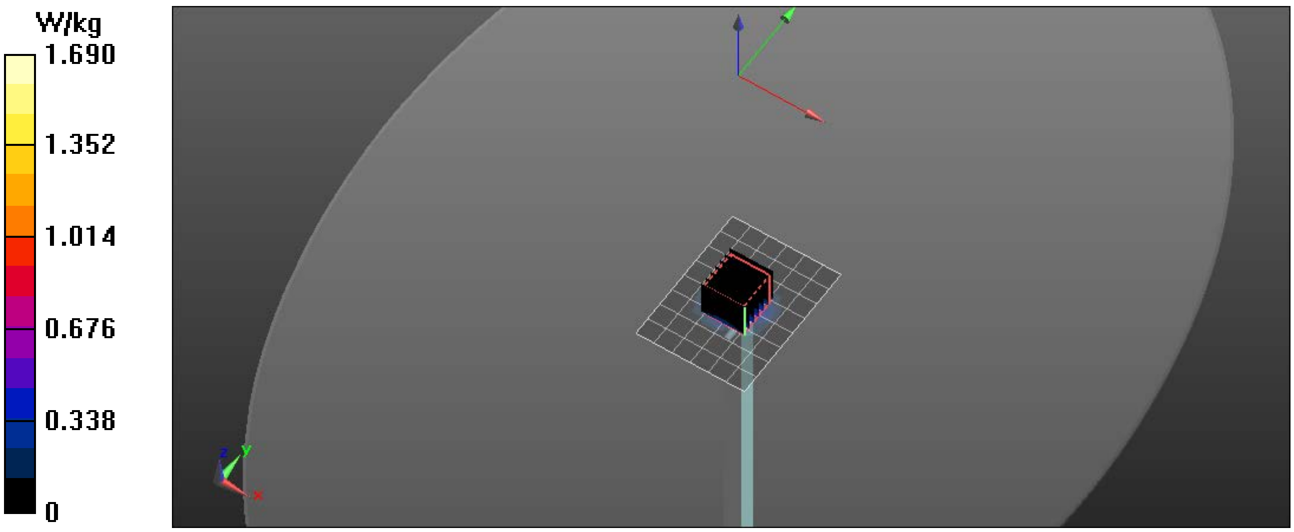
Test Date: Date: 8/19/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

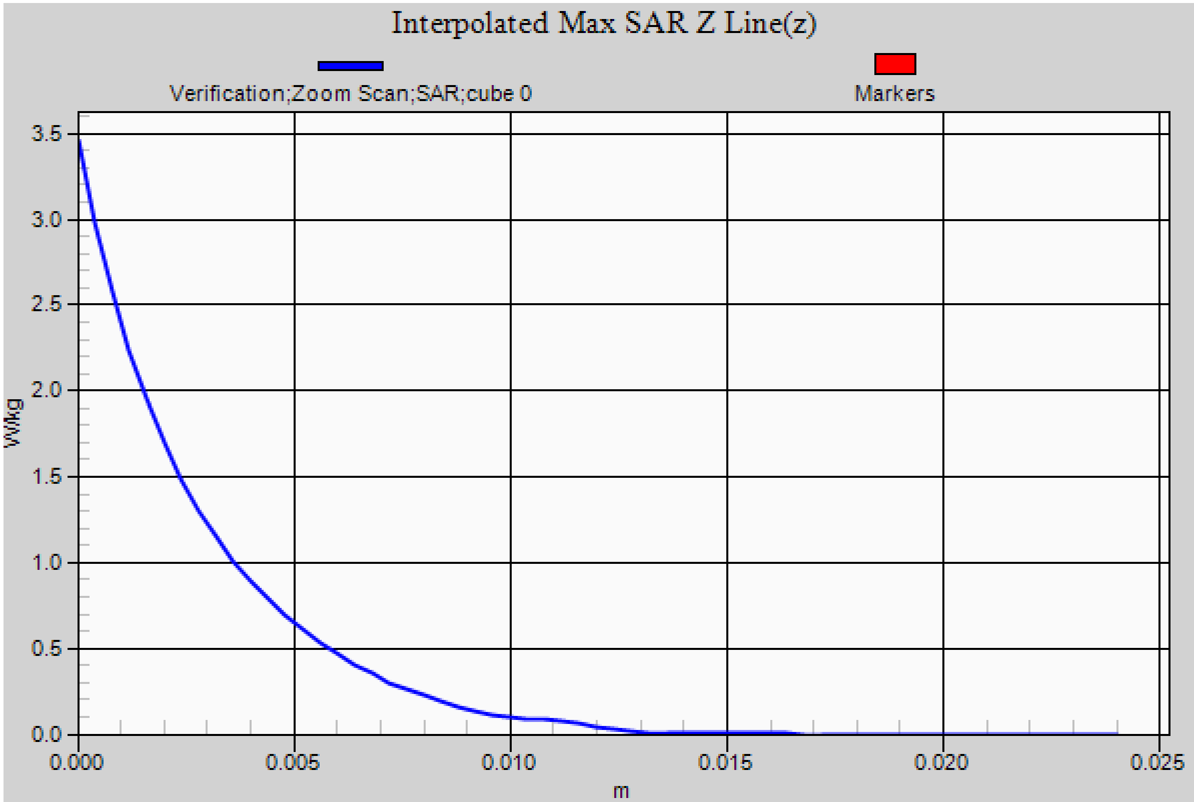
Probe: EX3DV4 - SN3662; ConvF(4.1, 4.1, 4.1); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7164)

### Procedure Notes:

**5800 MHz Body/Verification/Area Scan (7x9x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.71 W/kg

**5800 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 57.156 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.47 W/kg
$P_{in}$=10 mW
**SAR(1 g) = 0.73 W/kg; SAR(10 g) = 0.205 W/kg**
Maximum value of SAR (measured) = 1.66 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
m

# Appendix B – SAR Test Data Plots

# RF Exposure Lab

## Plot 1

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11b (DSSS, 1 Mbps); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: MSL2450; Medium parameters used (interpolated): f = 2437 MHz; $\sigma$ = 1.977 S/m; $\varepsilon_r$ = 52.599; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

Test Date: Date: 8/19/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.12, 7.12, 7.12); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

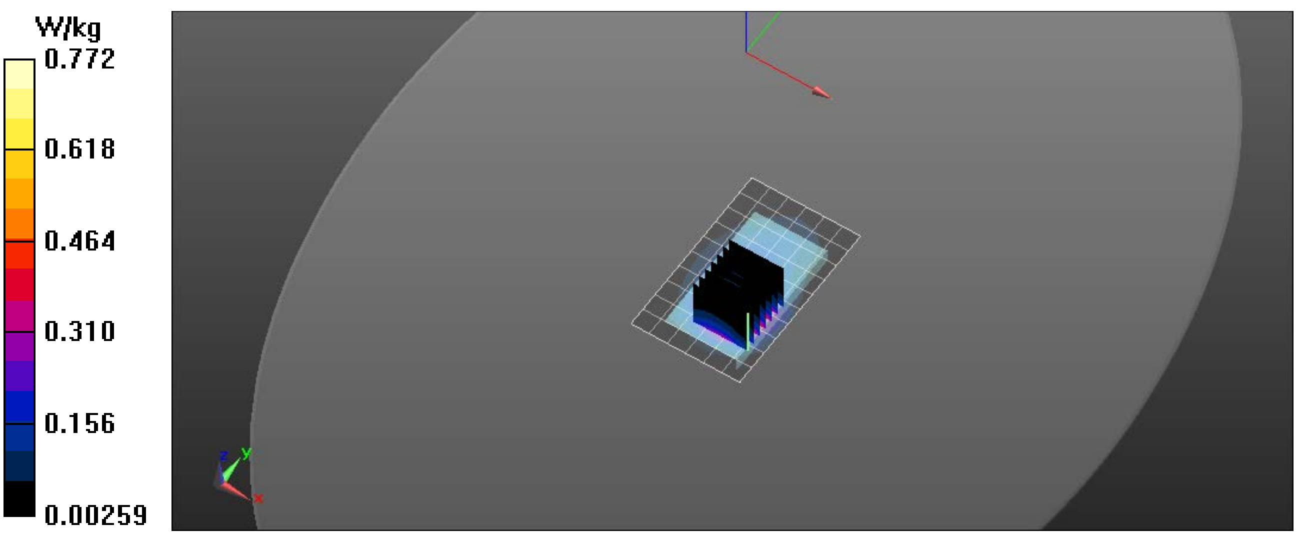
### Procedure Notes:

**2450 MHz - WiFi/Chain B Side A Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.779 W/kg

**2450 MHz - WiFi/Chain B Side A Mid/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 12.02 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.992 W/kg
**SAR(1 g) = 0.549 W/kg**

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.773 W/kg



# RF Exposure Lab

## Plot 2

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5220 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5220 MHz; $\sigma$ = 5.44 S/m; $\varepsilon_r$ = 48.89; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

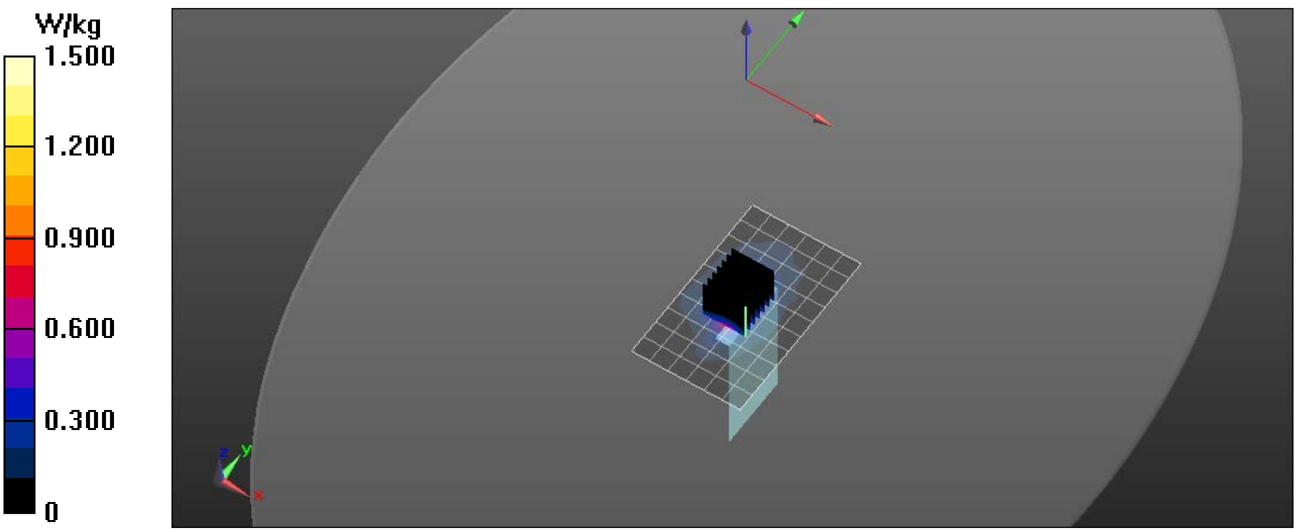
Test Date: Date: 8/18/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.59, 4.59, 4.59); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Procedure Notes:

**5200 MHz/Chain B Side C Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.16 W/kg

**5200 MHz/Chain B Side C Mid/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 11.30 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 2.71 W/kg
**SAR(1 g) = 0.719 W/kg**
Maximum value of SAR (measured) = 1.50 W/kg



# RF Exposure Lab

## Plot 3

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5300 MHz; $\sigma$ = 5.55 S/m; $\varepsilon_r$ = 48.77; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

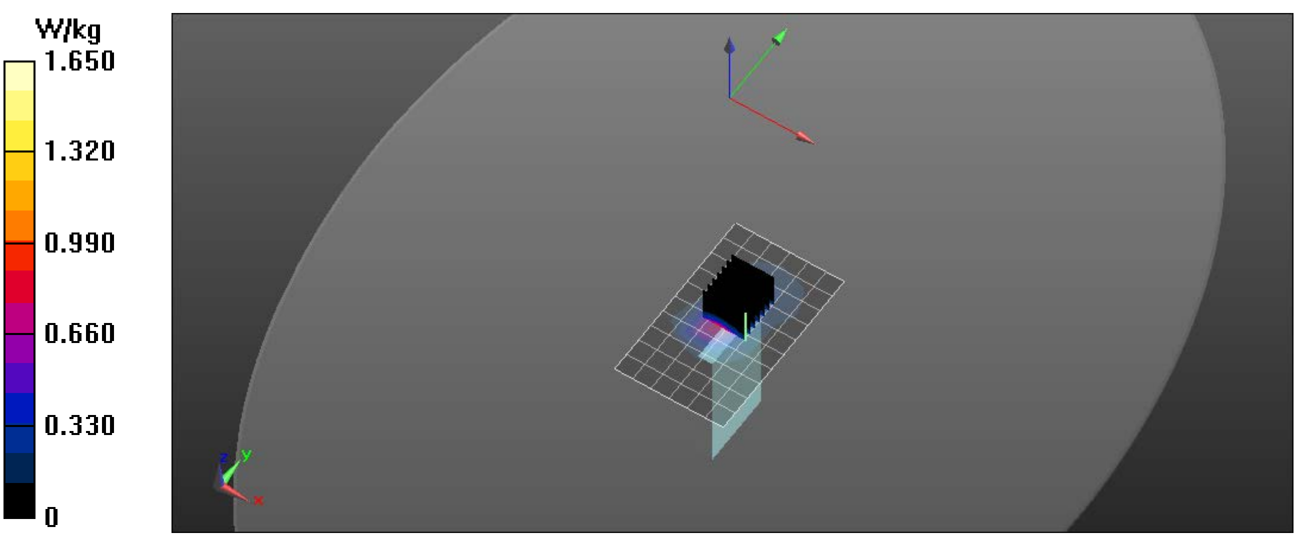
Test Date: Date: 8/16/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.43, 4.43, 4.43); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Procedure Notes:

**5300 MHz/Chain B Side C Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.48 W/kg

**5300 MHz/Chain B Side C Mid/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 10.16 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.48 W/kg
**SAR(1 g) = 0.761 W/kg**
Maximum value of SAR (measured) = 1.65 W/kg



# RF Exposure Lab

## Plot 4

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5560 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5560 MHz; $\sigma$ = 5.89 S/m; $\varepsilon_r$ = 48.39; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

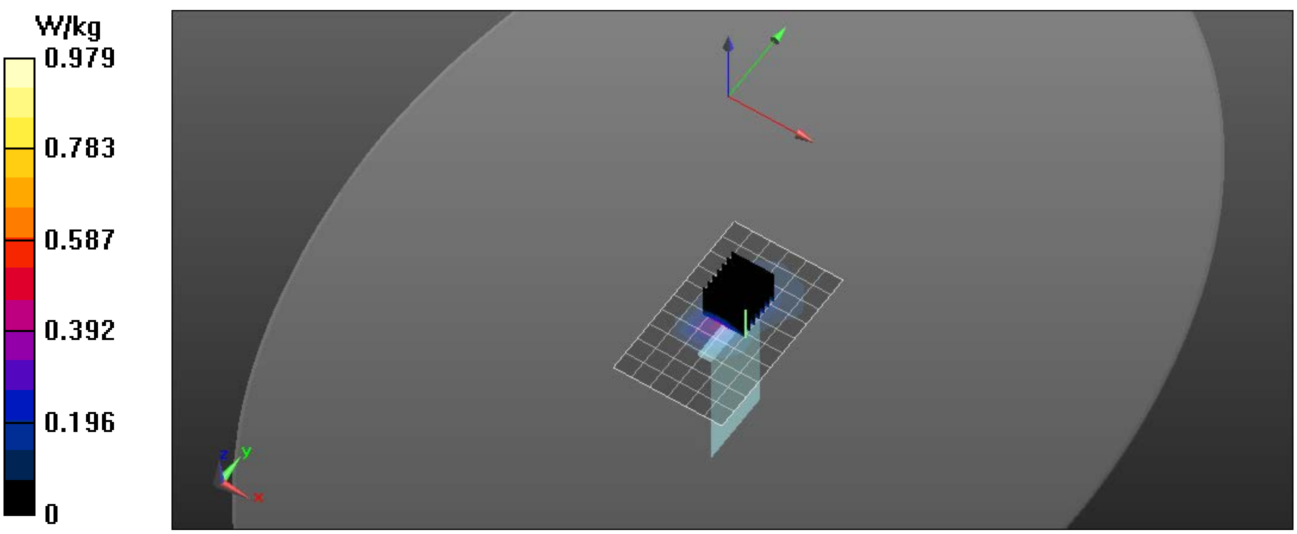
Test Date: Date: 8/16/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(3.97, 3.97, 3.97); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Procedure Notes:

**5600 MHz Low/Chain B Side C Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.844 W/kg

**5600 MHz Low/Chain B Side C Mid/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 6.202 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 2.10 W/kg
**SAR(1 g) = 0.459 W/kg**
Maximum value of SAR (measured) = 0.979 W/kg



# RF Exposure Lab

## Plot 5

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5660 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5660 MHz; $\sigma$ = 5.99 S/m; $\varepsilon_r$ = 48.25; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section

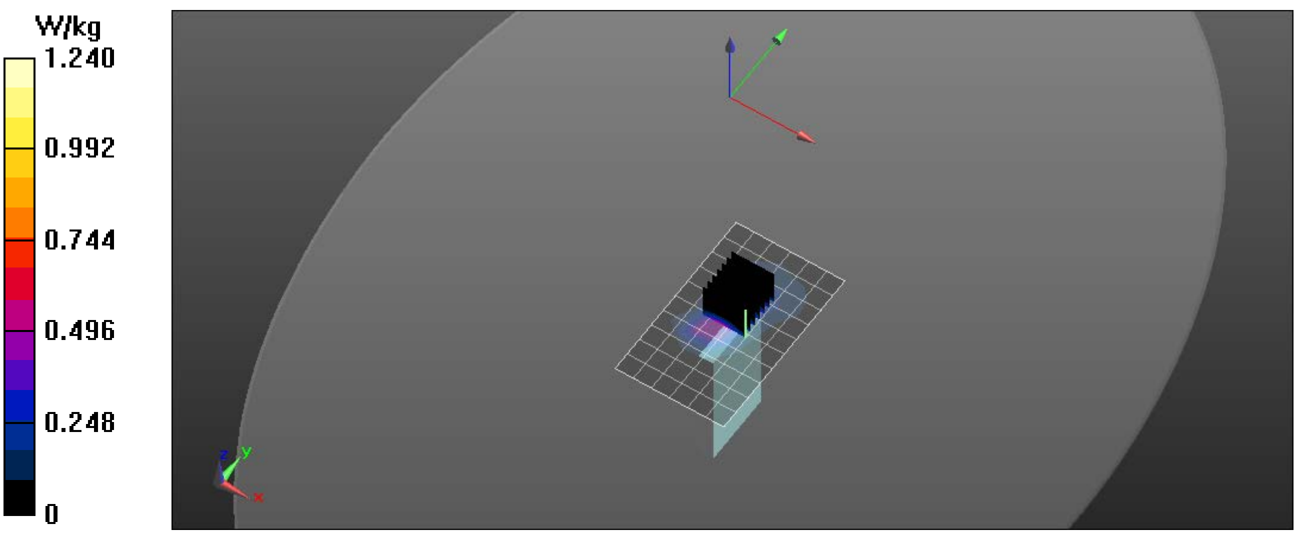
Test Date: Date: 8/16/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(3.97, 3.97, 3.97); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

### Procedure Notes:

**5600 MHz High/Chain B Side C Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.02 W/kg

**5600 MHz High/Chain B Side C Mid/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 7.411 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 2.58 W/kg
**SAR(1 g) = 0.536 W/kg**
Maximum value of SAR (measured) = 1.24 W/kg



# RF Exposure Lab

## Plot 6

### DUT: Modular Antenna; Type: PIFA Antenna; Serial: 001500F78D62

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5785 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used (interpolated): f = 5785 MHz; σ = 6.128 S/m; $\varepsilon_r$ = 48.073; ρ = 1000 kg/m$^3$
Phantom section: Flat Section

Test Date: Date: 8/15/2014; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.1, 4.1, 4.1); Calibrated: 4/15/2014;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 1/13/2014
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1251
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

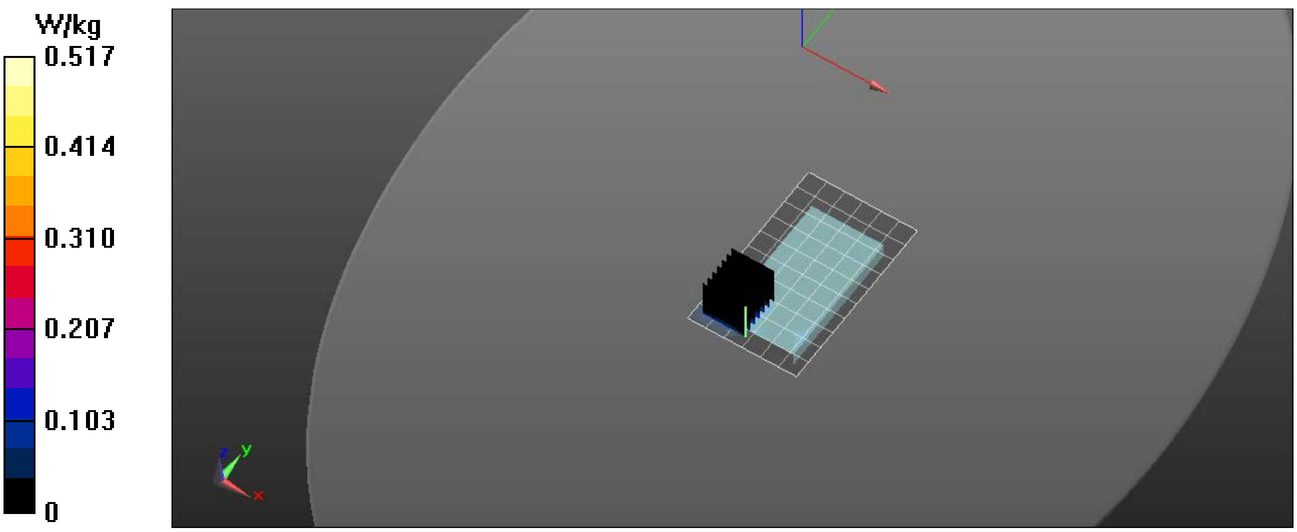
### Procedure Notes:

**5800 MHz/Chain B Side A Mid/Area Scan (7x11x1):** Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.357 W/kg

**5800 MHz/Chain B Side A Mid/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0.8000 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.18 W/kg
**SAR(1 g) = 0.227 W/kg**

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.517 W/kg



# Appendix D – Probe Calibration Data Sheets

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** **RF Exposure Lab**

**Certificate No: EX3-3662_Apr14**

# CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3662

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: April 15, 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 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Power sensor E4412A | MY41498087 | 03-Apr-14 (No. 217-01911) | Apr-15 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 03-Apr-14 (No. 217-01915) | Apr-15 |
| Reference 20 dB Attenuator | SN: S5277 (20x) | 03-Apr-14 (No. 217-01919) | Apr-15 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 03-Apr-14 (No. 217-01920) | Apr-15 |
| 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: April 15, 2014

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

## 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:3662

Manufactured: October 20, 2008
Calibrated: April 15, 2014

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3662

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.42 | 0.49 | 0.50 | ± 10.1 % |
| DCP (mV)[B] | 98.4 | 97.6 | 95.1 | |

## 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 | 119.4 | ±1.7 % |
| | | Y | 0.0 | 0.0 | 1.0 | | 118.3 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 110.9 | |

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:3662

## 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) |
|---|---|---|---|---|---|---|---|---|
| 150 | 52.3 | 0.76 | 10.96 | 10.96 | 10.96 | 0.00 | 1.00 | ± 13.3 % |
| 220 | 49.0 | 0.81 | 10.87 | 10.87 | 10.87 | 0.00 | 1.00 | ± 13.3 % |
| 450 | 43.5 | 0.87 | 10.99 | 10.99 | 10.99 | 0.18 | 1.20 | ± 13.3 % |
| 750 | 41.9 | 0.89 | 9.72 | 9.72 | 9.72 | 0.21 | 1.44 | ± 12.0 % |
| 835 | 41.5 | 0.90 | 9.43 | 9.43 | 9.43 | 0.22 | 1.20 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 9.23 | 9.23 | 9.23 | 0.15 | 1.56 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 8.01 | 8.01 | 8.01 | 0.76 | 0.57 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.75 | 7.75 | 7.75 | 0.46 | 0.77 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 7.04 | 7.04 | 7.04 | 0.57 | 0.68 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 6.84 | 6.84 | 6.84 | 0.26 | 1.06 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 5.22 | 5.22 | 5.22 | 0.30 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.99 | 4.99 | 4.99 | 0.30 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.89 | 4.89 | 4.89 | 0.35 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.84 | 4.84 | 4.84 | 0.35 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.87 | 4.87 | 4.87 | 0.35 | 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.

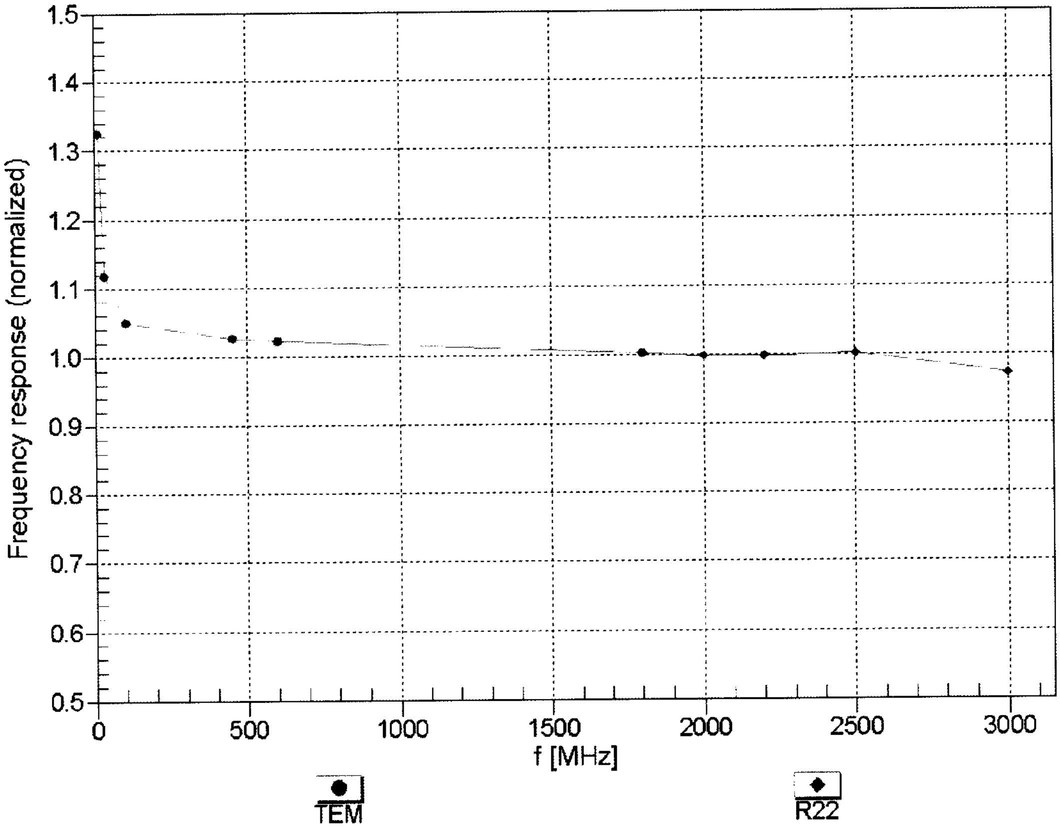
# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3662

## 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) |
|---|---|---|---|---|---|---|---|---|
| 150 | 61.9 | 0.80 | 10.62 | 10.62 | 10.62 | 0.00 | 1.00 | ± 13.3 % |
| 220 | 59.4 | 0.88 | 10.31 | 10.31 | 10.31 | 0.00 | 1.00 | ± 13.3 % |
| 450 | 56.7 | 0.94 | 10.37 | 10.37 | 10.37 | 0.10 | 1.20 | ± 13.3 % |
| 750 | 55.5 | 0.96 | 9.42 | 9.42 | 9.42 | 0.57 | 0.75 | ± 12.0 % |
| 835 | 55.2 | 0.97 | 9.30 | 9.30 | 9.30 | 0.43 | 0.86 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 9.13 | 9.13 | 9.13 | 0.39 | 0.89 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 7.76 | 7.76 | 7.76 | 0.27 | 1.06 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 7.47 | 7.47 | 7.47 | 0.42 | 0.82 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 7.12 | 7.12 | 7.12 | 0.77 | 0.57 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 6.95 | 6.95 | 6.95 | 0.80 | 0.50 | ± 12.0 % |
| 5200 | 49.0 | 5.30 | 4.59 | 4.59 | 4.59 | 0.40 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 4.43 | 4.43 | 4.43 | 0.40 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 4.22 | 4.22 | 4.22 | 0.40 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.97 | 3.97 | 3.97 | 0.50 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 4.10 | 4.10 | 4.10 | 0.50 | 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.

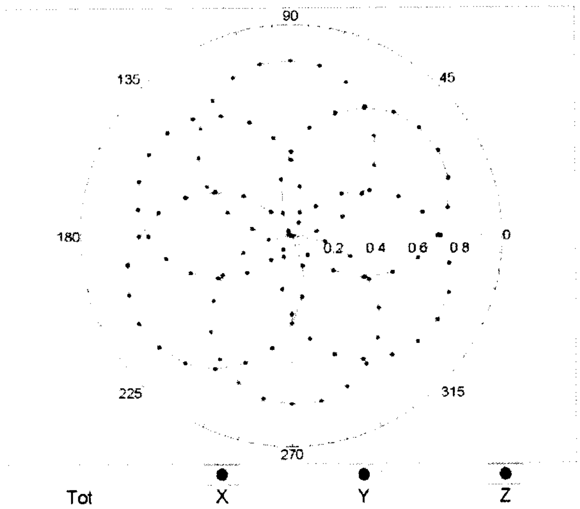
# Frequency Response of E-Field
## (TEM-Cell:ifi110 EXX, Waveguide: R22)



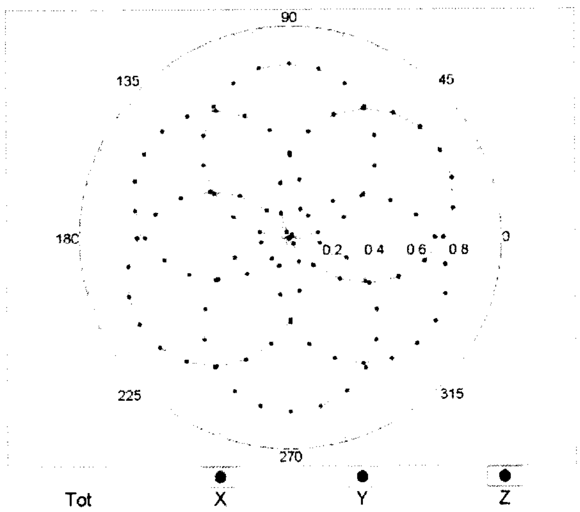

**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

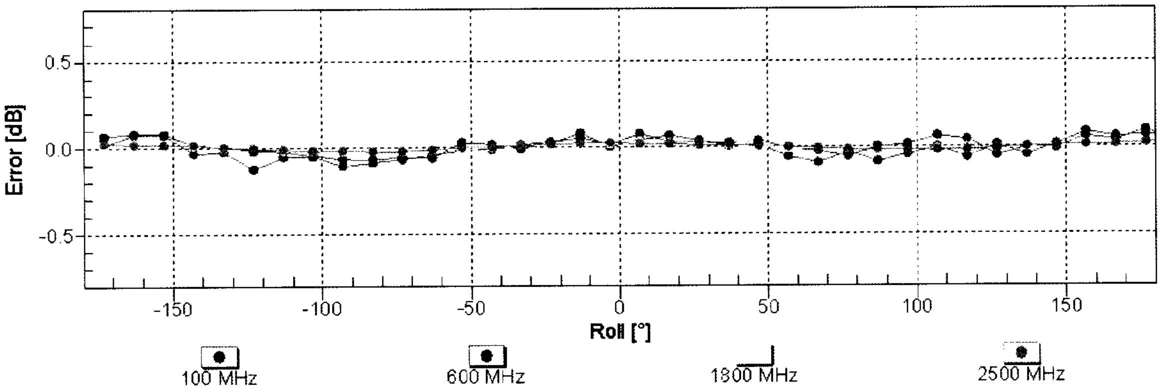
# Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM




f=1800 MHz,R22

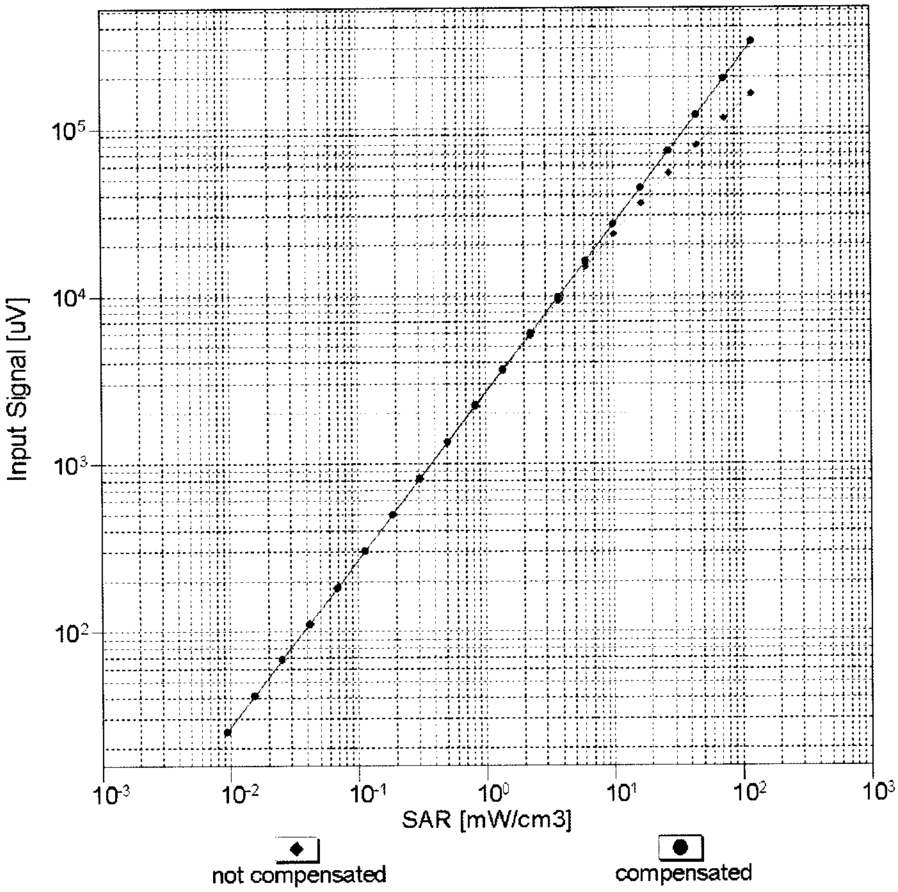


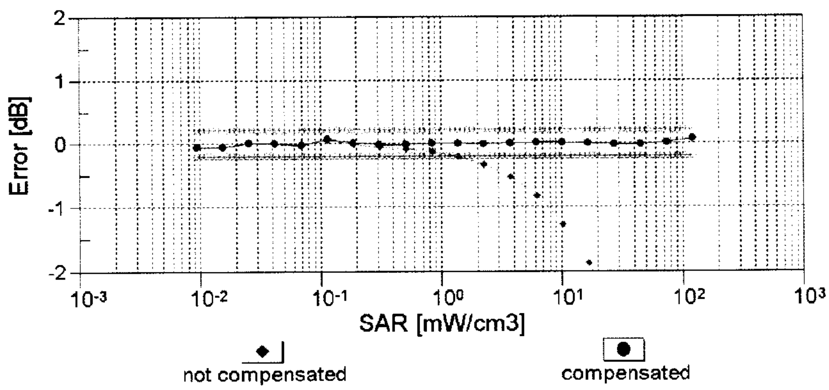




**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

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

**(TEM cell , $f_{eval}$= 1900 MHz)**

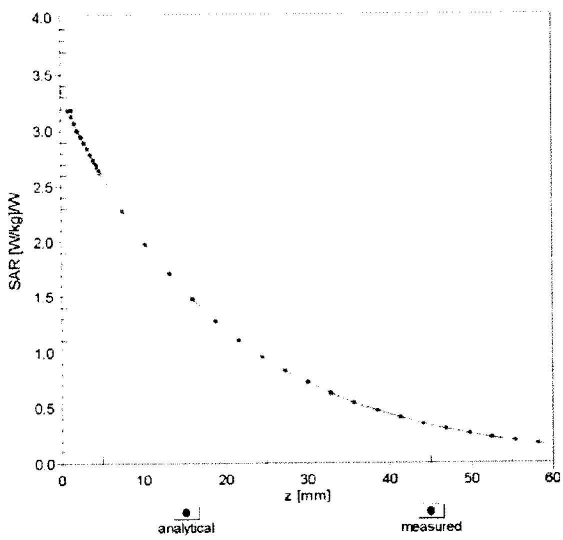


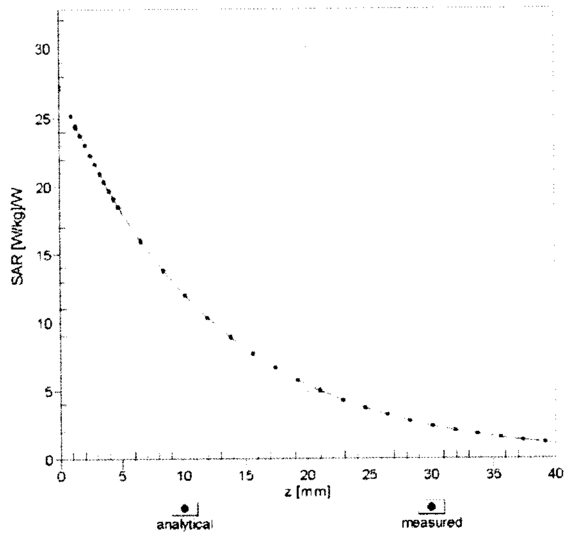

**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

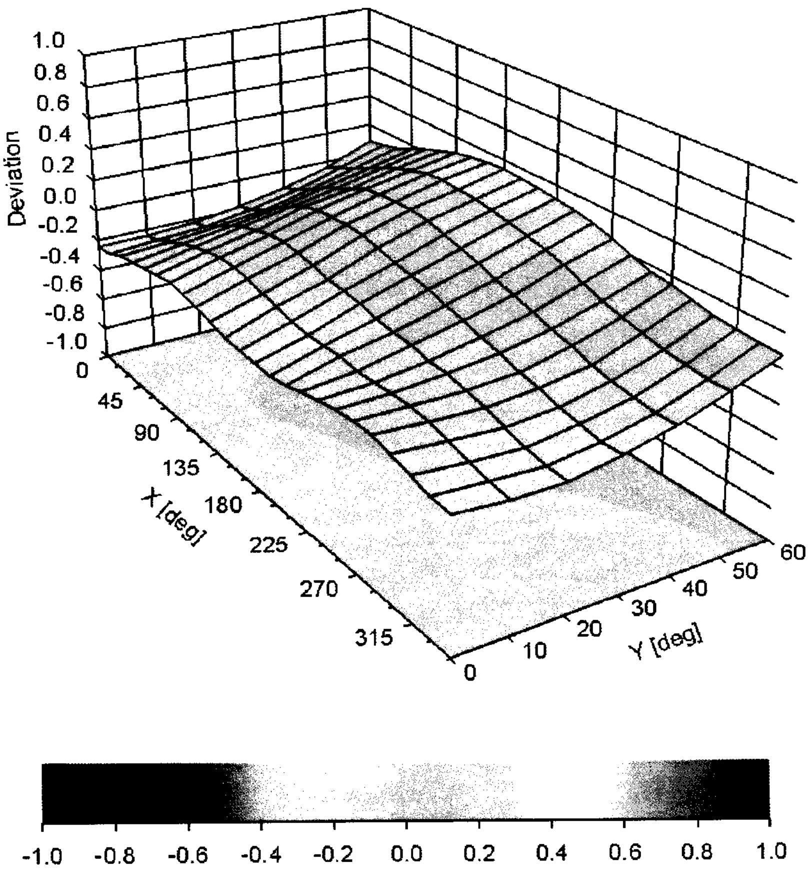



f = 1900 MHz,WGLS R22 (H_convF)




# 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:3662

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | -33.1 |
| 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 E – Dipole Calibration Data Sheets

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** **RF Exposure Lab**

**Certificate No: D2450V2-829_Dec12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 829 |
| Calibration procedure(s) | QA CAL-05.v8<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | December 04, 2012 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Power sensor HP 8481A | US37292783 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 27-Mar-12 (No. 217-01530) | Apr-13 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 27-Mar-12 (No. 217-01533) | Apr-13 |
| Reference Probe ES3DV3 | SN: 3205 | 30-Dec-11 (No. ES3-3205_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

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

Issued: December 4, 2012

**Glossary:**

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

**Calibration is Performed According to the Following Standards:**

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

**Additional Documentation:**

d) DASY4/5 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 | V52.8.3 |
| **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 | 38.2 ± 6 % | 1.84 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 | 13.7 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **53.9 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.33 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **25.1 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 | 50.7 ± 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 | 13.2 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.5 W/kg ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 6.08 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **24.0 W/kg ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 53.1 Ω + 4.2 jΩ |
| Return Loss | - 25.9 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 49.7 Ω + 5.1 jΩ |
| Return Loss | - 25.9 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.158 ns |

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | December 11, 2008 |

| D2450V2 SN: 829 - Body | | | | |
|---|---|---|---|---|
| Date of Measurement | Return Loss (dB) | Δ% | Impedance (Ω) | ΔΩ |
| 12/4/2012 | -25.9 | | 49.7 | |
| 12/5/2013 | -26.2 | 1.2 | 48.5 | -1.2 |
| | | | | |

| D2450V2 SN: 829 - Head | | | | |
|---|---|---|---|---|
| Date of Measurement | Return Loss (dB) | Δ% | Impedance (Ω) | ΔΩ |
| 12/4/2012 | -25.9 | | 53.1 | |
| 12/5/2013 | -26.5 | 2.3 | 52.6 | -0.5 |
| | | | | |

Date: 04.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 829**

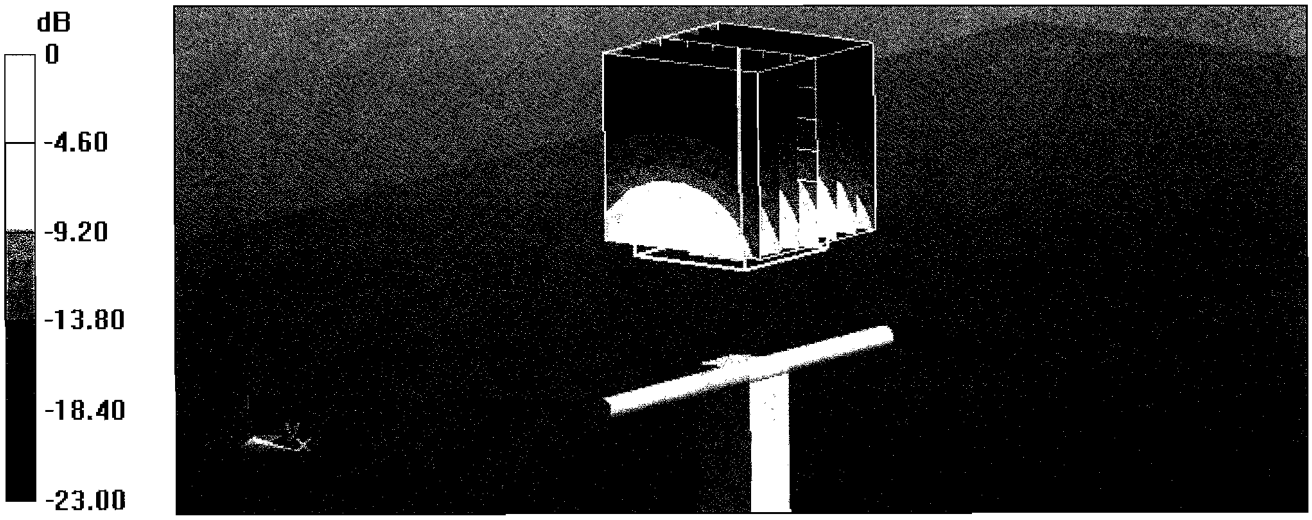
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 1.84 mho/m; $\varepsilon_r$ = 38.2; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

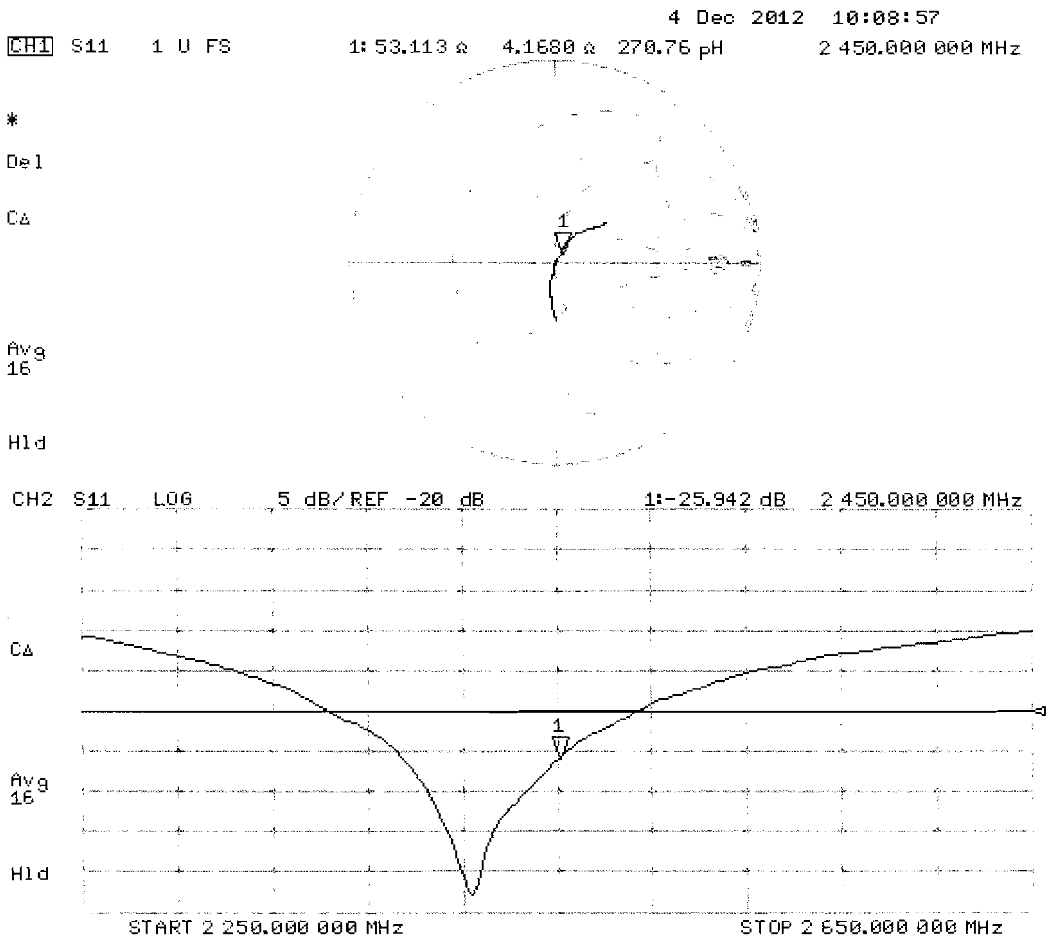
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.1 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 28.3 W/kg
**SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.33 W/kg**
Maximum value of SAR (measured) = 17.8 W/kg




0 dB = 17.8 W/kg = 12.50 dBW/kg

## Impedance Measurement Plot for Head TSL



Date: 04.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 829**

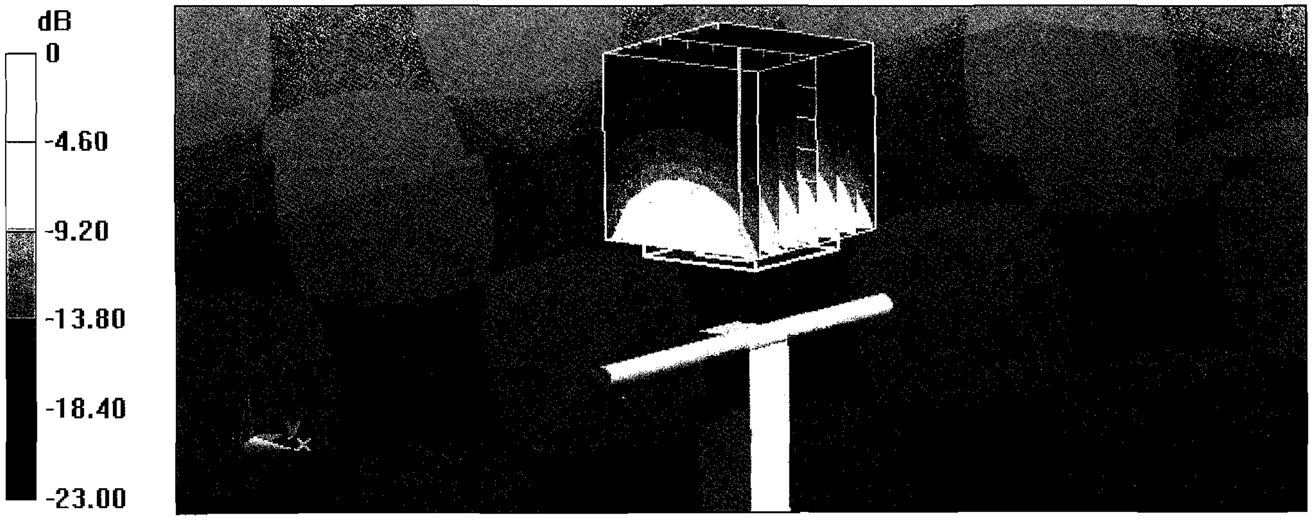
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma$ = 2.02 mho/m; $\varepsilon_r$ = 50.7; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

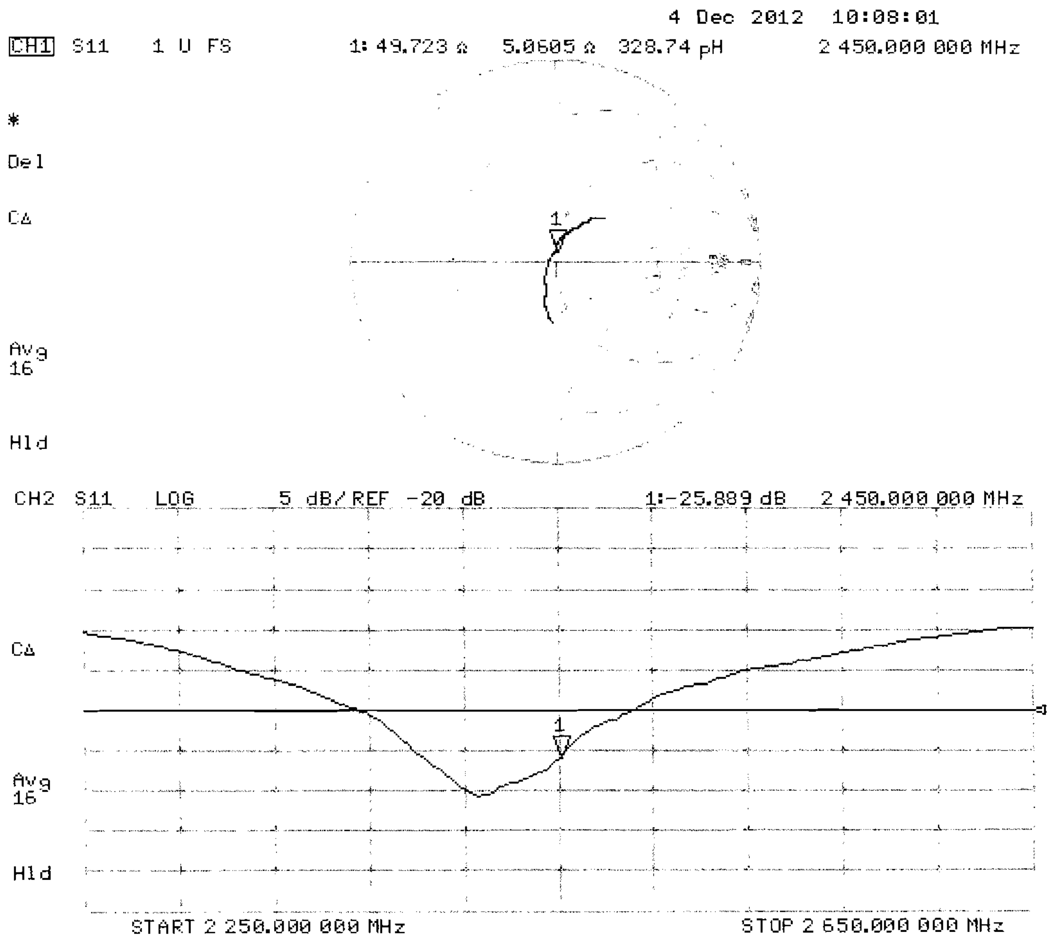
## Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 102.1 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 27.4 W/kg
**SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.08 W/kg**
Maximum value of SAR (measured) = 17.5 W/kg




0 dB = 17.5 W/kg = 12.43 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** **RF Exposure Lab**

**Certificate No: D5GHzV2-1085_Dec12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D5GHzV2 - SN: 1085 |
| Calibration procedure(s) | QA CAL-22.v1<br>Calibration procedure for dipole validation kits between 3-6 GHz |
| Calibration date: | December 11, 2012 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date (Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power meter EPM-442A | GB37480704 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Power sensor HP 8481A | US37292783 | 01-Nov-12 (No. 217-01640) | Oct-13 |
| Reference 20 dB Attenuator | SN: 5058 (20k) | 27-Mar-12 (No. 217-01530) | Apr-13 |
| Type-N mismatch combination | SN: 5047.3 / 06327 | 27-Mar-12 (No. 217-01533) | Apr-13 |
| Reference Probe EX3DV4 | SN: 3503 | 30-Dec-11 (No. EX3-3503_Dec11) | Dec-12 |
| DAE4 | SN: 601 | 27-Jun-12 (No. DAE4-601_Jun12) | Jun-13 |

| Secondary Standards | ID # | Check Date (in house) | Scheduled Check |
|---|---|---|---|
| Power sensor HP 8481A | MY41092317 | 18-Oct-02 (in house check Oct-11) | In house check: Oct-13 |
| RF generator R&S SMT-06 | 100005 | 04-Aug-99 (in house check Oct-11) | In house check: Oct-13 |
| Network Analyzer HP 8753E | US37390585 S4206 | 18-Oct-01 (in house check Oct-12) | In house check: Oct-13 |

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

Issued: December 11, 2012

## 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) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

## Additional Documentation:

c) 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 | V52.8.3 |
| **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>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 | 34.8 ± 6 % | 4.53 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 | 8.20 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **81.4 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.35 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.3 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 | 34.7 ± 6 % | 4.63 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 | 8.35 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **82.9 W / kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.39 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.7 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 | 34.2 ± 6 % | 4.93 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 | 8.69 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **86.1 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.48 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.5 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 | 34.0 ± 6 % | 5.15 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 | 8.16 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **80.9 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.33 W/kg |
| SAR for nominal Head TSL parameters | normalized to 1W | **23.1 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 | 46.8 ± 6 % | 5.35 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 | 7.41 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **73.4 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)** |

## 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 | 46.7 ± 6 % | 5.47 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 | 7.43 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **73.6 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.09 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.7 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 | 46.2 ± 6 % | 5.86 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 | 7.98 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **79.1 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.22 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.9 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 | 45.9 ± 6 % | 6.13 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 | 7.36 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **72.9 W/kg ± 19.9 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 100 mW input power | 2.04 W/kg |
| SAR for nominal Body TSL parameters | normalized to 1W | **20.2 W/kg ± 19.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 50.9 Ω - 9.9 jΩ |
| Return Loss | - 20.2 dB |

### Antenna Parameters with Head TSL at 5300 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 48.7 Ω - 5.6 jΩ |
| Return Loss | - 24.7 dB |

### Antenna Parameters with Head TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.1 Ω - 4.4 jΩ |
| Return Loss | - 23.0 dB |

### Antenna Parameters with Head TSL at 5800 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 51.9 Ω - 4.6 jΩ |
| Return Loss | - 26.2 dB |

### Antenna Parameters with Body TSL at 5200 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 50.0 Ω - 9.5 jΩ |
| Return Loss | - 20.5 dB |

### Antenna Parameters with Body TSL at 5300 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 49.7 Ω - 5.0 jΩ |
| Return Loss | - 26.0 dB |

### Antenna Parameters with Body TSL at 5600 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 56.5 Ω - 3.4 jΩ |
| Return Loss | - 23.2 dB |

### Antenna Parameters with Body TSL at 5800 MHz

| | |
|---|---|
| Impedance, transformed to feed point | 53.5 Ω - 4.7 jΩ |
| Return Loss | - 25.0 dB |

## General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.207 ns |

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

| | |
|---|---|
| Manufactured by | SPEAG |
| Manufactured on | December 21, 2009 |

**D5GHzV2 SN: 1085 - Head**

| Date of Measurement | Frequency | Return Loss (dB) | Δ% | Impedance (Ω) | ΔΩ |
|---|---|---|---|---|---|
| 12/11/2012 | 5200 MHz | -20.2 | | 50.9 | |
| 12/11/2013 | | -21.3 | 5.4 | 51.2 | 0.3 |
| | | | | | |
| 12/11/2012 | 5300 MHz | -24.7 | | 48.7 | |
| 12/11/2013 | | -24.3 | -1.6 | 47.9 | -0.8 |
| | | | | | |
| 12/11/2012 | 5600 MHz | -23.0 | | 56.1 | |
| 12/11/2013 | | -23.9 | 3.9 | 55.0 | -1.1 |
| | | | | | |
| 12/11/2012 | 5800 MHz | -26.2 | | 51.9 | |
| 12/11/2013 | | -25.6 | -2.3 | 53.1 | 1.2 |
| | | | | | |

**D5GHzV2 SN: 1085 - Body**

| Date of Measurement | Frequency | Return Loss (dB) | Δ% | Impedance (Ω) | ΔΩ |
|---|---|---|---|---|---|
| 12/11/2012 | 5200 MHz | -20.5 | | 50.0 | |
| 12/11/2013 | | -21.3 | 3.9 | 51.2 | 1.2 |
| | | | | | |
| 12/11/2012 | 5300 MHz | -26.0 | | 49.7 | |
| 12/11/2013 | | -25.3 | -2.7 | 51.3 | 1.6 |
| | | | | | |
| 12/11/2012 | 5600 MHz | -23.2 | | 56.5 | |
| 12/11/2013 | | -22.6 | -2.6 | 55.9 | -0.6 |
| | | | | | |
| 12/11/2012 | 5800 MHz | -25.0 | | 53.5 | |
| 12/11/2013 | | -23.9 | -4.4 | 52.6 | -0.9 |
| | | | | | |

Date: 11.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1085**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 4.53 mho/m; $\varepsilon_r$ = 34.8; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5300 MHz; $\sigma$ = 4.63 mho/m; $\varepsilon_r$ = 34.7; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 4.93 mho/m; $\varepsilon_r$ = 34.2; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 5.15 mho/m; $\varepsilon_r$ = 34; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

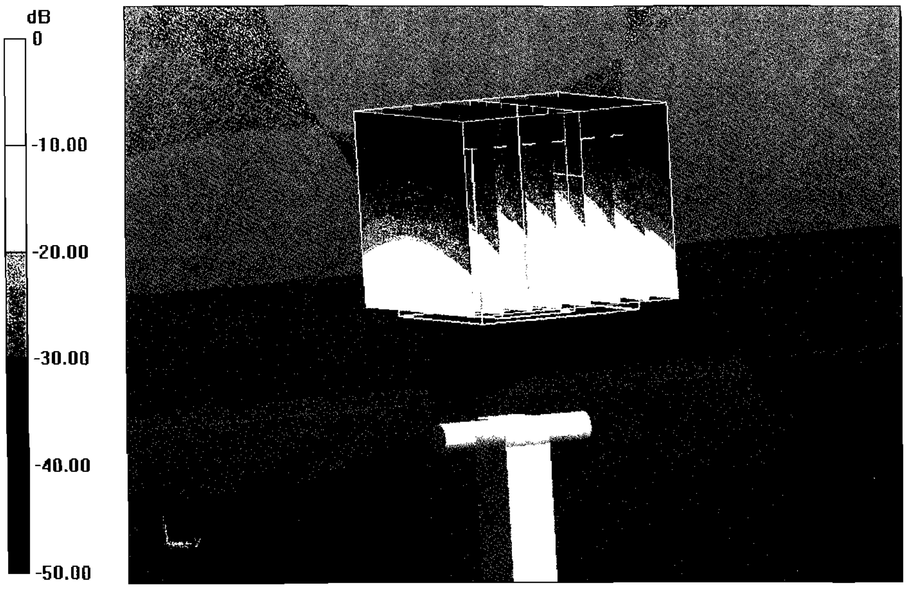
- Probe: EX3DV4 - SN3503; ConvF(5.41, 5.41, 5.41); Calibrated: 30.12.2011, ConvF(5.1, 5.1, 5.1); Calibrated: 30.12.2011, ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2011, ConvF(4.81, 4.81, 4.81); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

**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 = 64.782 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 30.1 W/kg
**SAR(1 g) = 8.2 W/kg; SAR(10 g) = 2.35 W/kg**
Maximum value of SAR (measured) = 18.9 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 = 64.947 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 31.3 W/kg
**SAR(1 g) = 8.35 W/kg; SAR(10 g) = 2.39 W/kg**
Maximum value of SAR (measured) = 19.4 W/kg

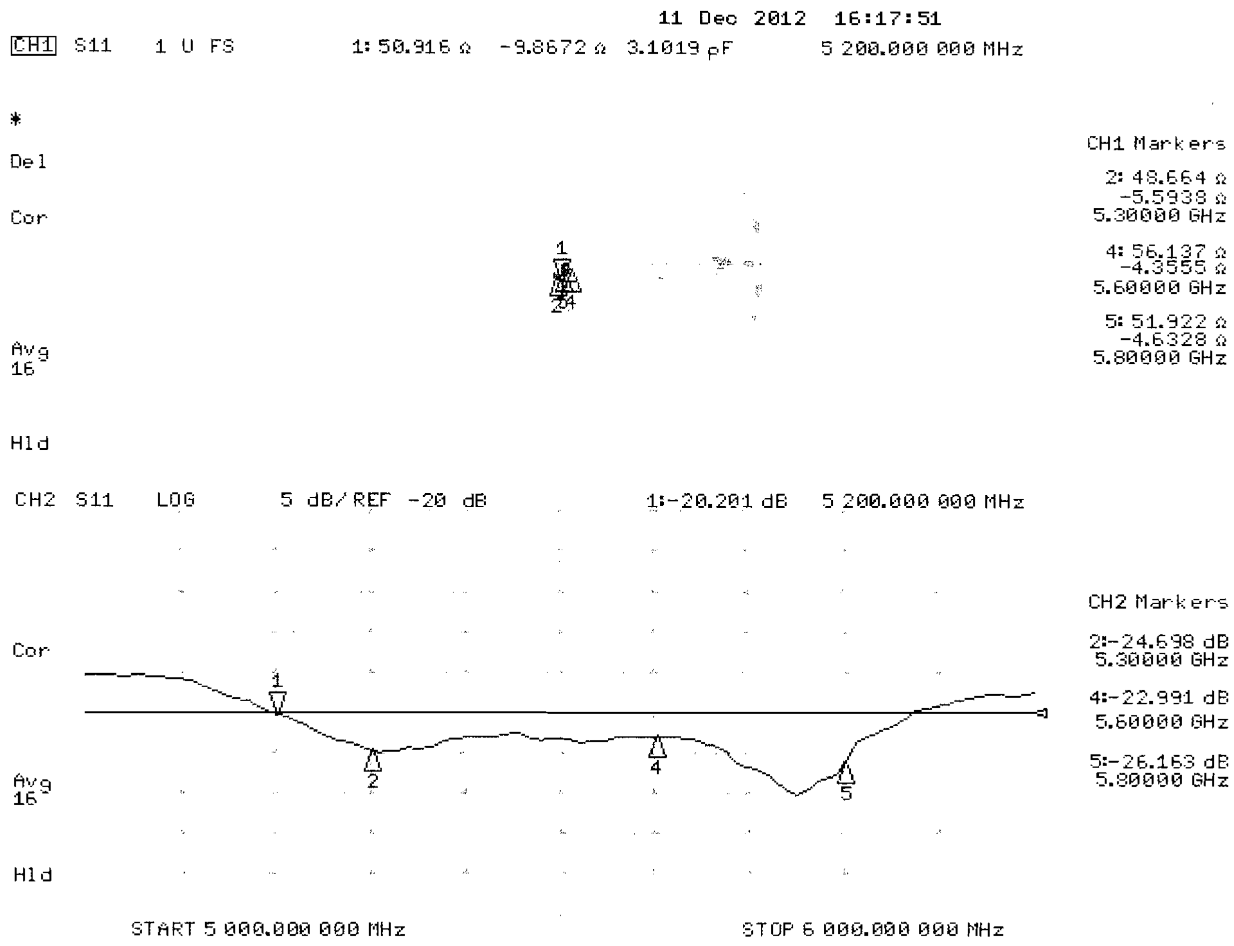
**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.857 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 34.4 W/kg
**SAR(1 g) = 8.69 W/kg; SAR(10 g) = 2.48 W/kg**
Maximum value of SAR (measured) = 20.8 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 = 61.816 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 33.5 W/kg
**SAR(1 g) = 8.16 W/kg; SAR(10 g) = 2.33 W/kg**
Maximum value of SAR (measured) = 19.9 W/kg




0 dB = 19.9 W/kg = 12.99 dBW/kg

## Impedance Measurement Plot for Head TSL



Date: 10.12.2012

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1085**

Communication System: CW; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz
Medium parameters used: f = 5200 MHz; $\sigma$ = 5.35 mho/m; $\varepsilon_r$ = 46.8; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5300 MHz; $\sigma$ = 5.47 mho/m; $\varepsilon_r$ = 46.7; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5600 MHz; $\sigma$ = 5.86 mho/m; $\varepsilon_r$ = 46.2; $\rho$ = 1000 kg/m$^3$ , Medium parameters used: f = 5800 MHz; $\sigma$ = 6.13 mho/m; $\varepsilon_r$ = 45.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

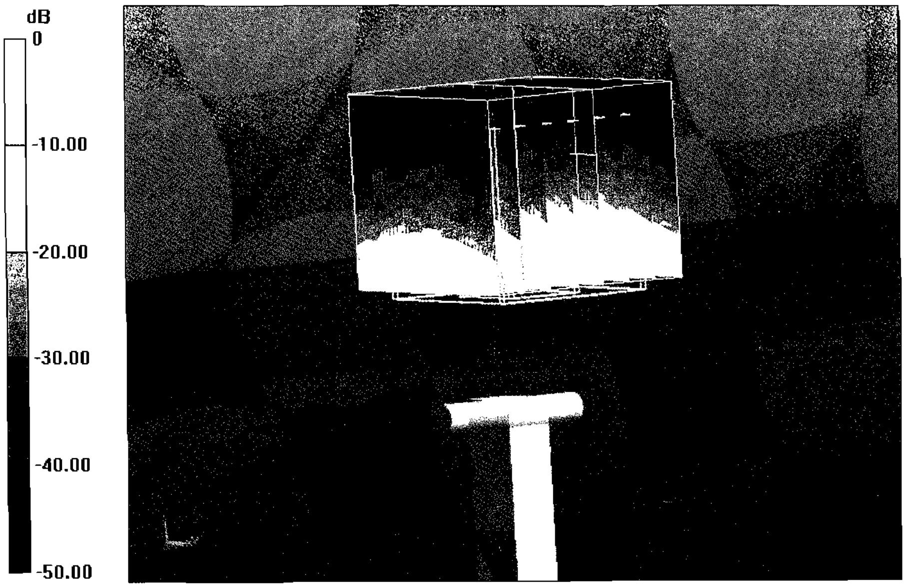
- Probe: EX3DV4 - SN3503; ConvF(4.91, 4.91, 4.91); Calibrated: 30.12.2011, ConvF(4.67, 4.67, 4.67); Calibrated: 30.12.2011, ConvF(4.22, 4.22, 4.22); Calibrated: 30.12.2011, ConvF(4.38, 4.38, 4.38); Calibrated: 30.12.2011;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.3(988); SEMCAD X 14.6.7(6848)

**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 = 58.435 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 29.5 W/kg
**SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg**
Maximum value of SAR (measured) = 17.3 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 = 57.938 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 30.1 W/kg
**SAR(1 g) = 7.43 W/kg; SAR(10 g) = 2.09 W/kg**
Maximum value of SAR (measured) = 17.4 W/kg

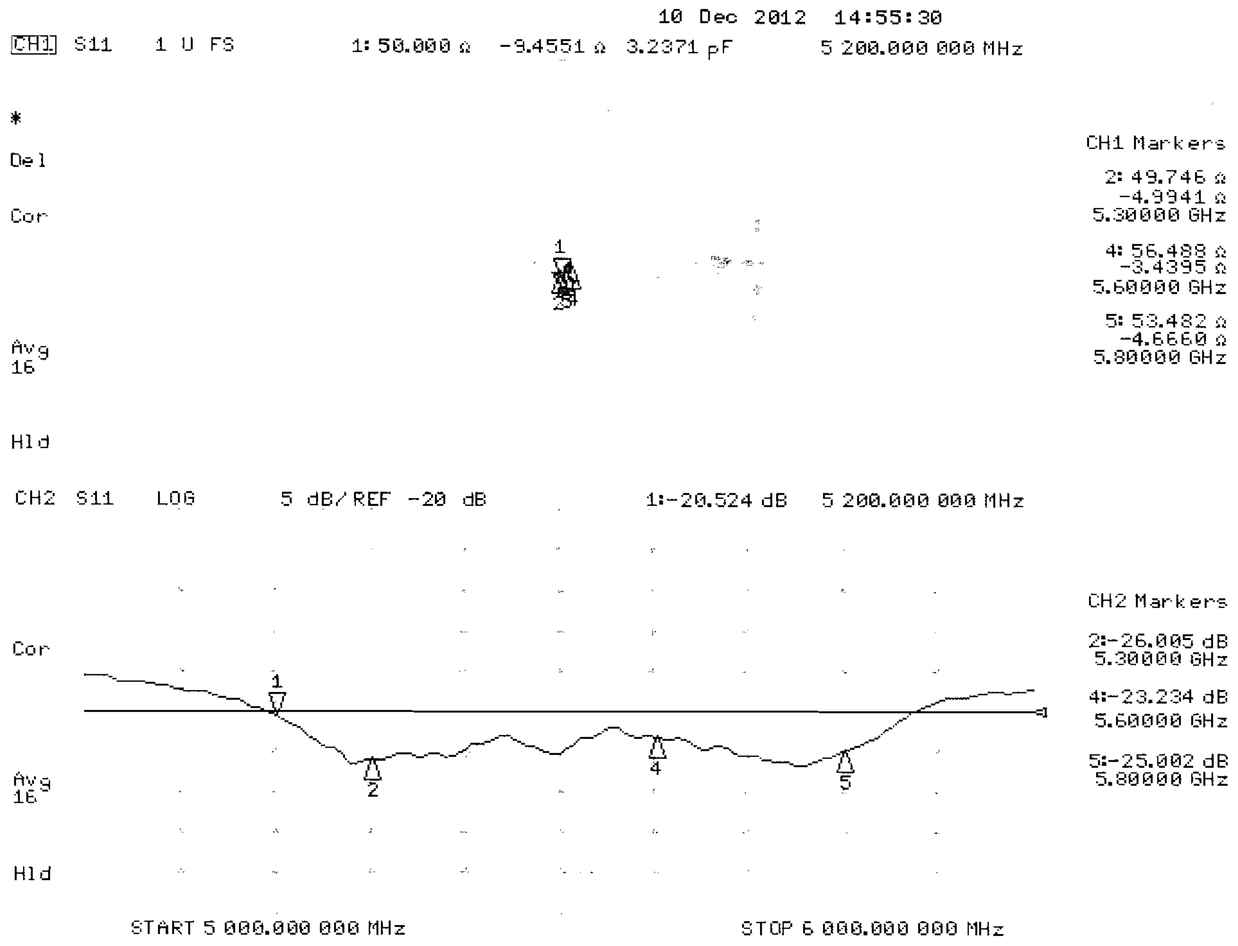
**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 58.467 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 35.4 W/kg
**SAR(1 g) = 7.98 W/kg; SAR(10 g) = 2.22 W/kg**
Maximum value of SAR (measured) = 19.5 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 = 54.901 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 34.6 W/kg
**SAR(1 g) = 7.36 W/kg; SAR(10 g) = 2.04 W/kg**
Maximum value of SAR (measured) = 18.3 W/kg




0 dB = 18.3 W/kg = 12.62 dBW/kg

# Impedance Measurement Plot for Body TSL



# Appendix F – Phantom Calibration Data Sheets

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Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

## Certificate of Conformity / First Article Inspection

| | |
|---|---|
| Item | Oval Flat Phantom ELI 4.0 |
| Type No | QD OVA 001 B |
| Series No | 1003 and higher |
| Manufacturer | Untersee Composites<br>Knebelstrasse 8<br>CH-8268 Mannenbach, Switzerland |

**Tests**
Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

| Test | Requirement | Details | Units tested |
|---|---|---|---|
| Material thickness | Compliant with the standard requirements | Bottom plate:<br>2.0mm +/- 0.2mm | all |
| Material parameters | Dielectric parameters for required frequencies | < 6 GHz: Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05 | Material sample |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. | DGBE based simulating liquids.<br>Observe Technical Note for material compatibility. | Equivalent phantoms, Material sample |
| Shape | Thickness of bottom material,<br>Internal dimensions,<br>Sagging<br>compatible with standards from minimum frequency | Bottom elliptical 600 x 400 mm<br>Depth 190 mm,<br>Shape is within tolerance for filling height up to 155 mm,<br>Eventual sagging is reduced or eliminated by support via DUT | Prototypes, Sample testing |

**Standards**

[1] CENELEC EN 50361-2001, « Basic standard for the measurement of the Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz) », July 2001
[2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
[3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
[4] IEC 62209 – 2, Draft, "Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices – Human models, Instrumentation and Procedures – Part 2: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30 MHz to 6 GHz Handheld and Body-Mounted Devices used in close proximity to the Body.", February 2005
[5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition January 2001

Based on the tests above, we certify that this item is in compliance with the standards [1] to [5] if operated according to the specific requirements and considering the thickness. The dimensions are fully compliant with [4] from 30 MHz to 6 GHz. For the other standards, the minimum lower frequency limit is limited due to the dimensional requirements ([1]: 450 MHz, [2]: 300 MHz, [3]: 800 MHz, [5]: 375 MHz) and possibly further by the dimensions of the DUT.

**Date** 28.4.2008 **Signature / Stamp**

s p e a g
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