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# FCC SAR Test Report

Report No. : SA131119C31  
Applicant : Datalogic ADC S.r.l.  
Address : Via S. Vitalino 13, 40012 Lippo di Calderara di Reno, Italy  
Product : Mobile Computer  
FCC ID : U4GN030  
Brand : Datalogic Memor  
Model No. : MEMORX3  
Standards : FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1992 / IEEE 1528:2003  
IEEE 1528a-2005 / KDB 865664 D01 v01r02 / KDB 248227 D01 v01r02  
KDB 447498 D01 v05r01 / KDB 648474 D04 v01r02  
Sample Received Date : Dec. 12, 2013  
Date of Testing : Jan. 02, 2014 ~ Feb. 10, 2014

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

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## Release Control Record

Issue No.	Reason for Change	Date Issued
R01	Initial release	Feb. 14, 2014



### 1. Summary of Maximum SAR Value

Equipment Class	Mode	Highest Reported Head SAR <sub>1g</sub> (W/kg)	Highest Reported Body SAR <sub>1g</sub> (1.5 cm Gap) (W/kg)
DTS	2.4G WLAN	0.03	0.01
	5.8G WLAN	0.00	0.02
NII	5.2G WLAN	0.07	0.02
	5.3G WLAN	0.19	0.07
	5.6G WLAN	0.17	0.08
DSS	Bluetooth	N/A	N/A
Highest Simultaneous Transmission SAR		Head (W/kg)	Body (W/kg)
DTS+DSS		0.08	0.07
NII+DSS		0.24	0.13

**Note:**

1. The SAR limit (**SAR<sub>1g</sub> 1.6 W/kg**) for general population / uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992.



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## 2. Description of Equipment Under Test

<b>EUT Type</b>	Mobile Computer
<b>FCC ID</b>	U4GN030
<b>Brand Name</b>	Datalogic Memor
<b>Model Name</b>	MEMORX3
<b>EUT Configurations</b>	EUT 1: EUT + 1D EUT 2: EUT + 2D EUT 3: EUT + CCD
<b>Tx Frequency Bands (Unit: MHz)</b>	WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 Bluetooth : 2402 ~ 2480
<b>Uplink Modulations</b>	802.11b : DSSS 802.11a/g/n : OFDM Bluetooth : GFSK
<b>Maximum Tune-up Conducted Power (Unit: dBm)</b>	WLAN 2.4G : 16.5 WLAN 5.2G : 16.5 WLAN 5.3G : 18.0 WLAN 5.6G : 15.0 WLAN 5.8G : 12.0 Bluetooth : 5.12
<b>Antenna Type</b>	Fixed Internal Antenna
<b>EUT Stage</b>	Identical Prototype

**Note:**

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

**List of Accessory:**

<b>Battery</b>	<b>Model Name</b>	Standard, memor X3
	<b>Serial Number</b>	TW13070113
	<b>Power Rating</b>	3.7Vdc, 1430mAh
	<b>Type</b>	Li-ion

### **3. SAR Measurement System**

#### **3.1 Definition of Specific Absorption Rate (SAR)**

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

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

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

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

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

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

Where:  $\sigma$  is the conductivity of the tissue,  $\rho$  is the mass density of the tissue and E is the RMS electrical field strength.

#### **3.2 SPEAG DASY System**

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

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**Fig-3.1 DASY System Setup**

### 3.2.1 Robot

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

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



**Fig-3.2 DASY4**





**Fig-3.3 DASY5**

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## 3.2.2 Probes

The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

<b>Model</b>	EX3DV4	
<b>Construction</b>	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).	
<b>Frequency</b>	10 MHz to 6 GHz Linearity: $\pm 0.2$ dB	
<b>Directivity</b>	$\pm 0.3$ dB in HSL (rotation around probe axis) $\pm 0.5$ dB in tissue material (rotation normal to probe axis)	
<b>Dynamic Range</b>	10 $\mu$ W/g to 100 mW/g Linearity: $\pm 0.2$ dB (noise: typically $< 1$ $\mu$ W/g)	
<b>Dimensions</b>	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

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


## 3.2.3 Data Acquisition Electronics (DAE)


<b>Model</b>	DAE3, DAE4	
<b>Construction</b>	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.	
<b>Measurement Range</b>	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)	
<b>Input Offset Voltage</b>	$< 5$ $\mu$ V (with auto zero)	
<b>Input Bias Current</b>	$< 50$ fA	
<b>Dimensions</b>	60 x 60 x 68 mm	



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## 3.2.4 Phantoms


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

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


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## 3.2.5 Device Holder

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

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

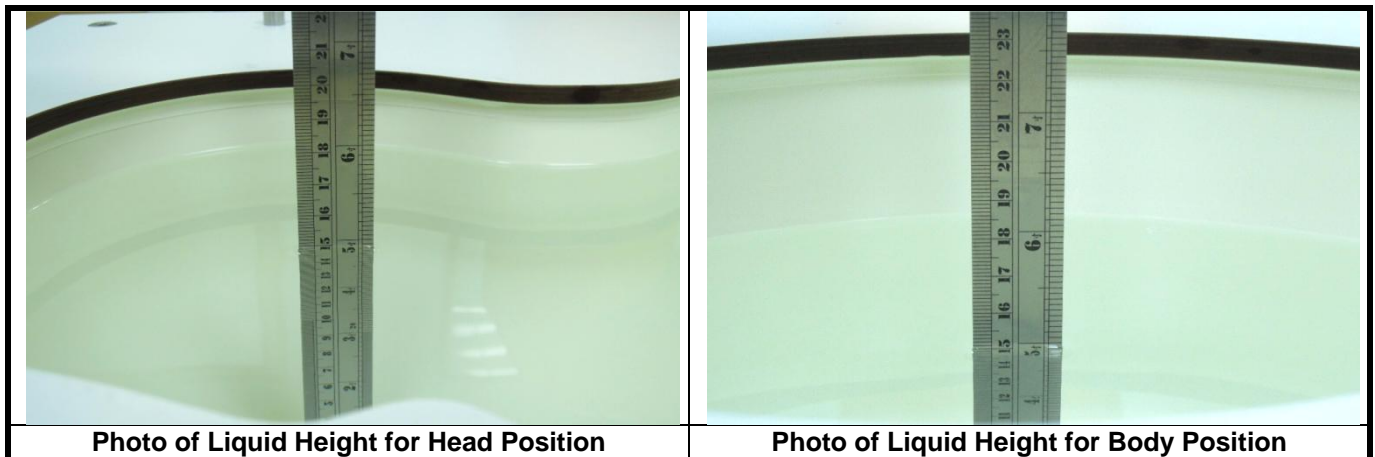
## 3.2.6 System Validation Dipoles

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

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### 3.2.7 Tissue Simulating Liquids

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



The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528, and KDB 865664 D01 Appendix A. For the body tissue simulating liquids, the dielectric properties are defined in KDB 865664 D01 Appendix A. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.



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Table-3.1 Targets of Tissue Simulating Liquid

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



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The following table gives the recipes for tissue simulating liquids.

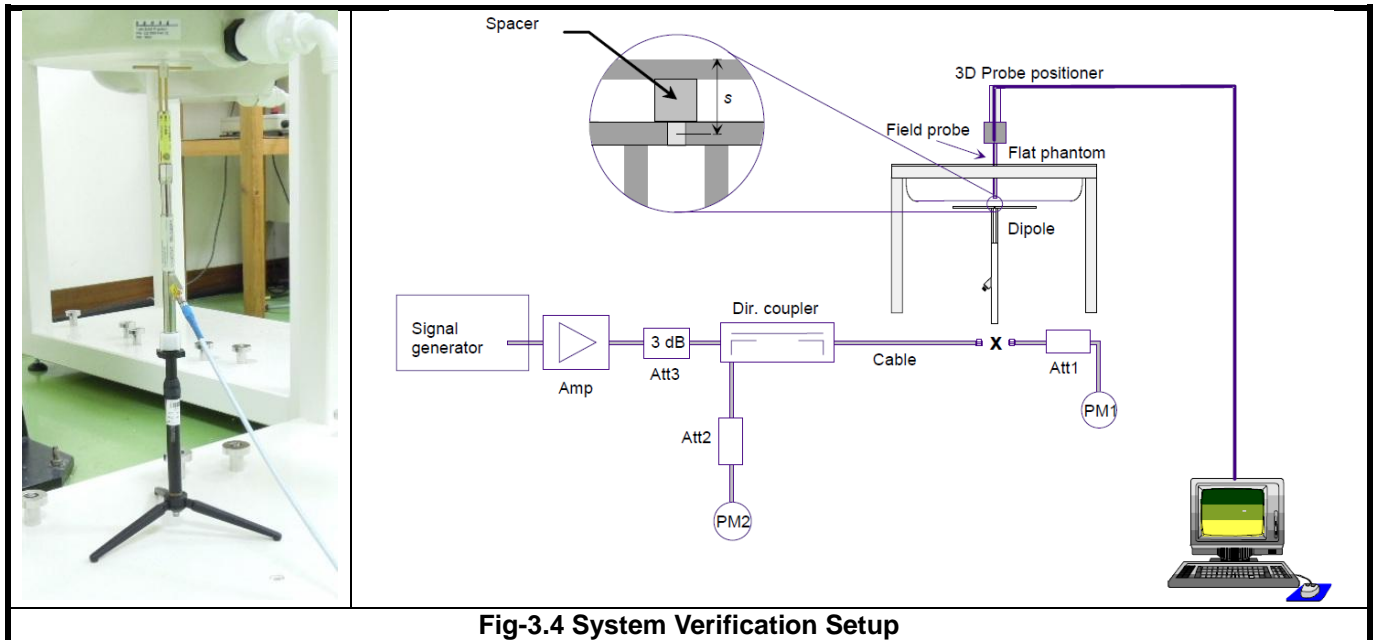
**Table-3.2 Recipes of Tissue Simulating Liquid**

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

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## 3.3 SAR System Verification

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



**Fig-3.4 System Verification Setup**

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The power meter PM1 measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

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

### **3.4 SAR Measurement Procedure**

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

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

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

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

#### **3.4.1 Area & Zoom Scan Procedure**

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g. According to KDB 865664 D01 v01r02, the resolution for Area and Zoom scan is specified in the table below.

Items	<= 2 GHz	2-3 GHz	3-4 GHz	4-5 GHz	5-6 GHz
Area Scan ( $\Delta x, \Delta y$ )	<= 15 mm	<= 12 mm	<= 12 mm	<= 10 mm	<= 10 mm
Zoom Scan ( $\Delta x, \Delta y$ )	<= 8 mm	<= 5 mm	<= 5 mm	<= 4 mm	<= 4 mm
Zoom Scan ( $\Delta z$ )	<= 5 mm	<= 5 mm	<= 4 mm	<= 3 mm	<= 2 mm
Zoom Scan Volume	>= 30 mm	>= 30 mm	>= 28 mm	>= 25 mm	>= 22 mm

**Note:**

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

#### **3.4.2 Volume Scan Procedure**

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

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### 3.4.3 Power Drift Monitoring

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

### 3.4.4 Spatial Peak SAR Evaluation

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

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

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

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

### 3.4.5 SAR Averaged Methods

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

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.



## 4. SAR Measurement Evaluation

### 4.1 EUT Configuration and Setting

For WLAN SAR testing, the EUT has installed WLAN engineering testing software which can provide continuous transmitting RF signal. According to KDB 248227 D01, WLAN SAR should be tested at the lowest data rate, and testing at higher data rate is not required when the maximum average output power is less than 1/4 dB higher than those measured at the lowest data rate. Since the WLAN power at lowest data rate has highest output power, WLAN SAR for this device was performed at the lowest data rate as set in 1 Mbps for 802.11b, and 6 Mbps for 802.11a. This RF signal utilized in SAR measurement has almost 100% duty cycle for 802.11b, and 96.3% duty cycle for 802.11a. Therefore, the duty factor is set to 1 for 802.11b, and 1.04 for 802.11a during WLAN SAR testing.

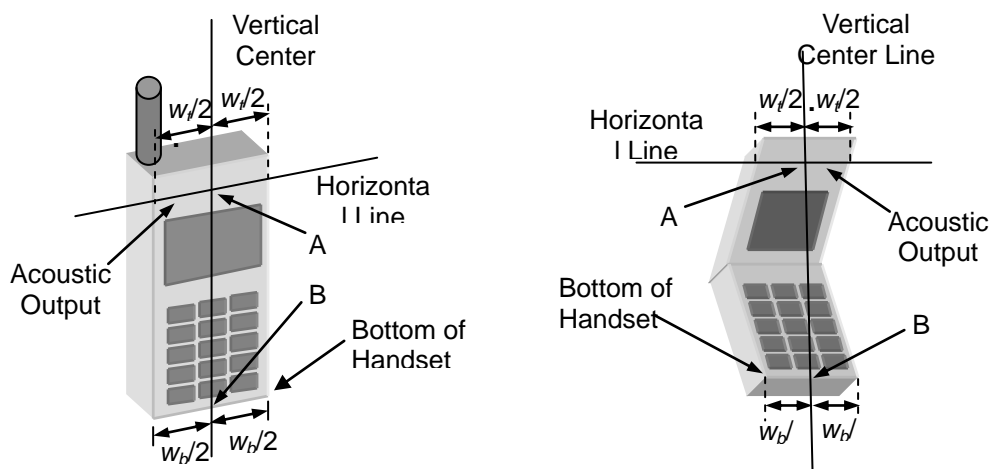
### 4.2 EUT Testing Position

According to KDB 648474 D04, handsets are tested for SAR compliance in head, body-worn accessory and other use configurations described in the following subsections.

#### 4.2.1 Head Exposure Conditions

Head exposure is limited to next to the ear voice mode operations. Head SAR compliance is tested according to the test positions defined in IEEE Std 1528-2003 using the SAM phantom illustrated as below.

1. Define two imaginary lines on the handset
  - (a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width  $w_t$  of the handset at the level of the acoustic output, and the midpoint of the width  $w_b$  of the bottom of the handset.
  - (b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.
  - (c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

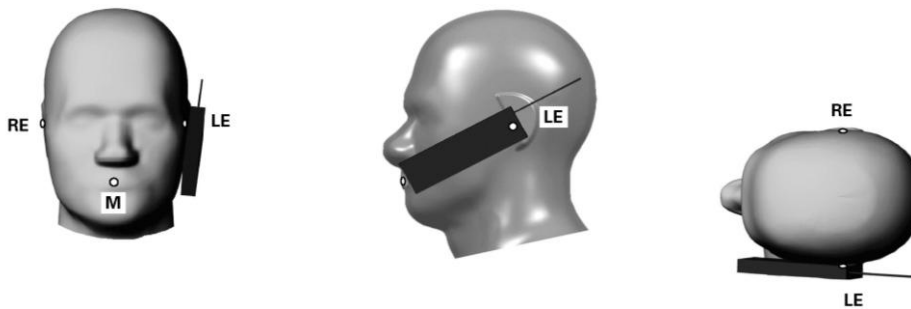


**Fig-4.1 Illustration for Handset Vertical and Horizontal Reference Lines**

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## 2. Cheek Position

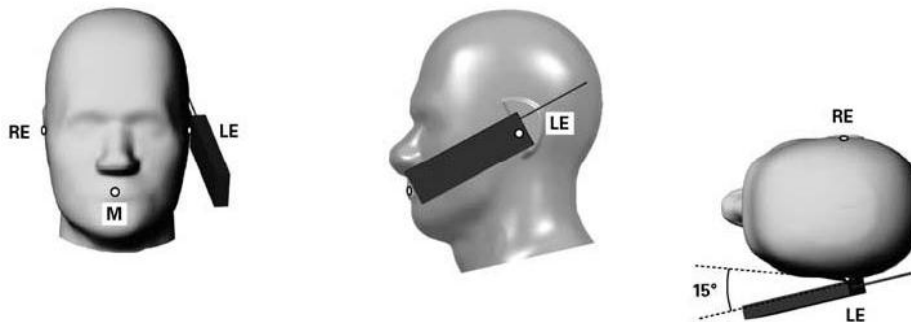
- (a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.
- (b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig-4.2).



**Fig-4.2 Illustration for Cheek Position**

## 3. Tilted Position

- (a) To position the device in the “cheek” position described above.
- (b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig-4.3).



**Fig-4.3 Illustration for Tilted Position**

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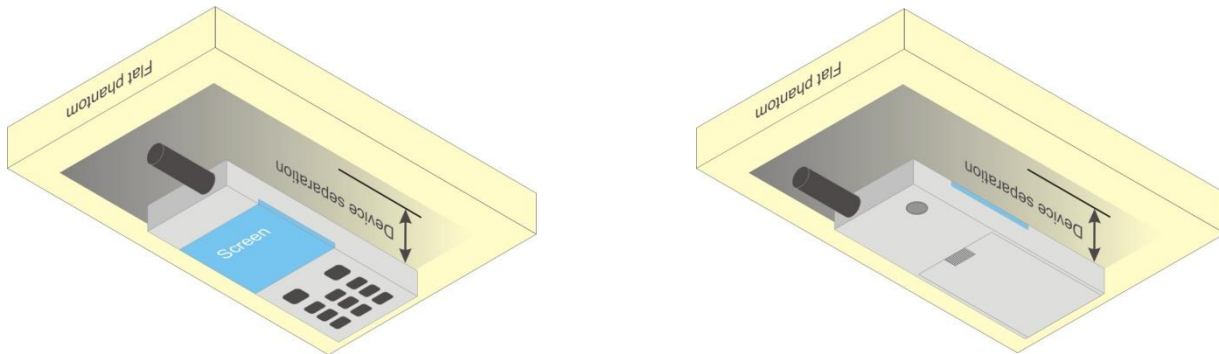
## 4.2.2 Body-Worn Accessory Exposure Conditions

Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in KDB 447498 D01 are used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is  $> 1.2 \text{ W/kg}$ , the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Body-worn accessories that do not contain metallic or conductive components may be tested according to worst-case exposure configurations, typically according to the smallest test separation distance required for the group of body-worn accessories with similar operating and exposure characteristics. All body-worn accessories containing metallic components are tested in conjunction with the host device.

Body-worn accessory SAR compliance is based on a single minimum test separation distance for all wireless and operating modes applicable to each body-worn accessory used by the host, and according to the relevant voice and/or data mode transmissions and operations. If a body-worn accessory supports voice only operations in its normal and expected use conditions, testing of data mode for body-worn compliance is not required.

A conservative minimum test separation distance for supporting off-the-shelf body-worn accessories that may be acquired by users of consumer handsets is used to test for body-worn accessory SAR compliance. This distance is determined by the handset manufacturer, according to the requirements of Supplement C 01-01. Devices that are designed to operate on the body of users using lanyards and straps, or without requiring additional body-worn accessories, will be tested using a conservative minimum test separation distance  $\leq 5 \text{ mm}$  to support compliance.



**Fig-4.4 Illustration for Body Worn Position**

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## 4.2.3 Extremity Exposure conditions

For smart phones with a display diagonal dimension > 15 cm or an overall diagonal dimension > 16 cm that provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets that support voice calls next to the ear, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

1. The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.
2. The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at <= 25 mm from that surface or edge, in direct contact with a flat phantom, for 10-g extremity SAR according to the body-equivalent tissue dielectric parameters in KDB 865664 to address interactive hand use exposure conditions. The UMPC mini-tablet 1-g SAR at 5 mm is not required. When hotspot mode applies, 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g SAR > 1.2 W/kg. The normal tablet procedures in KDB 616217 are required when the over diagonal dimension of the device is > 20 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Extremity 10-g SAR is also not required for the front (top) surface of large form factor full size tablets. The more conservative tablet SAR results can be used to support the 10-g extremity SAR for phablet mode.
3. The simultaneous transmission operating configurations applicable to voice and data transmissions for both phone and mini-tablet modes must be taken into consideration separately for 1-g and 10-g SAR to determine the simultaneous transmission SAR test exclusion and measurement requirements for the relevant wireless modes and exposure conditions.

## 4.2.4 SAR Test Exclusions

According to KDB 447498 D01, the SAR test exclusion condition is based on source-based time-averaged maximum conducted output power, adjusted for tune-up tolerance, and the minimum test separation distance required for the exposure conditions. The SAR exclusion threshold is determined by the following formula.

$$\frac{\text{Max. Tune up Power}_{(mW)}}{\text{Min. Test Separation Distance}_{(mm)}} \times \sqrt{f_{(GHz)}} \leq 3.0 \text{ for SAR-1g, } \leq 7.5 \text{ for SAR-10g}$$

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

Mode	Max. Tune-up Power (dBm)	Max. Tune-up Power (mW)	Body-Worn		
			Ant. to Surface (mm)	Calculated Result	Require SAR Testing?
BT (2.48 GHz)	5.5	4	15	0.4	No

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## 4.3 Tissue Verification

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

Test Date	Tissue Type	Frequency (MHz)	Liquid Temp. (°C)	Measured Conductivity (σ)	Measured Permittivity (ε <sub>r</sub> )	Target Conductivity (σ)	Target Permittivity (ε <sub>r</sub> )	Conductivity Deviation (%)	Permittivity Deviation (%)
Feb. 06, 2014	Head	2450	22.0	1.864	37.917	1.80	39.2	3.56	-3.27
Feb. 07, 2014	Head	5200	21.8	4.842	35.259	4.66	36.0	3.91	-2.06
Feb. 07, 2014	Head	5300	21.8	4.957	35.073	4.76	35.9	4.14	-2.30
Feb. 07, 2014	Head	5600	21.8	5.285	34.528	5.07	35.5	4.24	-2.74
Feb. 10, 2014	Head	5800	21.1	5.498	34.303	5.27	35.3	4.33	-2.82
Jan. 02, 2014	Body	2450	20.6	1.996	51.622	1.95	52.7	2.36	-2.05
Jan. 02, 2014	Body	5200	20.3	5.355	47.739	5.30	49.0	1.04	-2.57
Jan. 02, 2014	Body	5300	20.3	5.496	47.512	5.42	48.9	1.40	-2.84
Jan. 02, 2014	Body	5600	20.3	5.903	46.885	5.77	48.5	2.31	-3.33
Jan. 02, 2014	Body	5800	20.3	6.181	46.557	6.00	48.2	3.02	-3.41

### Note:

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

## 4.4 System Validation

The SAR measurement system was validated according to procedures in KDB 865664 D01 v01r01. The validation status in tabulated summary is as below.

Test Date	Probe S/N	Calibration Point		Measured Conductivity (σ)	Measured Permittivity (ε <sub>r</sub> )	Validation for CW			Validation for Modulation		
						Sensitivity Range	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
Feb. 06, 2014	3864	Head	2450	1.864	37.917	Pass	Pass	Pass	OFDM	N/A	Pass
Feb. 07, 2014	3864	Head	5200	4.842	35.259	Pass	Pass	Pass	OFDM	N/A	Pass
Feb. 07, 2014	3864	Head	5300	4.957	35.073	Pass	Pass	Pass	OFDM	N/A	Pass
Feb. 07, 2014	3864	Head	5600	5.285	34.528	Pass	Pass	Pass	OFDM	N/A	Pass
Feb. 10, 2014	3864	Head	5800	5.498	34.303	Pass	Pass	Pass	OFDM	N/A	Pass
Jan. 02, 2014	3801	Body	2450	1.996	51.622	Pass	Pass	Pass	OFDM	N/A	Pass
Jan. 02, 2014	3801	Body	5200	5.355	47.739	Pass	Pass	Pass	OFDM	N/A	Pass
Jan. 02, 2014	3801	Body	5300	5.496	47.512	Pass	Pass	Pass	OFDM	N/A	Pass
Jan. 02, 2014	3801	Body	5600	5.903	46.885	Pass	Pass	Pass	OFDM	N/A	Pass
Jan. 02, 2014	3801	Body	5800	6.181	46.557	Pass	Pass	Pass	OFDM	N/A	Pass



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## 4.5 System Verification

The measuring result for system verification is tabulated as below.

Test Date	Mode	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Feb. 06, 2014	Head	2450	53.2	12.7	50.80	-4.51	893	3864	1277
Feb. 07, 2014	Head	5200	79.2	7.91	79.10	-0.13	1018	3864	1277
Feb. 07, 2014	Head	5300	82.6	7.92	79.20	-4.12	1018	3864	1277
Feb. 07, 2014	Head	5600	82.8	7.64	76.40	-7.73	1018	3864	1277
Feb. 10, 2014	Head	5800	79.5	7.33	73.30	-7.80	1018	3864	1277
Jan. 02, 2014	Body	2450	49.60	13.0	52.00	4.84	737	3801	579
Jan. 02, 2014	Body	5200	74.90	7.47	74.70	-0.27	1018	3801	579
Jan. 02, 2014	Body	5300	75.70	7.41	74.10	-2.11	1018	3801	579
Jan. 02, 2014	Body	5600	80.40	7.75	77.50	-3.61	1018	3801	579
Jan. 02, 2014	Body	5800	74.90	7.53	75.30	0.53	1018	3801	579

### Note:

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

## 4.6 Maximum Output Power

### 4.6.1 Maximum Conducted Power

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

Mode	2.4G WLAN	5.2G WLAN	5.3G WLAN	5.6G WLAN	5.8G WLAN
802.11b	16.5	N/A	N/A	N/A	N/A
802.11g	14.5	N/A	N/A	N/A	N/A
802.11a	N/A	16.5	18.0	15.0	12.0
802.11n HT20	15.0	16.5	18.0	15.0	12.0

Mode	Bluetooth
All	5.5

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## 4.6.2 Measured Conducted Power Result

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

### <WLAN 2.4G>

Mode	802.11b		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
Average Power	16.50	16.06	15.97
Mode	802.11g		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
Average Power	14.06	14.16	13.97
Mode	802.11n (HT20)		
Channel / Frequency (MHz)	1 (2412)	6 (2437)	11 (2462)
Average Power	14.43	14.59	14.35

### <WLAN 5.2G>

Mode	802.11a			
Channel / Frequency (MHz)	36 (5180)	40 (5200)	44 (5220)	48 (5240)
Average Power	14.96	15.31	15.46	16.34
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	36 (5180)	40 (5200)	44 (5220)	48 (5240)
Average Power	14.86	15.29	15.42	16.25

### <WLAN 5.3G>

Mode	802.11a			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
Average Power	16.71	16.98	17.39	17.62
Mode	802.11n (HT20)			
Channel / Frequency (MHz)	52 (5260)	56 (5280)	60 (5300)	64 (5320)
Average Power	16.73	17.02	17.48	17.64

### <WLAN 5.6G>

Mode	802.11a							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
Average Power	14.63	14.26	13.91	13.65	13.56	11.98	12.01	12.07
Mode	802.11n (HT20)							
Channel / Frequency (MHz)	100 (5500)	104 (5520)	108 (5540)	112 (5560)	116 (5580)	132 (5660)	136 (5680)	140 (5700)
Average Power	14.58	13.27	13.05	12.69	13.52	11.15	10.81	11.62

### <WLAN 5.8G>

Mode	802.11a				
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)	165 (5825)
Average Power	11.82	11.51	11.46	11.42	11.44
Mode	802.11n (HT20)				
Channel / Frequency (MHz)	149 (5745)	153 (5765)	157 (5785)	161 (5805)	165 (5825)
Average Power	11.71	11.65	11.54	11.40	11.42



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## 4.7 SAR Testing Results

### 4.7.1 SAR Results for Head

Plot No.	Band	Test Position	Ch.	EUT Config.	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
01	802.11b	Right Cheek	1	1	16.5	16.5	1.00	0.18	0.032	0.03
	802.11b	Right Tilted	1	1	16.5	16.5	1.00	0.05	0.031	0.03
	802.11b	Left Cheek	1	1	16.5	16.5	1.00	0.04	0.02	0.02
	802.11b	Left Tilted	1	1	16.5	16.5	1.00	0.01	0.02	0.02
	802.11b	Right Cheek	1	2	16.5	16.5	1.00	0.05	0.011	0.01
	802.11b	Right Cheek	1	3	16.5	16.5	1.00	0.01	0.031	0.03
	802.11a	Right Cheek	48	1	16.5	16.34	1.04	0	0.021	0.02
	802.11a	Right Tilted	48	1	16.5	16.34	1.04	0	0.028	0.03
	802.11a	Left Cheek	48	1	16.5	16.34	1.04	0	0.046	0.05
02	802.11a	Left Tilted	48	1	16.5	16.34	1.04	-0.08	0.07	0.07
	802.11a	Left Tilted	48	2	16.5	16.34	1.04	0	0.022	0.02
	802.11a	Left Tilted	48	3	16.5	16.34	1.04	0	0.036	0.04
	802.11a	Right Cheek	64	1	18	17.62	1.09	-0.03	0.061	0.07
	802.11a	Right Tilted	64	1	18	17.62	1.09	0.05	0.092	0.10
	802.11a	Left Cheek	64	1	18	17.62	1.09	0.01	0.129	0.14
03	802.11a	Left Tilted	64	1	18	17.62	1.09	0.06	0.172	0.19
	802.11a	Left Tilted	64	2	18	17.62	1.09	0	0.054	0.06
	802.11a	Left Tilted	64	3	18	17.62	1.09	0.08	0.103	0.11
	802.11a	Right Cheek	100	1	15	14.63	1.09	0.14	0.027	0.03
	802.11a	Right Tilted	100	1	15	14.63	1.09	0.06	0.045	0.05
	802.11a	Left Cheek	100	1	15	14.63	1.09	0.04	0.076	0.08
	802.11a	Left Tilted	100	1	15	14.63	1.09	0.09	0.103	0.11
04	802.11a	Left Tilted	100	2	15	14.63	1.09	0.05	0.158	0.17
	802.11a	Left Tilted	100	3	15	14.63	1.09	0.06	0.152	0.17
	802.11a	Right Cheek	149	1	12	11.82	1.04	N/A	N/A	N/A
	802.11a	Right Tilted	149	1	12	11.82	1.04	N/A	N/A	N/A
	802.11a	Left Cheek	149	1	12	11.82	1.04	0	0.000152	0.00
05	802.11a	Left Tilted	149	1	12	11.82	1.04	0	0.000489	0.00
	802.11a	Left Tilted	149	2	12	11.82	1.04	N/A	N/A	N/A
	802.11a	Left Tilted	149	3	12	11.82	1.04	-0.08	0.000248	0.00

#### Note:

1. According to KDB 248227, when the extrapolated maximum peak SAR for the maximum output power channel is  $\leq 1.6$  W/kg and the 1g averaged SAR is  $\leq 0.8$  W/kg, WLAN SAR testing for other channels is not required.
2. SAR testing for 802.11g/n is not required when its maximum power is less than 1/4 dB higher than 802.11b.
3. SAR testing for 802.11n is not required when its maximum power is less than 1/4 dB higher than 802.11a.
4. The "N/A" means there is no SAR value or the SAR is too low to be measured.



4.7.1 SAR Results for Body (Separation Distance is 1.5 cm Gap)

Plot No.	Band	Test Position	Ch.	EUT Config.	Max. Tune-up Power (dBm)	Measured Conducted Power (dBm)	Scaling Factor	Power Drift (dB)	Measured SAR-1g (W/kg)	Scaled SAR-1g (W/kg)
	802.11b	Front Face	1	1	16.5	16.50	1.00	N/A	N/A	N/A
	802.11b	Rear Face	1	1	16.5	16.50	1.00	0.16	0.00933	0.01
	802.11b	Rear Face	1	2	16.5	16.50	1.00	0.17	0.00905	0.01
06	802.11b	Rear Face	1	3	16.5	16.50	1.00	-0.14	0.011	0.01
	802.11a	Front Face	48	1	16.5	16.34	1.04	-0.15	0.00285	0.00
	802.11a	Rear Face	48	1	16.5	16.34	1.04	-0.12	0.016	0.02
	802.11a	Rear Face	48	2	16.5	16.34	1.04	N/A	N/A	N/A
07	802.11a	Rear Face	48	3	16.5	16.34	1.04	-0.10	0.022	0.02
	802.11a	Front Face	64	1	18.0	17.62	1.09	0.00	0.029	0.03
	802.11a	Rear Face	64	1	18.0	17.62	1.09	0.00	0.035	0.04
	802.11a	Rear Face	64	2	18.0	17.62	1.09	0.00	0.016	0.02
08	802.11a	Rear Face	64	3	18.0	17.62	1.09	-0.01	0.062	0.07
	802.11a	Front Face	100	1	15.0	14.63	1.09	N/A	N/A	N/A
	802.11a	Rear Face	100	1	15.0	14.63	1.09	0.00	0.015	0.02
	802.11a	Rear Face	100	2	15.0	14.63	1.09	0.08	0.031	0.03
09	802.11a	Rear Face	100	3	15.0	14.63	1.09	0.00	0.076	0.08
	802.11a	Front Face	149	1	12.0	11.82	1.04	N/A	N/A	N/A
	802.11a	Rear Face	149	1	12.0	11.82	1.04	N/A	N/A	N/A
	802.11a	Rear Face	149	2	12.0	11.82	1.04	N/A	N/A	N/A
10	802.11a	Rear Face	149	3	12.0	11.82	1.04	0.06	0.02	0.02

Note:

1. According to KDB 248227, when the extrapolated maximum peak SAR for the maximum output power channel is  $\leq 1.6$  W/kg and the 1g averaged SAR is  $\leq 0.8$  W/kg, WLAN SAR testing for other channels is not required.
2. SAR testing for 802.11g/n is not required when its maximum power is less than 1/4 dB higher than 802.11b.
3. SAR testing for 802.11n is not required when its maximum power is less than 1/4 dB higher than 802.11a.
4. The "N/A" means there is no SAR value or the SAR is too low to be measured.

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### 4.7.2 SAR Measurement Variability

According to KDB 865664 D01 v01r01, SAR measurement variability was assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. Alternatively, if the highest measured SAR for both head and body tissue-equivalent media are  $\leq 1.45$  W/kg and the ratio of these highest SAR values, i.e., largest divided by smallest value, is  $\leq 1.10$ , the highest SAR configuration for either head or body tissue-equivalent medium may be used to perform the repeated measurement. These additional measurements are repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device should be returned to ambient conditions (normal room temperature) with the battery fully charged before it is re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

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

### 4.7.3 Simultaneous Multi-band Transmission Evaluation

#### <Estimated SAR Calculation>

According to KDB 447498 D01, when standalone SAR test exclusion applies to an antenna that transmits simultaneously with other antennas, the standalone SAR was estimated according to following formula to result in substantially conservative SAR values of  $\leq 0.4$  W/kg to determine simultaneous transmission SAR test exclusion.

$$\text{Estimated SAR} = \frac{\text{Max. Tune up Power}_{(mW)}}{\text{Min. Test Separation Distance}_{(mm)}} \times \frac{\sqrt{f_{(GHz)}}}{7.5}$$

If the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is used for estimated SAR calculation. When the test separation distance is  $> 50$  mm, the 0.4 W/kg is used for SAR-1g.

Mode / Band	Frequency (GHz)	Max. Tune-up Power (dBm)	Test Position	Separation Distance (mm)	Estimated SAR (W/kg)
BT (DSS)	2.48	5.5	Body-worn	15	0.05

#### Note:

1. The separation distance is determined from the outer housing of the EUT to the user.
2. When standalone SAR testing is not required, an estimated SAR can be applied to determine simultaneous transmission SAR test exclusion.



# FCC SAR Test Report

## <SAR Summation Analysis>

Simultaneous transmission SAR test exclusion is determined for each operating configuration and exposure condition according to the reported standalone SAR of each applicable simultaneous transmitting antenna. When the sum of SAR<sub>1g</sub> of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit (SAR<sub>1g</sub> 1.6 W/kg), the simultaneous transmission SAR is not required. When the sum of SAR<sub>1g</sub> is greater than the SAR limit (SAR<sub>1g</sub> 1.6 W/kg), SAR test exclusion is determined by the SPLSR.

No.	Conditions (SAR1 + SAR2)	Exposure Condition	Test Position	Max. SAR1	Max. SAR2	SAR Summation	SPLSR Analysis
1	WLAN (DTS) + BT (DSS)	Head	Right Cheek	0.03	0.05	0.08	Σ SAR < 1.6, Not required
			Right Tilted	0.03	0.05	0.08	Σ SAR < 1.6, Not required
			Left Cheek	0.02	0.05	0.07	Σ SAR < 1.6, Not required
			Left Tilted	0.02	0.05	0.07	Σ SAR < 1.6, Not required
		Body-Worn	Front Face	0.00	0.05	0.05	Σ SAR < 1.6, Not required
			Rear Face	0.02	0.05	0.07	Σ SAR < 1.6, Not required
2	WLAN (NII) + BT (DSS)	Head	Right Cheek	0.07	0.05	0.12	Σ SAR < 1.6, Not required
			Right Tilted	0.10	0.05	0.15	Σ SAR < 1.6, Not required
			Left Cheek	0.14	0.05	0.19	Σ SAR < 1.6, Not required
			Left Tilted	0.19	0.05	0.24	Σ SAR < 1.6, Not required
		Body-Worn	Front Face	0.03	0.05	0.08	Σ SAR < 1.6, Not required
			Rear Face	0.08	0.05	0.13	Σ SAR < 1.6, Not required

Test Engineer : Ulysses Liu, and Sam Onn



## 5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Kit	SPEAG	D2450V2	737	Jan. 21, 2013	Annual
System Validation Kit	SPEAG	D2450V2	893	Aug. 30, 2013	Annual
System Validation Kit	SPEAG	D5GHzV2	1018	Jul. 24, 2013	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3801	Jun. 20, 2013	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3864	Jul. 31, 2013	Annual
Data Acquisition Electronics	SPEAG	DAE3	579	Apr. 24, 2013	Annual
Data Acquisition Electronics	SPEAG	DAE4	1277	Jul. 26, 2013	Annual
SAM Phantom	SPEAG	QD000P40CD	TP-1127	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1496	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1653	N/A	N/A
SAM Phantom	SPEAG	QD000P40CD	TP-1654	N/A	N/A
ENA Series Network Analyzer	Agilent	E5071C	MY46214281	Jun. 10, 2013	Annual
MXG Analog Signal Generator	Agilent	N5181A	MY50143868	Jun. 06, 2013	Annual
Power Meter	Anritsu	ML2495A	1218009	Jun. 11, 2013	Annual
Power Sensor	Anritsu	MA2411B	1207252	Jun. 11, 2013	Annual
EXA Spectrum Analyzer	Agilent	N9010A	MY52100136	Jun. 26, 2013	Annual
Dielectric Probe Kit	Agilent	85070D	E2-020018	May 13, 2013	Annual
Thermometer	YFE	YF-160A	110600361	Feb. 20, 2013	Annual
Directional Coupler	Woken	0110A056020-10	11122702	Apr. 18, 2013	Annual
Power Amplifier	AR	5S1G4	0339656	Apr. 18, 2013	Annual
Power Amplifier	Mini-Circuit	ZVE-8G	001000422	Apr. 18, 2013	Annual
Attenuator	Woken	00800A1G01L-03	N/A	Apr. 18, 2013	Annual

## 6. Measurement Uncertainty

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

Uncertainty budget for frequency range 300 MHz to 3 GHz



# FCC SAR Test Report

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

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



## FCC SAR Test Report

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### 7. Information on the Testing Laboratories

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

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

**Taiwan HwaYa EMC/RF/Safety/Telecom Lab:**

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**Web Site:** [www.adt.com.tw](http://www.adt.com.tw)

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

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## **Appendix A. SAR Plots of System Verification**

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



## System Check\_H2450\_140206

**DUT: Dipole 2450 MHz; Type: D2450V2; SN: 893**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: H2450\_0206 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.864$  S/m;  $\epsilon_r = 37.917$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.8 °C; Liquid Temperature : 22.0 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(7.47, 7.47, 7.47); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 19.9 W/kg

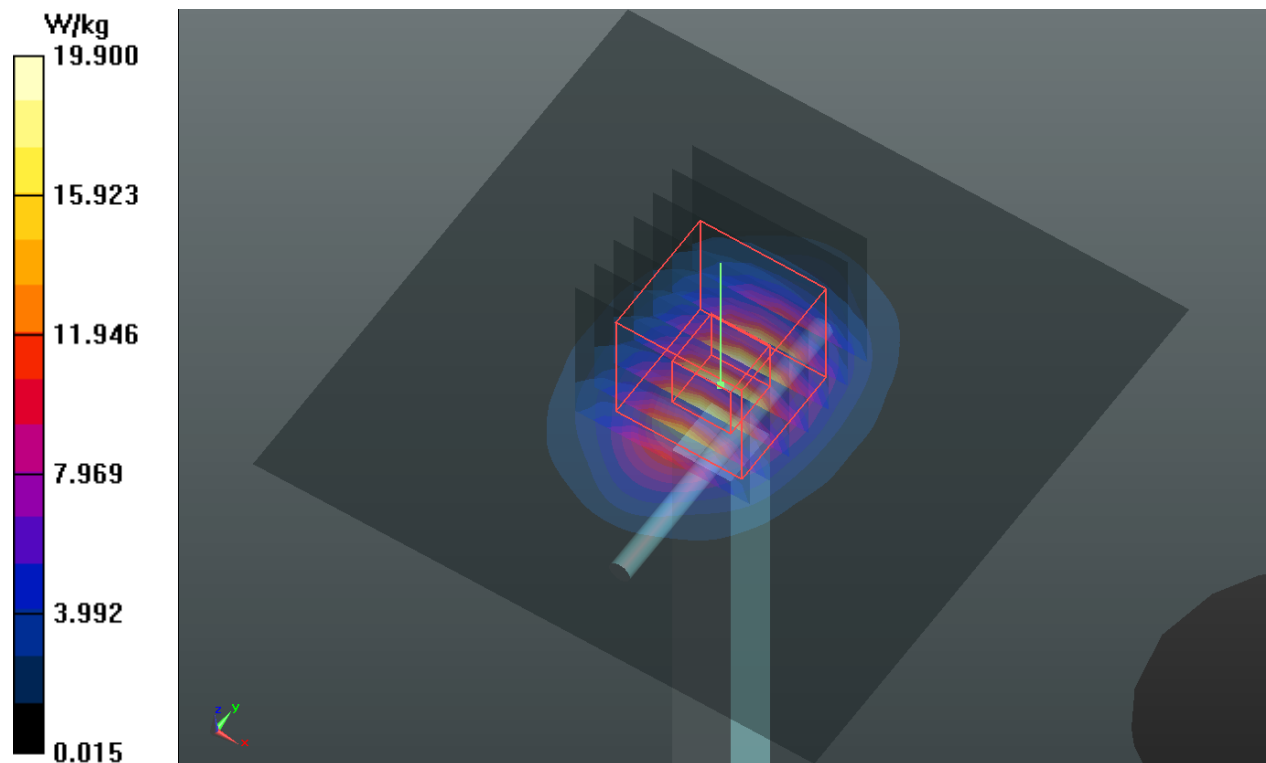
**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.0 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 27.3 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.8 W/kg**

Maximum value of SAR (measured) = 19.9 W/kg



## System Check\_H5200\_140207

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: H5G\_0207 Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.842$  S/m;  $\epsilon_r = 35.259$ ;  $\rho = 1000$  kg/m<sup>3</sup>

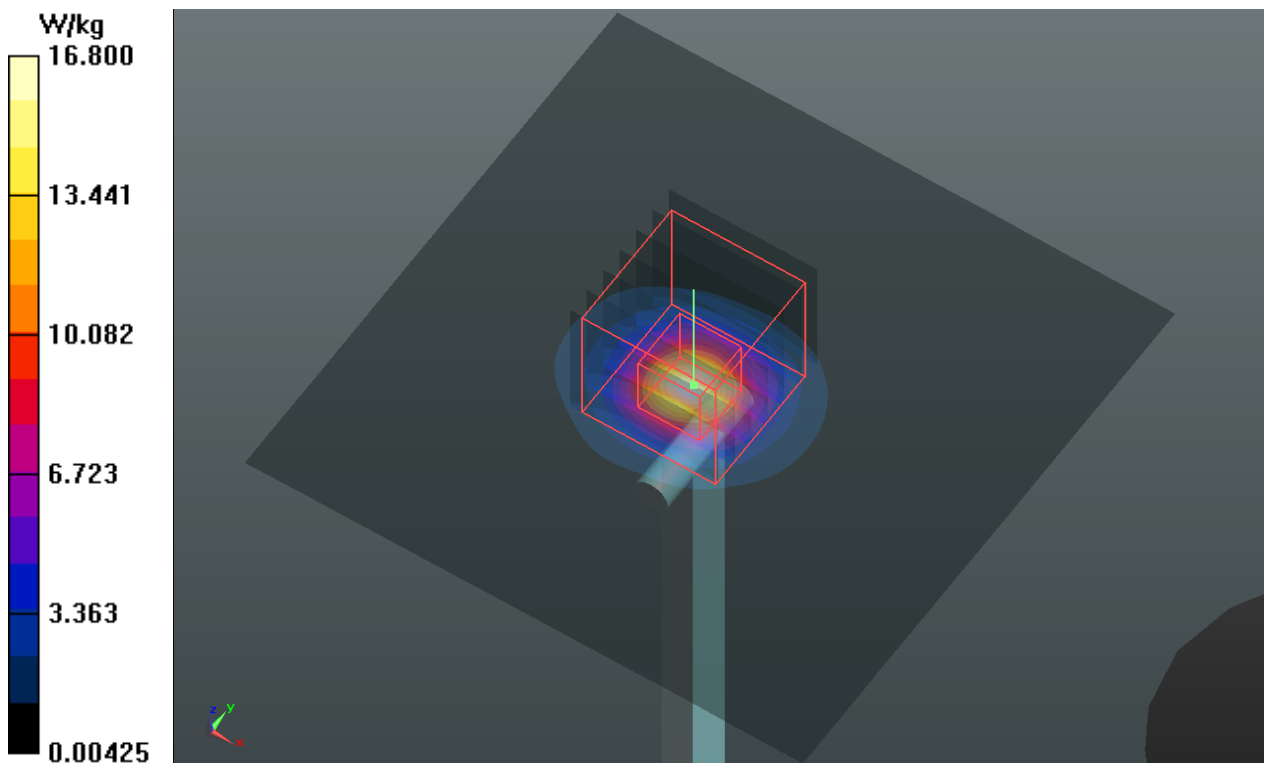
Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(5.33, 5.33, 5.33); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 16.8 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 59.302 V/m; Power Drift = 0.08 dB  
Peak SAR (extrapolated) = 34.3 W/kg  
**SAR(1 g) = 7.91 W/kg; SAR(10 g) = 2.25 W/kg**  
Maximum value of SAR (measured) = 16.5 W/kg



## System Check\_H5300\_140207

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: H5G\_0207 Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.957$  S/m;  $\epsilon_r = 35.073$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(5.13, 5.13, 5.13); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 17.4 W/kg

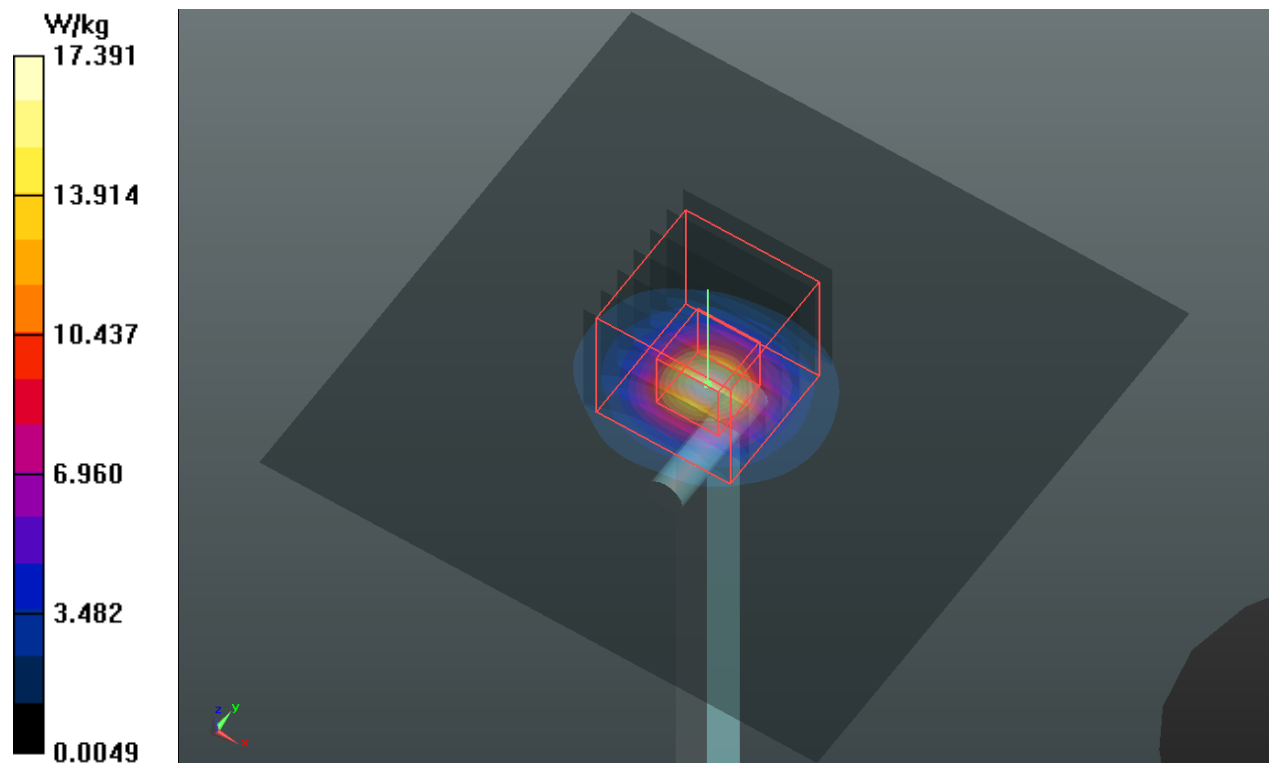
**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 58.897 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 35.4 W/kg

**SAR(1 g) = 7.92 W/kg; SAR(10 g) = 2.23 W/kg**

Maximum value of SAR (measured) = 16.7 W/kg



## System Check\_H5600\_140207

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: H5G\_0207 Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.285$  S/m;  $\epsilon_r = 34.528$ ;  $\rho = 1000$  kg/m<sup>3</sup>

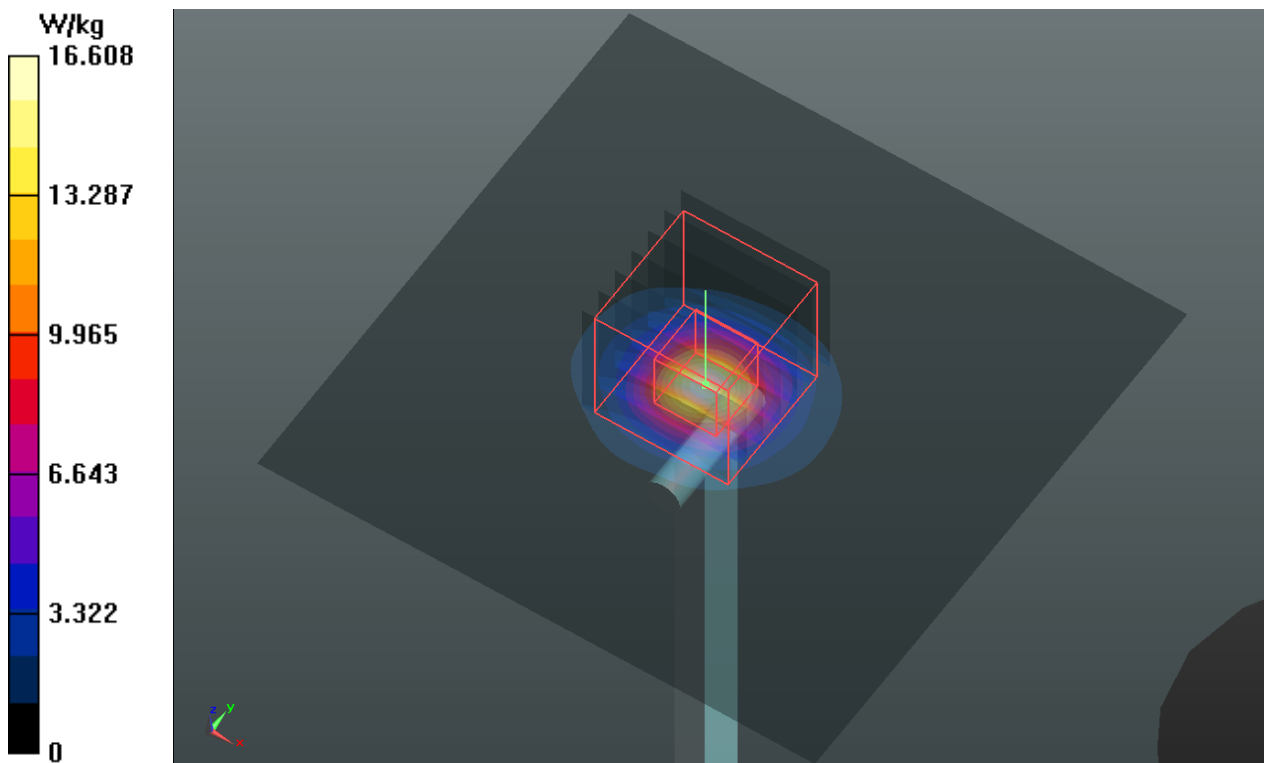
Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(4.78, 4.78, 4.78); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 16.6 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 57.387 V/m; Power Drift = 0.11 dB  
Peak SAR (extrapolated) = 34.5 W/kg  
**SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.17 W/kg**  
Maximum value of SAR (measured) = 15.9 W/kg



## System Check\_H5800\_140210

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: H5G\_0210 Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.498$  S/m;  $\epsilon_r = 34.303$ ;  $\rho = 1000$  kg/m<sup>3</sup>

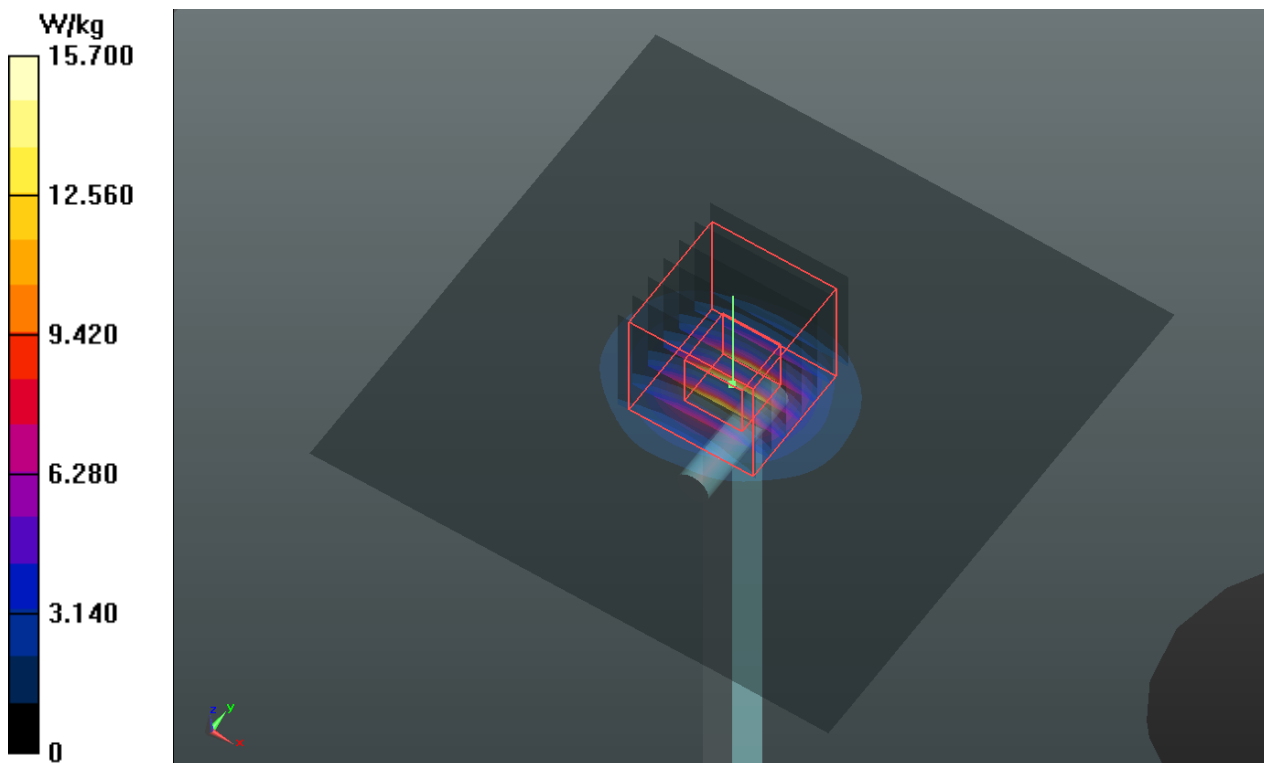
Ambient Temperature : 21.5 °C; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(4.67, 4.67, 4.67); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Left; Type: SAM V4.0; Serial: TP 1653
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 15.7 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 56.047 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 33.6 W/kg  
**SAR(1 g) = 7.33 W/kg; SAR(10 g) = 2.08 W/kg**  
Maximum value of SAR (measured) = 15.6 W/kg



## System Check\_B2450\_140102

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

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: B2450\_0102 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.996$  S/m;  $\epsilon_r = 51.622$ ;  $\rho = 1000$  kg/m<sup>3</sup>

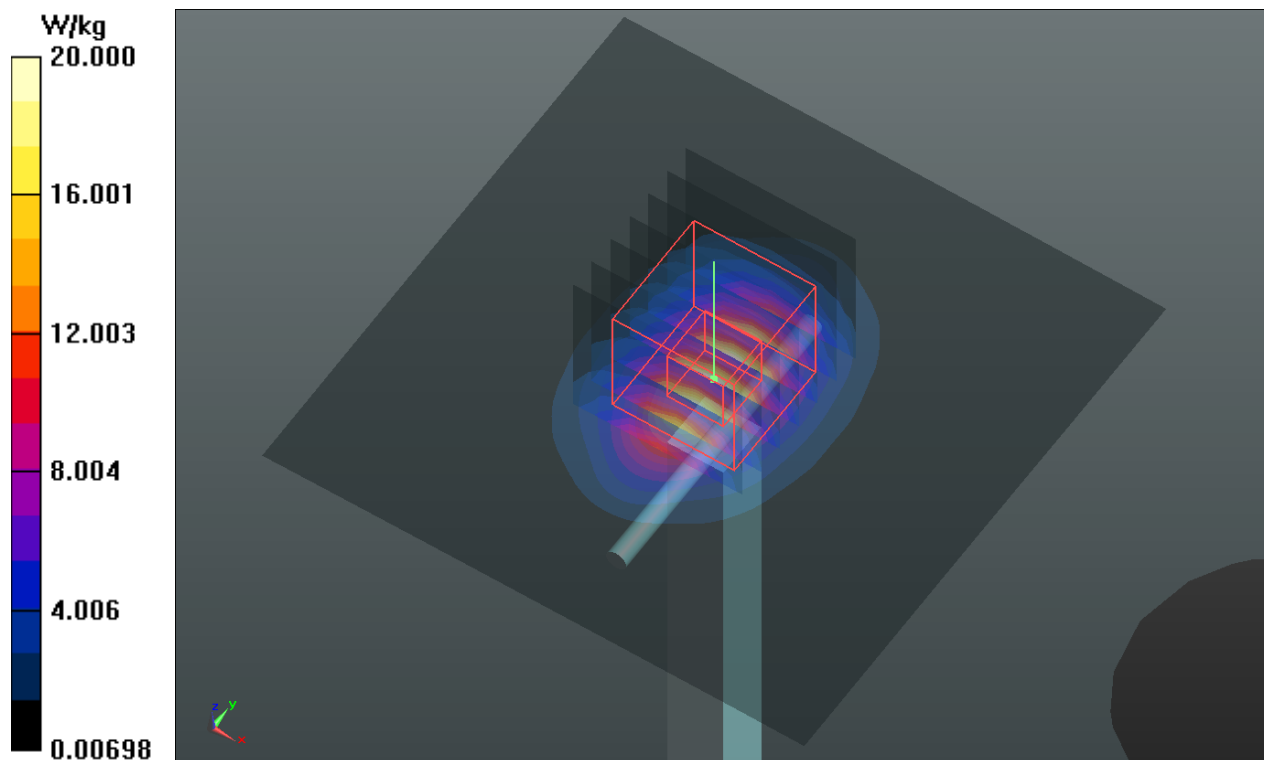
Ambient Temperature : 21.8 °C ; Liquid Temperature : 20.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(6.69, 6.69, 6.69); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Right; Type: QD000P40CC; Serial: TP:1496
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=250mW/Area Scan (81x81x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm  
Maximum value of SAR (interpolated) = 20.0 W/kg

**Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm  
Reference Value = 101.5 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 27.4 W/kg  
**SAR(1 g) = 13 W/kg; SAR(10 g) = 5.98 W/kg**  
Maximum value of SAR (measured) = 20.1 W/kg



## System Check\_B5200\_140102

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5200 MHz; Duty Cycle: 1:1

Medium: B5G\_0102 Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.355$  S/m;  $\epsilon_r = 47.739$ ;  $\rho = 1000$  kg/m<sup>3</sup>

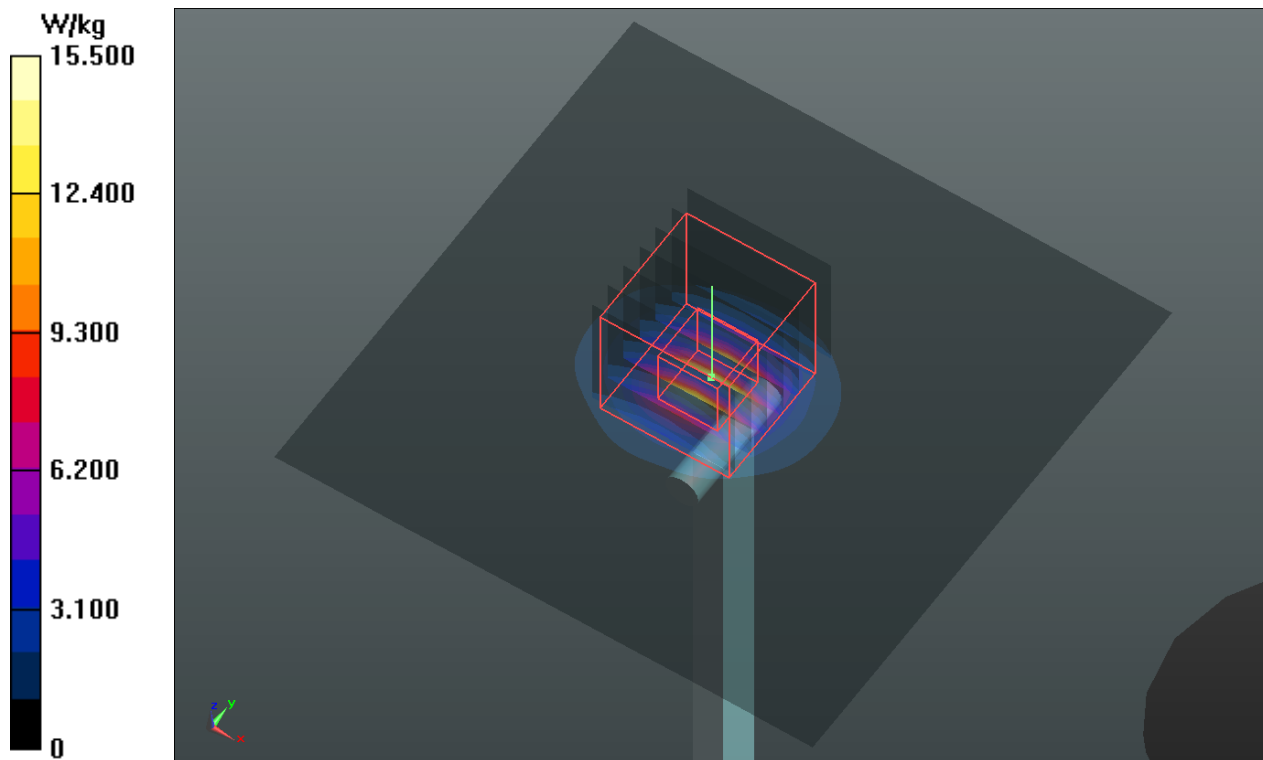
Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(4.24, 4.24, 4.24); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 15.5 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 55.917 V/m; Power Drift = 0.10 dB  
Peak SAR (extrapolated) = 30.7 W/kg  
**SAR(1 g) = 7.47 W/kg; SAR(10 g) = 2.12 W/kg**  
Maximum value of SAR (measured) = 15.7 W/kg



## System Check\_B5300\_140102

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5300 MHz; Duty Cycle: 1:1

Medium: B5G\_0102 Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.496$  S/m;  $\epsilon_r = 47.512$ ;  $\rho = 1000$  kg/m<sup>3</sup>

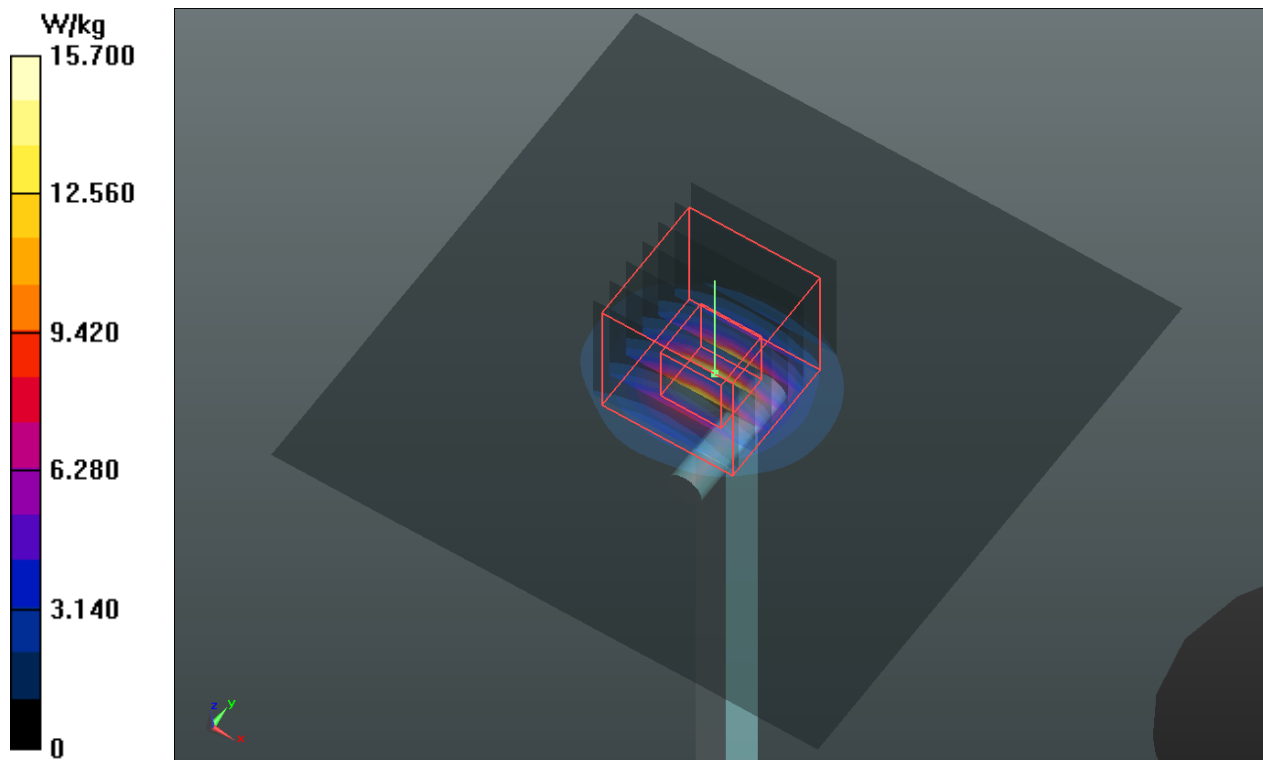
Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(4.05, 4.05, 4.05); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 15.7 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 54.943 V/m; Power Drift = 0.07 dB  
Peak SAR (extrapolated) = 30.9 W/kg  
**SAR(1 g) = 7.41 W/kg; SAR(10 g) = 2.08 W/kg**  
Maximum value of SAR (measured) = 15.5 W/kg





## System Check\_B5600\_140102

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: B5G\_0102 Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.903$  S/m;  $\epsilon_r = 46.885$ ;  $\rho = 1000$  kg/m<sup>3</sup>

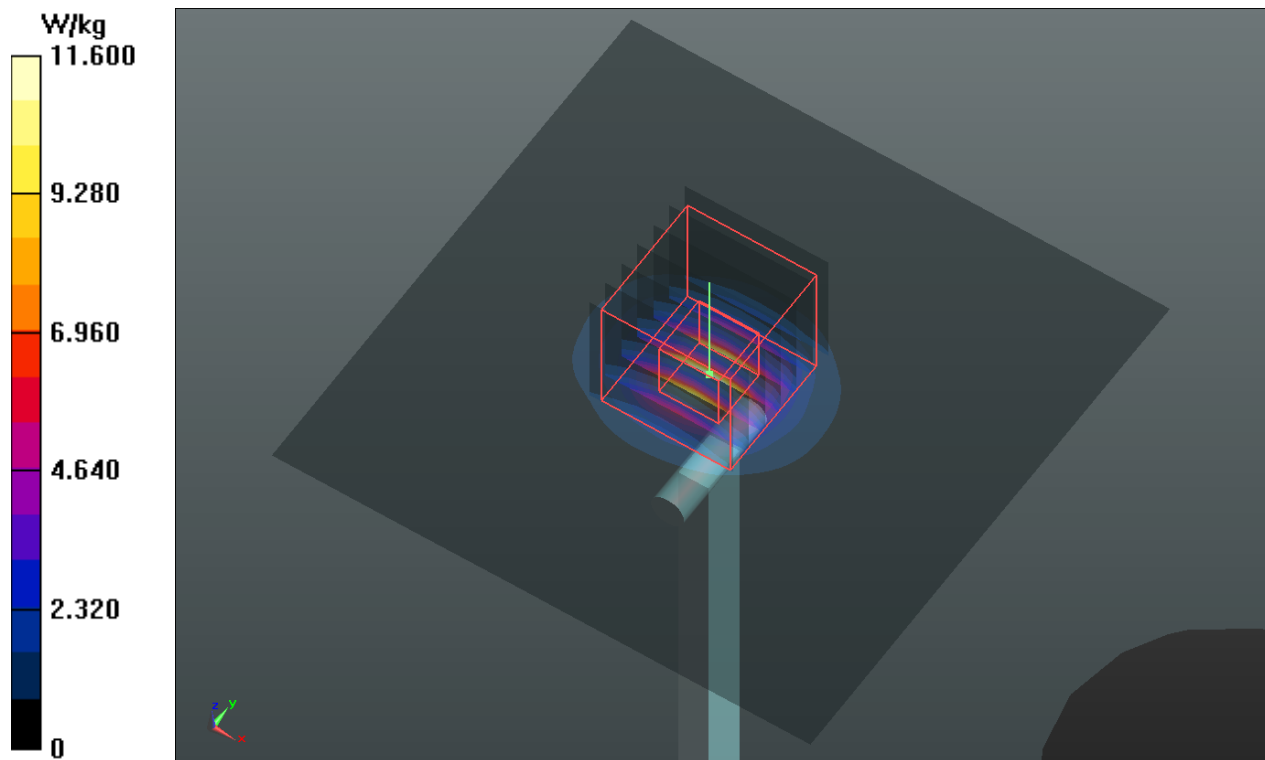
Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(4, 4, 4); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 15.5 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 55.433 V/m; Power Drift = 0.09 dB  
Peak SAR (extrapolated) = 33.4 W/kg  
**SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.19 W/kg**  
Maximum value of SAR (measured) = 16.4 W/kg



## System Check\_B5800\_140102

**DUT: Dipole 5 GHz; Type: D5GHzV2; SN: 1018**

Communication System: CW; Frequency: 5800 MHz; Duty Cycle: 1:1

Medium: B5G\_0102 Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.181$  S/m;  $\epsilon_r = 46.557$ ;  $\rho = 1000$  kg/m<sup>3</sup>

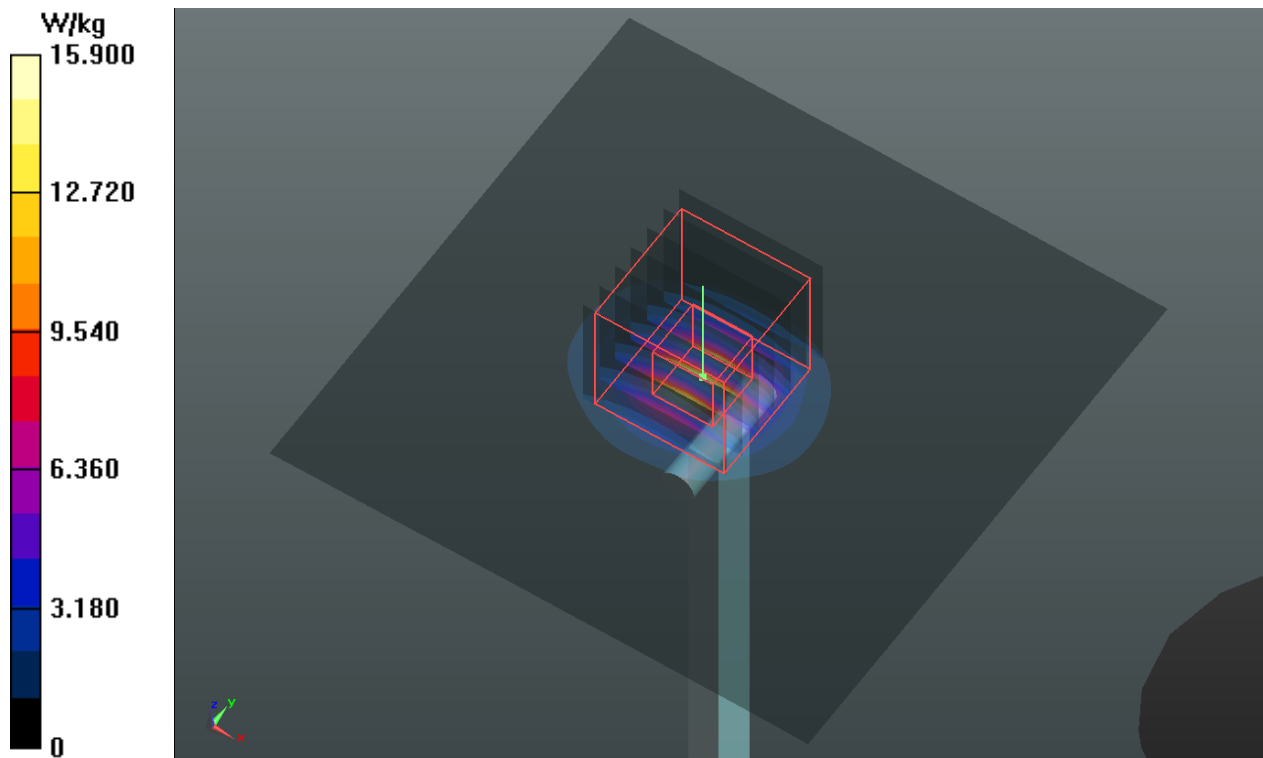
Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(3.9, 3.9, 3.9); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Pin=100mW/Area Scan (91x91x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 17.0 W/kg

**Pin=100mW/Zoom Scan (7x7x12)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2mm  
Reference Value = 55.963 V/m; Power Drift = -0.00 dB  
Peak SAR (extrapolated) = 30.3 W/kg  
**SAR(1 g) = 7.53 W/kg; SAR(10 g) = 2.14 W/kg**  
Maximum value of SAR (measured) = 16.2 W/kg





## **Appendix B. SAR Plots of SAR Measurement**

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

## P01 802.11b\_Right Cheek\_Ch1\_Sample 1

**DUT: 131119C31**

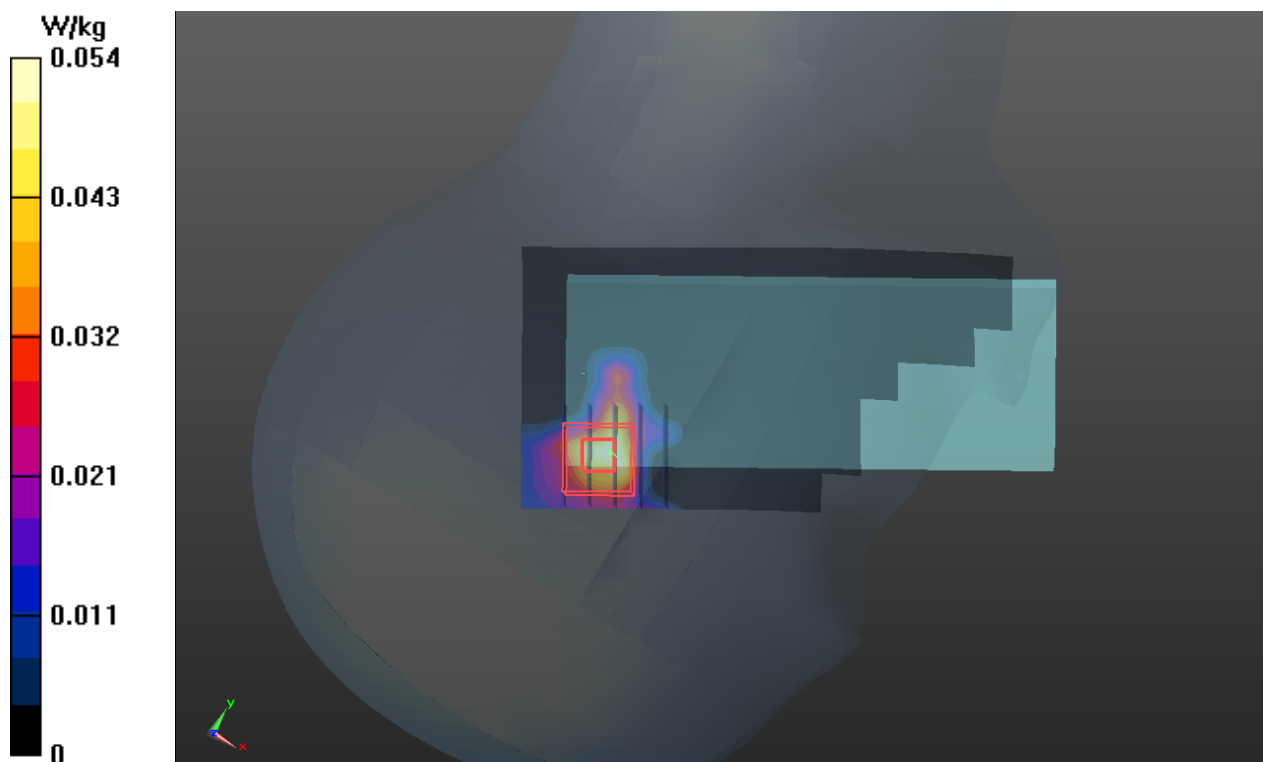
Communication System: WLAN\_2.4G; Frequency: 2412 MHz; Duty Cycle: 1:1  
Medium: H2450\_0206 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.819$  S/m;  $\epsilon_r = 38.036$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Ambient Temperature : 22.8 °C; Liquid Temperature : 22.0 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(7.47, 7.47, 7.47); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (71x151x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm  
Maximum value of SAR (interpolated) = 0.0535 W/kg

- **Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
Reference Value = 2.317 V/m; Power Drift = 0.18 dB  
Peak SAR (extrapolated) = 0.0610 W/kg  
**SAR(1 g) = 0.032 W/kg; SAR(10 g) = 0.016 W/kg**  
Maximum value of SAR (measured) = 0.0445 W/kg



## P02 802.11a\_Left Tilted\_Ch48\_Sample 1

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5240 MHz; Duty Cycle: 1:1.04

Medium: H5G\_0207 Medium parameters used:  $f = 5240$  MHz;  $\sigma = 4.885$  S/m;  $\epsilon_r = 35.172$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(5.33, 5.33, 5.33); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x201x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.183 W/kg

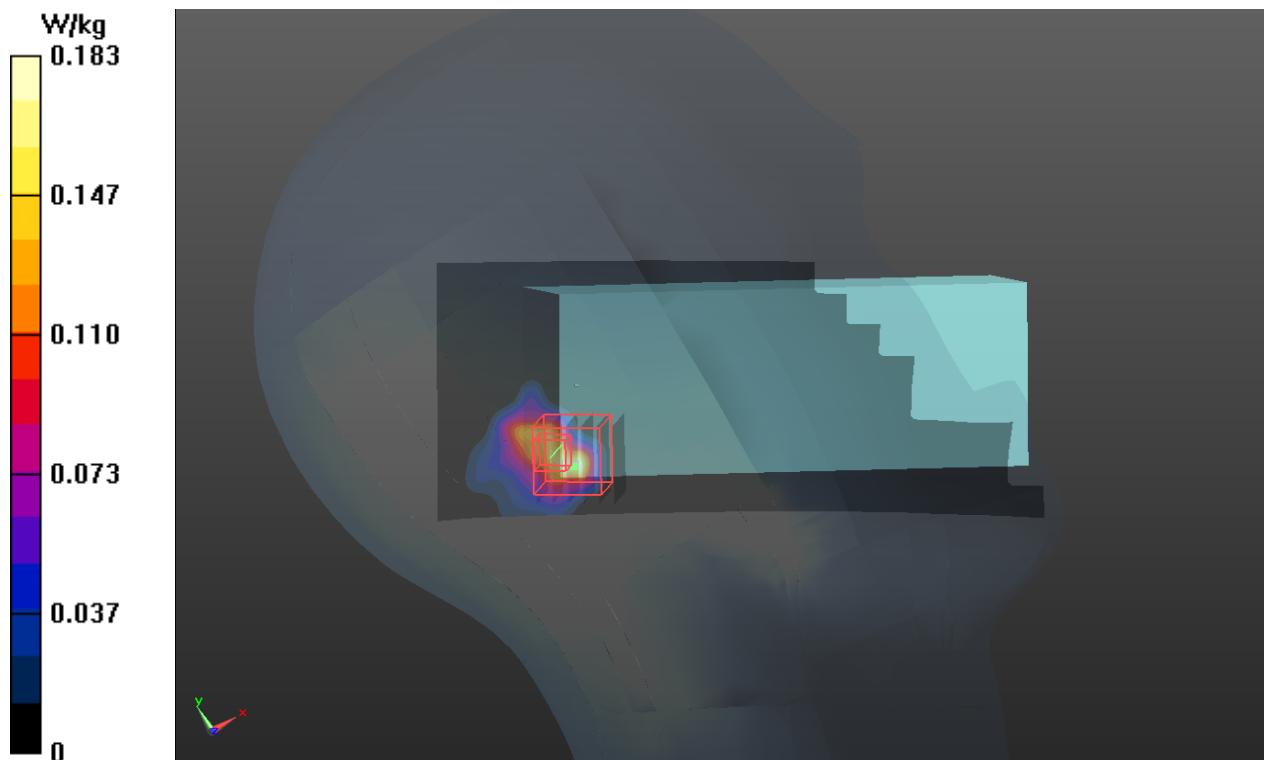
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.018 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 0.233 W/kg

**SAR(1 g) = 0.070 W/kg; SAR(10 g) = 0.022 W/kg**

Maximum value of SAR (measured) = 0.145 W/kg



## P03 802.11a\_Left Tilted\_Ch64\_Sample 1

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5320 MHz; Duty Cycle: 1:1.04

Medium: H5G\_0207 Medium parameters used:  $f = 5320$  MHz;  $\sigma = 4.972$  S/m;  $\epsilon_r = 35.041$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

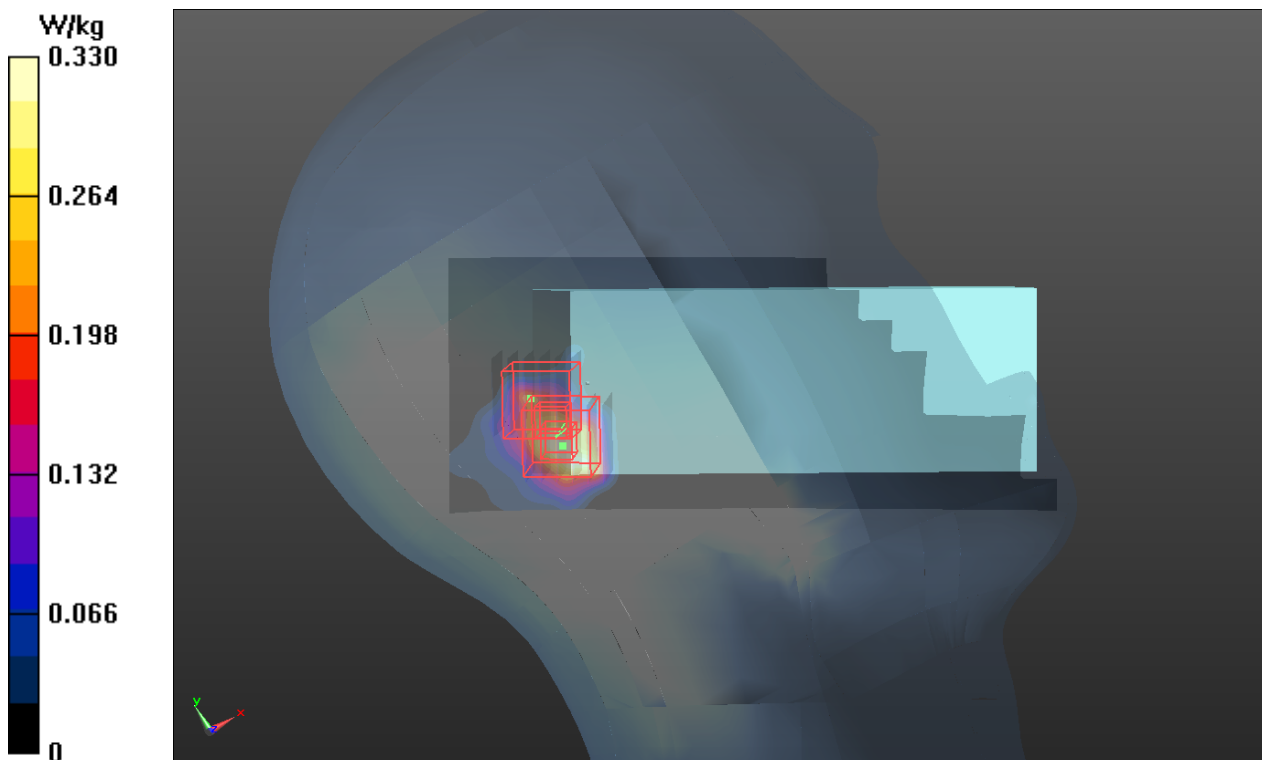
DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(5.13, 5.13, 5.13); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x201x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm  
Maximum value of SAR (interpolated) = 0.330 W/kg

- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm  
Reference Value = 1.627 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 0.545 W/kg  
**SAR(1 g) = 0.172 W/kg; SAR(10 g) = 0.061 W/kg**  
Maximum value of SAR (measured) = 0.322 W/kg

- **Zoom Scan (6x6x12)/Cube 1:** Measurement grid: dx=5mm, dy=5mm, dz=2mm  
Reference Value = 1.627 V/m; Power Drift = 0.06 dB  
Peak SAR (extrapolated) = 0.566 W/kg  
**SAR(1 g) = 0.144 W/kg; SAR(10 g) = 0.040 W/kg**  
Maximum value of SAR (measured) = 0.329 W/kg



## P04 802.11a\_Left Tilted\_Ch100\_Sample 2

### DUT: 131119C31

Communication System: WLAN\_5G; Frequency: 5500 MHz; Duty Cycle: 1:1.04

Medium: H5G\_0207 Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.176$  S/m;  $\epsilon_r = 34.704$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 22.2 °C; Liquid Temperature : 21.8 °C

#### DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(4.96, 4.96, 4.96); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1654
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x201x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.336 W/kg

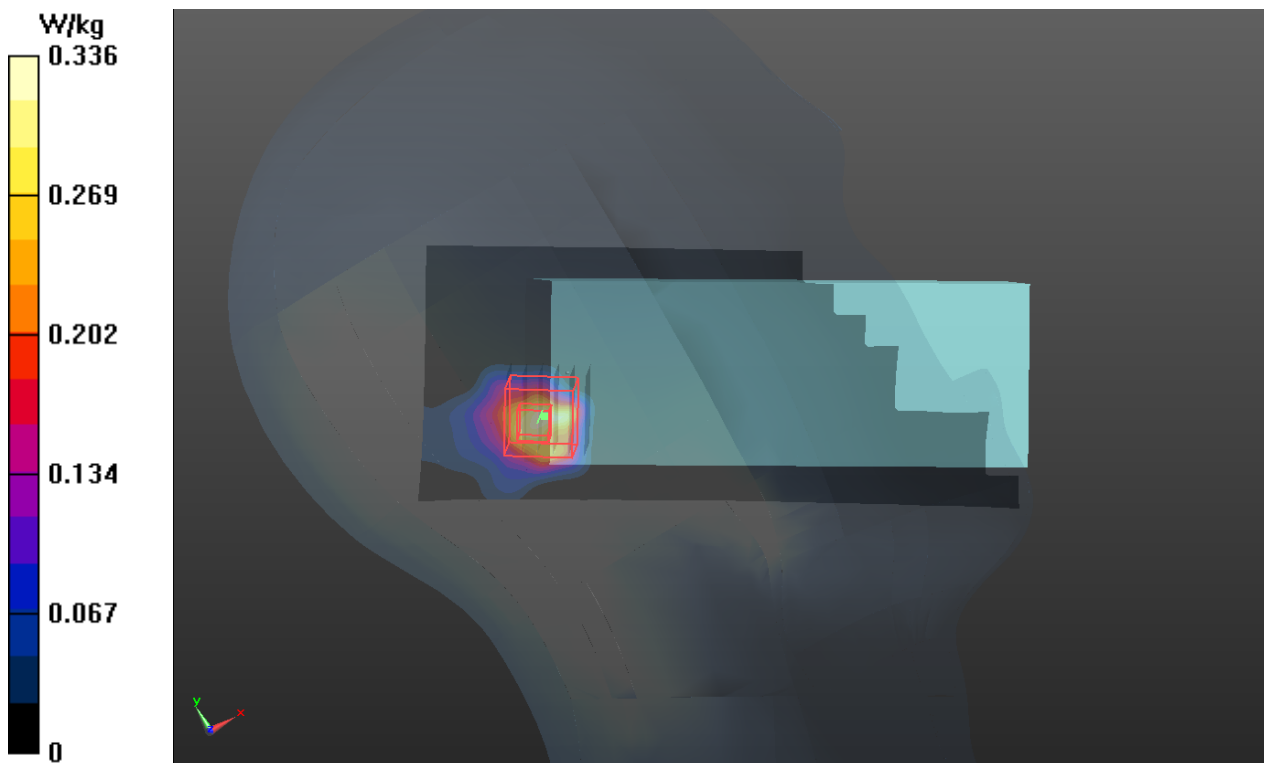
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 3.178 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 0.777 W/kg

**SAR(1 g) = 0.158 W/kg; SAR(10 g) = 0.054 W/kg**

Maximum value of SAR (measured) = 0.309 W/kg



## P05 802.11a\_Left Tilted\_Ch149\_Sample 1

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5745 MHz; Duty Cycle: 1:1.04

Medium: H5G\_0210 Medium parameters used:  $f = 5745$  MHz;  $\sigma = 5.422$  S/m;  $\epsilon_r = 34.433$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.5 °C; Liquid Temperature : 21.1 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3864; ConvF(4.67, 4.67, 4.67); Calibrated: 2013/07/31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1277; Calibrated: 2013/07/26
- Phantom: SAM Phantom\_Left; Type: SAM V4.0; Serial: TP 1653
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x201x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0763 W/kg

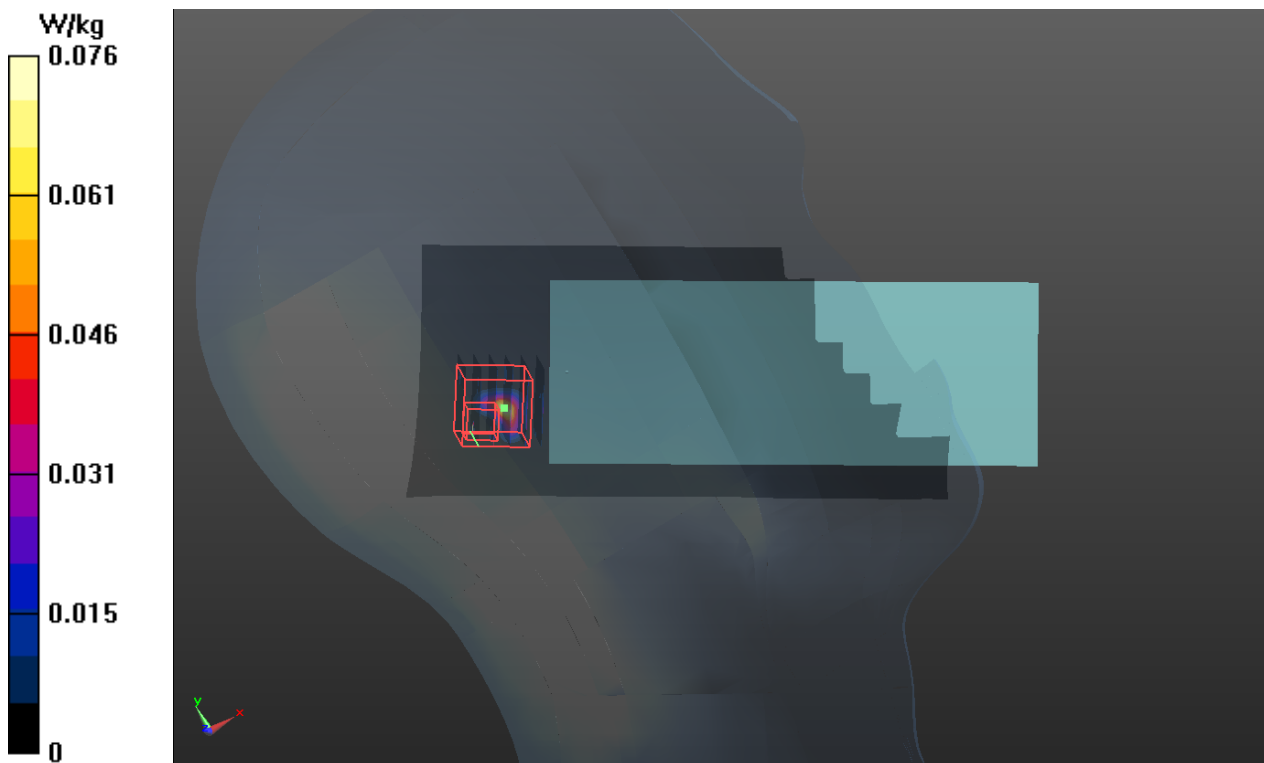
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.275 W/kg

**SAR(1 g) = 0.000489 W/kg; SAR(10 g) = 7.64e-005 W/kg**

Maximum value of SAR (measured) = 0.275 W/kg





### P06 802.11b\_Rear Face\_1.5cm\_Ch1\_Sample3

**DUT: 131119C31**

Communication System: WLAN\_2.4G; Frequency: 2412 MHz; Duty Cycle: 1:1

Medium: B2450\_0102 Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.942$  S/m;  $\epsilon_r = 51.765$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.8 °C ; Liquid Temperature : 20.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(6.69, 6.69, 6.69); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Right; Type: QD000P40CC; Serial: TP:1496
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (71x151x1):** Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.0146 W/kg

- **Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.406 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.0180 W/kg

**SAR(1 g) = 0.011 W/kg; SAR(10 g) = 0.0056 W/kg**

Maximum value of SAR (measured) = 0.0148 W/kg

- **Zoom Scan (5x5x7)/Cube 1:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.406 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.0180 W/kg

**SAR(1 g) = 0.00943 W/kg; SAR(10 g) = 0.0043 W/kg**

Maximum value of SAR (measured) = 0.0139 W/kg

-

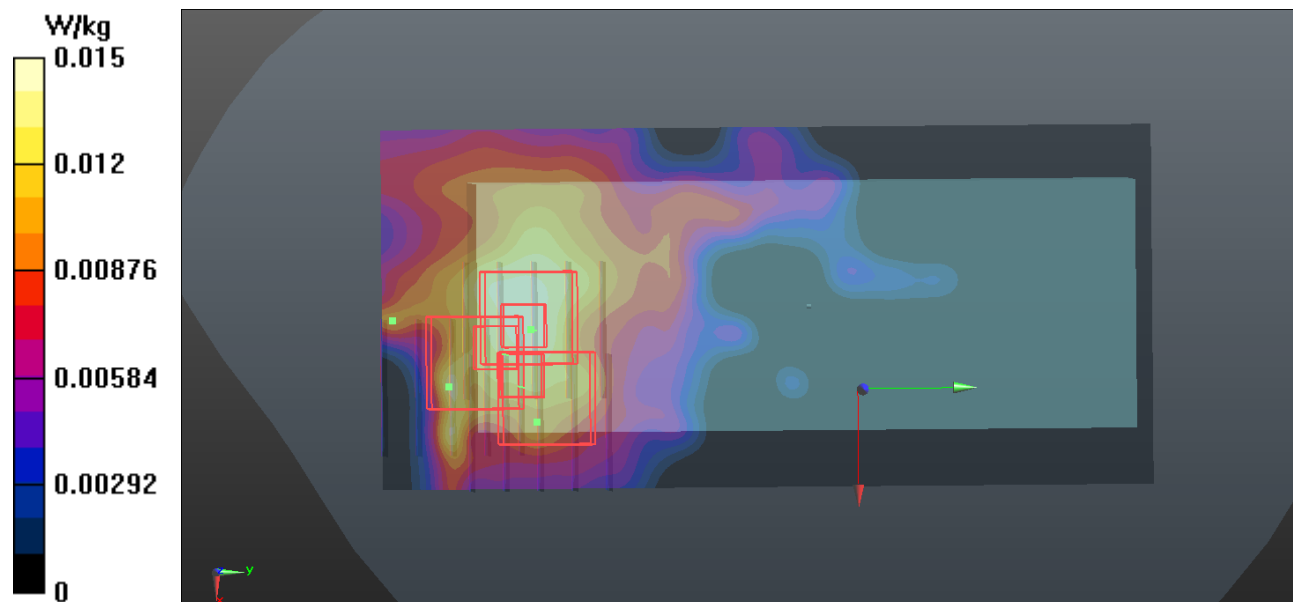
**Zoom Scan (5x5x7)/Cube 2:** Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.406 V/m; Power Drift = -0.14 dB

Peak SAR (extrapolated) = 0.0250 W/kg

**SAR(1 g) = 0.00939 W/kg; SAR(10 g) = 0.00472 W/kg**

Maximum value of SAR (measured) = 0.0142 W/kg



### P07 802.11a\_Rear Face\_1.5cm\_Ch48\_Sample3

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5240 MHz; Duty Cycle: 1:1.04

Medium: B5G\_0102 Medium parameters used:  $f = 5240$  MHz;  $\sigma = 5.401$  S/m;  $\epsilon_r = 47.656$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(4.24, 4.24, 4.24); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

**Ch48/Area Scan (101x181x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0732 W/kg

**Ch48/Zoom Scan (6x6x12)/Cube 1:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.032 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.0700 W/kg

**SAR(1 g) = 0.022 W/kg; SAR(10 g) = 0.00874 W/kg**

Maximum value of SAR (measured) = 0.0444 W/kg

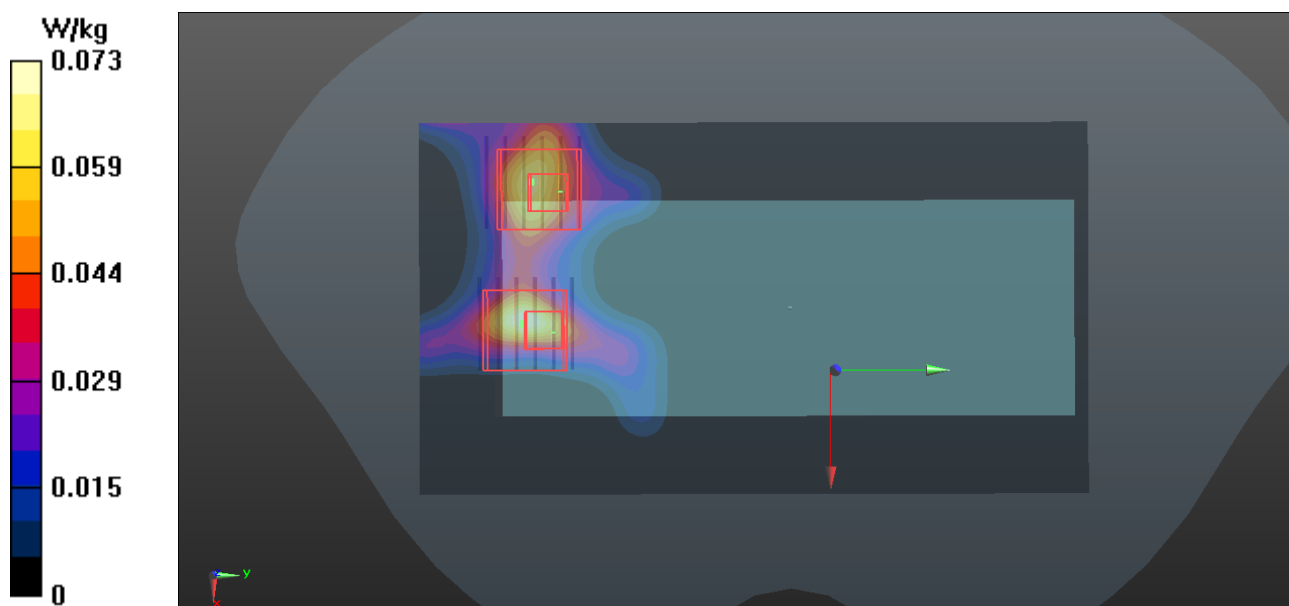
**Ch48/Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 1.032 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.0600 W/kg

**SAR(1 g) = 0.020 W/kg; SAR(10 g) = 0.00784 W/kg**

Maximum value of SAR (measured) = 0.0451 W/kg



### P08 802.11a\_Rear Face\_1.5cm\_Ch64\_Sample3

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5320 MHz; Duty Cycle: 1:1.04

Medium: B5G\_0102 Medium parameters used:  $f = 5320$  MHz;  $\sigma = 5.518$  S/m;  $\epsilon_r = 47.489$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.6 °C; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(4.05, 4.05, 4.05); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x161x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.122 W/kg

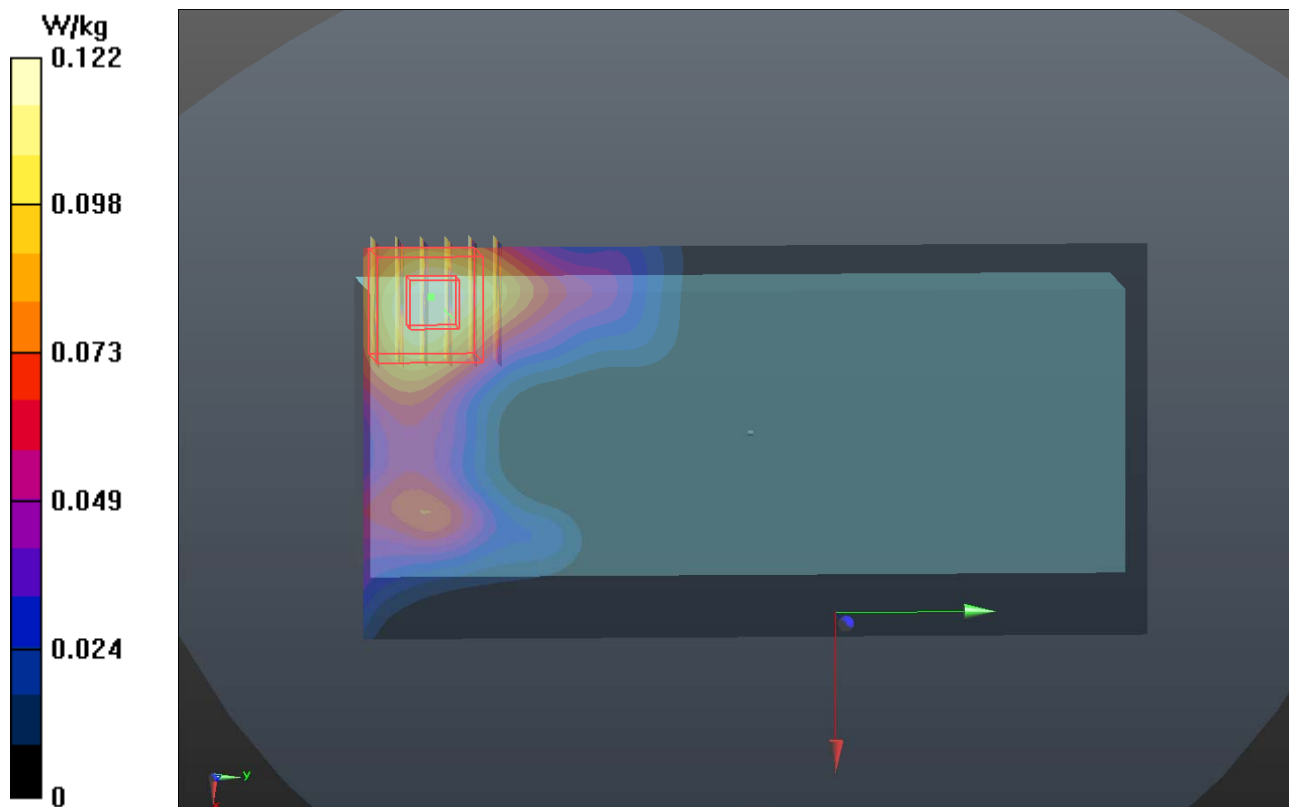
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0.372 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 0.207 W/kg

**SAR(1 g) = 0.062 W/kg; SAR(10 g) = 0.024 W/kg**

Maximum value of SAR (measured) = 0.112 W/kg



### P09 802.11a\_Rear Face\_1.5cm\_Ch100\_Sample3

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5500 MHz; Duty Cycle: 1:1.04

Medium: B5G\_0102 Medium parameters used:  $f = 5500$  MHz;  $\sigma = 5.77$  S/m;  $\epsilon_r = 47.078$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.6 °C; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(3.83, 3.83, 3.83); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x181x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.187 W/kg

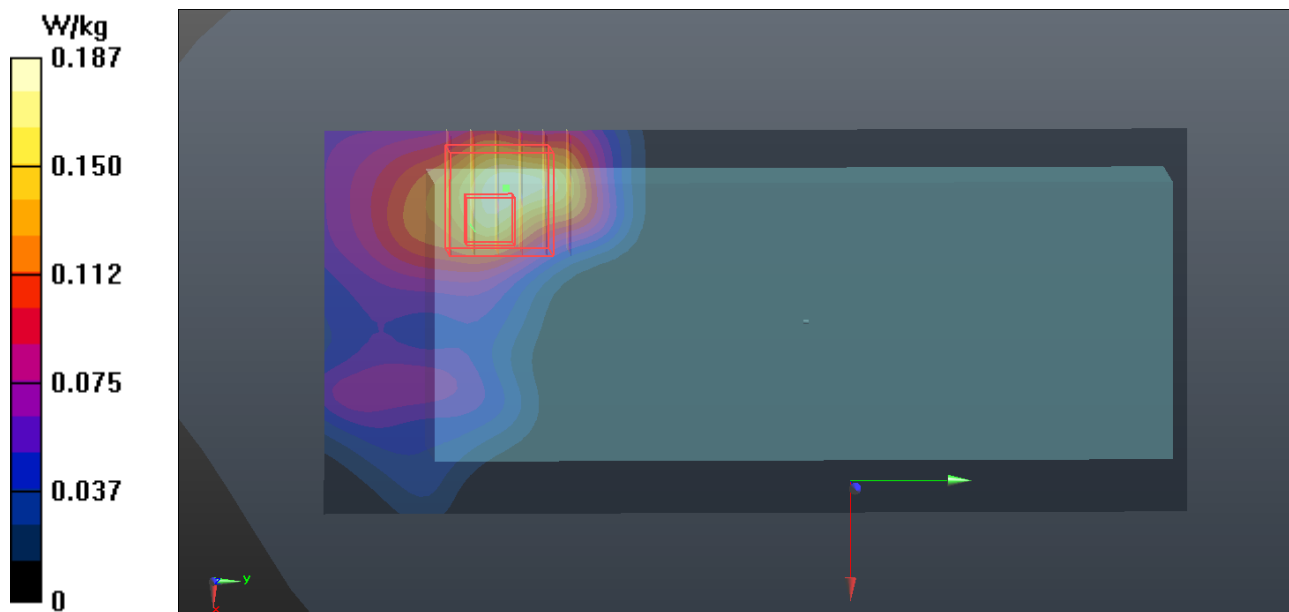
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.250 W/kg

**SAR(1 g) = 0.076 W/kg; SAR(10 g) = 0.031 W/kg**

Maximum value of SAR (measured) = 0.144 W/kg



### P10 802.11a\_Rear Face\_1.5cm\_Ch149\_Sample3

**DUT: 131119C31**

Communication System: WLAN\_5G; Frequency: 5745 MHz; Duty Cycle: 1:1.04

Medium: B5G\_0102 Medium parameters used:  $f = 5745$  MHz;  $\sigma = 6.128$  S/m;  $\epsilon_r = 46.646$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Ambient Temperature : 21.6 °C ; Liquid Temperature : 20.3 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3801; ConvF(3.9, 3.9, 3.9); Calibrated: 2013/06/20;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn579; Calibrated: 2013/04/24
- Phantom: SAM Phantom\_Front; Type: SAM V4.0; Serial: TP 1127
- Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

- **Area Scan (81x181x1):** Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0257 W/kg

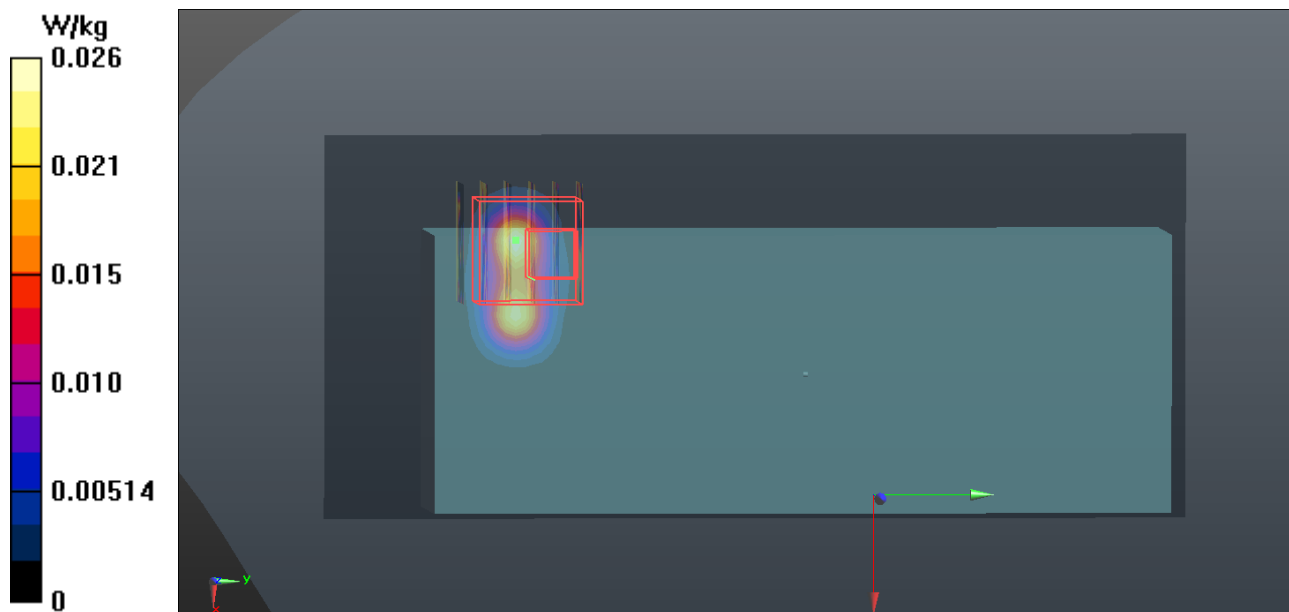
- **Zoom Scan (6x6x12)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.242 W/kg

**SAR(1 g) = 0.020 W/kg; SAR(10 g) = 0.00804 W/kg**

Maximum value of SAR (measured) = 0.0331 W/kg





## Appendix C. Calibration Certificate for Probe and Dipole

The SPEAG calibration certificates are shown as follows.



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

Accreditation No.: **SCS 108**

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

Certificate No: **D2450V2-737\_Jan13**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 737**

Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **January 21, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
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

Calibrated by: **Leif Klynsner**      **Leif Klynsner**      **L. Klynsner**  
Name      Function      Signature  
Laboratory Technician

Approved by: **Fin Bomholt**      **Fin Bomholt**  
Deputy Technical Manager

Issued: January 21, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

### Glossary:

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

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

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

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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.

<b>DASY Version</b>	DASY5	V52.8.5
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2450 MHz ± 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	37.9 ± 6 %	1.85 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>52.5 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.4 W/kg ± 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.7	1.95 mho/m
<b>Measured Body TSL parameters</b>	(22.0 ± 0.2) °C	50.5 ± 6 %	2.01 mho/m ± 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	12.7 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>49.6 W/kg ± 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	5.86 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.1 W/kg ± 16.5 % (k=2)</b>

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.4 $\Omega$ + 3.7 j $\Omega$
Return Loss	- 26.3 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.1 $\Omega$ + 5.3 j $\Omega$
Return Loss	- 25.5 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

### Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 26, 2003

## DASY5 Validation Report for Head TSL

Date: 21.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.85$  S/m;  $\epsilon_r = 37.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

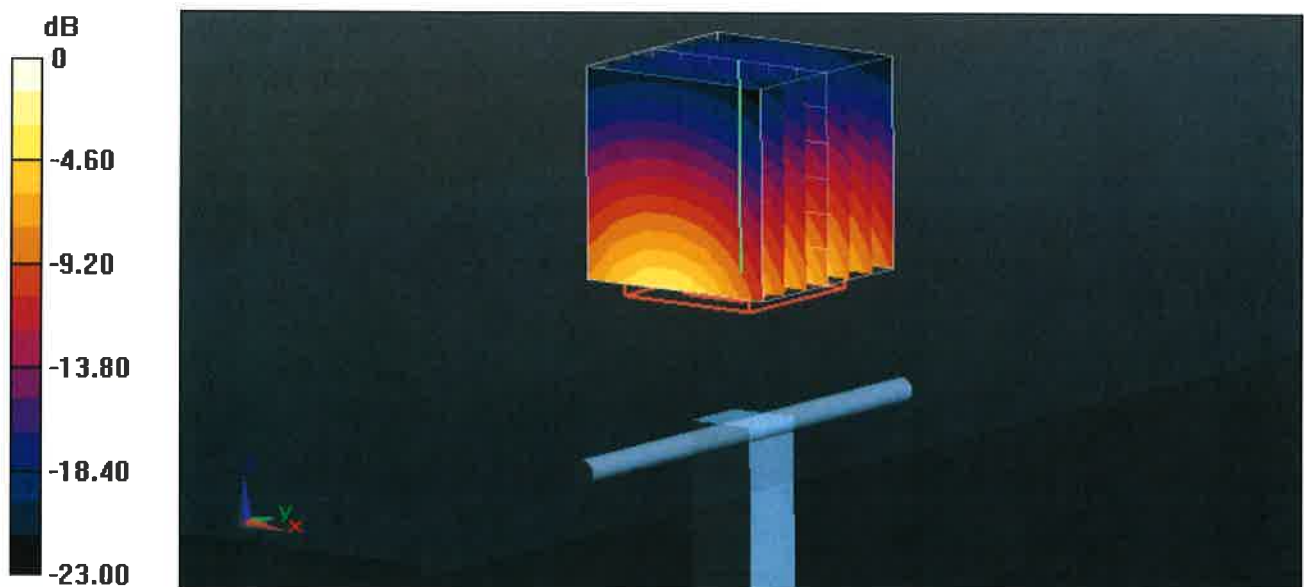
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.892 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 28.0 W/kg

**SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.17 W/kg**

Maximum value of SAR (measured) = 17.2 W/kg



# Impedance Measurement Plot for Head TSL

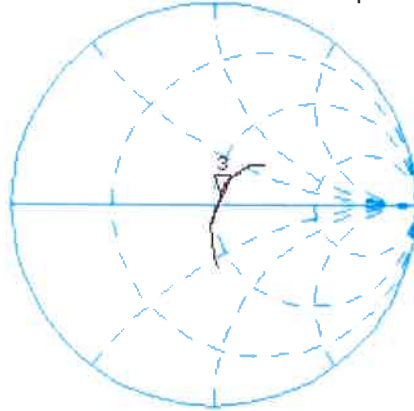
18 Jan 2013 12:34:33  
CH1 S11 1 U FS 3: 53.387  $\Delta$  3.7109  $\Delta$  241.07 pH 2 450.000 000 MHz

\*  
De l

C $\Delta$

Avg  
16

H1d

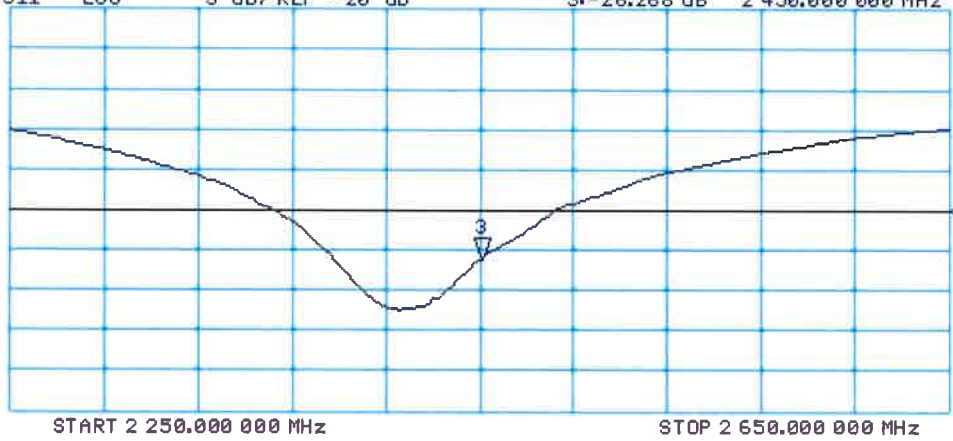


CH2 S11 LOG 5 dB/REF -20 dB 3:-26.268 dB 2 450.000 000 MHz

C $\Delta$

Avg  
16

H1d



## DASY5 Validation Report for Body TSL

Date: 18.01.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

Communication System: CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.01$  S/m;  $\epsilon_r = 50.5$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 27.06.2012
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.5(1059); SEMCAD X 14.6.8(7028)

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

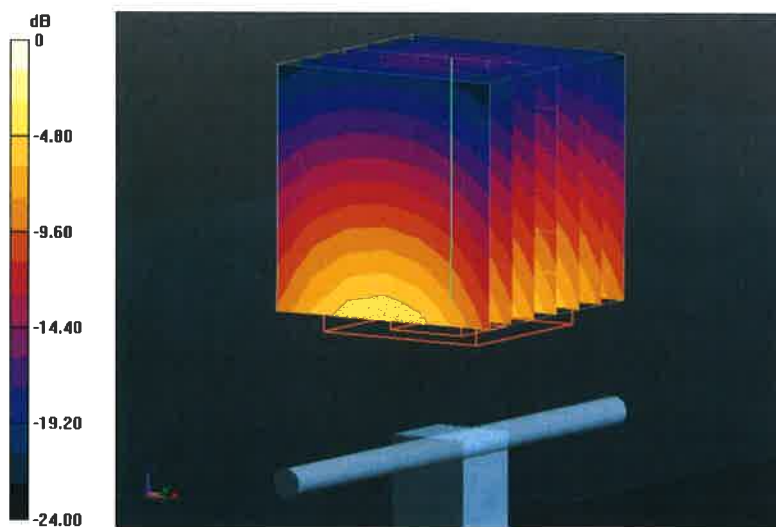
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.076 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 26.9 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.86 W/kg**

Maximum value of SAR (measured) = 16.8 W/kg



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

# Impedance Measurement Plot for Body TSL

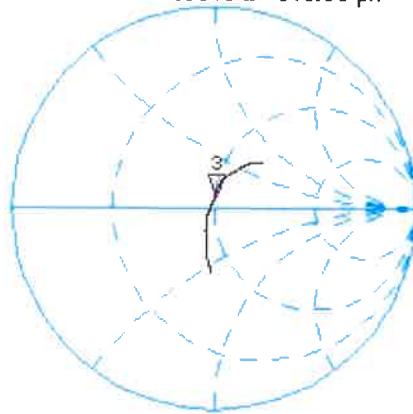
18 Jan 2013 12:34:02  
[CH1] S11 1 U FS 3: 50.123  $\Delta$  5.3340  $\Delta$  346.50 pH 2 450.000 000 MHz

\*  
De1

C $\Delta$

Avg  
16

H1d



CH2 S11 LOG 5 dB/REF -20 dB 3:-25.479 dB 2 450.000 000 MHz

C $\Delta$

Avg  
16

H1d







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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

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

Certificate No: **D2450V2-893\_Aug13**

## CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 893**

Calibration procedure(s) **QA CAL-05.v9  
Calibration procedure for dipole validation kits above 700 MHz**

Calibration date: **August 30, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature  $(22 \pm 3)^\circ\text{C}$  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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe ES3DV3	SN: 3205	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
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	
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 30, 2013

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



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Accreditation No.: **SCS 108**

### Glossary:

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

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

- IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

### Additional Documentation:

- DASY4/5 System Handbook

### Methods Applied and Interpretation of Parameters:

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

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.

<b>DASY Version</b>	DASY5	V52.8.7
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy, dz = 5 mm	
<b>Frequency</b>	2450 MHz $\pm$ 1 MHz	

## Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	39.2	1.80 mho/m
<b>Measured Head TSL parameters</b>	(22.0 $\pm$ 0.2) °C	37.8 $\pm$ 6 %	1.80 mho/m $\pm$ 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	---	---

## SAR result with Head TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	250 mW input power	13.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>53.2 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	250 mW input power	6.23 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>24.8 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Body TSL parameters</b>	22.0 °C	52.7	1.95 mho/m
<b>Measured Body TSL parameters</b>	(22.0 $\pm$ 0.2) °C	50.6 $\pm$ 6 %	2.03 mho/m $\pm$ 6 %
<b>Body TSL temperature change during test</b>	< 0.5 °C	---	---

## SAR result with Body TSL

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Body TSL</b>	Condition	
SAR measured	250 mW input power	13.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>50.5 W/kg <math>\pm</math> 17.0 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Body TSL</b>	condition	
SAR measured	250 mW input power	5.99 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>23.6 W/kg <math>\pm</math> 16.5 % (k=2)</b>

## Appendix

### Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.7 $\Omega$ + 2.0 j $\Omega$
Return Loss	- 24.8 dB

### Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.5 $\Omega$ + 4.3 j $\Omega$
Return Loss	- 26.9 dB

### General Antenna Parameters and Design

Electrical Delay (one direction)	1.161 ns
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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	October 06, 2011

## DASY5 Validation Report for Head TSL

Date: 30.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 893**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.8$  S/m;  $\epsilon_r = 37.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.52, 4.52, 4.52); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

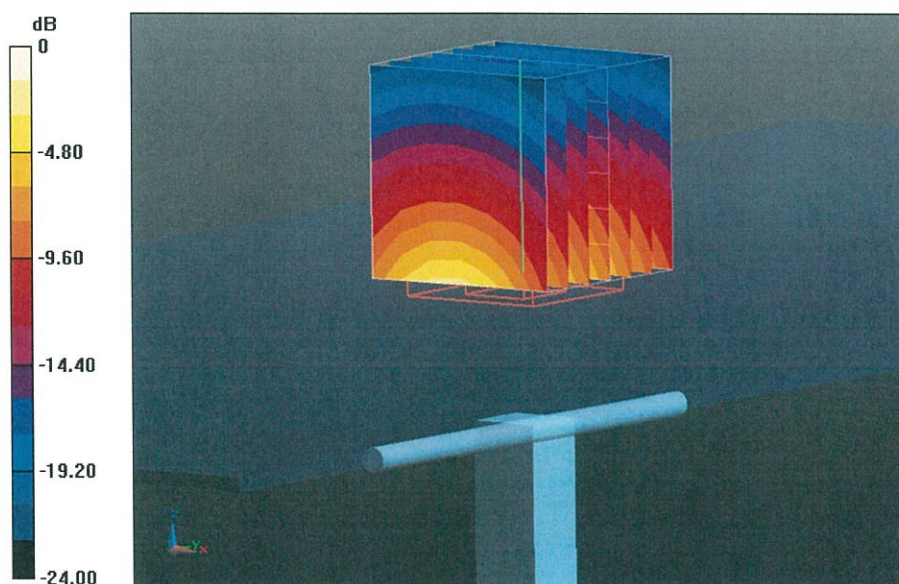
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.274 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 27.7 W/kg

**SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.23 W/kg**

Maximum value of SAR (measured) = 17.2 W/kg

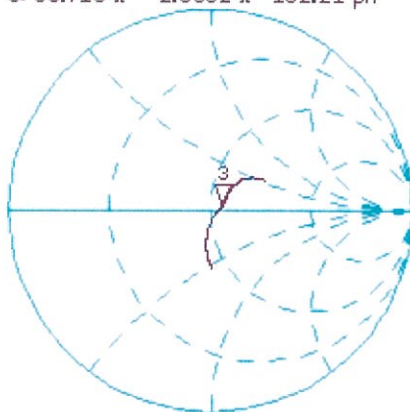


0 dB = 17.2 W/kg = 12.36 dBW/kg

# Impedance Measurement Plot for Head TSL

29 Aug 2013 16:06:54  
 CH1 S11 1 U FS 3: 55.713  $\Omega$  2.0352  $\Omega$  132.21  $\rho H$  2 450.000 000 MHz

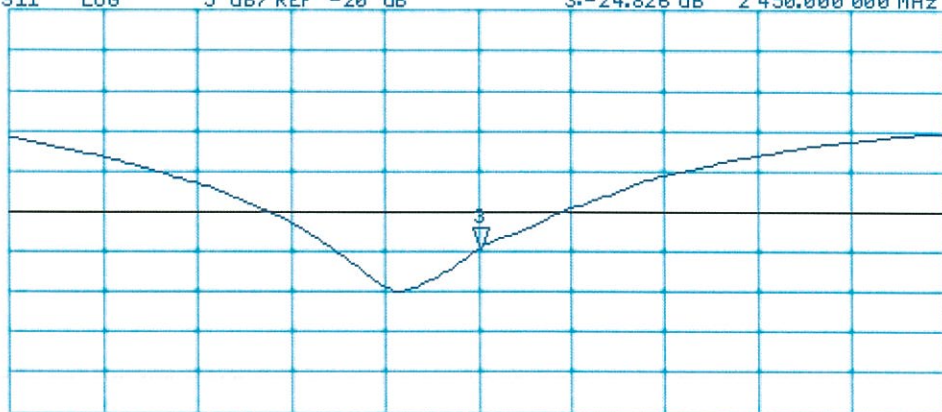
\*  
 De1  
 Ca



Avg  
 16  
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-24.825 dB 2 450.000 000 MHz

Ca



Avg  
 16  
 H1d

START 2 250.000 000 MHz

STOP 2 650.000 000 MHz



## DASY5 Validation Report for Body TSL

Date: 30.08.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 893**

Communication System: UID 0 - CW; Frequency: 2450 MHz

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 2.03$  S/m;  $\epsilon_r = 50.6$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.42, 4.42, 4.42); Calibrated: 28.12.2012;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

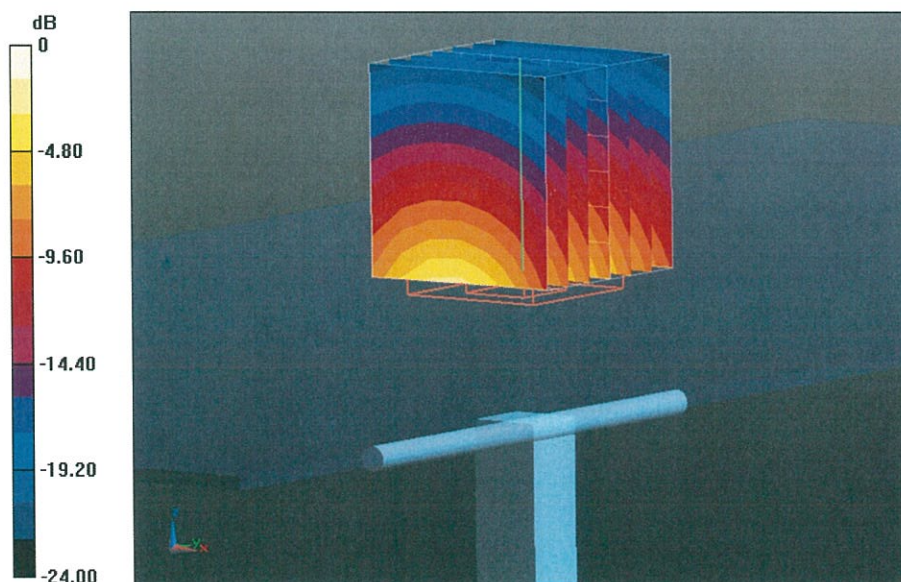
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.274 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 27.3 W/kg

**SAR(1 g) = 13 W/kg; SAR(10 g) = 5.99 W/kg**

Maximum value of SAR (measured) = 17.0 W/kg



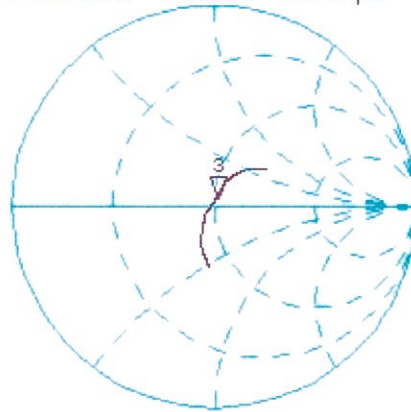
0 dB = 17.0 W/kg = 12.30 dBW/kg

# Impedance Measurement Plot for Body TSL

29 Aug 2013 15:32:38

CH1 S11 1 U FS 3: 51.545  $\Omega$  4.3027  $\Omega$  279.51 pF 2 450.000 000 MHz

\*  
De1  
CA



Avg  
16

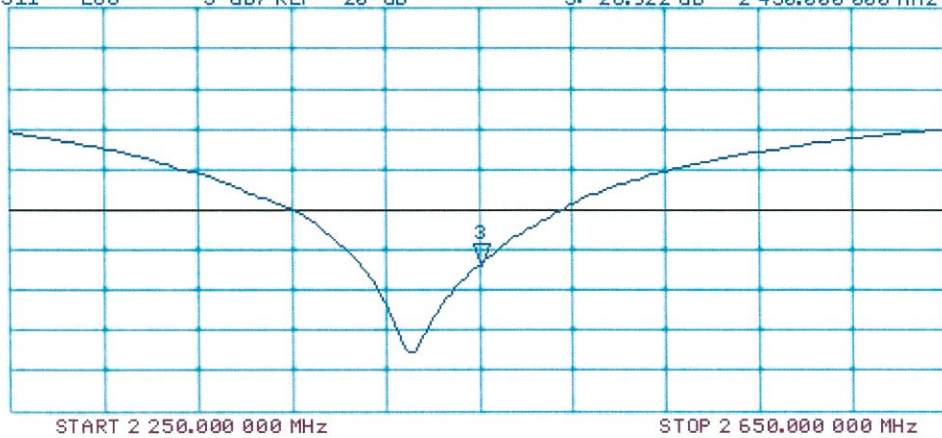
H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-26.922 dB 2 450.000 000 MHz

CA

Avg  
16

H1d





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Accreditation No.: **SCS 108**

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

Certificate No: **D5GHzV2-1018\_Jul13**

## CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN: 1018**

Calibration procedure(s) **QA CAL-22.v2  
Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date: **July 24, 2013**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature ( $22 \pm 3$ )°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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
Reference Probe EX3DV4	SN: 3503	28-Dec-12 (No. EX3-3503_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14

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:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 24, 2013

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Accreditation No.: **SCS 108**

### Glossary:

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

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

- 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.

<b>DASY Version</b>	DASY5	V52.8.7
<b>Extrapolation</b>	Advanced Extrapolation	
<b>Phantom</b>	Modular Flat Phantom V5.0	
<b>Distance Dipole Center - TSL</b>	10 mm	with Spacer
<b>Zoom Scan Resolution</b>	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
<b>Frequency</b>	5200 MHz ± 1 MHz 5300 MHz ± 1 MHz 5600 MHz ± 1 MHz 5800 MHz ± 1 MHz	

## Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
<b>Nominal Head TSL parameters</b>	22.0 °C	36.0	4.66 mho/m
<b>Measured Head TSL parameters</b>	(22.0 ± 0.2) °C	35.2 ± 6 %	4.46 mho/m ± 6 %
<b>Head TSL temperature change during test</b>	< 0.5 °C	----	----

## SAR result with Head TSL at 5200 MHz

<b>SAR averaged over 1 cm<sup>3</sup> (1 g) of Head TSL</b>	Condition	
SAR measured	100 mW input power	7.97 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>79.2 W/kg ± 19.9 % (k=2)</b>

<b>SAR averaged over 10 cm<sup>3</sup> (10 g) of Head TSL</b>	condition	
SAR measured	100 mW input power	2.29 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.7 W/kg ± 19.5 % (k=2)</b>

### 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	35.1 ± 6 %	4.55 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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>82.6 W / kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (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	<b>23.7 W/kg ± 19.5 % (k=2)</b>

### 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	34.7 ± 6 %	4.85 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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>82.8 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.38 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>23.6 W/kg ± 19.5 % (k=2)</b>

## 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	34.4 ± 6 %	5.05 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 <sup>3</sup> (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.01 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>79.5 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	<b>22.6 W/kg ± 19.5 % (k=2)</b>

### 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	48.9 ± 6 %	5.40 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 <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>74.9 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>21.0 W/kg ± 19.5 % (k=2)</b>

### Body TSL parameters at 5300 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.42 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.8 ± 6 %	5.55 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 <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.63 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>75.7 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>21.3 W/kg ± 19.5 % (k=2)</b>

### 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	48.2 ± 6 %	5.93 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 <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>80.4 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>22.4 W/kg ± 19.5 % (k=2)</b>

### 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	47.9 ± 6 %	6.21 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 <sup>3</sup> (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	<b>74.9 W/kg ± 19.9 % (k=2)</b>

SAR averaged over 10 cm <sup>3</sup> (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	<b>20.8 W/kg ± 19.5 % (k=2)</b>

## Appendix

### Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	52.0 $\Omega$ - 8.6 j $\Omega$
Return Loss	- 21.3 dB

### Antenna Parameters with Head TSL at 5300 MHz

Impedance, transformed to feed point	54.0 $\Omega$ - 1.4 j $\Omega$
Return Loss	- 27.9 dB

### Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	54.7 $\Omega$ - 6.5 j $\Omega$
Return Loss	- 22.4 dB

### Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	54.3 $\Omega$ + 0.8 j $\Omega$
Return Loss	- 27.6 dB

### Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.1 $\Omega$ - 8.4 j $\Omega$
Return Loss	- 21.5 dB

### Antenna Parameters with Body TSL at 5300 MHz

Impedance, transformed to feed point	53.7 $\Omega$ - 1.8 j $\Omega$
Return Loss	- 28.1 dB

### Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	56.2 $\Omega$ - 3.1 j $\Omega$
Return Loss	- 23.7 dB

### Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	57.1 $\Omega$ + 3.7 j $\Omega$
Return Loss	- 22.6 dB

## General Antenna Parameters and Design

Electrical Delay (one direction)	1.202 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

## Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 05, 2004

## DASY5 Validation Report for Head TSL

Date: 23.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1018**

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 4.46$  S/m;  $\epsilon_r = 35.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 4.55$  S/m;  $\epsilon_r = 35.1$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 4.85$  S/m;  $\epsilon_r = 34.7$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 5.05$  S/m;  $\epsilon_r = 34.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 28.12.2012, ConvF(5.1, 5.1, 5.1); Calibrated: 28.12.2012, ConvF(4.76, 4.76, 4.76); Calibrated: 28.12.2012, ConvF(4.81, 4.81, 4.81); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Dipole Calibration for Head Tissue/Pin=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 = 63.126 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 28.9 W/kg

**SAR(1 g) = 7.97 W/kg; SAR(10 g) = 2.29 W/kg**

Maximum value of SAR (measured) = 18.4 W/kg

**Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5300 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 64.006 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 30.8 W/kg

**SAR(1 g) = 8.31 W/kg; SAR(10 g) = 2.39 W/kg**

Maximum value of SAR (measured) = 19.5 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 = 62.606 V/m; Power Drift = 0.08 dB

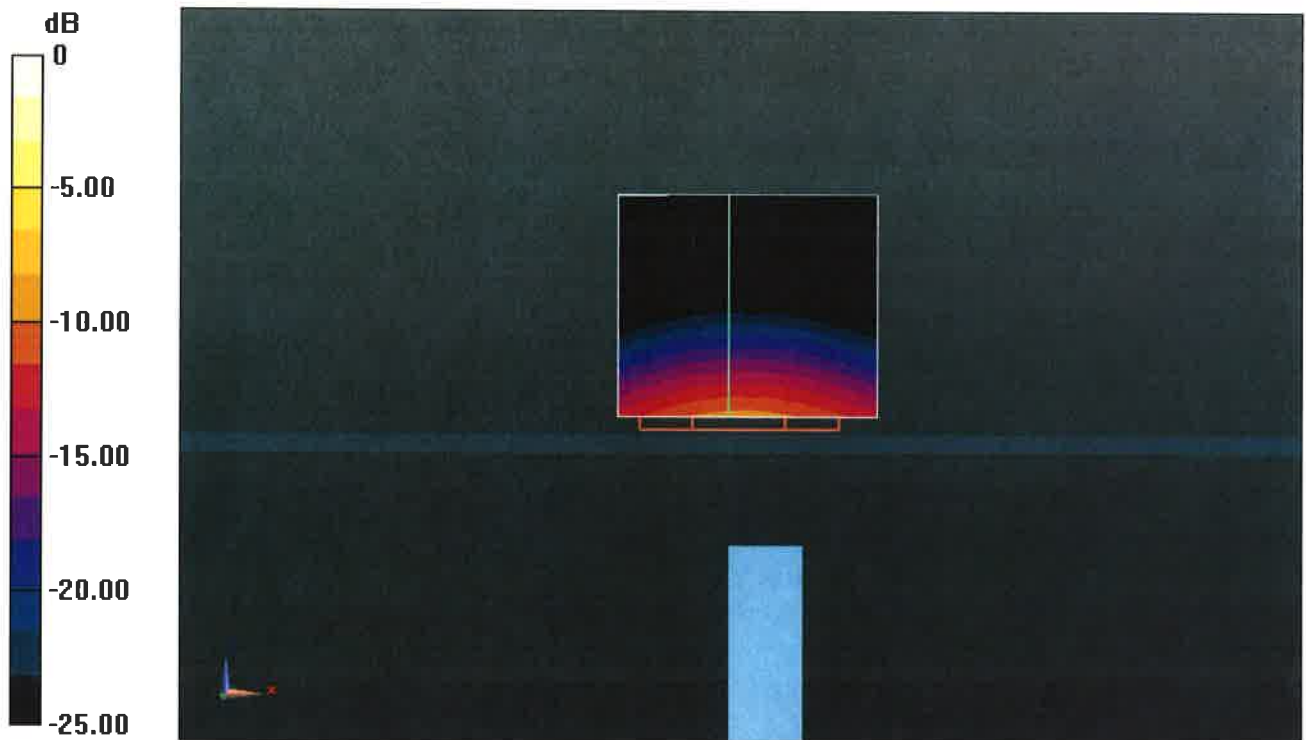
Peak SAR (extrapolated) = 32.4 W/kg

**SAR(1 g) = 8.34 W/kg; SAR(10 g) = 2.38 W/kg**

Maximum value of SAR (measured) = 20.0 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 = 60.010 V/m; Power Drift = 0.09 dB  
Peak SAR (extrapolated) = 32.6 W/kg  
SAR(1 g) = 8.01 W/kg; SAR(10 g) = 2.28 W/kg



0 dB = 19.5 W/kg = 12.90 dBW/kg

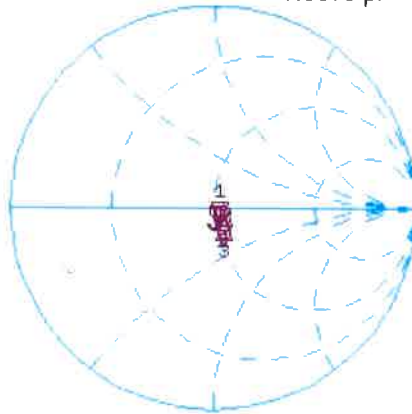
# Impedance Measurement Plot for Head TSL

23 Jul 2013 12:09:28

CH1 S11 1 U FS

1: 51.992  $\Omega$  -8.6035  $\Omega$  3.5575 pF 5 200.000 000 MHz

\*  
De1  
Cor  
Avg  
16  
H1 d



CH1 Markers

2: 53.961  $\Omega$   
-1.4277  $\Omega$   
5.30000 GHz  
3: 54.682  $\Omega$   
-6.4609  $\Omega$   
5.60000 GHz  
4: 54.260  $\Omega$   
0.8125  $\Omega$   
5.80000 GHz

CH2 S11 L06 5 dB/REF -20 dB 1: -21.282 dB 5 200.000 000 MHz

Cor  
Avg  
16  
H1 d



CH2 Markers

2: -27.851 dB  
5.30000 GHz  
3: -22.371 dB  
5.60000 GHz  
4: -27.623 dB  
5.80000 GHz

START 5 000.000 000 MHz

STOP 6 000.000 000 MHz

## DASY5 Validation Report for Body TSL

Date: 24.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 5GHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1018**

Communication System: UID 0 - CW ; Frequency: 5200 MHz, Frequency: 5300 MHz, Frequency: 5600 MHz, Frequency: 5800 MHz

Medium parameters used:  $f = 5200$  MHz;  $\sigma = 5.4$  S/m;  $\epsilon_r = 48.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5300$  MHz;  $\sigma = 5.55$  S/m;  $\epsilon_r = 46.8$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5600$  MHz;  $\sigma = 5.93$  S/m;  $\epsilon_r = 48.2$ ;  $\rho = 1000$  kg/m<sup>3</sup>, Medium parameters used:  $f = 5800$  MHz;  $\sigma = 6.21$  S/m;  $\epsilon_r = 47.9$ ;  $\rho = 1000$  kg/m<sup>3</sup>

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: 28.12.2012, ConvF(4.67, 4.67, 4.67); Calibrated: 28.12.2012, ConvF(4.22, 4.22, 4.22); Calibrated: 28.12.2012, ConvF(4.38, 4.38, 4.38); Calibrated: 28.12.2012;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

**Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5200 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 59.030 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 29.0 W/kg

**SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.1 W/kg**

Maximum value of SAR (measured) = 17.4 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 = 59.012 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 30.3 W/kg

**SAR(1 g) = 7.63 W/kg; SAR(10 g) = 2.15 W/kg**

Maximum value of SAR (measured) = 17.8 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

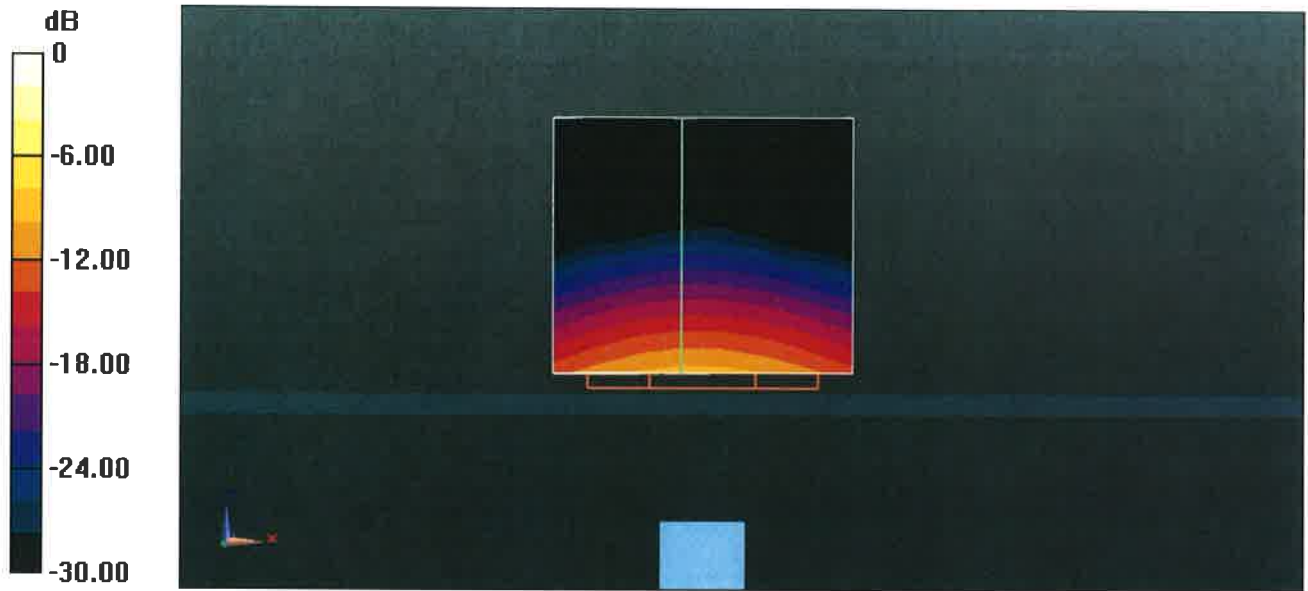
Reference Value = 58.525 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 34.9 W/kg

**SAR(1 g) = 8.04 W/kg; SAR(10 g) = 2.24 W/kg**

Maximum value of SAR (measured) = 19.4 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 = 55.098 V/m; Power Drift = 0.01 dB  
Peak SAR (extrapolated) = 34.3 W/kg  
**SAR(1 g) = 7.49 W/kg; SAR(10 g) = 2.08 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

