FCC SAR TEST REPORT

REPORT NO.: SA111107C15

MODEL NO.: HSTNN-GR04

FCC ID: MXF-HNGR04

RECEIVED: Sep. 16, 2011

TESTED: Nov. 15 ~ Nov. 16, 2011

ISSUED: Nov. 23, 2011

APPLICANT: Gemtek Technology Co., Ltd.

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ISSUED BY: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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RELEASE CONTROL RECORD

ISSUE NO.	REASON FOR CHANGE	DATE ISSUED
Original release	N/A	Nov. 23, 2011

1. CERTIFICATION

PRODUCT:	Wireless Audio
MODEL NO.:	HSTNN-GR04
FCC ID:	MXF-HNGR04
BRAND:	hp
APPLICANT:	Gemtek Technology Co., Ltd.
TESTED:	Nov. 15 ~ Nov. 16, 2011
STANDARDS:	**FCC Part 2 (Section 2.1093)**
	FCC OET Bulletin 65, Supplement C (01-01)
	IEEE 1528-2003

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, 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.

PREPARED BY : _Ivonne Wu_ , **DATE :** Nov. 23, 2011

Ivonne Wu / Senior Specialist

APPROVED BY : _Roy Wu_ , **DATE :** Nov. 23, 2011

Roy Wu / Manager

2. GENERAL INFORMATION

2.1 GENERAL DESCRIPTION OF EUT

EUT	Wireless Audio
MODEL NO.	HSTNN-GR04
FCC ID	MXF-HNGR04
MODULATION TYPE	QPSK
CHANNEL BANDWIDTH	22 MHz
TRANSFER RATE	100 kbps
OPERATING FREQUENCY	2412 ~ 2464 MHz, 5180 ~ 5240 MHz, 5736 ~ 5814 MHz
MAX. SAR (1g)	0.141 W/kg
ANTENNA TYPE	Printed antenna (Max. Gain: -1 dBi for 2.4GHz, 1 dBi for 5GHz)

NOTE:

1. The EUT conducted average power(dBm) listed as below:

Frequency	2412	2438	2464	5180	5210	5240	5736	5762	5814
Avg. Power	11.40	10.90	11.20	13.10	12.70	12.80	10.70	11.00	11.30

2. The above EUT information is declared by manufacturer and for more detailed feature description, please refer to the manufacturer's specifications or User's Manual.

2.2 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to the specifications of the manufacturer, this product must comply with the requirements of the following standards:

FCC Part 2 (2.1093)

FCC OET Bulletin 65, Supplement C (01- 01)

IEEE 1528-2003

All test items have been performed and recorded as per the above standards.

2.3 GENERAL INOFRMATION OF THE SAR SYSTEM

DASY5 **(Software DASY52, Version 52.6)** 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 DASY5 software defined. The DASY5 software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

EX3DV4 ISOTROPIC E-FIELD PROBE

CONSTRUCTION	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
FREQUENCY	10 MHz to > 6 GHz Linearity: $\pm$ 0.2 dB (30 MHz to 6 GHz)
DIRECTIVITY	$\pm$ 0.3 dB in HSL (rotation around probe axis) $\pm$ 0.5 dB in tissue material (rotation normal to probe axis)
DYNAMIC RANGE	10 μ W/g to > 100 mW/g Linearity: $\pm$ 0.2 dB (noise: typically < 1 μ W/g)
DIMENSIONS	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
APPLICATION	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

NOTE

1. The Probe parameters have been calibrated by the SPEAG. Please reference "APPENDIX D" for the Calibration Certification Report.

2. For frequencies above 800MHz, calibration in a rectangular wave-guide is used, because wave-guide size is manageable.

3. For frequencies below 800MHz, temperature transfer calibration is used because the wave-guide size becomes relatively large.

TWIN SAM V4.0

CONSTRUCTION	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 62209-1 and IEC 62209. 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 manually teaching three points with the robot.
SHELL THICKNESS	2 ± 0.2mm
FILLING VOLUME	15 cm deep from the ERP
DIMENSIONS	Height: 810mm; Length: 1000mm; Width: 500mm

SYSTEM VALIDATION KITS:

CONSTRUCTION   Symmetrical dipole with l/4 balun enables measurement of feedpoint impedance with NWA matched for use near flat phantoms filled with brain simulating solutions.
Includes distance holder and tripod adaptor

CALIBRATION   Calibrated SAR value for specified position and input power at the flat phantom in brain simulating solutions

FREQUENCY   2450MHz

RETURN LOSS   > 20dB at specified validation position

POWER CAPABILITY   > 100W (f < 1GHz); > 40W (f > 1GHz)

OPTIONS   Dipoles for other frequencies or solutions and other calibration conditions upon request

DEVICE HOLDER FOR SAM TWIN PHANTOM

CONSTRUCTION   The device holder for the mobile phone device is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity ε =3 and loss tangent δ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered. The device holder for the portable device makes up of the polyethylene foam. The dielectric parameters of material close to the dielectric parameters of the air.

DATA ACQUISITION ELECTRONICS

CONSTRUCTION

The data acquisition electronics (DAE4) consists of a highly sensitive electrometer grade preamplifier with auto-zeroing, a channel and gain-switching multiplex, a fast 16 bit AD converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock. The mechanical probe is mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection. The input impedance of the DAE3 box is 200MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

2.4 TEST EQUIPMENT

FOR SAR MEASURENENT

NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Signal Generator	Agilent	E8257C	MY43320668	Dec. 27, 2010	Dec. 26, 2011
E-Field Probe	S & P	EX3DV4	3590	Feb. 25, 2011	Feb. 24, 2012
DAE	S & P	DAE4	861	Aug. 29, 2011	Aug. 28, 2012
Robot Positioner	Staubli Unimation	NA	NA	NA	NA
Validation Dipole	S & P	D5GHzV2	1019	Jan. 25, 2011	Jan. 24, 2012

NOTE: Before starting the measurement, all test equipment shall be warmed up for 30min.

FOR TISSUE PROPERTY

NAME	BRAND	TYPE	SERIES NO.	DATE OF CALIBRATION	DUE DATE OF CALIBRATION
Network Analyzer	Agilent	E8358A	US41480538	Dec. 30, 2010	Dec. 29, 2011
Dielectric Probe	Agilent	85070D	NA	NA	NA

NOTE:

1. Before starting, all test equipment shall be warmed up for 30min.
2. The tolerance (k=1) specified by Agilent for general dielectric measurements, deriving from inaccuracies in the calibration data, analyzer drift, and random errors, are usually ±2.5% and ±5% for measured permittivity and conductivity, respectively. However, the tolerances for the conductivity is smaller for material with large loss tangents, i.e., less than ±2.5% (k=1). It can be substantially smaller if more accurate methods are applied

2.5 GENERAL DESCRIPTION OF THE SPATIAL PEAK SAR EVALUATION

The DASY52 post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the micro-volt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters:	- Frequency	F
	- Crest factor	Cf
Media parameters:	- Conductivity	σ
	- Density	ρ

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

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

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

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

$$\text{E-fieldprobes: } E_i = \sqrt{\frac{V_1}{Norm_i \cdot ConvF}}$$

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

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

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

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

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

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

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

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

1. The extraction of the measured data (grid and values) from the Zoom Scan

2. The calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)

3. The generation of a high-resolution mesh within the measured volume

4. The interpolation of all measured values from the measurement grid to the high-resolution grid

5. The extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface

6. The calculation of the averaged SAR within masses of 1g and 10g.

The probe is calibrated at the center of the dipole sensors that is located 1 to 2.7mm away from the probe tip. During measurements, the probe stops shortly above the phantom surface, depending on the probe and the surface detecting system. Both distances are included as parameters in the probe configuration file. The software always knows exactly how far away the measured point is from the surface. As the probe cannot directly measure at the surface, the values between the deepest measured point and the surface must be extrapolated. The angle between the probe axis and the surface normal line is less than 30 degree.

The maximum search is automatically performed after each area scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the area scanning measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations. The 1g and 10g peak evaluations are only available for the predefined cube 5 x 5 x 7 scans. The routines are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 32 x 32 x 30mm contains about 30g of tissue. The first procedure is an extrapolation (incl. boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid (42875 points). In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

3.   RECIPES FOR TISSUE SIMULATING LIQUIDS

For the measurement of the field distribution inside the SAM phantom, the phantom must be filled with tissue simulation liquid to a depth of 15 cm

The following ingredients are used：

• **WATER-**   Deionized water (pure H20), resistivity _16 M - as basis for the liquid
• **DGMBE-**   Diethylenglycol-monobuthyl ether (DGMBE), Fluka Chemie GmbH,
                    CAS # 112-34-5 - to reduce relative permittivity

THE RECIPES FOR 2450MHz SIMULATING LIQUID TABLE

INGREDIENT	BODY SIMULATING LIQUID 2450MHz (MSL-2450)
Water	69.83%
DGMBE	30.17%
Dielectric Parameters at 22 ℃	f= 2450MHz ε= 52.7 ± 5% σ= 1.95 ± 5% S/m

Testing the liquids using the Agilent Network Analyzer E8358A and Agilent Dielectric Probe Kit 85070D.The testing procedure is following as

1. Turn Network Analyzer on and allow at least 30min. warm up.
2. Mount dielectric probe kit so that interconnecting cable to Network Analyzer will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in Agilent-Software (Calibration Setup).
5. Perform calibration.
6. Validate calibration with dielectric material of known properties (e.g. polished ceramic slab with >8mm thickness ε'=10.0, ε''=0.0). If measured parameters do not fit within tolerance, repeat calibration (±0.2 for ε': ±0.1 for ε'').
7. Conductivity can be calculated from ε'' by $\sigma = \omega \, \varepsilon_0 \, \varepsilon'' = \varepsilon''$ f [GHz] / 18.
8. Measure liquid shortly after calibration. Repeat calibration every hour.
9. Stir the liquid to be measured. Take a sample (~ 50ml) with a syringe from the center of the liquid container.
10. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
11. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
12. Perform measurements.
13. Adjust medium parameters in DASY52 for the frequencies necessary for the measurements.
14. Select the current medium for the frequency of the validation.

FOR SIMULATING LIQUID

Frequency (MHz)	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (εr)	Date
5200	21.1	5.293	49.511	Nov. 15, 2011
5200	21.3	5.3	49.5	Nov. 16, 2011
5800	21.1	6.2	48.541	Nov. 15, 2011
5800	21.3	6.1	48.6	Nov. 16, 2011

4. SYSTEM VALIDATION

The system validation was performed in the flat phantom with equipment listed in the following table. Since the SAR value is calculated from the measured electric field, dielectric constant and conductivity of the body tissue and the SAR is proportional to the square of the electric field. So, the SAR value will be also proportional to the RF power input to the system validation dipole under the same test environment. In our system validation test, 250mW RF input power was used.

4.1 TEST PROCEDURE

Before the system performance check, we need only to tell the system which components (probe, medium, and device) are used for the system performance check; the system will take care of all parameters. The dipole must be placed beneath the flat section of the SAM Twin Phantom with the correct distance holder in place. The distance holder should touch the phantom surface with a light pressure at the reference marking (little cross) and be oriented parallel to the long side of the phantom. Accurate positioning is not necessary, since the system will search for the peak SAR location, except that the dipole arms should be parallel to the surface. The device holder for mobile phones can be left in place but should be rotated away from the dipole.

1. The "Power Reference Measurement" and "Power Drift Measurement" jobs are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the amplifier output power. If it is too high (above ±0.1 dB), the system performance check should be repeated; some amplifiers have very high drift during warm-up. A stable amplifier gives drift results in the DASY system below ±0.02dB.

2. The "Surface Check" job tests the optical surface detection system of the DASY system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above ±0.1mm). In that case it is better to abort the system performance check and stir the liquid.

3. The "Area Scan" job measures the SAR above the dipole on a plane parallel to the surface. It is used to locate the approximate location of the peak SAR. The proposed scan uses large grid spacing for faster measurement; due to the symmetric field, the peak detection is reliable. If a finer graphic is desired, the grid spacing can be reduced. Grid spacing and orientation have no influence on the SAR result.

4. The "Zoom Scan" job measures the field in a volume around the peak SAR value assessed in the previous "Area Scan" job (for more information see the application note on SAR evaluation).

About the validation dipole positioning uncertainty, the constant and low loss dielectric spacer is used to establish the correct distance between the top surface of the dipole and the bottom surface of the phantom, the error component introduced by the uncertainty of the distance between the liquid (i.e., phantom shell) and the validation dipole in the DASY52 system is less than ±0.1mm.

$$SAR_{tolerance}[\%] = 100 \times (\frac{(a+d)^2}{a^2} - 1)$$

As the closest distance is 10mm, the resulting tolerance $SAR_{tolerance}[\%]$ is <2%.

4.2 VALIDATION RESULTS

Date	Frequency (MHz)	Targeted SAR (W/kg)	Measured SAR (W/kg)	Normalized SAR (W/kg)	Deviation (%)
Nov. 15, 2011	5200	77.10	8.08	80.80	4.80
Nov. 16, 2011	5200	77.10	8.11	81.10	5.19
Nov. 15, 2011	5800	73.40	7.30	73.00	-0.54
Nov. 16, 2011	5800	73.40	7.20	72.00	-1.91

NOTE:

1. Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Above table shows the target SAR and measured SAR after normalized to 1W input power.

2. Please see Appendix for the photo of system validation test.

4.3 SYSTEM VALIDATION UNCERTAINTIES

In the table below, the system validation uncertainty with respect to the analytically assessed SAR value of a dipole source as given in the IEEE 1528 standard is given. This uncertainty is smaller than the expected uncertainty for mobile phone measurements due to the simplified setup and the symmetric field distribution.

Error Description	Tolerance (±%)	Probability Distribution	Divisor	(C_i)		Standard Uncertainty (±%)		(v_i)
				(1g)	(10g)	(1g)	(10g)	
Measurement System								
Probe Calibration	6.55	Normal	1	1	1	6.55	6.55	∞
Axial Isotropy	0.25	Rectangular	$\sqrt{3}$	0.7	0.7	0.10	0.10	∞
Hemispherical Isotropy	1.30	Rectangular	$\sqrt{3}$	0.7	0.7	0.53	0.53	∞
Boundary effects	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	0.30	Rectangular	$\sqrt{3}$	1	1	0.17	0.17	∞
System Detection Limits	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	0.30	Normal	1	1	1	0.30	0.30	∞
Response Time	0.80	Rectangular	$\sqrt{3}$	1	1	0.46	0.46	∞
Integration Time	2.60	Rectangular	$\sqrt{3}$	1	1	1.50	1.50	∞
RF Ambient Noise	3.00	Rectangular	$\sqrt{3}$	1	1	1.73	1.73	9
RF Ambient Reflections	3.00	Rectangular	$\sqrt{3}$	1	1	1.73	1.73	9
Probe Positioner	0.40	Rectangular	$\sqrt{3}$	1	1	0.23	0.23	∞
Probe Positioning	2.90	Rectangular	$\sqrt{3}$	1	1	1.67	1.67	∞
Max. SAR Eval.	1.00	Rectangular	$\sqrt{3}$	1	1	0.58	0.58	∞
Test sample related								
Sample positioning	1.90	Normal	1	1	1	1.90	1.90	4
Device holder uncertainty	2.80	Normal	1	1	1	2.80	2.80	4
Output power variation-SAR drift measurement	4.50	Rectangular	$\sqrt{3}$	1	1	2.60	2.60	1
Dipole Related								
Dipole Axis to Liquid Distance	1.60	Rectangular	$\sqrt{3}$	1	1	0.92	0.92	4
Input Power Drift	2.33	Rectangular	$\sqrt{3}$	1	1	1.34	1.34	1
Phantom and Tissue parameters								
Phantom Uncertainty	4.00	Rectangular	$\sqrt{3}$	1	1	2.31	2.31	∞
Liquid Conductivity (target)	5.00	Rectangular	$\sqrt{3}$	0.64	0.43	1.85	1.24	∞
Liquid Conductivity (measurement)	3.04	Normal	1	0.64	0.43	1.95	1.31	9
Liquid Permittivity (target)	5.00	Rectangular	$\sqrt{3}$	0.6	0.49	1.73	1.41	∞
Liquid Permittivity (measurement)	2.73	Normal	1	0.6	0.49	1.64	1.34	9
Combined Standard Uncertainty						9.73	9.43	
Coverage Factor for 95%						Kp=2		
Expanded Uncertainty (K=2)						19.46	18.85	

5. TEST RESULTS

5.1 TEST PROCEDURES

Use the software to control the EUT channel and transmission power. Then record the conducted power before the testing. Place the EUT to the specific test location. After the testing, must writing down the conducted power of the EUT into the report. The SAR value was calculated via the 3D spline interpolation algorithm that has been implemented in the software of DASY SAR measurement system manufactured and calibrated by SPEAG. According to the IEEE 1528 standards, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

• Power reference measurement

• Verification of the power reference measurement

• Area scan

• Zoom scan

• Power reference measurement

The area scan was performed for the highest spatial SAR location. The zoom scan was performed for SAR value averaged over 1g and 10g spatial volumes.

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 measures 5x5x7 points with step size 8, 8 and 5 mm for below 3 GHz, and 7x7x9 points with step size 4, 4 and 2.5 mm for above 5 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

The measurement time is 0.5s at each point of the zoom scan. The probe boundary effect compensation shall be applied during the SAR test. Because of the tip of the probe to the Phantom surface separated distances are longer than half a tip probe diameter.

In the area scan, the separation distance is 2mm between the each measurement point and the phantom surface. The scan size shall be included the transmission portion of the EUT. The measurement time is the same as the zoom scan. At last the reference power drift shall be less than ±5%.

5.2 MEASURED SAR RESULTS

Plot No.	Channel Frequency (MHz)	Test Position	Separation Distance (cm)	SAR$_{1g}$ (W/kg)
8	5180	Horizontal Up	0.5	**0.141**
9	5180	Horizontal Down	0.5	0.036
10	5180	Vertical Front	0.5	0.057
11	5180	Vertical Back	0.5	0.00206
12	5180	Tip Mode	0.5	0.0074
13	5210	Horizontal Up	0.5	0.099
14	5240	Horizontal Up	0.5	0.11
15	5814	Horizontal Up	0.5	0.096
16	5814	Horizontal Down	0.5	0.055
17	5814	Vertical Front	0.5	0.051
18	5814	Vertical Back	0.5	0.00597
19	5814	Tip Mode	0.5	0.03
20	5736	Horizontal Up	0.5	0.078
21	5762	Horizontal Up	0.5	0.065

NOTE:

1. In this testing, the limit for General Population Spatial Peak averaged over 1g, **1.6 W/kg**, is applied.

2. Please see the Appendix A for the data.

3. Since the maximum power for 2.4GHz band is less than 60/f, the SAR testing for 2.4GHz band was not required.

6. SAR LIMITS

HUMAN EXPOSURE	SAR (W/kg)	
	(GENERAL POPULATION / UNCONTROLLED EXPOSURE ENVIRONMENT)	(OCCUPATIONAL / CONTROLLED EXPOSURE ENVIRONMENT)
Spatial Average (whole body)	0.08	0.4
Spatial Peak (averaged over 1 g)	**1.6**	8.0
Spatial Peak (hands / wrists / feet / ankles averaged over 10 g)	4.0	20.0

NOTE:

1. This limits accord to 47 CFR 2.1093 – Safety Limit.

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.

Copies of accreditation and authorization certificates of our laboratories obtained from approval agencies can be downloaded from our web site:
www.adt.com.tw/index.5.phtml. If you have any comments, please feel free to contact us at the following:

Linko EMC/RF Lab:
Tel: 886-2-26052180
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Hsin Chu EMC/RF Lab:
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Web Site: www.adt.com.tw

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

---END---

System Check_MSL5200_111115

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

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5200 MHz; σ = 5.293 mho/m; ε_r = 49.511; ρ

= 1000 kg/m^3
Ambient Temperature：22.6 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Pin=100mW, f=5200 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.597 mW/g

Pin=100mW, f=5200 MHz/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm,
dy=4mm, dz=2.5mm
Reference Value = 63.127 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 29.842 W/kg
SAR(1 g) = 8.08 mW/g; SAR(10 g) = 2.3 mW/g
Maximum value of SAR (measured) = 16.769 mW/g
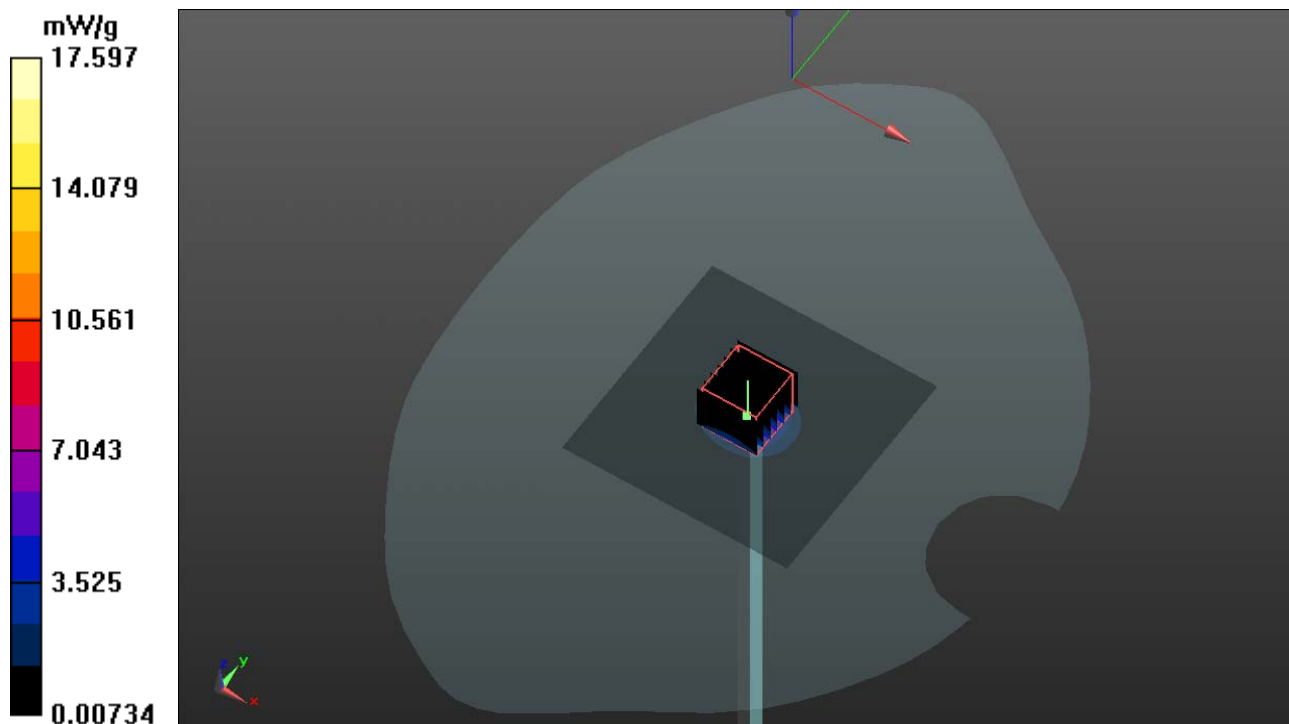
System Check_MSL5200_111116

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

Communication System: CW; Frequency: 5200 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5200 MHz; σ = 5.3 mho/m; ε_r = 49.5; ρ =

1000 kg/m^3
Ambient Temperature：22.5 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Pin=100mW, f=5200 MHz 3/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 17.481 mW/g

Pin=100mW, f=5200 MHz 3/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm,
dy=4mm, dz=2.5mm
Reference Value = 63.906 V/m; Power Drift = -0.17 dB
Peak SAR (extrapolated) = 29.214 W/kg
SAR(1 g) = 8.11 mW/g; SAR(10 g) = 2.22 mW/g
Maximum value of SAR (measured) = 16.939 mW/g

System Check_MSL5800_111115

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

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5800 MHz; σ = 6.2 mho/m; $ε_r$ = 48.541; ρ = 1000 kg/m^3
Ambient Temperature：22.6 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Pin=100mW, f=5800 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
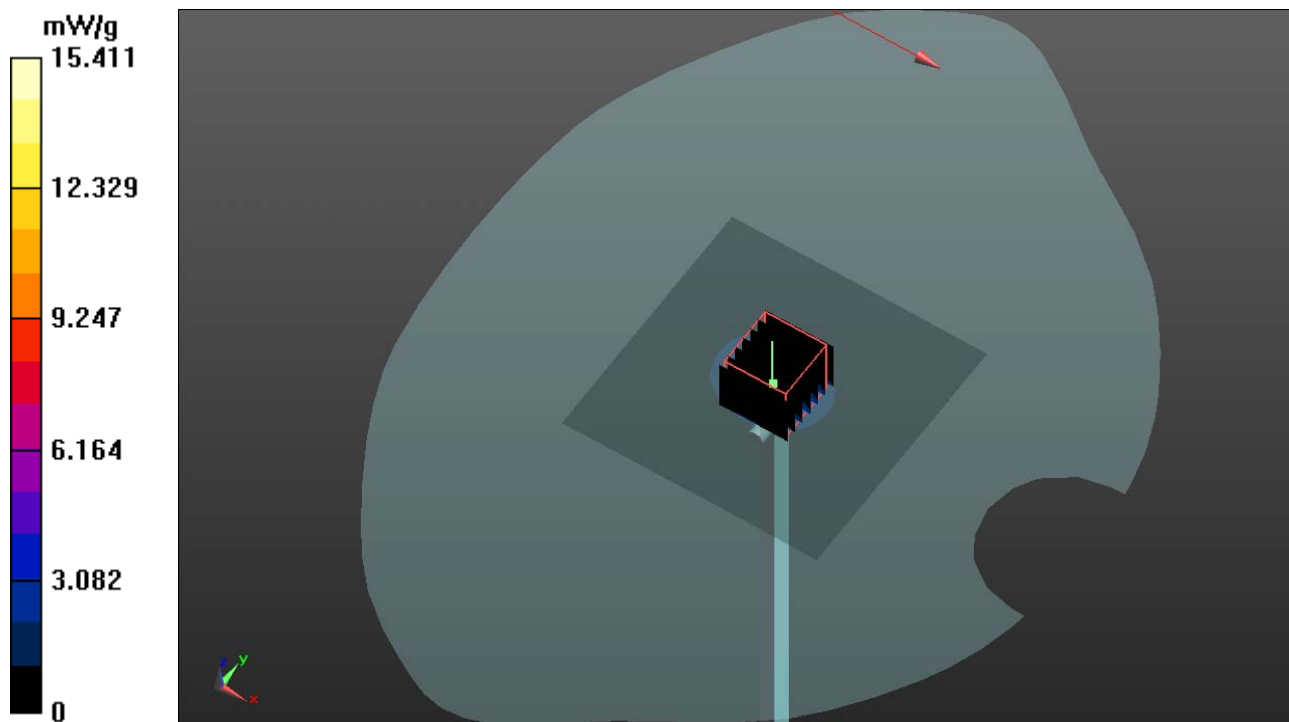Maximum value of SAR (interpolated) = 15.308 mW/g

Pin=100mW, f=5800 MHz/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 54.473 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 29.713 W/kg
SAR(1 g) = 7.3 mW/g; SAR(10 g) = 2.1 mW/g
Maximum value of SAR (measured) = 15.636 mW/g
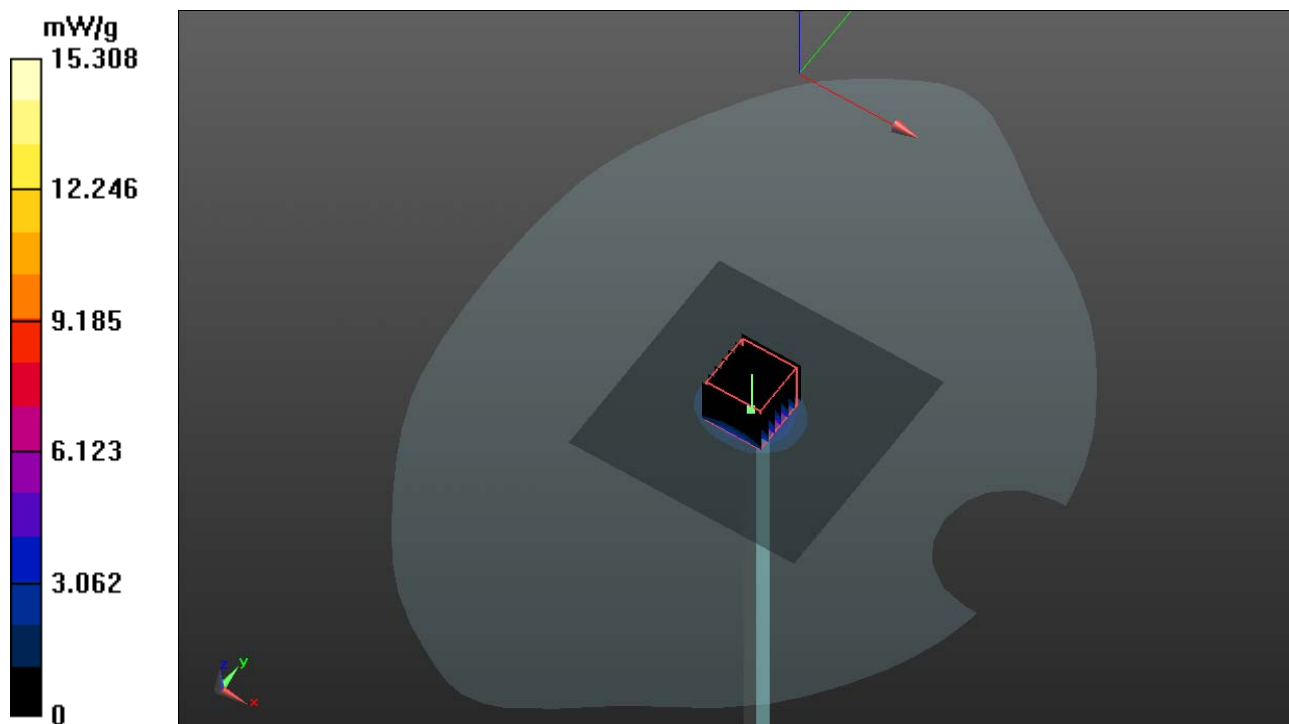
System Check_MSL5800_111116

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

Communication System: CW; Frequency: 5800 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5800 MHz; σ = 6.1 mho/m; ε_r = 48.6; ρ =

1000 kg/m^3
Ambient Temperature：22.5 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Pin=100mW, f=5800 MHz/Area Scan (91x91x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 15.269 mW/g

Pin=100mW, f=5800 MHz/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm,
dy=4mm, dz=2.5mm
Reference Value = 54.855 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 29.162 W/kg
SAR(1 g) = 7.2 mW/g; SAR(10 g) = 1.94 mW/g
Maximum value of SAR (measured) = 15.411 mW/g

P08 5180MHz_Horizontal Up_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5180 MHz; σ = 5.283 mho/m; ε_r = 49.706; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.135 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.456 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 1.107 W/kg
SAR(1 g) = 0.141 mW/g; SAR(10 g) = 0.033 mW/g
Maximum value of SAR (measured) = 0.276 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 4.456 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.397 W/kg
SAR(1 g) = 0.112 mW/g; SAR(10 g) = 0.029 mW/g
Maximum value of SAR (measured) = 0.229 mW/g
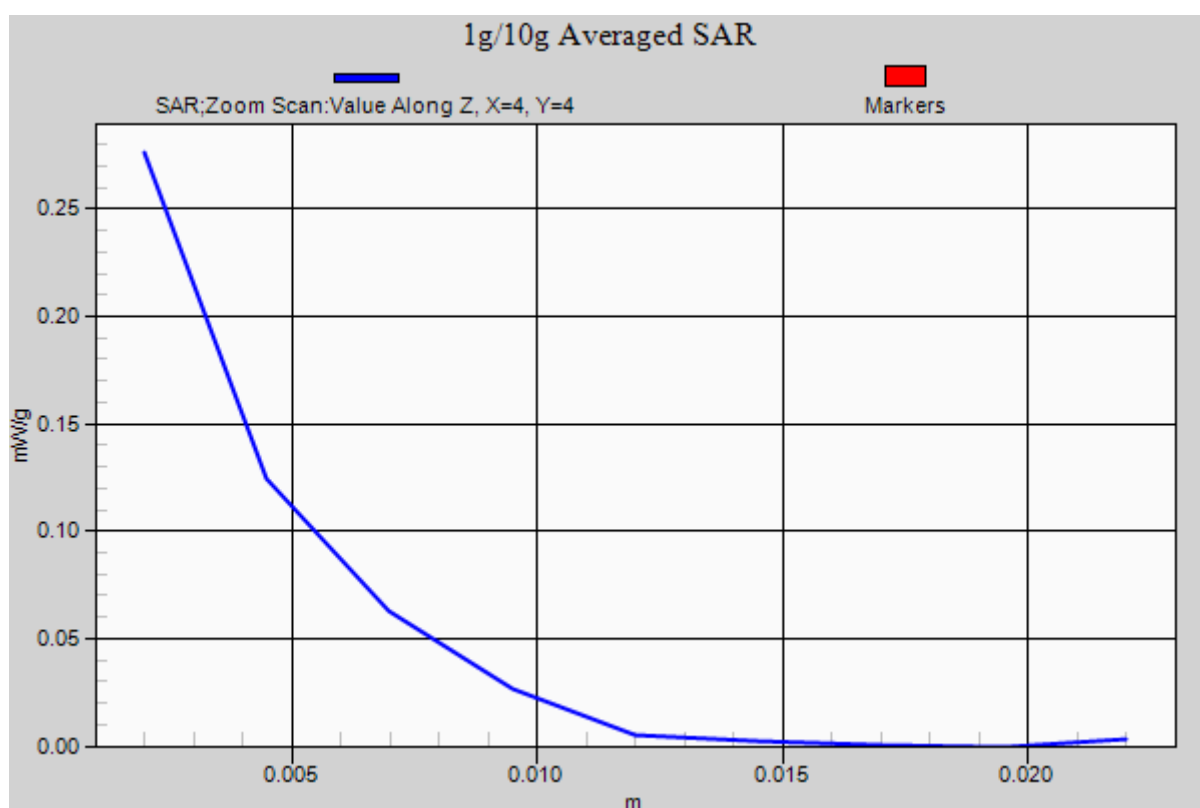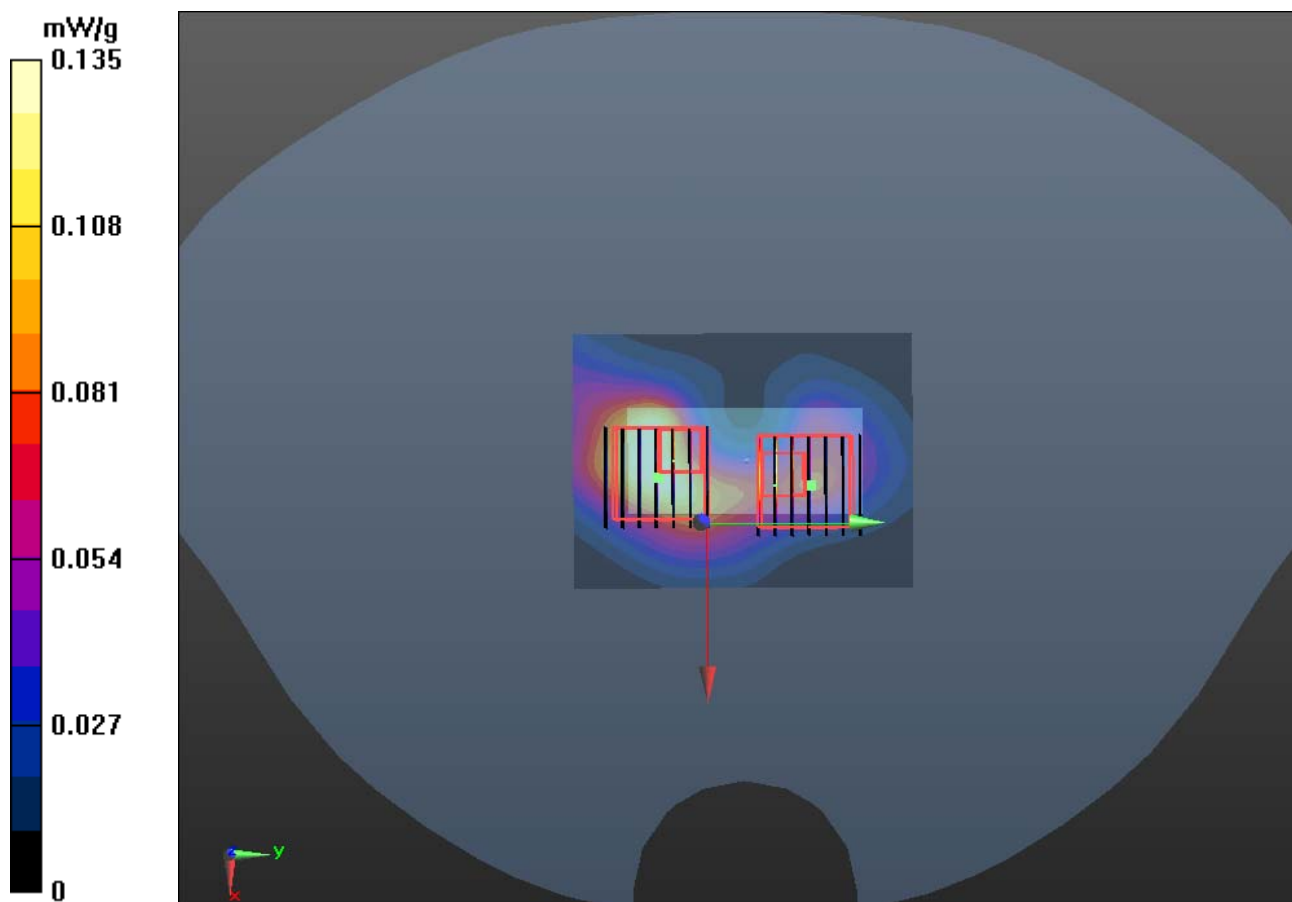
P09 5180MHz_Horizontal Down_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5180 MHz; σ = 5.283 mho/m; ε_r = 49.706; ρ = 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (61x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.100 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.259 V/m; Power Drift = 0.11 dB
Peak SAR (extrapolated) = 0.230 W/kg
SAR(1 g) = 0.036 mW/g; SAR(10 g) = 0.013 mW/g
Maximum value of SAR (measured) = 0.090 mW/g
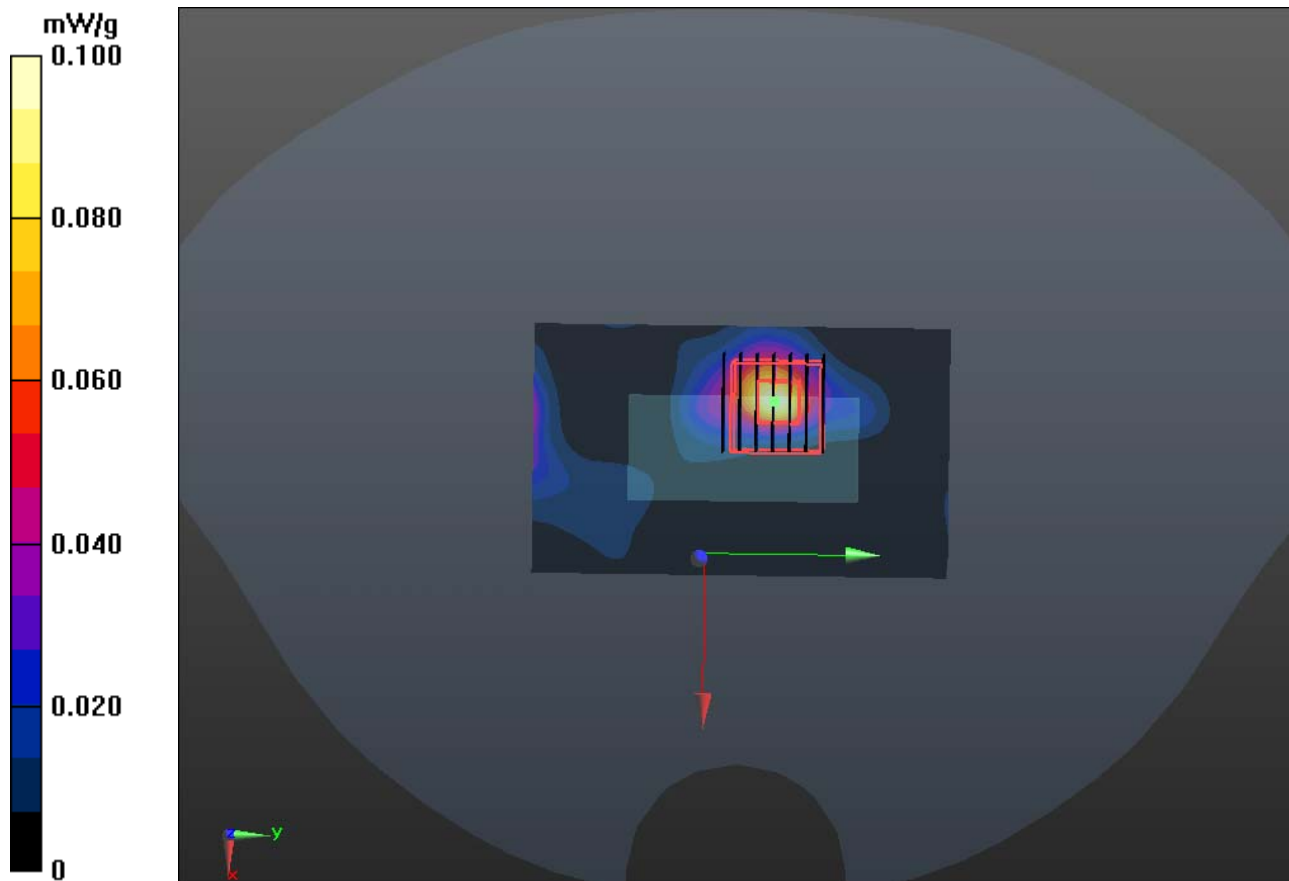
P10 5180MHz_Vertical Front_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5180 MHz; σ = 5.283 mho/m; ε_r = 49.706; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.114 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.064 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 0.224 W/kg
SAR(1 g) = 0.057 mW/g; SAR(10 g) = 0.017 mW/g
Maximum value of SAR (measured) = 0.122 mW/g
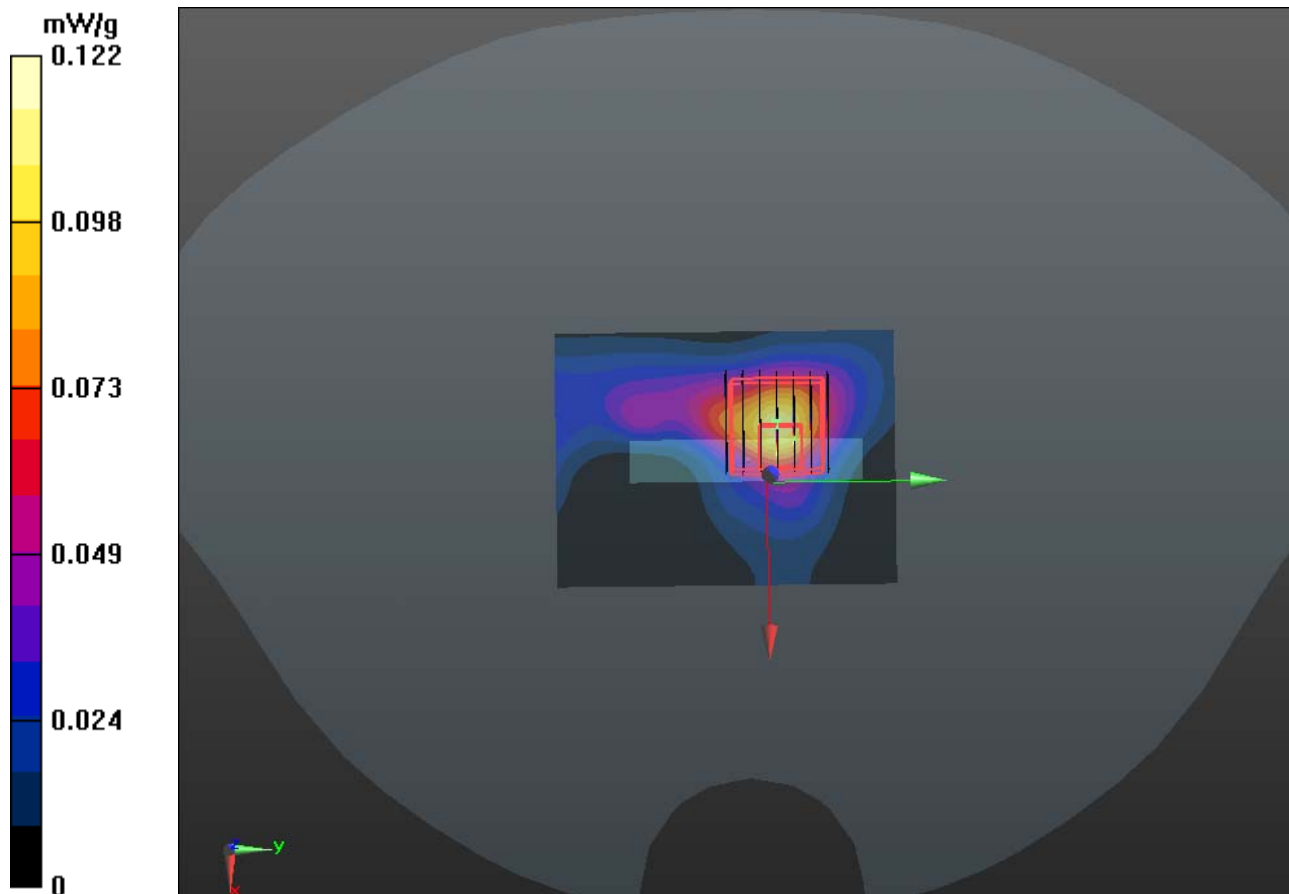
P11 5180MHz_Vertical Back_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5180 MHz; σ = 5.283 mho/m; ε_r = 49.706; ρ
= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (101x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.017 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0 V/m; Power Drift = 0 dB
Peak SAR (extrapolated) = 0.037 W/kg
SAR(1 g) = 0.00206 mW/g; SAR(10 g) = 0.000615 mW/g
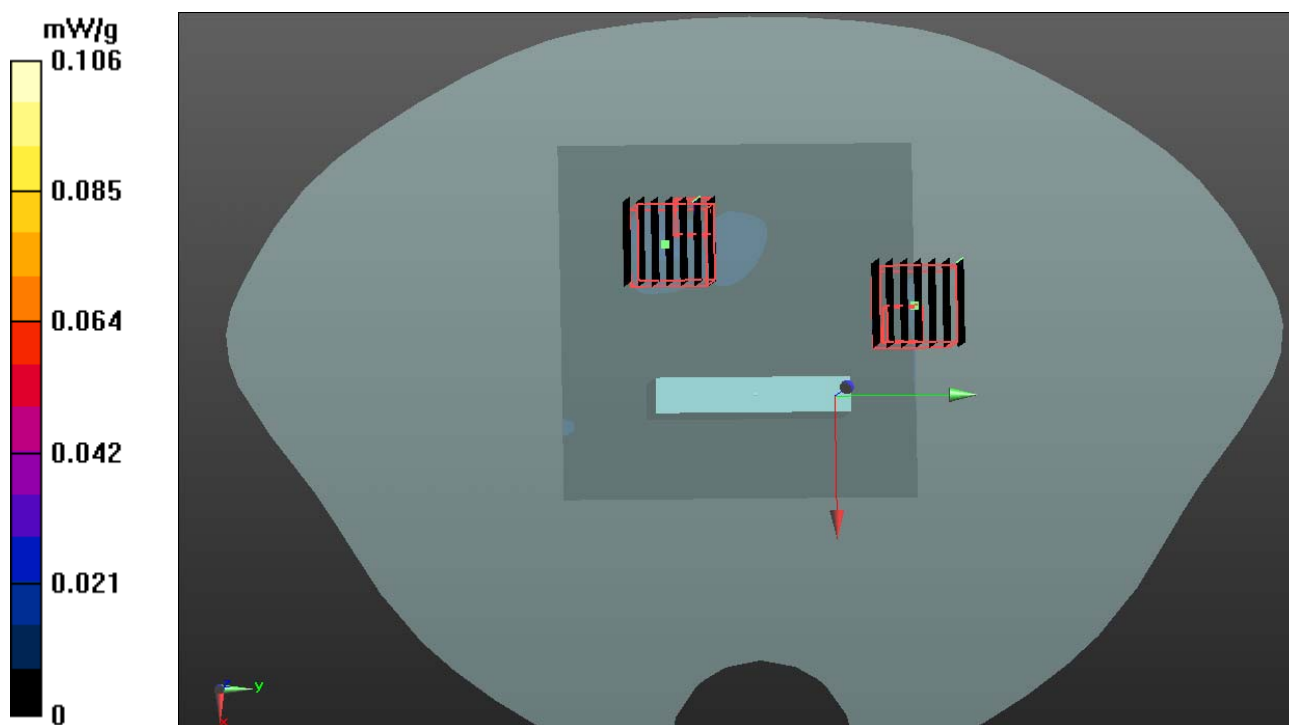Maximum value of SAR (measured) = 0.00952 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0 V/m; Power Drift = 0 dB
Peak SAR (extrapolated) = 0.034 W/kg
SAR(1 g) = 0.00111 mW/g; SAR(10 g) = 0.000256 mW/g
Maximum value of SAR (measured) = 0.106 mW/g

P12 5180MHz_Tip Mode_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5180 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5180 MHz; σ = 5.283 mho/m; ε_r = 49.706; ρ

= 1000 kg/m^3
Ambient Temperature：22.3 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (61x61x1): Measurement grid: dx=10mm, dy=10mm
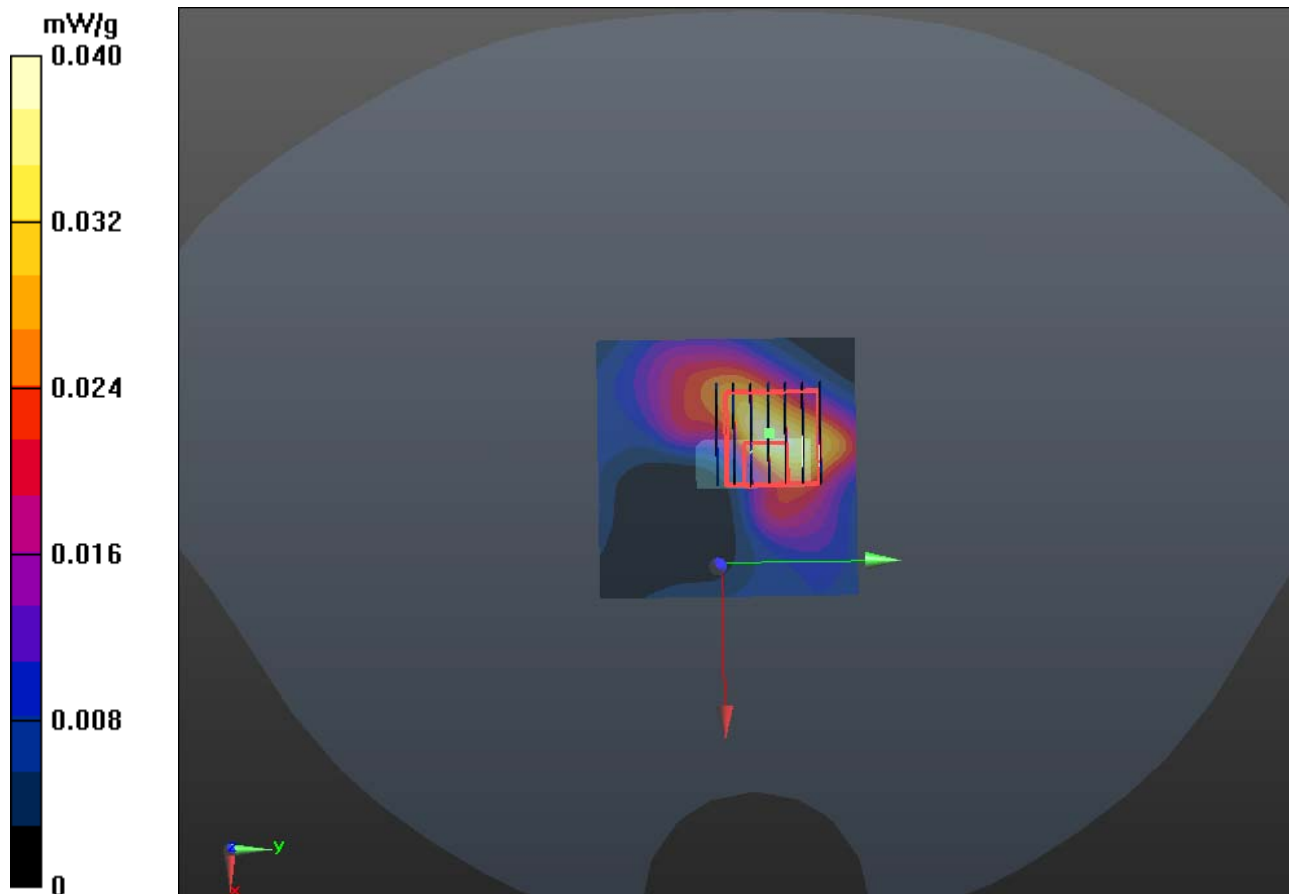Maximum value of SAR (interpolated) = 0.040 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.650 V/m; Power Drift = -3.02 dB
Peak SAR (extrapolated) = 0.458 W/kg
SAR(1 g) = 0.0074 mW/g; SAR(10 g) = 0.00165 mW/g
Maximum value of SAR (measured) = 0.458 mW/g

P13 5210MHz_Horizontal Up_0.5cm_Ch1

DUT: 111107C15

Communication System: 5G; Frequency: 5210 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5210 MHz; σ = 5.322 mho/m; $ε_r$ = 49.429; ρ
= 1000 kg/m^3
Ambient Temperature：22.3 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch1/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.218 mW/g

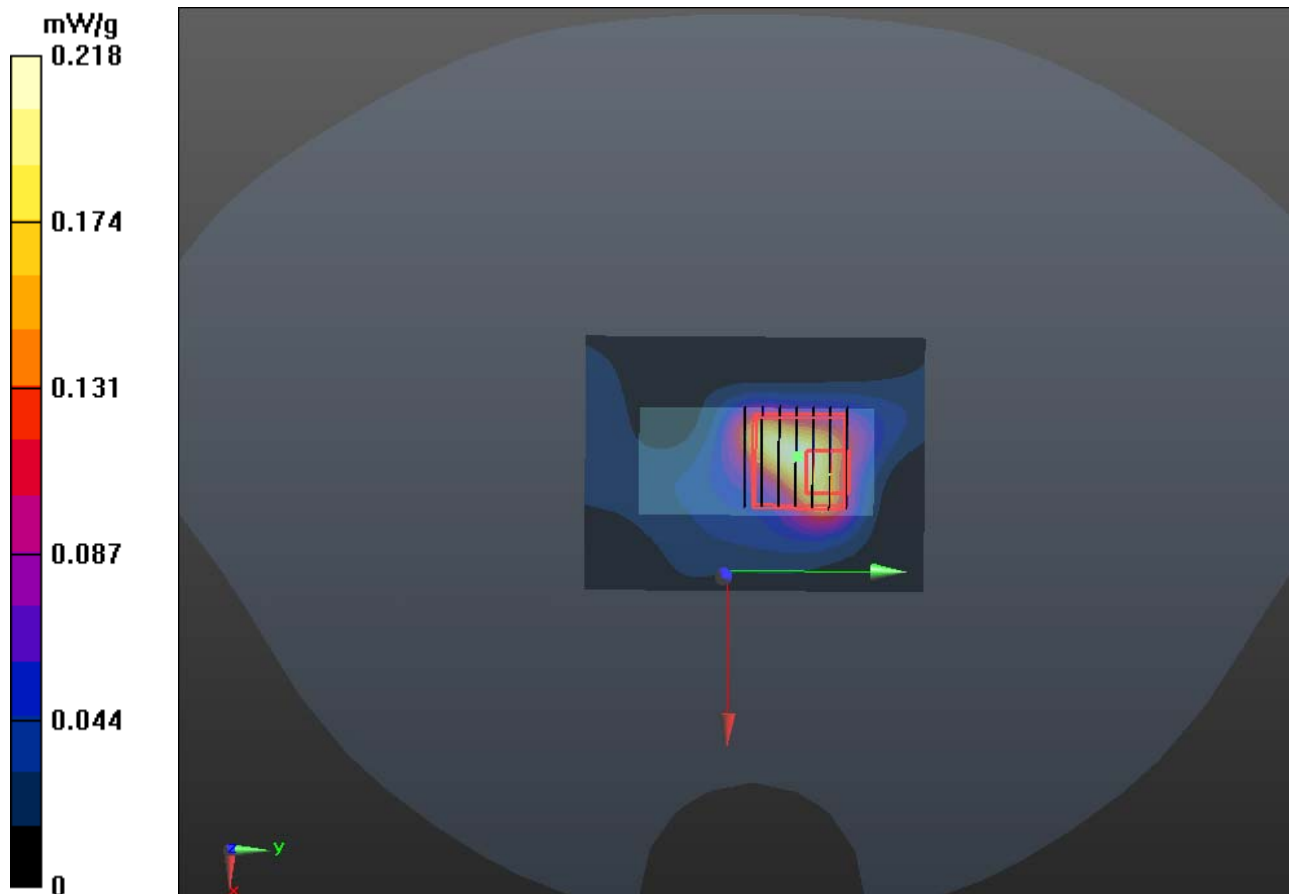**Ch1/Zoom Scan (7x7x9)/Cube 0:** Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 6.117 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.385 W/kg
SAR(1 g) = 0.099 mW/g; SAR(10 g) = 0.024 mW/g
Maximum value of SAR (measured) = 0.215 mW/g

P14 5240MHz_Horizontal Up_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5240 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5240 MHz; σ = 5.429 mho/m; ε_r = 49.401; ρ
= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.81, 4.81, 4.81); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
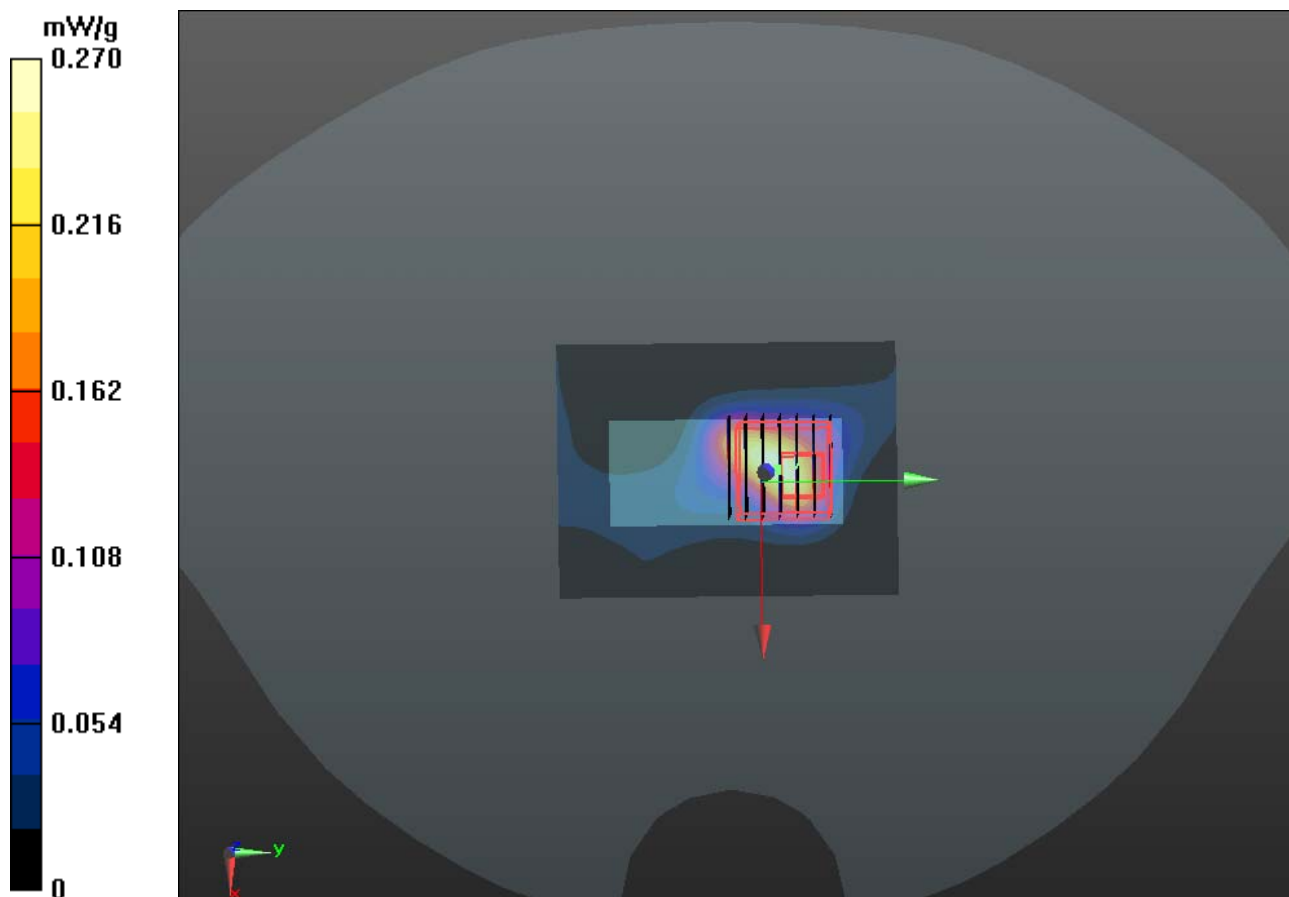Maximum value of SAR (interpolated) = 0.270 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 5.905 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 0.423 W/kg
SAR(1 g) = 0.110 mW/g; SAR(10 g) = 0.028 mW/g
Maximum value of SAR (measured) = 0.228 mW/g

P15 5814MHz_Horizontal Up_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5814 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used : f = 5814 MHz; σ = 6.203 mho/m; $ε_r$ = 48.671; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
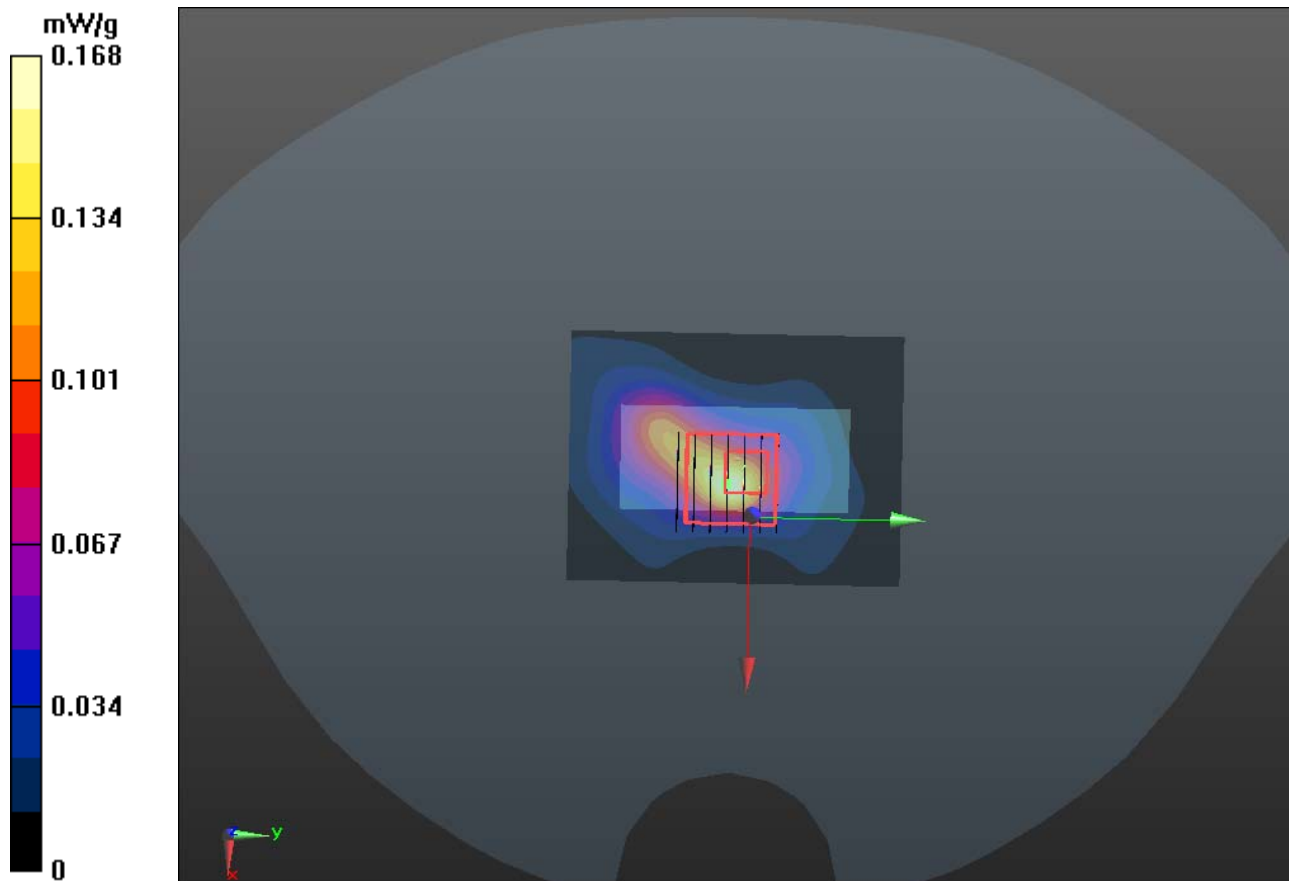Maximum value of SAR (interpolated) = 0.168 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
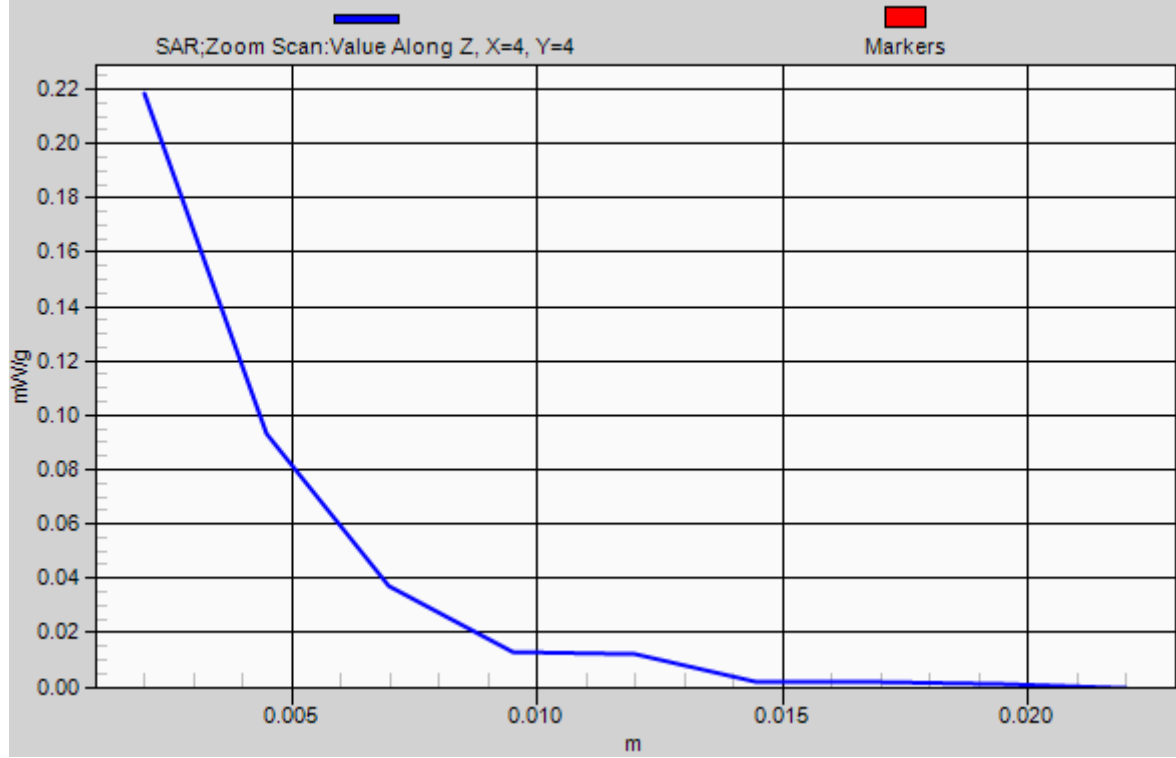Reference Value = 6.102 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.428 W/kg
SAR(1 g) = 0.096 mW/g; SAR(10 g) = 0.025 mW/g
Maximum value of SAR (measured) = 0.218 mW/g

P16 5814MHz_Horizontal Down_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5814 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used : f = 5814 MHz; σ = 6.203 mho/m; ε_r = 48.671; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (61x101x1): Measurement grid: dx=10mm, dy=10mm
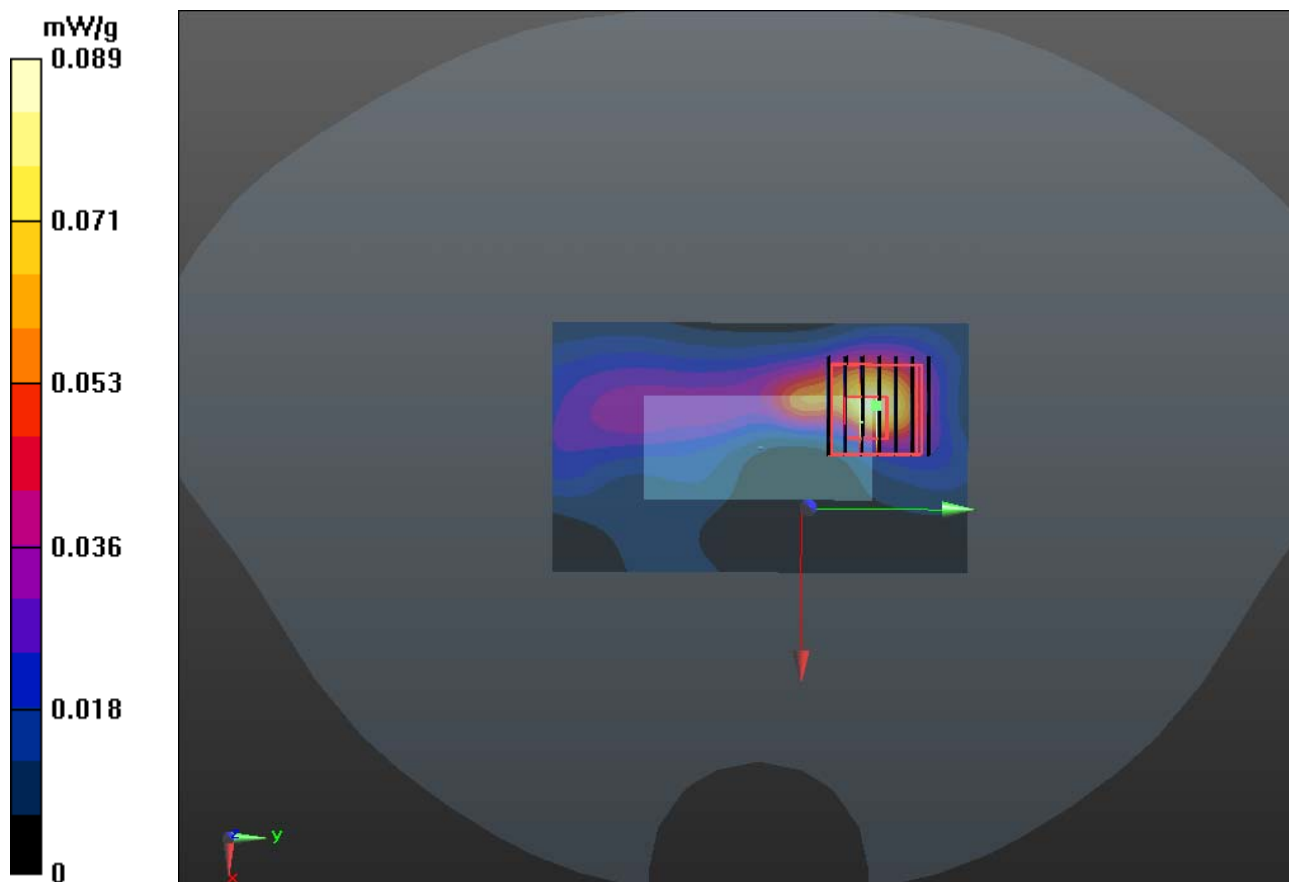Maximum value of SAR (interpolated) = 0.089 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.043 V/m; Power Drift = -0.15 dB
Peak SAR (extrapolated) = 0.332 W/kg
SAR(1 g) = 0.055 mW/g; SAR(10 g) = 0.014 mW/g
Maximum value of SAR (measured) = 0.128 mW/g

P17 5814MHz_Vertical Front_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5814 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used : f = 5814 MHz; σ = 6.203 mho/m; ε_r = 48.671; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.106 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.390 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 0.350 W/kg
SAR(1 g) = 0.051 mW/g; SAR(10 g) = 0.014 mW/g
Maximum value of SAR (measured) = 0.161 mW/g
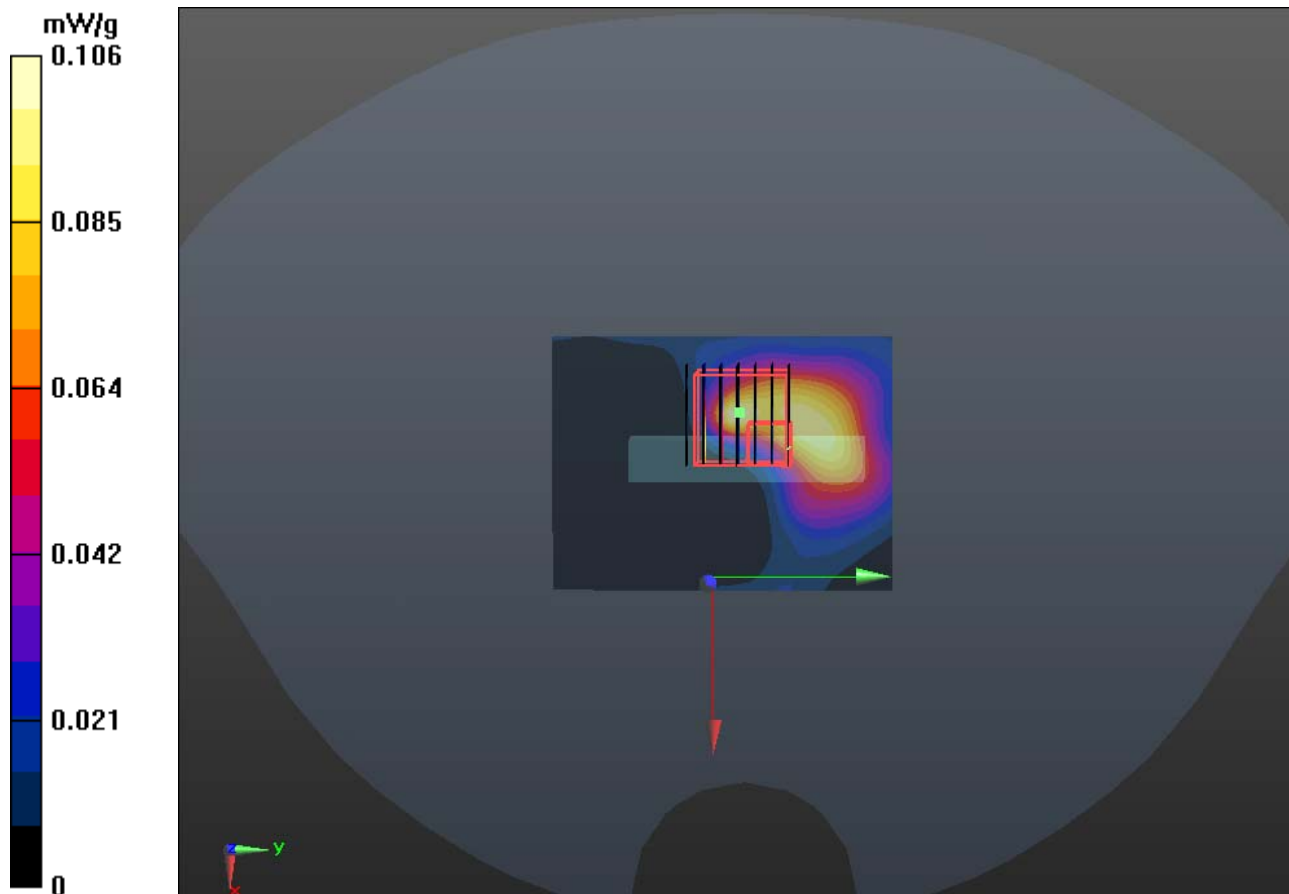
P18 5814MHz_Vertical Back_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5814 MHz;Duty Cycle: 1:1
Medium: MSL5000_1115 Medium parameters used: f = 5814 MHz; σ = 6.203 mho/m; ε_r = 48.671; ρ

= 1000 kg/m^3
Ambient Temperature：22.3 ℃；Liquid Temperature：21.1 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (101x101x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.023 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0 V/m; Power Drift = 0.04dB
Peak SAR (extrapolated) = 0.081 W/kg
SAR(1 g) = 0.00597 mW/g; SAR(10 g) = 0.00129 mW/g
Maximum value of SAR (measured) = 0.018 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 0 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.045 W/kg
SAR(1 g) = 0.00145 mW/g; SAR(10 g) = 0.000339 mW/g
Maximum value of SAR (measured) = 0.012 mW/g
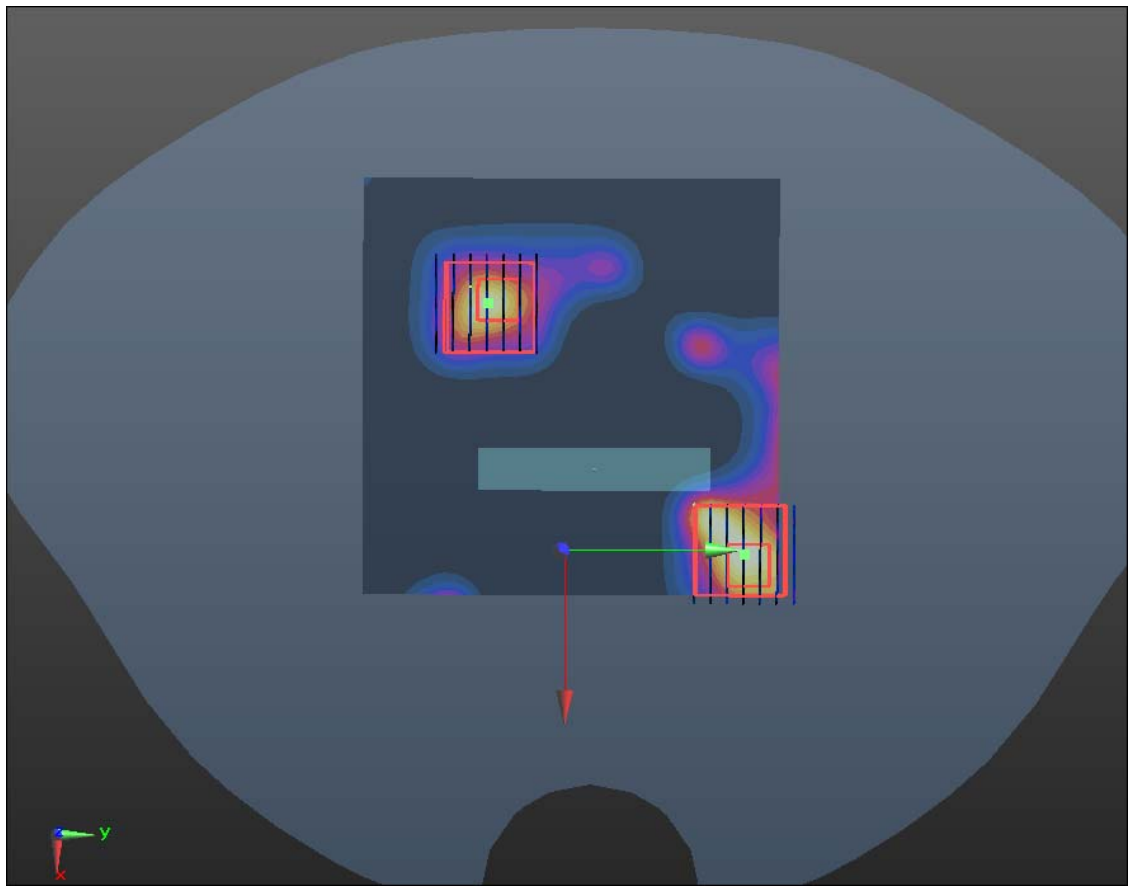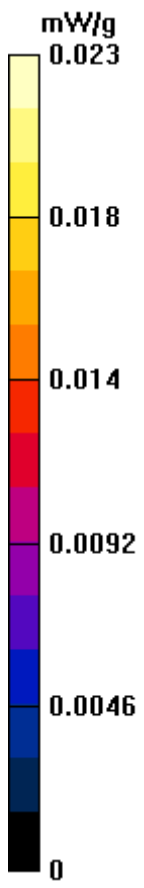
P19 5814MHz_Tip Mode_0.5cm_Ch2

DUT: 111107C15

Communication System: 5G; Frequency: 5814 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used : f = 5814 MHz; σ = 6.203 mho/m; ε_r = 48.671; ρ

= 1000 kg/m^3
Ambient Temperature：22.3 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch2/Area Scan (81x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.024 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.475 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.174 W/kg
SAR(1 g) = 0.030 mW/g; SAR(10 g) = 0.00555 mW/g
Maximum value of SAR (measured) = 0.081 mW/g

Ch2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 3.475 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 0.043 W/kg
SAR(1 g) = 0.00268 mW/g; SAR(10 g) = 0.00054 mW/g
Maximum value of SAR (measured) = 0.012 mW/g
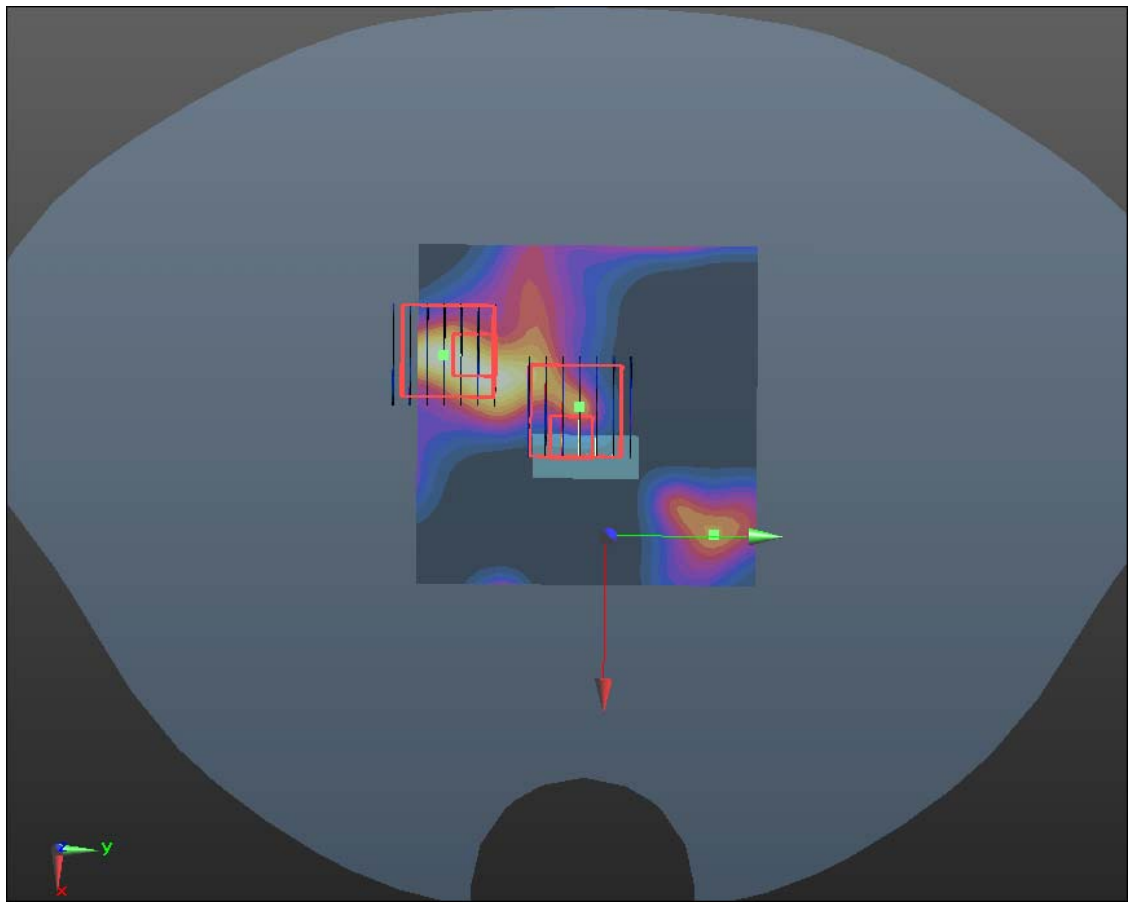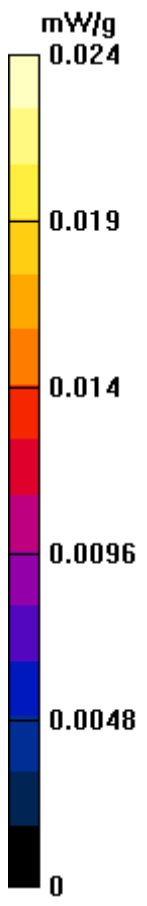
P20 5736MHz_Horizontal Up_0.5cm_Ch0

DUT: 111107C15

Communication System: 5G; Frequency: 5736 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5736 MHz; σ = 5.961 mho/m; $ε_r$ = 48.687; ρ

= 1000 kg/m^3
Ambient Temperature：22.4 ℃；Liquid Temperature：21.3 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch0/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.120 mW/g

Ch0/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
Reference Value = 2.575 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 0.570 W/kg
SAR(1 g) = 0.078 mW/g; SAR(10 g) = 0.021 mW/g
Maximum value of SAR (measured) = 0.293 mW/g
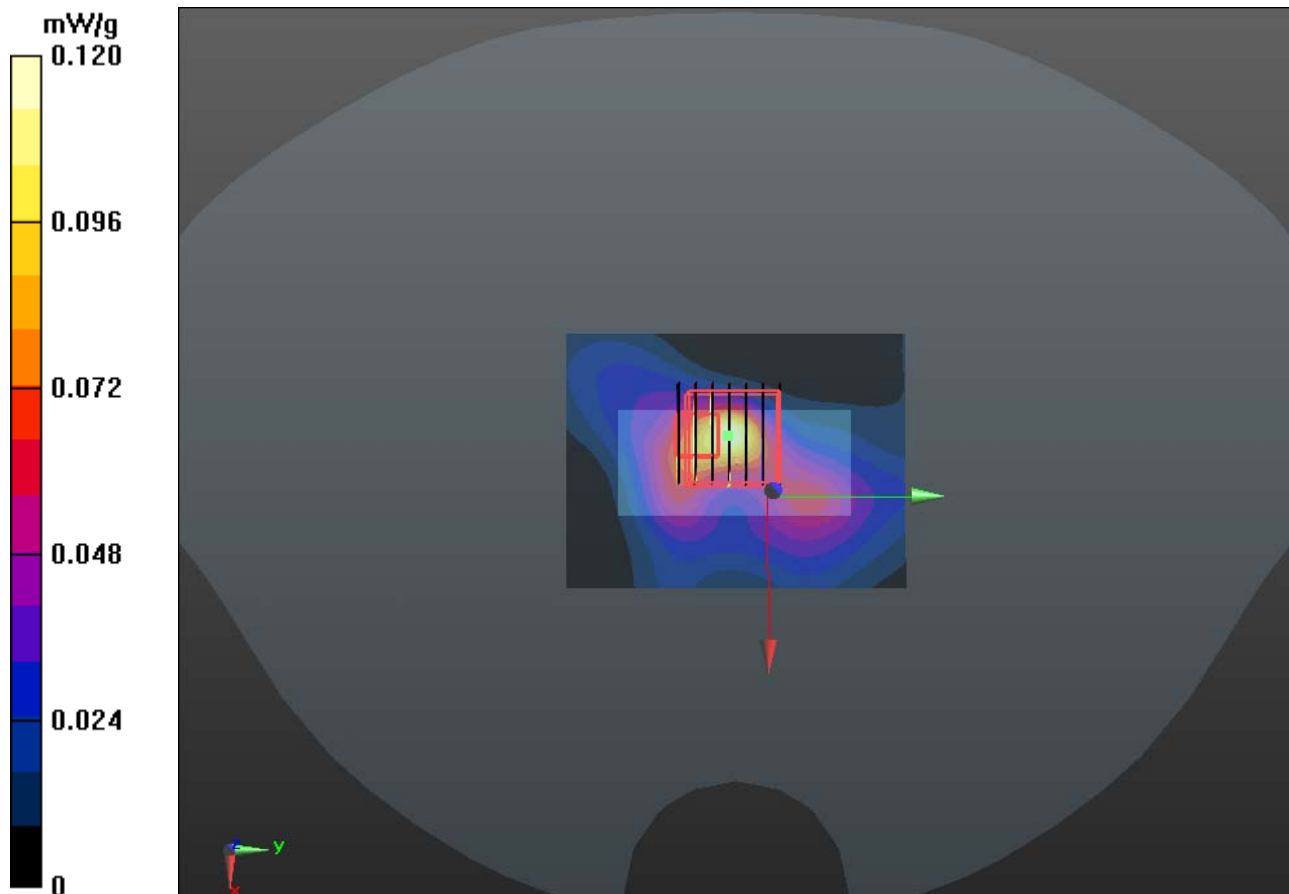
P21 5762MHz_Horizontal Up_0.5cm_Ch1

DUT: 111107C15

Communication System: 5G; Frequency: 5762 MHz;Duty Cycle: 1:1
Medium: MSL5000_1116 Medium parameters used: f = 5762 MHz; σ = 6.016 mho/m; ε_r = 48.414; ρ
= 1000 kg/m^3
Ambient Temperature：22.3 ℃；Liquid Temperature：21.4 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN3590; ConvF(4.55, 4.55, 4.55); Calibrated: 2011/02/25
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn861; Calibrated: 2011/08/29
- Phantom: SAM Phantom_Front; Type: SAM; Serial: TP-1485
- Measurement SW: DASY52, Version 52.6 (2); SEMCAD X Version 14.4.5 (3634)

Ch1/Area Scan (61x81x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (interpolated) = 0.092 mW/g

Ch1/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2.5mm
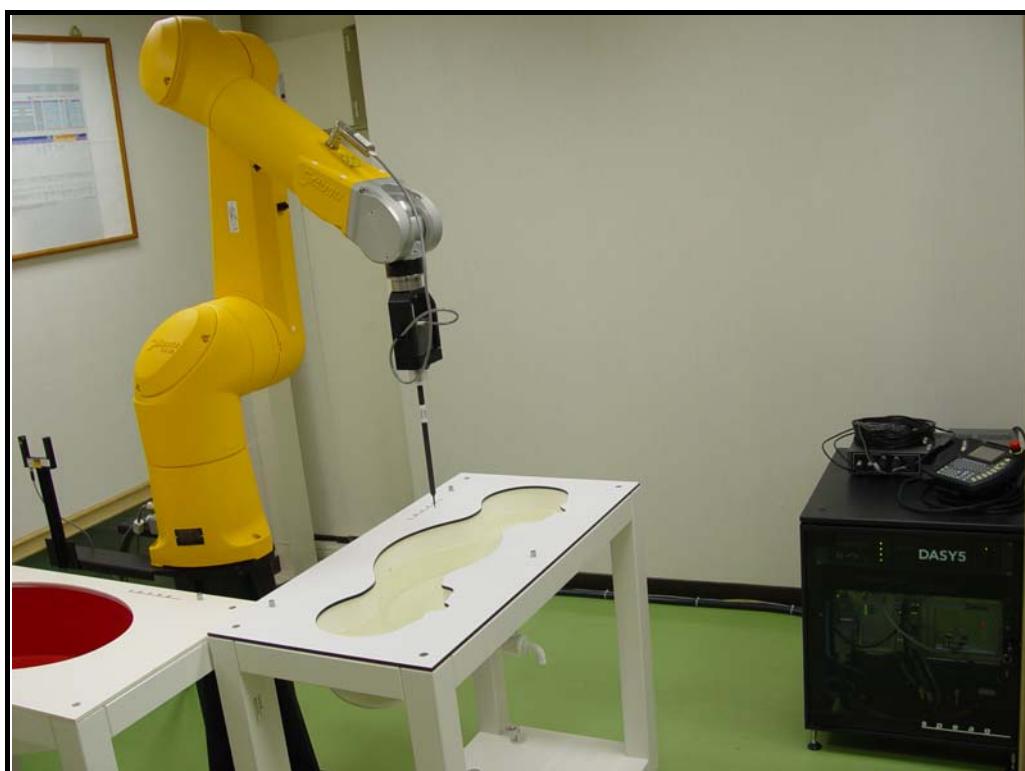Reference Value = 2.493 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.335 W/kg
SAR(1 g) = 0.065 mW/g; SAR(10 g) = 0.019 mW/g
Maximum value of SAR (measured) = 0.200 mW/g
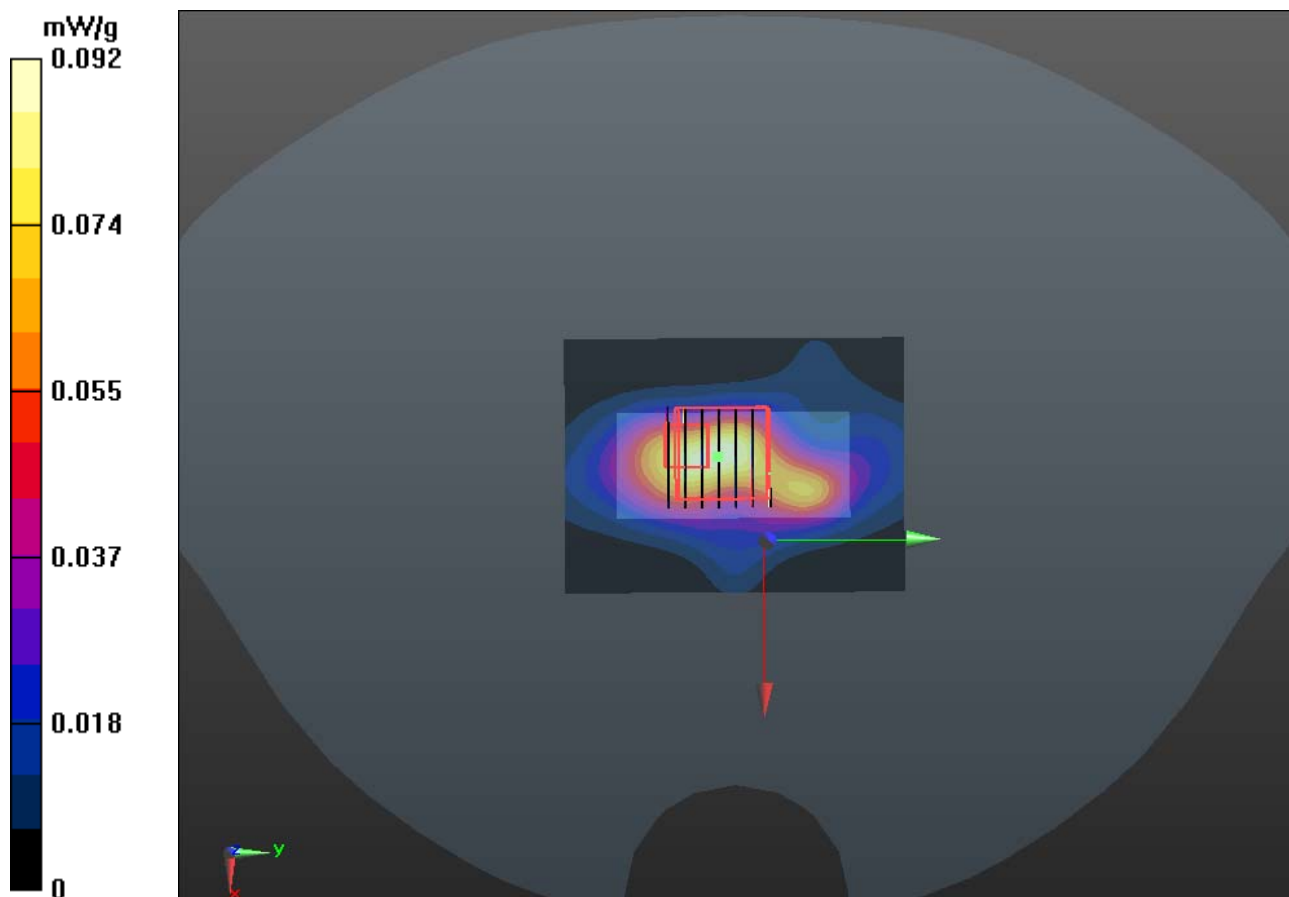
APPENDIX B: BV ADT SAR MEASUREMENT SYSTEM

APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION

APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION

D1: 8 CG=A 9 HF =7 `9 !: =9 @8 `DF C 6 9

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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 108**

Client   **BV ADT (Auden)**

Certificate No: **EX3-3590_Feb11**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3590
Calibration procedure(s)	QA CAL-01.v7, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v3 Calibration procedure for dosimetric E-field probes
Calibration date:	February 25, 2011

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41495277	01-Apr-10 (No. 217-01136)	Apr-11
Power sensor E4412A	MY41498087	01-Apr-10 (No. 217-01136)	Apr-11
Reference 3 dB Attenuator	SN: S5054 (3c)	30-Mar-10 (No. 217-01159)	Mar-11
Reference 20 dB Attenuator	SN: S5086 (20b)	30-Mar-10 (No. 217-01161)	Mar-11
Reference 30 dB Attenuator	SN: S5129 (30b)	30-Mar-10 (No. 217-01160)	Mar-11
Reference Probe ES3DV2	SN: 3013	29-Dec-10 (No. ES3-3013_Dec10)	Dec-11
DAE4	SN: 654	23-Apr-10 (No. DAE4-654_Apr10)	Apr-11
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Niels Kuster	Quality Manager	

Issued: February 25, 2011

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

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).

- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.

- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.

- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics

- *Ax,y,z; Bx,y,z; Cx,y,z* are numerical linearization parameters in dB assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media.

- *VR:* VR is the validity range of the calibration related to the average diode voltage or DAE voltage in mV.

- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.

- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.

- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe EX3DV4

SN:3590

Manufactured: March 23, 2009
Calibrated: February 25, 2011

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

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

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm $(\mu V/(V/m)^2)^A$	0.51	0.48	0.51	± 10.1 %
DCP $(mV)^B$	94.6	95.5	92.8	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc^E (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	119.0	±2.7 %
			Y	0.00	0.00	1.00	141.4	
			Z	0.00	0.00	1.00	115.0	

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

^{A} The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
^{B} Numerical linearization parameter: uncertainty not required.
^{E} Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [c]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	41.5	0.90	10.21	10.21	10.21	0.56	0.68	± 12.0 %
1640	40.3	1.29	9.25	9.25	9.25	0.68	0.60	± 12.0 %
1750	40.1	1.37	9.03	9.03	9.03	0.79	0.58	± 12.0 %
1950	40.0	1.40	8.45	8.45	8.45	0.55	0.66	± 12.0 %
2300	39.5	1.67	8.14	8.14	8.14	0.40	0.80	± 12.0 %
2450	39.2	1.80	7.73	7.73	7.73	0.29	1.00	± 12.0 %
2600	39.0	1.96	7.53	7.53	7.53	0.28	1.06	± 12.0 %
3500	37.9	2.91	7.55	7.55	7.55	0.36	1.03	± 13.1 %
5200	36.0	4.66	5.51	5.51	5.51	0.30	1.80	± 13.1 %
5300	35.9	4.76	5.17	5.17	5.17	0.30	1.80	± 13.1 %
5500	35.6	4.96	5.00	5.00	5.00	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.52	4.52	4.52	0.50	1.80	± 13.1 %
5800	35.3	5.27	4.53	4.53	4.53	0.50	1.80	± 13.1 %

[c] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

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

## Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
835	55.2	0.97	10.32	10.32	10.32	0.38	0.82	± 12.0 %
1640	53.8	1.40	9.72	9.72	9.72	0.51	0.79	± 12.0 %
1750	53.4	1.49	8.77	8.77	8.77	0.37	0.92	± 12.0 %
1950	53.3	1.52	8.49	8.49	8.49	0.60	0.67	± 12.0 %
2300	52.9	1.81	8.08	8.08	8.08	0.30	1.00	± 12.0 %
2450	52.7	1.95	7.91	7.91	7.91	0.42	0.82	± 12.0 %
2600	52.5	2.16	7.78	7.78	7.78	0.25	1.17	± 12.0 %
3500	51.3	3.31	7.14	7.14	7.14	0.43	0.96	± 13.1 %
5200	49.0	5.30	4.81	4.81	4.81	0.50	1.90	± 13.1 %
5300	48.9	5.42	4.56	4.56	4.56	0.50	1.90	± 13.1 %
5500	48.6	5.65	4.32	4.32	4.32	0.50	1.90	± 13.1 %
5600	48.5	5.77	4.01	4.01	4.01	0.60	1.90	± 13.1 %
5800	48.2	6.00	4.55	4.55	4.55	0.50	1.90	± 13.1 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
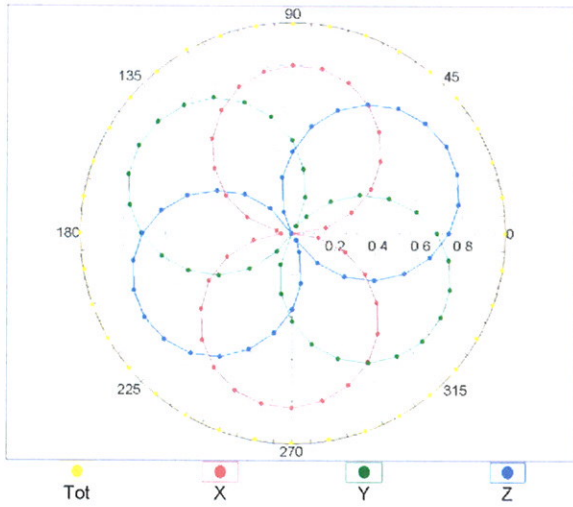
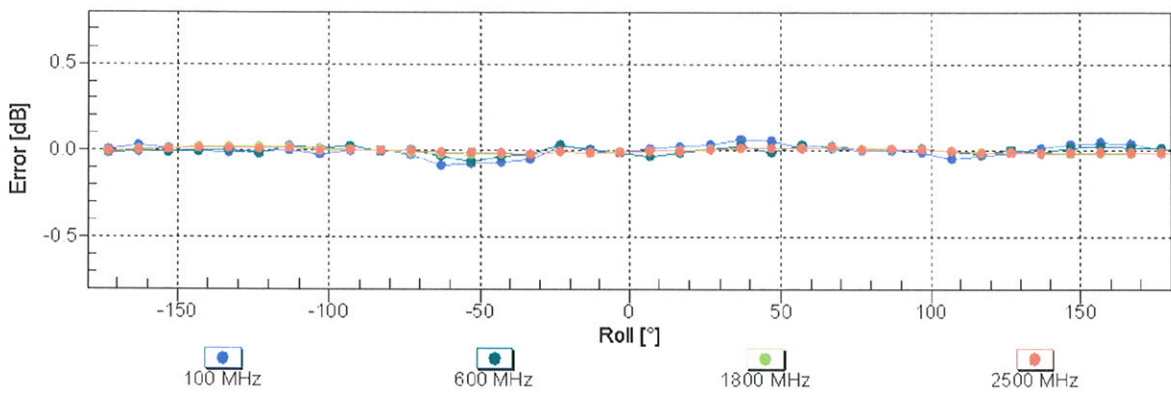# Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)
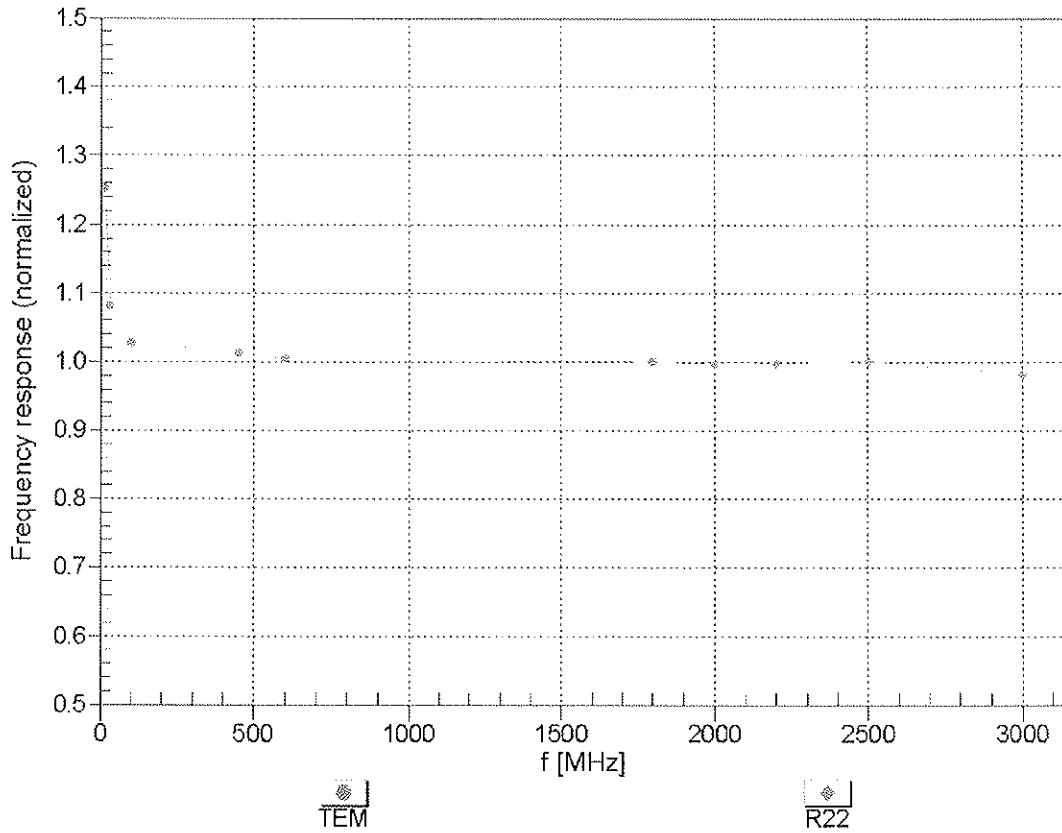
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM

Tot   X   Y   Z

f=1800 MHz,R22

Tot   X   Y   Z

100 MHz   600 MHz   1800 MHz   2500 MHz
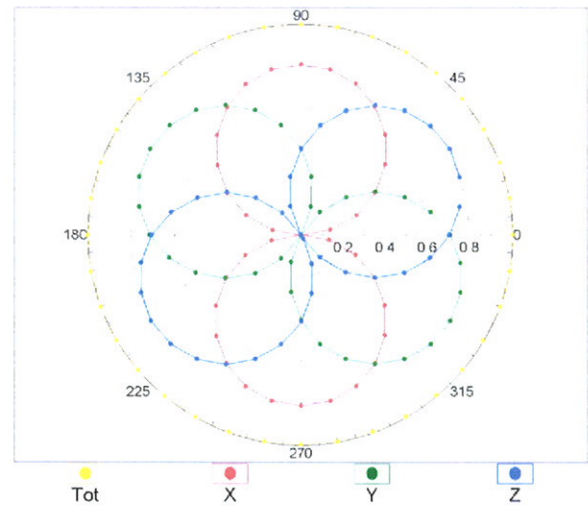
Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR$_{head}$)
(TEM cell , f = 900 MHz)
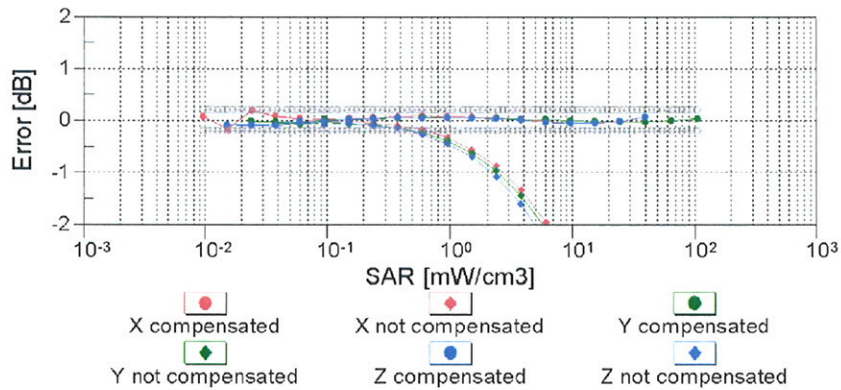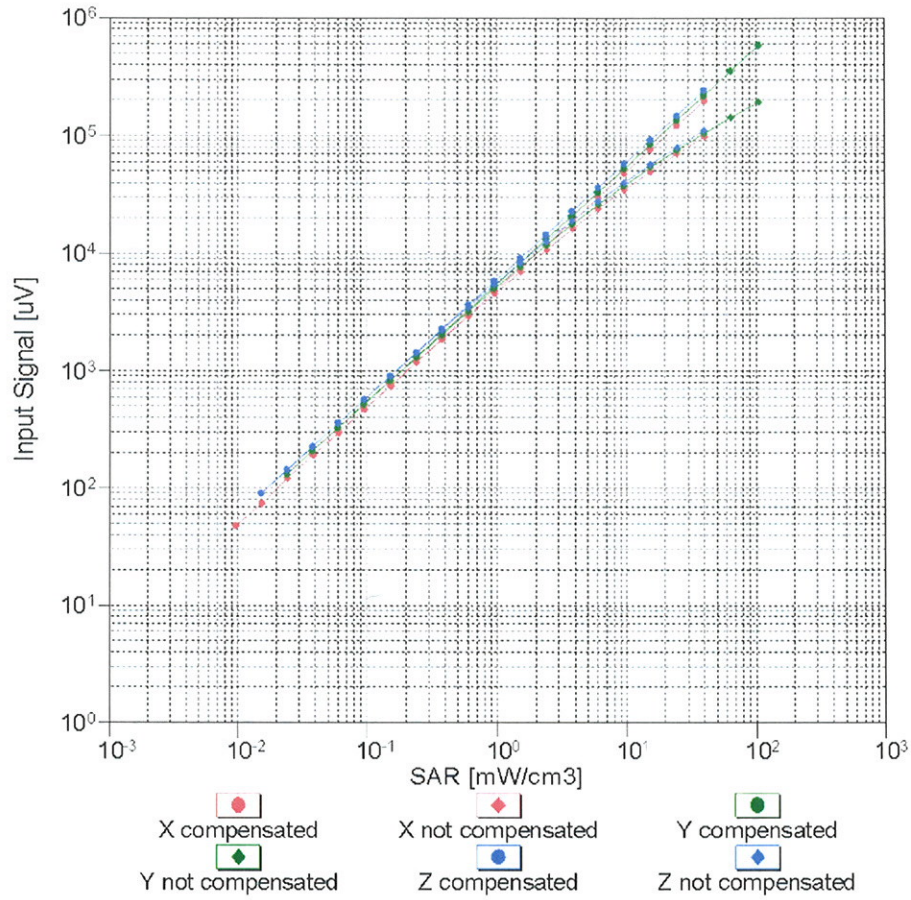
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 1750 MHz,WGLS R22 (H_convF)

f = 835 MHz,WGLS R9 (H_convF)
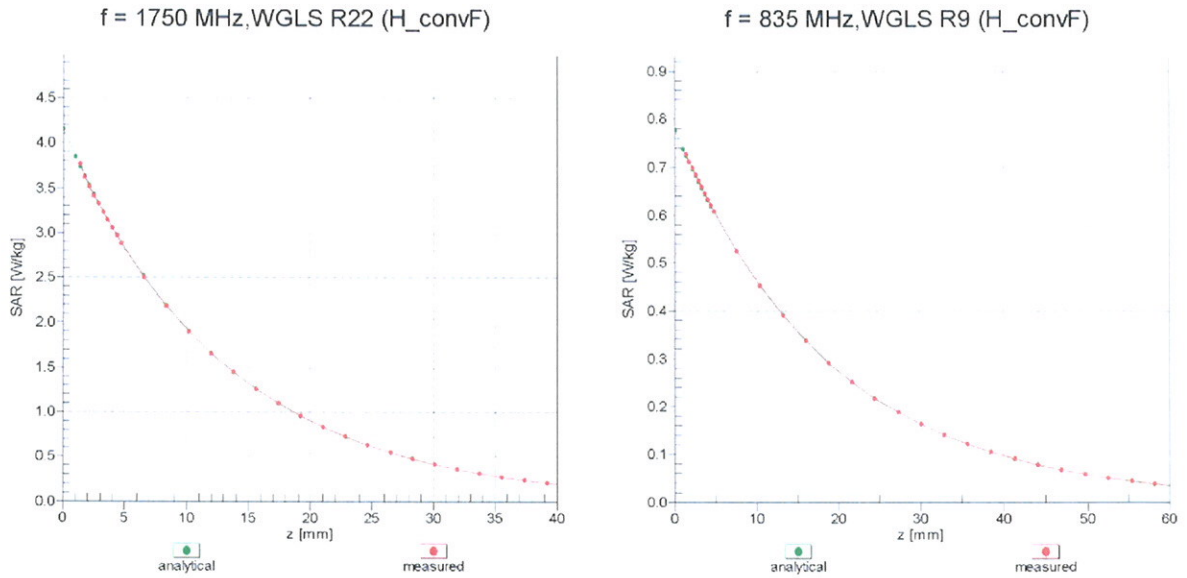
Deviation from Isotropy in Air
Error (ϕ, ϑ), f = 900 MHz

Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)
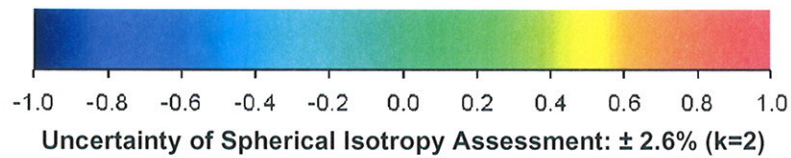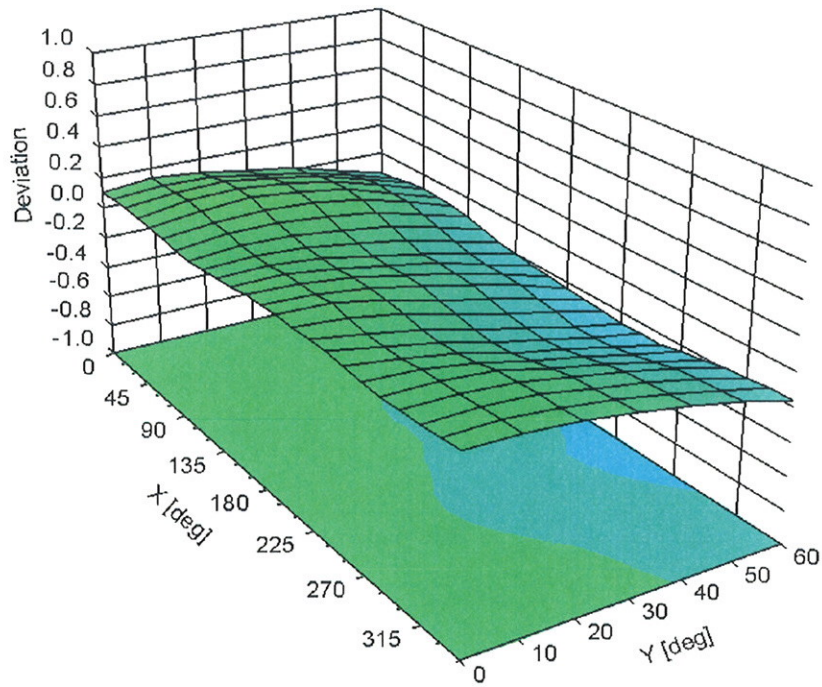
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3590

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	2 mm

D2: SYSTEM VALIDATION DIPOLE

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

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Accreditation No.: **SCS 108**

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

Certificate No: **D5GHzV2-1019_Jan11**

CALIBRATION CERTIFICATE

Object	D5GHzV2 - SN: 1019

Calibration procedure(s)	**QA CAL-22.v1** **Calibration procedure for dipole validation kits between 3-6 GHz**

Calibration date:	January 25, 2011

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%.
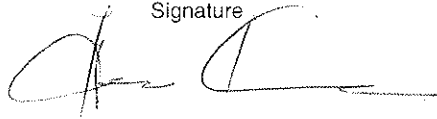
Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-10 (No. 217-01266)	Oct-11
Power sensor HP 8481A	US37292783	06-Oct-10 (No. 217-01266)	Oct-11
Reference 20 dB Attenuator	SN: 5086 (20g)	30-Mar-10 (No. 217-01158)	Mar-11
Type-N mismatch combination	SN: 5047.2 / 06327	30-Mar-10 (No. 217-01162)	Mar-11
Reference Probe EX3DV4	SN: 3503	05-Mar-10 (No. EX3-3503_Mar10)	Mar-11
DAE4	SN: 601	10-Jun-10 (No. DAE4-601_Jun10)	Jun-11

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-09)	In house check: Oct-11
RF generator R&S SMT-06	100005	4-Aug-99 (in house check Oct-09)	In house check: Oct-11
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-10)	In house check: Oct-11

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

Issued: January 25, 2011

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

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

Glossary:

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

Calibration is Performed According to the Following Standards:

a) 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.

Measurement Conditions

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

DASY Version	DASY5	V52.6
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Area Scan resolution	dx, dy = 10 mm	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 2.0 mm	
Frequency	5200 MHz ± 1 MHz 5500 MHz ± 1 MHz 5800 MHz ± 1 MHz	

Head TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	36.0	4.66 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.3 ± 6 %	4.50 mho/m ± 6 %
Head TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Head TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.21 mW / g
SAR normalized	normalized to 1W	82.1 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**81.8 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.32 mW / g
SAR normalized	normalized to 1W	23.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.1 mW / g ± 19.5 % (k=2)**

Head TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.6	4.96 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Head TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.87 mW / g
SAR normalized	normalized to 1W	88.7 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**88.9 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.49 mW / g
SAR normalized	normalized to 1W	24.9 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.9 mW / g ± 19.5 % (k=2)**

Head TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.3	5.27 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	35.5 ± 6 %	5.17 mho/m ± 6 %
Head TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Head TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	condition	
SAR measured	100 mW input power	8.32 mW / g
SAR normalized	normalized to 1W	83.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**83.2 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.33 mW / g
SAR normalized	normalized to 1W	23.3 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**23.3 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5200 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	49.0	5.30 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.2 ± 6 %	5.37 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Body TSL at 5200 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.77 mW / g
SAR normalized	normalized to 1W	77.7 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**77.1 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 mW / g
SAR normalized	normalized to 1W	21.5 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5500 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.6	5.65 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.6 ± 6 %	5.75 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Body TSL at 5500 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	100 mW input power	8.31 mW / g
SAR normalized	normalized to 1W	83.1 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**82.4 mW / g ± 19.9 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.29 mW / g
SAR normalized	normalized to 1W	22.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**22.7 mW / g ± 19.5 % (k=2)**

Body TSL parameters at 5800 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.2	6.00 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.14 mho/m ± 6 %
Body TSL temperature during test	(21.5 ± 0.2) °C	----	----

SAR result with Body TSL at 5800 MHz

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	100 mW input power	7.40 mW / g
SAR normalized	normalized to 1W	74.0 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	73.4 mW / g ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.02 mW / g
SAR normalized	normalized to 1W	20.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	20.0 mW / g ± 19.5 % (k=2)

Appendix

Antenna Parameters with Head TSL at 5200 MHz

Impedance, transformed to feed point	51.9 Ω - 8.4 jΩ
Return Loss	-21.5 dB

Antenna Parameters with Head TSL at 5500 MHz

Impedance, transformed to feed point	51.4 Ω - 2.1 jΩ
Return Loss	-31.9 dB

Antenna Parameters with Head TSL at 5800 MHz

Impedance, transformed to feed point	56.3 Ω + 2.6 jΩ
Return Loss	-23.9 dB

Antenna Parameters with Body TSL at 5200 MHz

Impedance, transformed to feed point	51.8 Ω - 6.7 jΩ
Return Loss	-23.3 dB

Antenna Parameters with Body TSL at 5500 MHz

Impedance, transformed to feed point	51.6 Ω - 0.4 jΩ
Return Loss	-36.0 dB

Antenna Parameters with Body TSL at 5800 MHz

Impedance, transformed to feed point	56.4 Ω + 3.9 jΩ
Return Loss	-23.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.204 ns

After long term use with 40 W 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.
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

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1019

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: HSL 5000
Medium parameters used: $f = 5200$ MHz; $\sigma = 4.51$ mho/m; $\varepsilon_r = 35.3$; $\rho = 1000$ kg/m^3 ,
Medium parameters used: $f = 5500$ MHz; $\sigma = 4.87$ mho/m; $\varepsilon_r = 36.2$; $\rho = 1000$ kg/m^3 ,
Medium parameters used: $f = 5800$ MHz; $\sigma = 5.18$ mho/m; $\varepsilon_r = 35.5$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.36, 5.36, 5.36), ConvF(4.85, 4.85, 4.85), ConvF(4.74, 4.74, 4.74); Calibrated: 05.03.2010

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

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

- Measurement SW: DASY52, V52.6.1 Build (408)

- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

Pin=100mW/d=10mm, f=5200 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 63.766 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 31.432 W/kg
SAR(1 g) = 8.21 mW/g; SAR(10 g) = 2.32 mW/g
Maximum value of SAR (measured) = 16.241 mW/g

Pin=100mW/d=10mm, f=5500 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 64.225 V/m; Power Drift = 0.13 dB
Peak SAR (extrapolated) = 36.205 W/kg
SAR(1 g) = 8.87 mW/g; SAR(10 g) = 2.49 mW/g
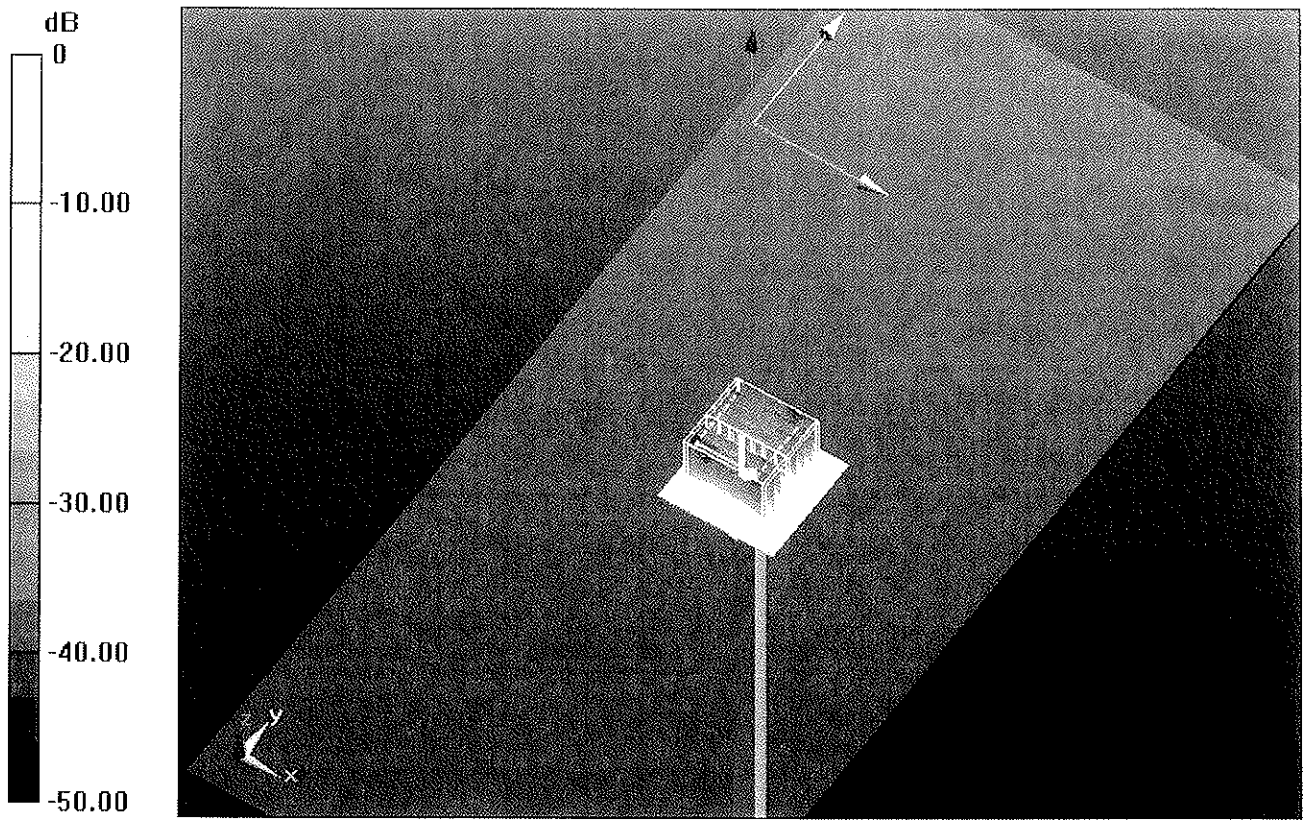Maximum value of SAR (measured) = 17.917 mW/g

Pin=100mW/d=10mm, f=5800 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=4mm
Reference Value = 60.818 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 37.120 W/kg
SAR(1 g) = 8.32 mW/g; SAR(10 g) = 2.33 mW/g
Maximum value of SAR (measured) = 16.571 mW/g

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0 dB = 16.570mW/g

Impedance Measurement Plot for Head TSL

17 Jan 2011   17:42:04

[CH1] S11   1 U FS   1: 51.904 Ω   -8.3555 Ω 3.6631 pF   5 200.000 000 MHz

*

Del

Cor

CH1 Markers

2: 51.426 Ω
-2.1426 Ω
5.50000 GHz

3: 56.254 Ω
2.5820 Ω
5.80000 GHz
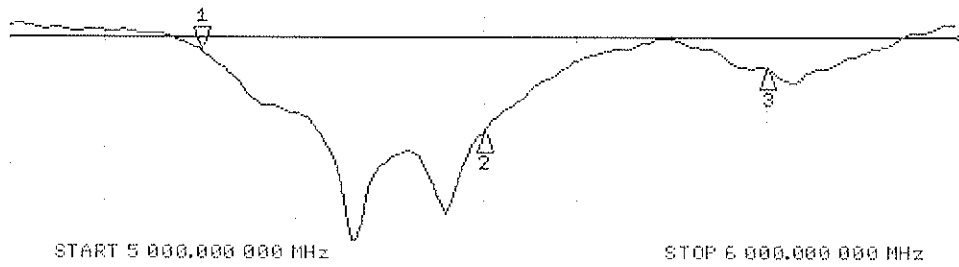
Avg
16

↑

CH2 S11   LOG   5 dB/ REF -20 dB   1:-21.534 dB   5 200.000 000 MHz

CH2 Markers

Cor

2:-31.912 dB
5.50000 GHz

3:-23.923 dB
5.80000 GHz

Avg
16

↑

START 5 000.000 000 MHz   STOP 6 000.000 000 MHz

DASY5 Validation Report for Body TSL

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 5GHz; Type: D5GHz; Serial: D5GHzV2 - SN:1019

Communication System: CW; Frequency: 5200 MHz, Frequency: 5500 MHz, Frequency: 5800 MHz; Duty Cycle: 1:1
Medium: MSL 5000 MHz
Medium parameters used: f = 5200 MHz; σ = 5.4 mho/m; ε_r = 47.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5500 MHz; σ = 5.78 mho/m; ε_r = 46.6; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5800 MHz; σ = 6.18 mho/m; ε_r = 46.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.88, 4.88, 4.88), ConvF(4.37, 4.37, 4.37), ConvF(4.57, 4.57, 4.57); Calibrated: 05.03.2010

- Sensor-Surface: 2mm (Mechanical Surface Detection)

- Electronics: DAE4 Sn601; Calibrated: 10.06.2010

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

- Measurement SW: DASY52, V52.6.1 Build (408)

- Postprocessing SW: SEMCAD X, V14.4.2 Build (2595)

Pin=100mW/d=10mm, f=5200 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.081 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 30.750 W/kg
SAR(1 g) = 7.77 mW/g; SAR(10 g) = 2.15 mW/g
Maximum value of SAR (measured) = 15.289 mW/g

Pin=100mW/d=10mm, f=5500 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 60.368 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 35.267 W/kg
SAR(1 g) = 8.31 mW/g; SAR(10 g) = 2.29 mW/g
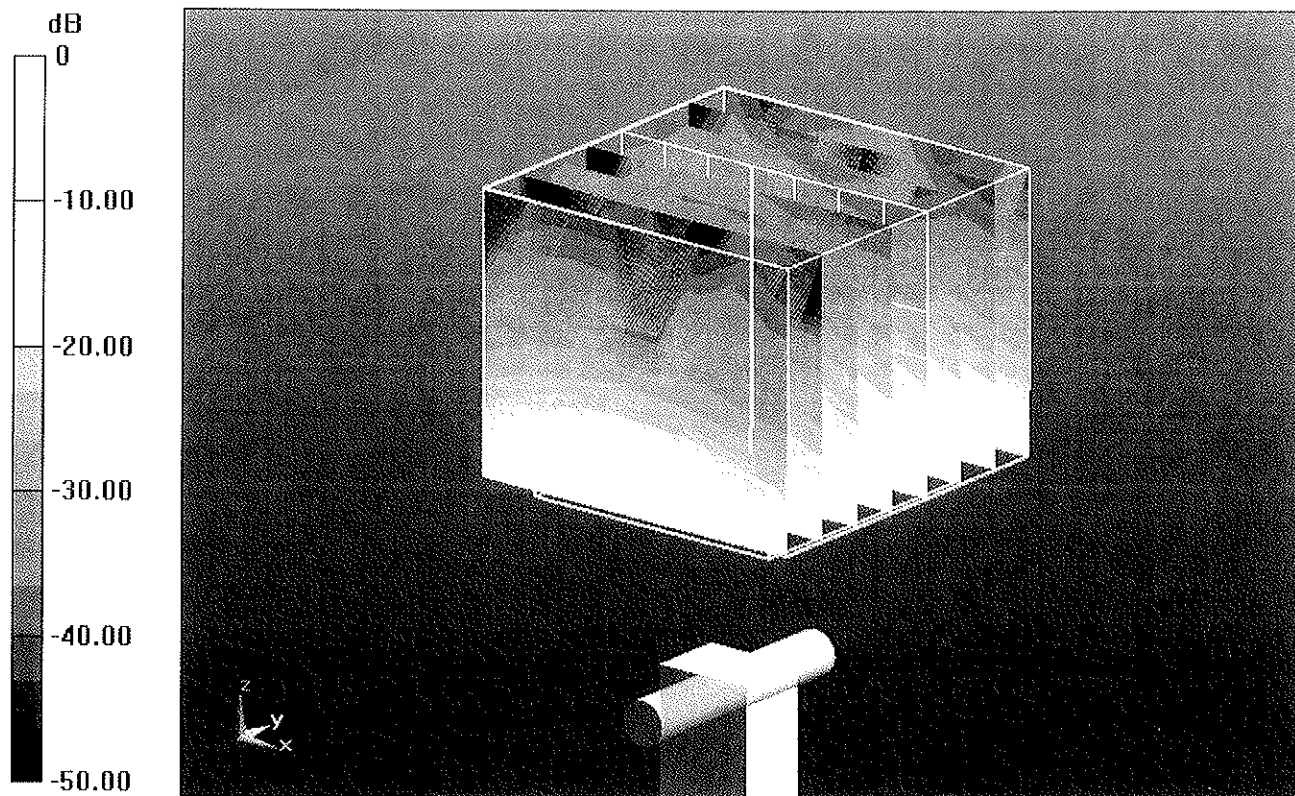Maximum value of SAR (measured) = 16.599 mW/g

Pin=100mW/d=10mm, f=5800 MHz/Zoom Scan (4x4x2mm), dist=2mm (8x8x6)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=4mm
Reference Value = 54.998 V/m; Power Drift = -0.0083 dB
Peak SAR (extrapolated) = 35.336 W/kg
SAR(1 g) = 7.4 mW/g; SAR(10 g) = 2.02 mW/g
Maximum value of SAR (measured) = 14.674 mW/g

0 dB = 14.670mW/g

Impedance Measurement Plot for Body TSL

[CH1] S11   1 U FS   1: 51.754 Ω   -6.7227 Ω 4.5528 pF   5 200.000 000 MHz

*

Del

Cor

Avg
16

CH2 S11   LOG   5 dB/REF -20 dB   1:-23.328 dB   5 200.000 000 MHz

Cor

Avg
16

START 5 000.000 000 MHz   STOP 6 000.000 000 MHz