

FCC SAR Test Report

APPLICANT : ZTE CORPORATION
EQUIPMENT : HSPA+ USB Modem
BRAND NAME : ZTE
MODEL NAME : MF656
FCC ID : Q78-MF656
STANDARD : FCC 47 CFR Part 2 (2.1093)
IEEE C95.1-1999
IEEE 1528-2003
FCC OET Bulletin 65 Supplement C (Edition 01-01)

The product was received on Aug. 05, 2010 and completely tested on Aug. 29, 2010. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (KUNSHAN) INC., the test report shall not be reproduced except in full.

Reviewed by:



Roy Wu / Manager



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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA080530	Rev. 01	Initial issue of report	Sep. 02, 2010

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **ZTE CORPORATION HSPA+ USB Modem ZTE MF656** are as follows (with expanded uncertainty 21.4 % for 300 MHz to 3 GHz).

Band	Position	SAR _{1g} (W/kg)
GSM850	Body	0.763
GSM1900	Body	1.02
WCDMA Band V	Body	0.357
WCDMA Band II	Body	0.774

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1999, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL (KUNSHAN) INC.
Test Site Location	No. 3-2, PingXiang Road, Kunshan, Jiangsu Province, P.R.C. TEL: +86-0512-5790-0158 FAX: +86-0512-5790-0958

2.2 Applicant

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

2.3 Manufacturer

Company Name	ZTE CORPORATION
Address	ZTE Plaza, Keji Road South, Hi-Tech Industrial Park, Nanshan District, Shenzhen, Guangdong, 518057, P.R.China

2.4 Application Details

Date of Receipt of Application	Aug. 05, 2010
Date of Start during the Test	Aug. 27, 2010
Date of End during the Test	Aug. 29, 2010

3. General Information

3.1 Description of Device Under Test (DUT)

Product Feature & Specification	
DUT Type	HSPA+ USB Modem
Brand Name	ZTE
Model Name	MF656
FCC ID	Q78-MF656
Tx Frequency	GSM850 : 824 MHz ~ 849 MHz GSM1900 : 1850 MHz ~ 1910 MHz WCDMA Band V : 824 MHz ~ 849 MHz WCDMA Band II : 1850 MHz ~ 1910 MHz
Rx Frequency	GSM850 : 869 MHz ~ 894 MHz GSM1900 : 1930 MHz ~ 1990 MHz WCDMA Band V : 869 MHz ~ 894 MHz WCDMA Band II : 1930 MHz ~ 1990 MHz
Maximum Output Power to Antenna	GSM850 : 32.28 dBm GSM1900 : 28.91 dBm WCDMA Band V : 22.15 dBm WCDMA Band II : 21.78 dBm
Antenna Type	Fixed Internal Antenna
HW Version	d17b
SW Version	M6600ASCAUTSZ1561
Type of Modulation	GSM / GPRS : GMSK EDGE : 8PSK WCDMA : QPSK HSDPA : QPSK / 16QAM HSUPA : BPSK
DUT Stage	Identical Prototype

Note:

1. This device is not support 16QAM for uplink
2. The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3.2 Product Photos

Please refer to Appendix D.

3.3 Applied Standards

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

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1999
- IEEE 1528-2003
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- FCC KDB 447498 D02 v02
- FCC KDB 941225 D01 v02
- FCC KDB 941225 D03 v01
- FCC KDB 941225 D04 v01

3.4 Device Category and SAR Limits

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

3.5 Test Conditions

3.5.1 Ambient Condition

Ambient Temperature	20 to 24 °C
Humidity	< 60 %

3.5.2 Test Configuration

The device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the DUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of DUT. The DUT was set from the emulator to radiate maximum output power during all tests.

For WWAN SAR testing, the DUT is in GPRS or WCDMA link mode.

In general, the crest factor is 8.3 for GSM and GPRS/EDGE multi-slot class 8, 4 for GPRS/EDGE multi-slot class 10, 2 for EDGE multi-slot class 12, and 1 for WCDMA/HSDPA/HSUPA.

For GSM/GPRS/EDGE body SAR testing, the DUT was set in GPRS multi-slot class 10 with 2 uplink slots for GSM850 and GSM1900 due to maximum source-based time-averaged output power as following table:

Source-Based Time-Averaged Power						
Band	GSM850			GSM1900		
Channel	128	189	251	512	661	810
GPRS 8 (1 Uplink)	23.15	23.19	23.28	19.91	19.42	19.49
GPRS 10 (2 Uplink)	24.62	24.63	25.00	20.72	20.58	20.41
EDGE 8 (1 Uplink)	17.33	17.40	17.58	16.43	16.30	16.26
EDGE 10 (2 Uplink)	17.47	17.50	17.63	16.35	16.31	16.22
EDGE 12 (4 Uplink)	18.37	18.64	18.72	16.90	16.68	16.57
Note: The source-based time-averaged power is linearly scaled the maximum burst averaged power based on time slots. The calculated method are shown as below: Source based time averaged power = Maximum burst averaged power (1 Uplink) - 9 dB Source based time averaged power = Maximum burst averaged power (2 Uplink) - 6 dB Source based time averaged power = Maximum burst averaged power (4 Uplink) - 3 dB The maximum burst averaged power can be referred to section 11.1 of this report.						

4. Specific Absorption Rate (SAR)

4.1 Introduction

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

4.2 SAR Definition

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

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = C \left(\frac{\delta T}{\delta t} \right)$$

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

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

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

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

5. SAR Measurement System

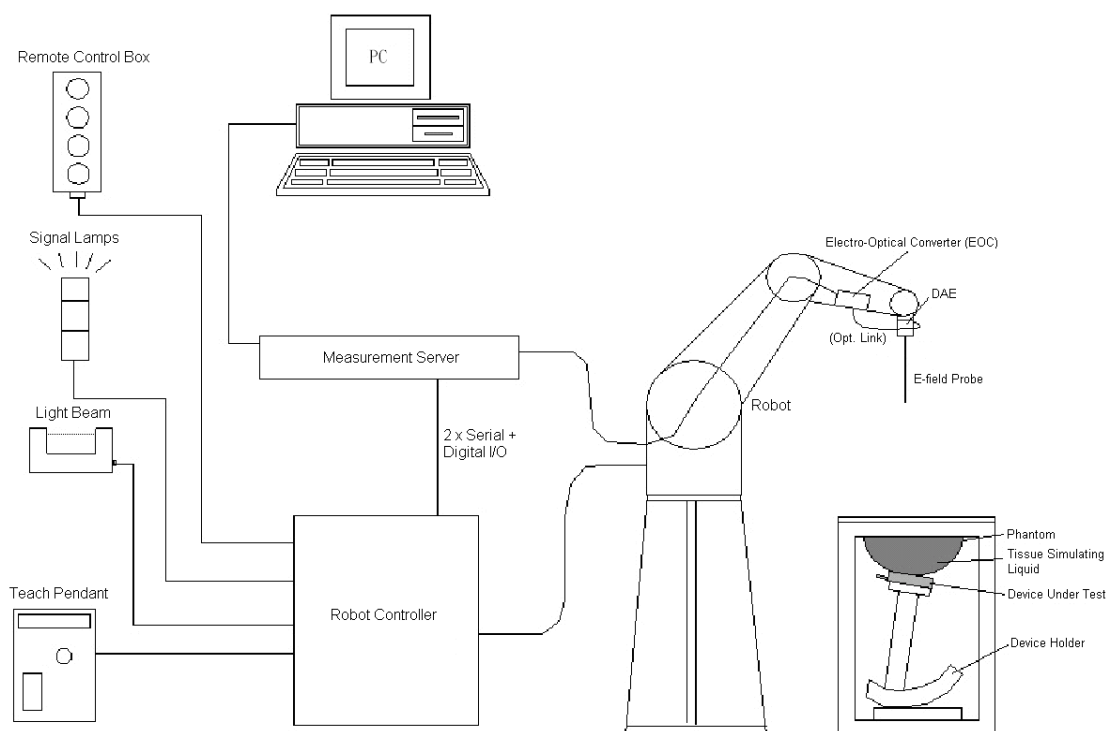


Fig 5.1 SPEAG DASY5 System Configurations

The DASY5 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (ECO) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY5 software
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

5.1 E-Field Probe

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

5.1.1 E-Field Probe Specification

<ET3DV6>

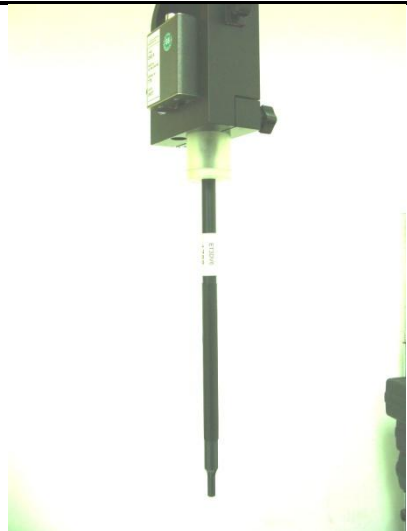
Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)	
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB	
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)	
Dynamic Range	5 μ W/g to 100 mW/g; Linearity: ± 0.2 dB	
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm	

Fig 5.2 Photo of ET3DV6

<EX3DV4 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: ± 0.2 dB	
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)	
Dynamic Range	10 μ W/g to 100 mW/g; Linearity: ± 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	

Fig 5.3 Photo of EX3DV4

5.1.2 E-Field Probe Calibration

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

5.2 Data Acquisition Electronics (DAE)

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



Fig 5.4 Photo of DAE

5.3 Robot

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

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



Fig 5.5 Photo of DASY5

5.4 Measurement Server

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

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



Fig 5.6 Photo of Server for DASY5

5.5 Phantom

<SAM Twin Phantom>

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



Fig 5.7 Photo of SAM Phantom

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

<ELI4 Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

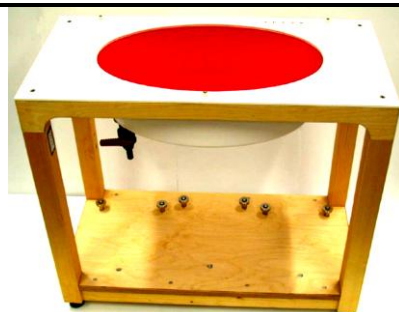


Fig 5.8 Photo of ELI4 Phantom

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

5.6 Device Holder

<Device Holder for SAM Twin Phantom>

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

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

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



Fig 5.9 Device Holder

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

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

5.7.2 Data Evaluation

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

Probe parameters :	- Sensitivity	$\text{Norm}_i, a_{i0}, a_{i1}, a_{i2}$
	- Conversion factor	ConvF_i
	- Diode compression point	dcp_i
Device parameters :	- Frequency	f
	- Crest factor	cf
Media parameters :	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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

The formula for each channel can be given as :

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

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

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

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

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

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

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

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

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

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

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

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

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Nov. 23, 2009	Nov. 22, 2010
SPEAG	Data Acquisition Electronics	DAE4	1210	Nov. 16, 2009	Nov. 15, 2010
SPEAG	835MHz System Validation Kit	D835V2	4d091	Nov. 23, 2009	Nov. 22, 2011
SPEAG	1800MHz System Validation Kit	D1800V2	2d177	Nov. 24, 2009	Nov. 23, 2011
SPEAG	1900MHz System Validation Kit	D1900V2	5d118	Nov. 24, 2009	Nov. 23, 2011
SPEAG	2450MHz System Validation Kit	D2450V2	840	Mar. 18, 2010	Mar. 17, 2012
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1477	NCR	NCR
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1479	NCR	NCR
SPEAG	ELI4 Phantom	QD OVA 001 BB	1079	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46106933	Jul. 06, 2010	Jul. 05, 2011
Agilent	Wireless Communication Test Set	E5515C	MY48367160	Feb. 16, 2010	Feb. 15, 2012
R&S	Universal Radio Communication Tester	CMU200	100954	Oct. 14, 2009	Oct. 13, 2010
Agilent	Dielectric Probe Kit	85070E	MY44300475	NCR	NCR
Agilent	Power Amplifier	8449B	3008A02371	Dec. 07, 2009	Dec. 06, 2010
R&S	Signal Generator	SMR40	100455	Dec. 08, 2008	Dec. 78, 2010
R&S	Spectrum Analyzer	FSP7	100819	Apr. 09, 2010	Apr. 08, 2011

Table 5.1 Test Equipment List

Note: The calibration certificate of DASY can be referred to appendix C of this report.

6. Tissue Simulating Liquids

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

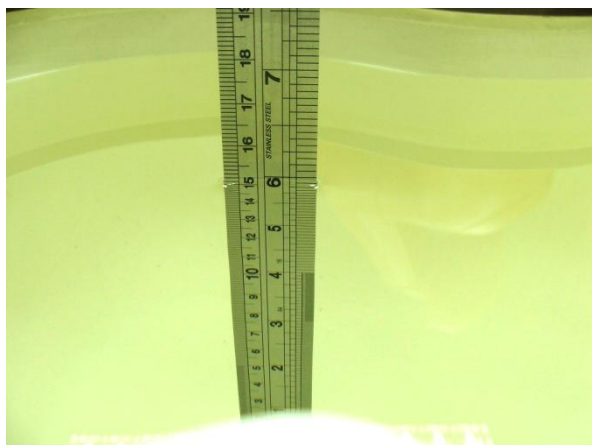


Fig 6.1 Photo of Liquid Height for Head SAR



Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ϵ_r)
For Head								
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
For Body								
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7

Table 6.1 Recipes of Tissue Simulating Liquid

The following table gives the targets for tissue simulating liquid.

Frequency (MHz)	Liquid Type	Conductivity (σ)	$\pm 5\%$ Range	Permittivity (ϵ_r)	$\pm 5\%$ Range
835	Head	0.90	0.86 ~ 0.95	41.5	39.4 ~ 43.6
900	Head	0.97	0.92 ~ 1.02	41.5	39.4 ~ 43.6
1800, 1900, 2000	Head	1.40	1.33 ~ 1.47	40.0	38.0 ~ 42.0
2450	Head	1.80	1.71 ~ 1.89	39.2	37.2 ~ 41.2
835	Body	0.97	0.92 ~ 1.02	55.2	52.4 ~ 58.0
900	Body	1.05	1.00 ~ 1.10	55.0	52.3 ~ 57.8
1800, 1900, 2000	Body	1.52	1.44 ~ 1.60	53.3	50.6 ~ 56.0
2450	Body	1.95	1.85 ~ 2.05	52.7	50.1 ~ 55.3

Table 6.2 Targets of Tissue Simulating Liquid

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070E Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Frequency (MHz)	Liquid Type	Temperature ($^{\circ}\text{C}$)	Conductivity (σ)	Permittivity (ϵ_r)	Measurement Date
835	Body	21.5	0.969	56.1	Aug. 29, 2010
1900	Body	21.5	1.5	53.8	Aug. 27, 2010

Table 6.3 Measuring Results for Simulating Liquid

7. Uncertainty Assessment

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

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

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/k ^(b)	1/√3	1/√6	1/√2

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

(b) k is the coverage factor

Table 7.1 Standard Uncertainty for Assumed Distribution

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

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 7.2.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)
Measurement System					
Probe Calibration	5.5	Normal	1	1	± 5.5 %
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	0.3	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	0.4	Rectangular	√3	1	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	± 0.6 %
Test Sample Related					
Device Positioning	2.9	Normal	1	1	± 2.9 %
Device Holder	3.6	Normal	1	1	± 3.6 %
Power Drift	5.0	Rectangular	√3	1	± 2.9 %
Phantom and Setup					
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %
Liquid Conductivity (Meas.)	2.5	Normal	1	0.64	± 1.6 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	± 1.5 %
Combined Standard Uncertainty					± 10.7 %
Coverage Factor for 95 %					K = 2
Expanded Uncertainty					± 21.4 %

Table 7.2 Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz

8. SAR Measurement Evaluation

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

8.1 Purpose of System Performance check

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

8.2 System Setup

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

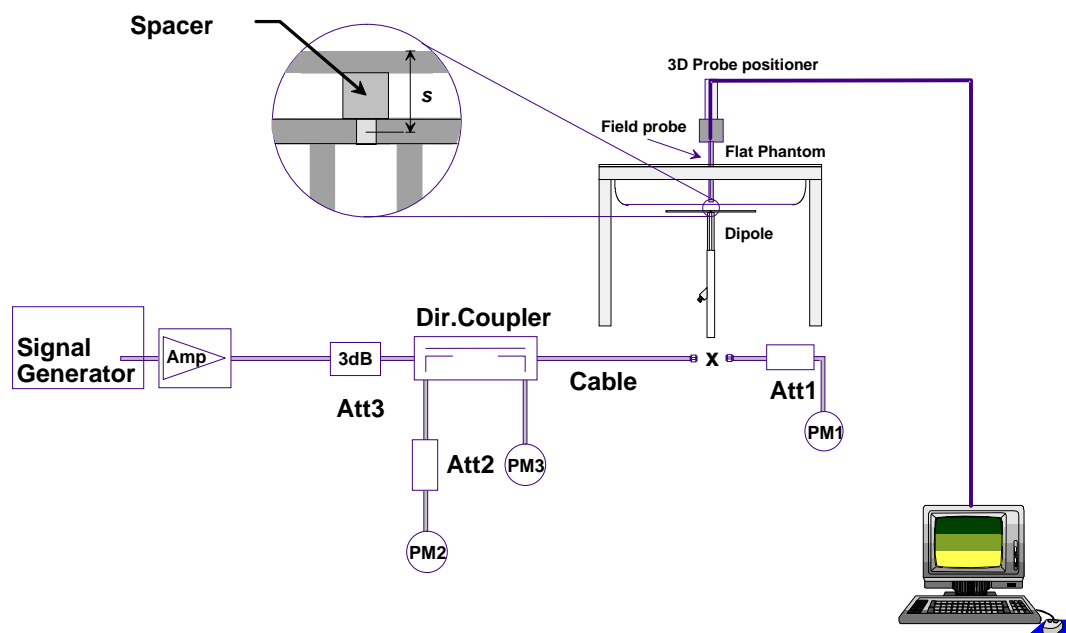


Fig 8.1 System Setup for System Evaluation

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

The output power on dipole port must be calibrated to 20 dBm (100 mW) before dipole is connected.

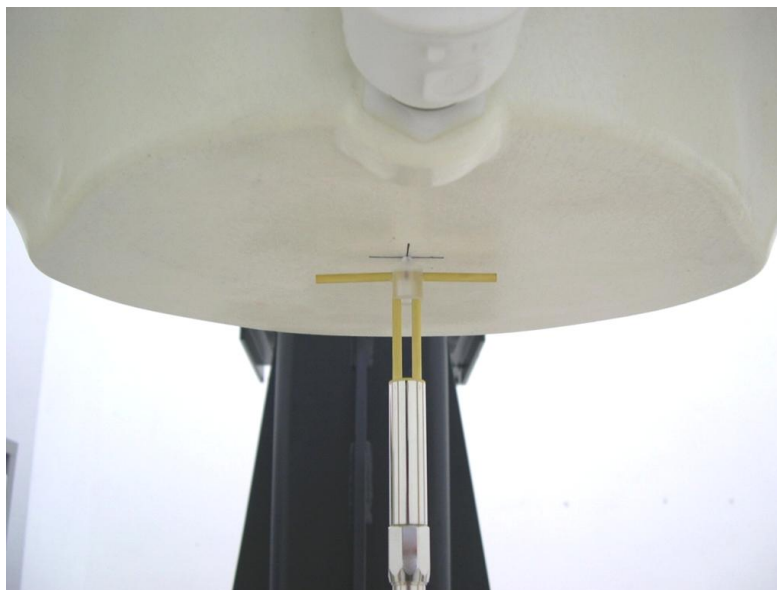


Fig 8.2 Photo of Dipole Setup

8.3 Validation Results

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Measurement Date	Frequency (MHz)	Targeted SAR _{1g} (W/kg)	Measured SAR _{1g} (W/kg)	Deviation (%)
Aug. 29, 2010	835	9.80	9.25	-5.61
Aug. 27, 2010	1900	39.60	37.00	-6.57

Table 8.1 Target and Measurement SAR after Normalized

9. DUT Testing Position

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





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

Fig 9.1 Illustration for USB Connector Orientations

10. Measurement Procedures

The measurement procedures are as follows:

- (a) For WWAN function, link DUT with base station emulator in highest power channel
- (b) Set base station emulator to allow DUT to radiate maximum output power
- (c) Measure output power through RF cable and power meter
- (d) Place the DUT in the positions described in the last section
- (e) Set scan area, grid size and other setting on the DASY software
- (f) Taking data for the middle channel on each testing position
- (g) Find out the largest SAR result on these testing positions of each band
- (h) Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

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

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

10.1 Spatial Peak SAR Evaluation

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

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

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

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values 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

10.2 Area & Zoom Scan Procedures

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for 300 MHz to 3 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

10.3 Volume Scan Procedures

The volume scan is used for assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

10.4 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.

10.5 Power Drift Monitoring

All SAR testing is under the DUT 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 DUT 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.

11. SAR Test Results

11.1 Conducted Power (Unit: dBm)

Band	GSM850			GSM1900		
Channel	128	189	251	512	661	810
Frequency (MHz)	824.2	836.4	848.8	1850.2	1880.0	1909.8
GPRS 8 (1 Uplink)	32.15	32.19	32.28	28.91	28.42	28.49
GPRS 10 (2 Uplink)	30.62	30.63	31.00	26.72	26.58	26.41
EDGE 8 (1 Uplink)	26.33	26.40	26.58	25.43	25.30	25.26
EDGE 10 (2 Uplink)	23.47	23.50	23.63	22.35	22.31	22.22
EDGE 12 (4 Uplink)	21.37	21.64	21.72	19.90	19.68	19.57

Band	WCDMA Band V			WCDMA Band II		
Channel	4132	4182	4233	9262	9400	9538
Frequency (MHz)	826.4	836.4	846.6	1852.4	1880.0	1907.6
RMC 12.2K	22.11	22.15	22.12	21.73	21.78	21.75
HSDPA Subtest-1	19.77	19.78	19.69	19.45	19.54	19.47
HSDPA Subtest-2	19.76	19.74	19.65	19.42	19.37	19.35
HSDPA Subtest-3	19.79	19.76	19.64	19.58	19.59	19.54
HSDPA Subtest-4	19.77	19.78	19.69	19.42	19.46	19.37
HSUPA Subtest-1	20.43	20.11	20.30	19.11	19.45	19.13
HSUPA Subtest-2	18.55	18.53	18.34	18.13	18.10	18.09
HSUPA Subtest-3	19.34	19.34	19.28	19.11	19.06	18.97
HSUPA Subtest-4	18.35	18.45	18.28	18.06	18.02	18.00
HSUPA Subtest-5	20.23	20.35	19.88	19.03	19.53	19.42

11.2 Test Records for Body SAR Test

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Channel	SAR _{1g} (W/kg)
#17	GSM850	GPRS 10	Horizontal Up (Laptop)	0.5	251	0.763
#18	GSM850	GPRS 10	Horizontal Down (USB Cable)	0.5	251	0.51
#19	GSM850	GPRS 10	Vertical Front (USB Cable)	0.5	251	0.62
#20	GSM850	GPRS 10	Vertical Back (Laptop)	0.5	251	0.714
#21	GSM850	GPRS 10	Tip (USB Cable)	0.5	251	0.071
#08	GSM1900	GPRS 10	Horizontal Up (Laptop)	0.5	512	0.903
#09	GSM1900	GPRS 10	Horizontal Down (USB Cable)	0.5	512	1.02
#10	GSM1900	GPRS 10	Vertical Front (USB Cable)	0.5	512	0.788
#11	GSM1900	GPRS 10	Vertical Back (Laptop)	0.5	512	0.119
#12	GSM1900	GPRS 10	Tip (USB Cable)	0.5	512	0.411
#13	GSM1900	GPRS 10	Horizontal Up (Laptop)	0.5	661	0.855
#14	GSM1900	GPRS 10	Horizontal Up (Laptop)	0.5	810	0.883
#15	GSM1900	GPRS 10	Horizontal Down (USB Cable)	0.5	661	0.903
#16	GSM1900	GPRS 10	Horizontal Down (USB Cable)	0.5	810	0.756
#24	WCDMA Band V	RMC 12.2K	Horizontal Up (Laptop)	0.5	4182	0.357
#25	WCDMA Band V	RMC 12.2K	Horizontal Down (USB Cable)	0.5	4182	0.272
#26	WCDMA Band V	RMC 12.2K	Vertical Front (USB Cable)	0.5	4182	0.282
#27	WCDMA Band V	RMC 12.2K	Vertical Back (Laptop)	0.5	4182	0.265
#28	WCDMA Band V	RMC 12.2K	Tip (USB Cable)	0.5	4182	0.036
#01	WCDMA Band II	RMC 12.2K	Horizontal Up (Laptop)	0.5	9400	0.738
#02	WCDMA Band II	RMC 12.2K	Horizontal Down (USB Cable)	0.5	9400	0.774
#03	WCDMA Band II	RMC 12.2K	Vertical Front (USB Cable)	0.5	9400	0.458
#04	WCDMA Band II	RMC 12.2K	Vertical Back (Laptop)	0.5	9400	0.263
#05	WCDMA Band II	RMC 12.2K	Tip (USB Cable)	0.5	9400	0.249

Note: For body SAR testing, the DUT was set in GPRS multi-slot class 10 with 2 uplink slots for GSM850 and GSM1900 due to maximum source-based time-averaged output power.

Test Engineer : Suhe Yin

12. References

- [1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”
- [2] IEEE Std. C95.1-1999, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, 1999
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- [5] SPEAG DASY System Handbook
- [6] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007
- [7] FCC KDB 447498 D01 v04, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, November 2009
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- [9] FCC KDB 616217 D01 v01r01, “SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens”, November 2009
- [10] FCC KDB 616217 D03 v01, “SAR Evaluation Considerations for Laptop/Notebook/Netbook and Tablet Computers”, November 2009
- [11] FCC KDB 648474 D01 v01r05, “SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas”, September 2008
- [12] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007
- [13] FCC KDB 941225 D03 v01, “Recommended SAR Test Reduction Procedures for GSM / GPRS / EDGE”, December 2008
- [14] FCC KDB 941225 D04 v01, “Evaluating SAR for GSM/(E)GPRS Dual Transfer Mode”, January 27 2010



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Body_835MHz_100829

DUT: Dipole 835 MHz

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.969 \text{ mho/m}$; $\epsilon_r = 56.1$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Pin=100mW/Area Scan (61x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 1.000 mW/g

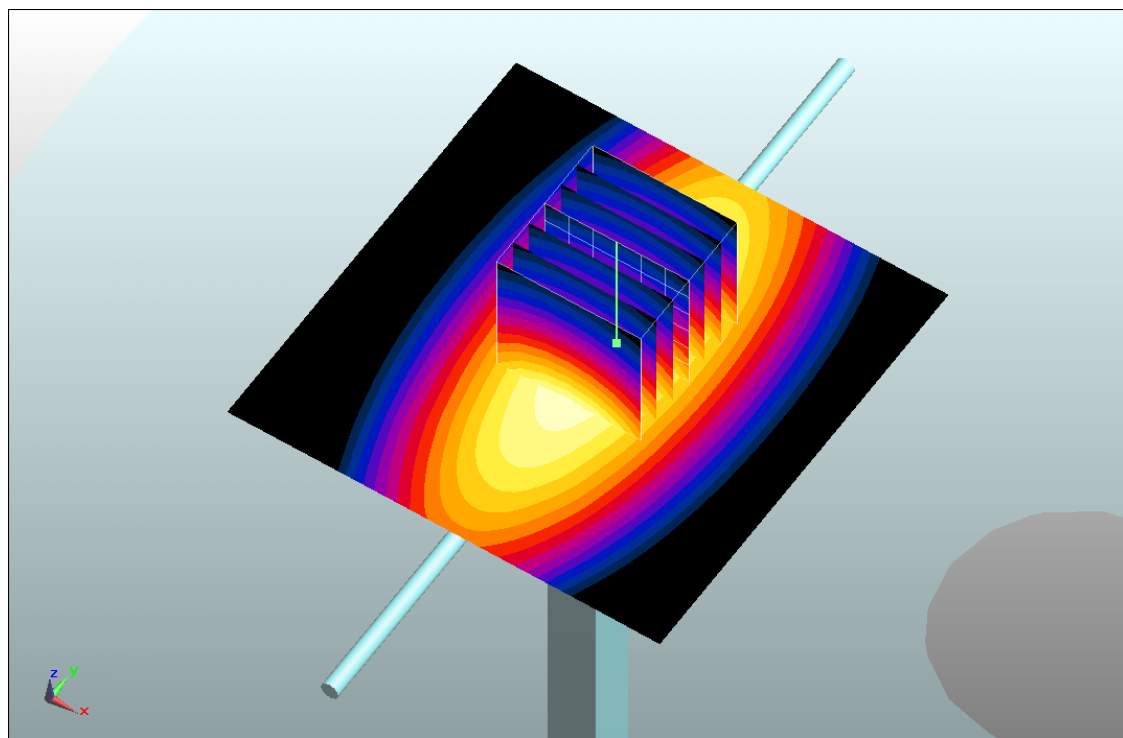
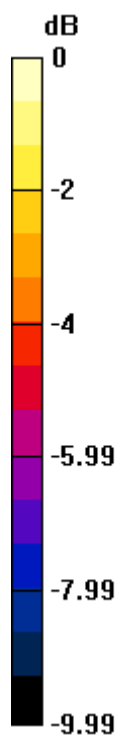
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 31.7 V/m ; Power Drift = -0.00112 dB

Peak SAR (extrapolated) = 1.37 W/kg

SAR(1 g) = 0.925 mW/g ; SAR(10 g) = 0.611 mW/g

Maximum value of SAR (measured) = 0.997 mW/g



0 dB = 0.997mW/g

System Check_Body_1900MHz_100827

DUT: Dipole 1900 MHz

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.5 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Pin=100mW/Area Scan (61x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 4.2 mW/g

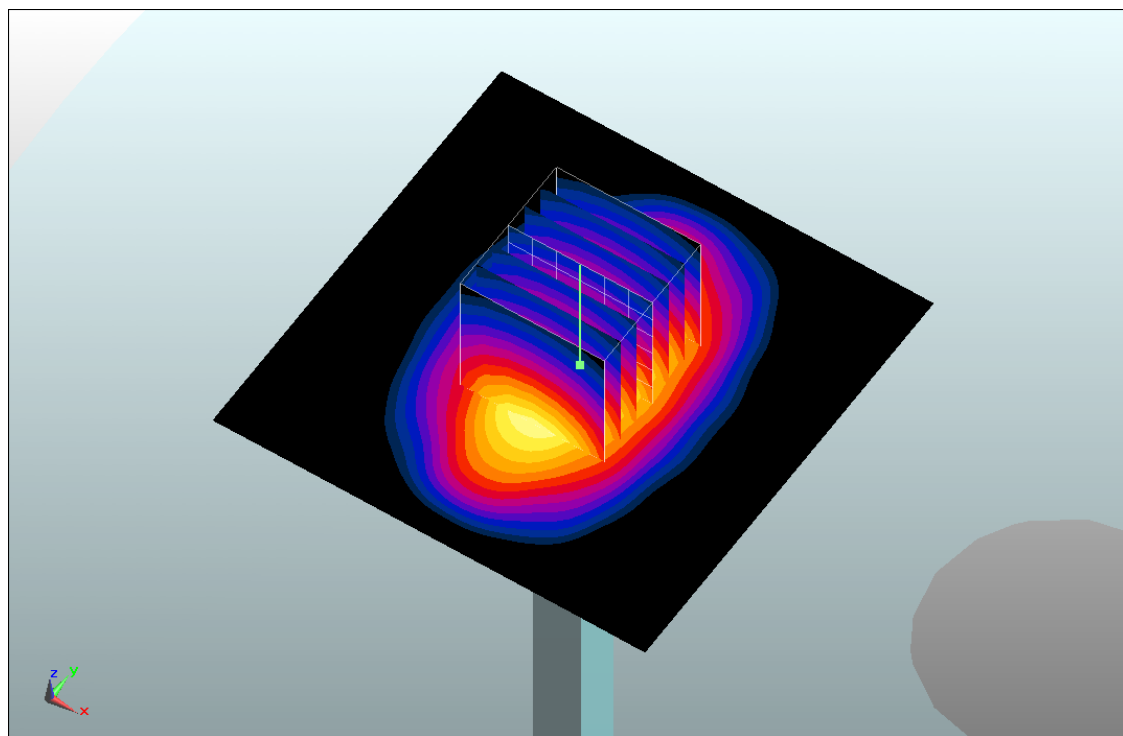
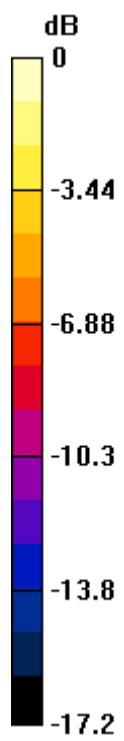
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.3 V/m ; Power Drift = -0.00112 dB

Peak SAR (extrapolated) = 6.94 W/kg

SAR(1 g) = 3.7 mW/g ; SAR(10 g) = 1.9 mW/g

Maximum value of SAR (measured) = 4.21 mW/g



0 dB = 4.21mW/g



Appendix B. Plots of SAR Measurement

The plots are shown as follows.

#17 GSM850_GPRS 10_Horizontal Up_0.5cm_Ch251

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849$ MHz; $\sigma = 0.982$ mho/m; $\epsilon_r = 55.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.818 mW/g

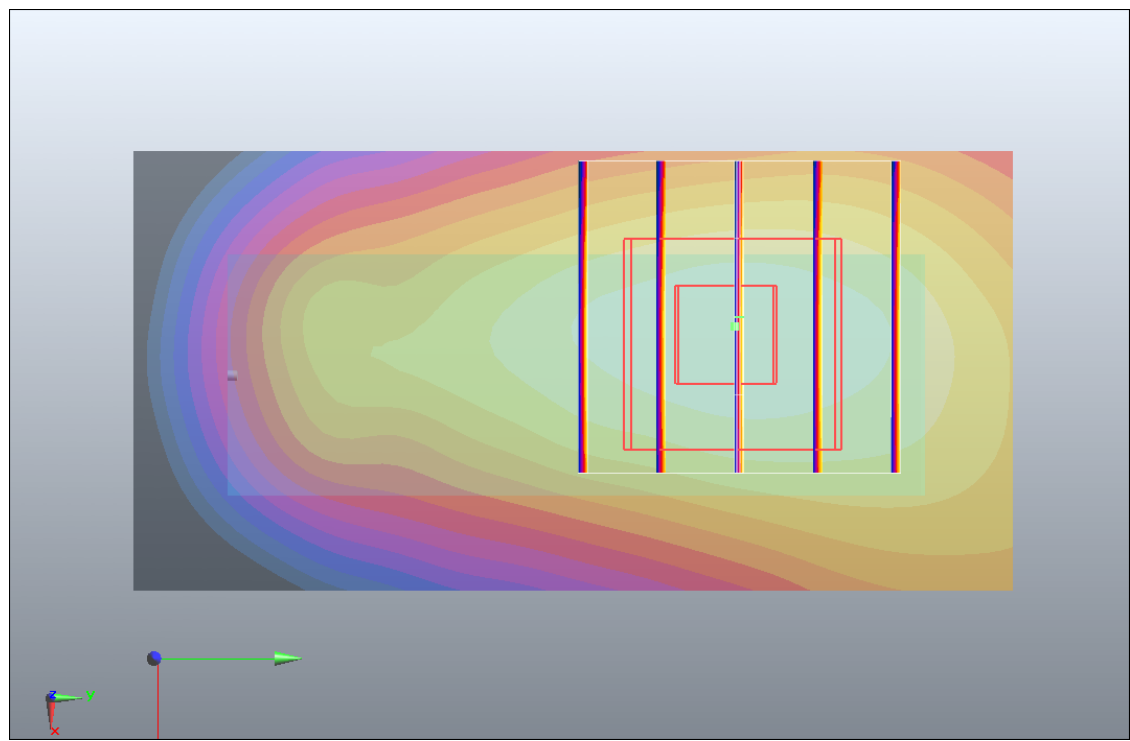
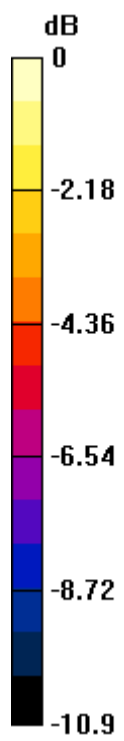
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.8 V/m; Power Drift = 0.076 dB

Peak SAR (extrapolated) = 1.11 W/kg

SAR(1 g) = 0.763 mW/g; SAR(10 g) = 0.505 mW/g

Maximum value of SAR (measured) = 0.813 mW/g



0 dB = 0.813mW/g

#17 GSM850_GPRS 10_Horizontal Up_0.5cm_Ch251_2D

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849$ MHz; $\sigma = 0.982$ mho/m; $\epsilon_r = 55.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.818 mW/g

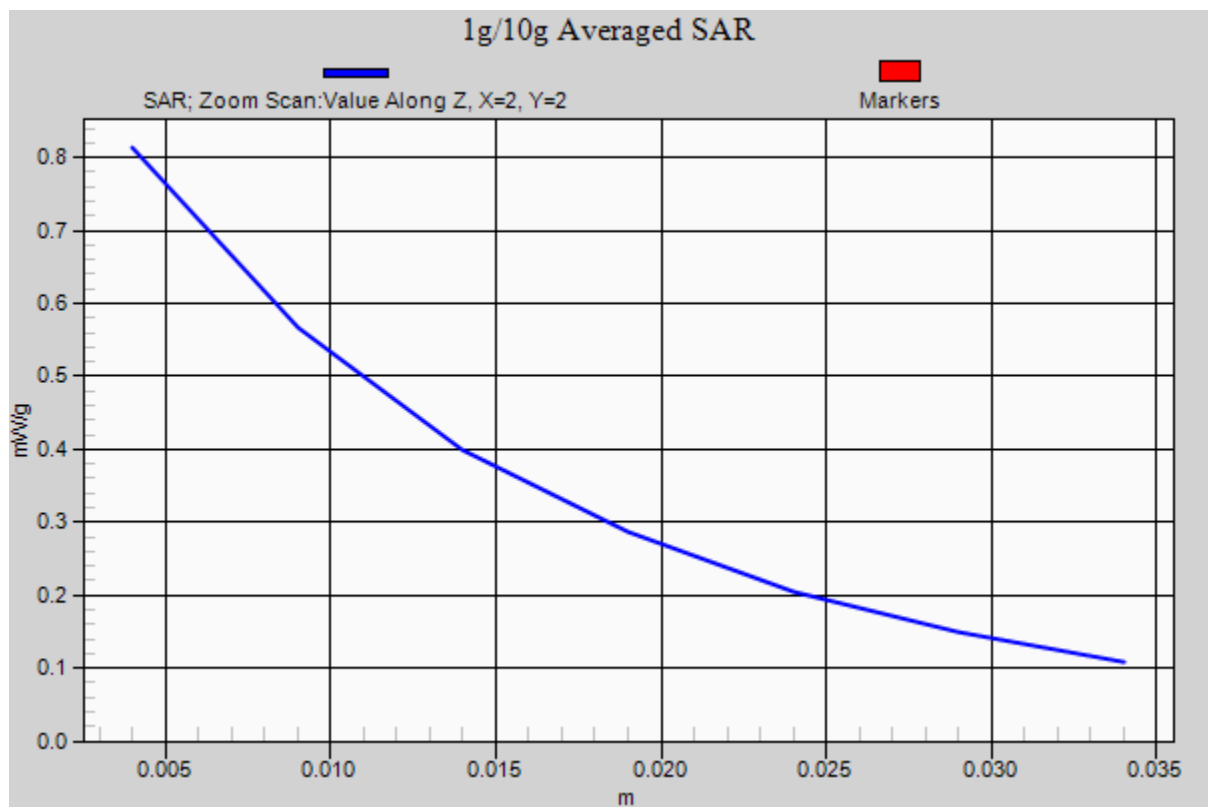
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 10.8 V/m; Power Drift = 0.076 dB

Peak SAR (extrapolated) = 1.11 W/kg

SAR(1 g) = 0.763 mW/g; SAR(10 g) = 0.505 mW/g

Maximum value of SAR (measured) = 0.813 mW/g



#18 GSM850_GPRS 10_Horizontal Down_0.5cm_Ch251

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849$ MHz; $\sigma = 0.982$ mho/m; $\epsilon_r = 55.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.630 mW/g

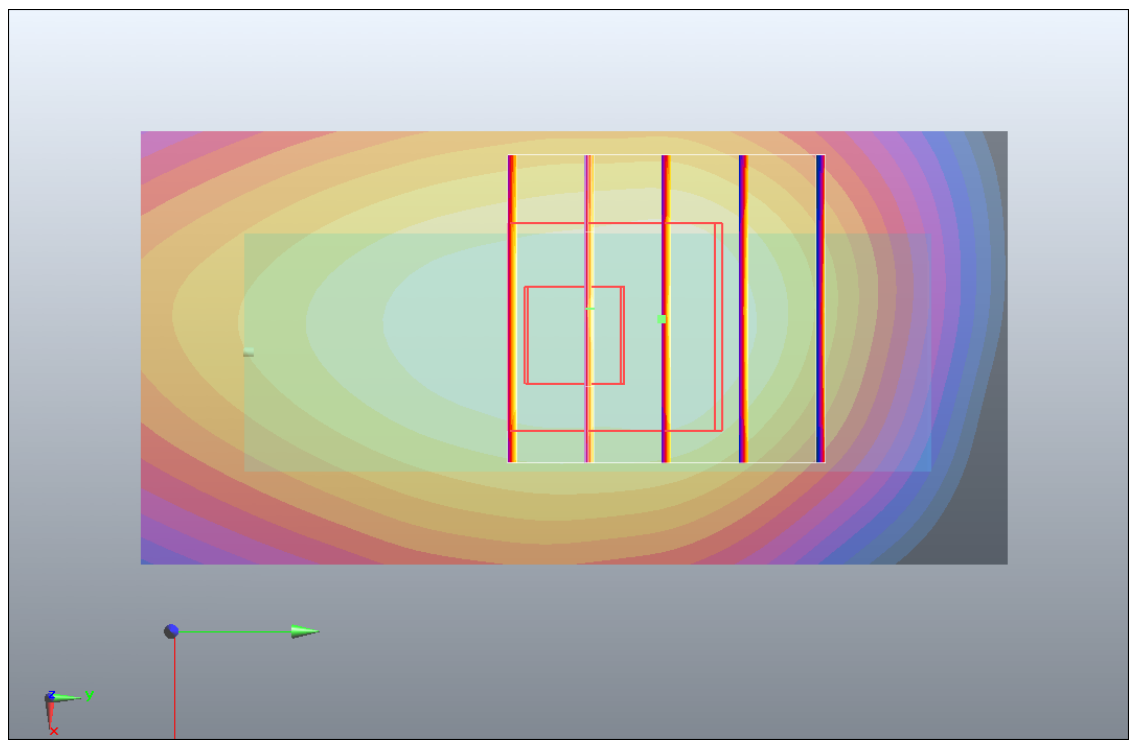
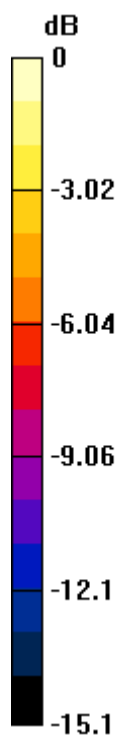
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.2 V/m; Power Drift = -0.113 dB

Peak SAR (extrapolated) = 0.827 W/kg

SAR(1 g) = 0.510 mW/g; SAR(10 g) = 0.335 mW/g

Maximum value of SAR (measured) = 0.544 mW/g



0 dB = 0.544mW/g

#19 GSM850_GPRS 10_Vertical Front_0.5cm_Ch251

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849$ MHz; $\sigma = 0.982$ mho/m; $\epsilon_r = 55.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.654 mW/g

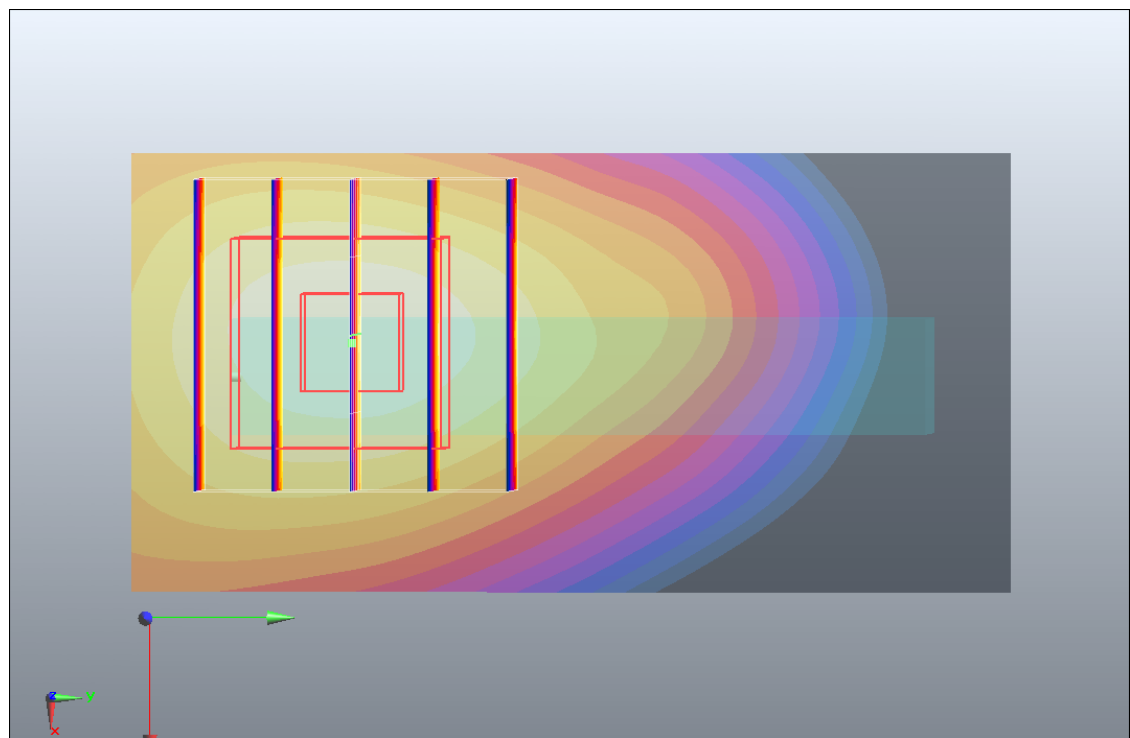
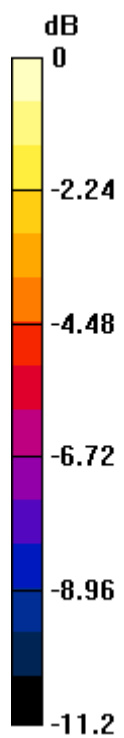
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.5 V/m; Power Drift = -0.072 dB

Peak SAR (extrapolated) = 0.940 W/kg

SAR(1 g) = 0.620 mW/g; SAR(10 g) = 0.401 mW/g

Maximum value of SAR (measured) = 0.672 mW/g



0 dB = 0.672mW/g

#20 GSM850_GPRS 10_Vertical Back_0.5cm_Ch251

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849 \text{ MHz}$; $\sigma = 0.982 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.712 mW/g

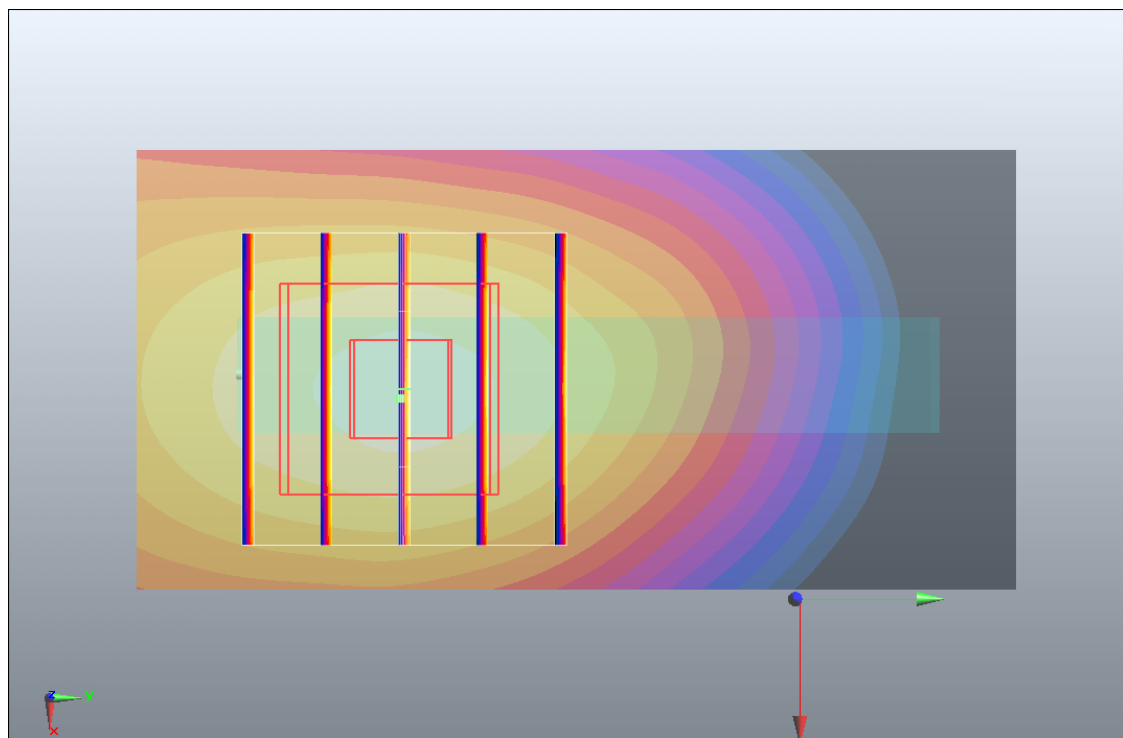
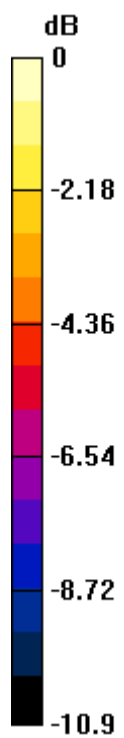
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 9.14 V/m ; Power Drift = 0.050 dB

Peak SAR (extrapolated) = 1.05 W/kg

SAR(1 g) = 0.714 mW/g ; SAR(10 g) = 0.468 mW/g

Maximum value of SAR (measured) = 0.778 mW/g



0 dB = 0.778mW/g

#21 GSM850_GPRS 10_Tip_0.5cm_Ch251

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 848.8 MHz; Duty Cycle: 1:4

Medium: MSL_850_100829 Medium parameters used: $f = 849 \text{ MHz}$; $\sigma = 0.982 \text{ mho/m}$; $\epsilon_r = 55.9$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch251/Area Scan (41x31x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.081 mW/g

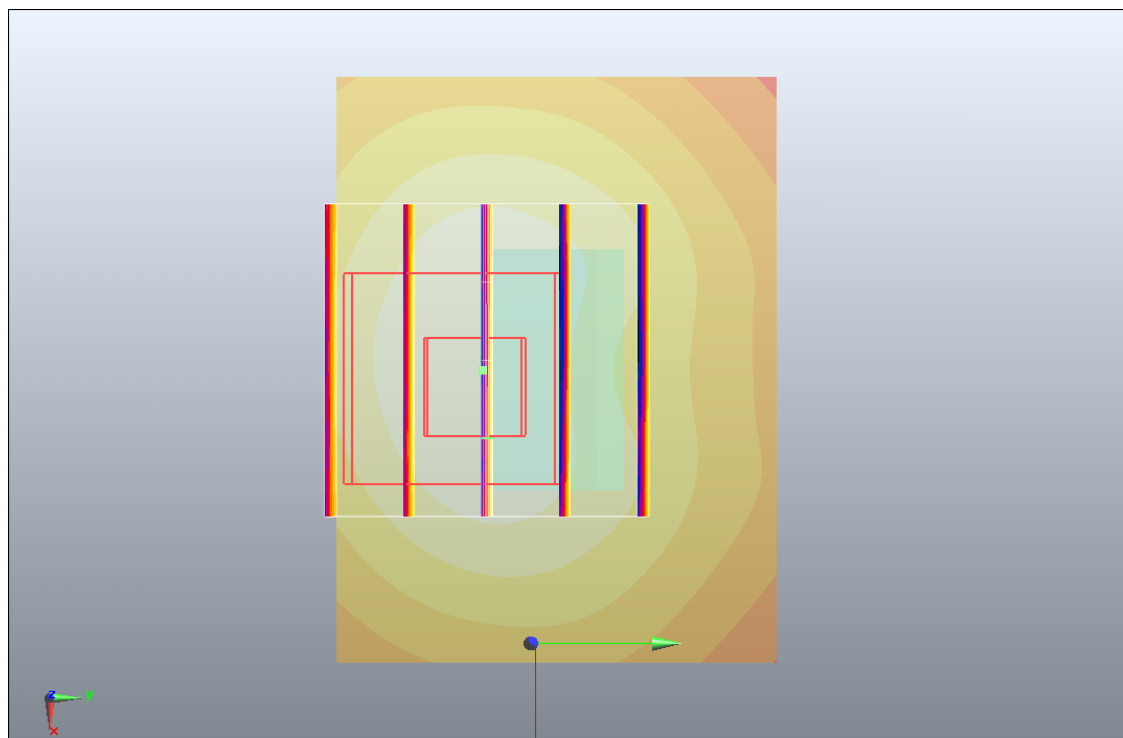
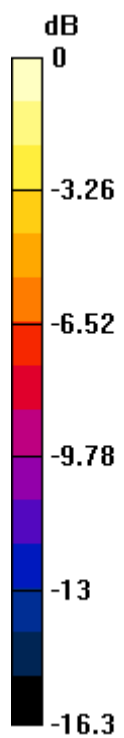
Ch251/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.04 V/m ; Power Drift = -0.052 dB

Peak SAR (extrapolated) = 0.125 W/kg

SAR(1 g) = 0.071 mW/g ; SAR(10 g) = 0.042 mW/g

Maximum value of SAR (measured) = 0.077 mW/g



0 dB = 0.077mW/g

#08 GSM1900_GPRS 10_Horizontal Up_0.5cm_Ch512

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.934 mW/g

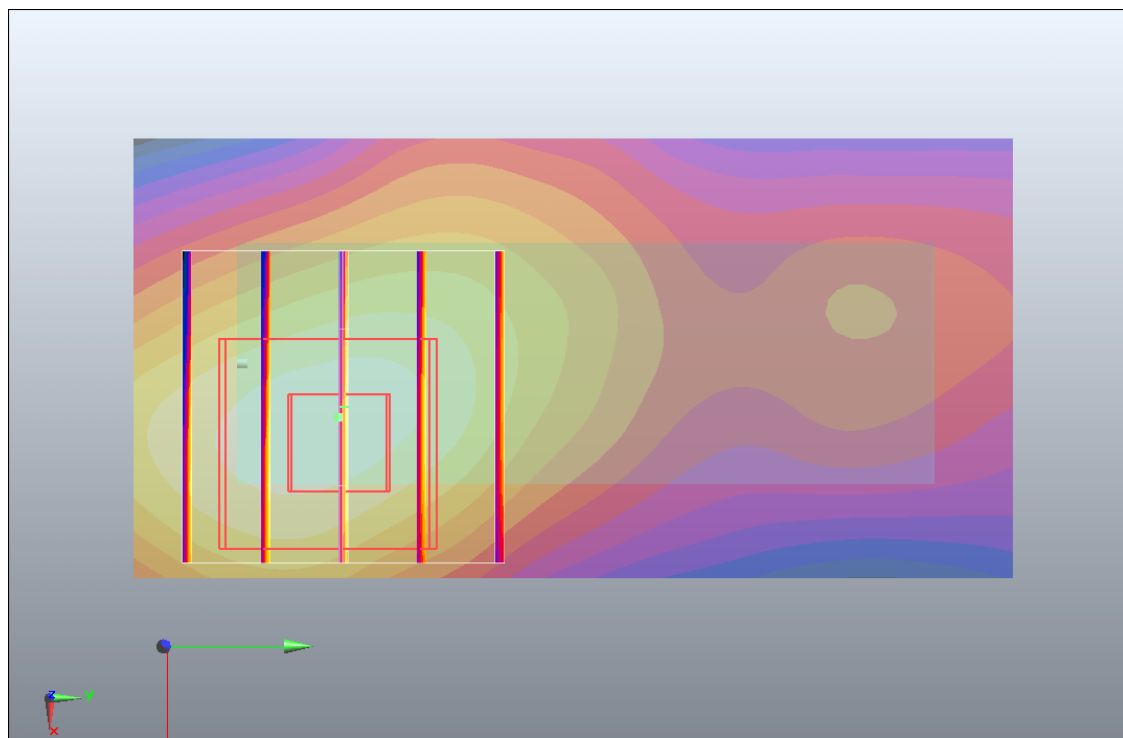
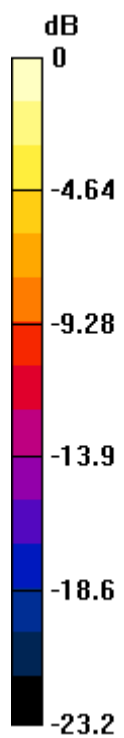
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 24.8 V/m; Power Drift = -0.070 dB

Peak SAR (extrapolated) = 1.89 W/kg

SAR(1 g) = 0.903 mW/g; SAR(10 g) = 0.412 mW/g

Maximum value of SAR (measured) = 1.05 mW/g



0 dB = 1.05mW/g

#09 GSM1900_GPRS 10_Horizontal Down_0.5cm_Ch512

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.703 mW/g

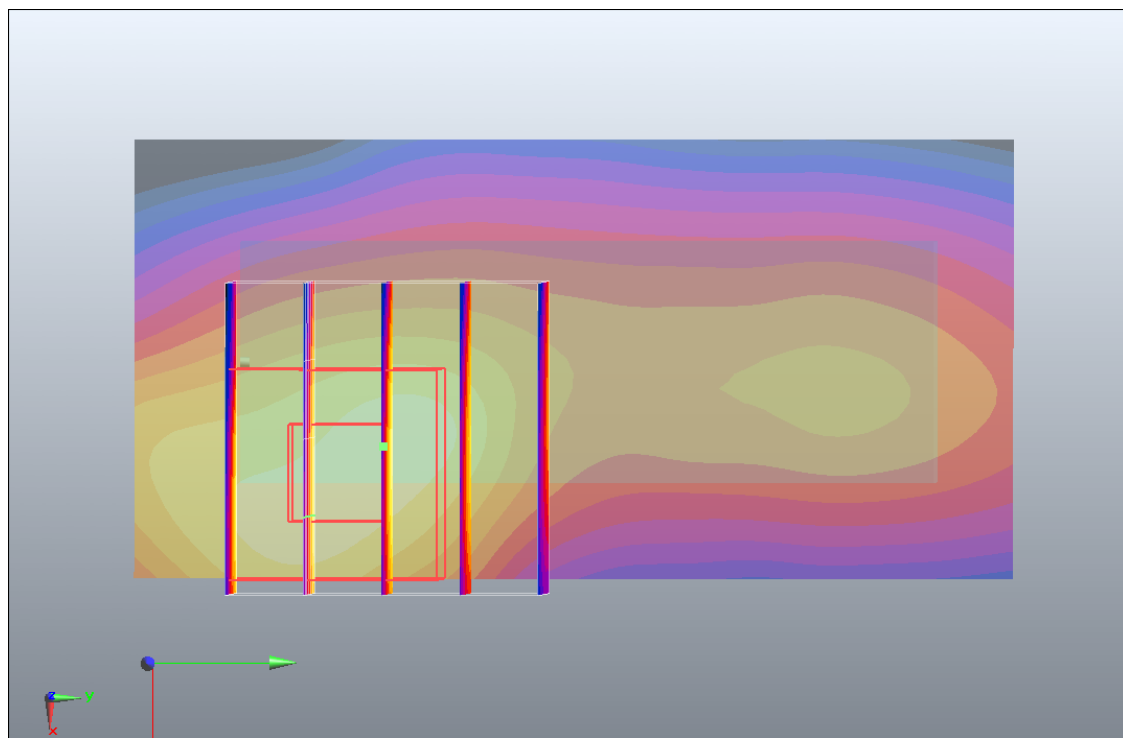
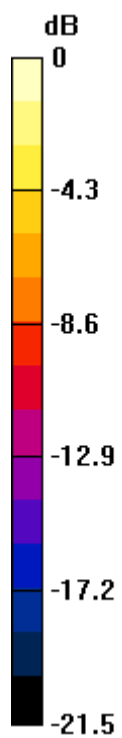
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.1 V/m; Power Drift = 0.100 dB

Peak SAR (extrapolated) = 2.32 W/kg

SAR(1 g) = 1.02 mW/g; SAR(10 g) = 0.443 mW/g

Maximum value of SAR (measured) = 1.05 mW/g



0 dB = 1.05mW/g

#09 GSM1900_GPRS 10_Horizontal Down_0.5cm_Ch512_2D

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.703 mW/g

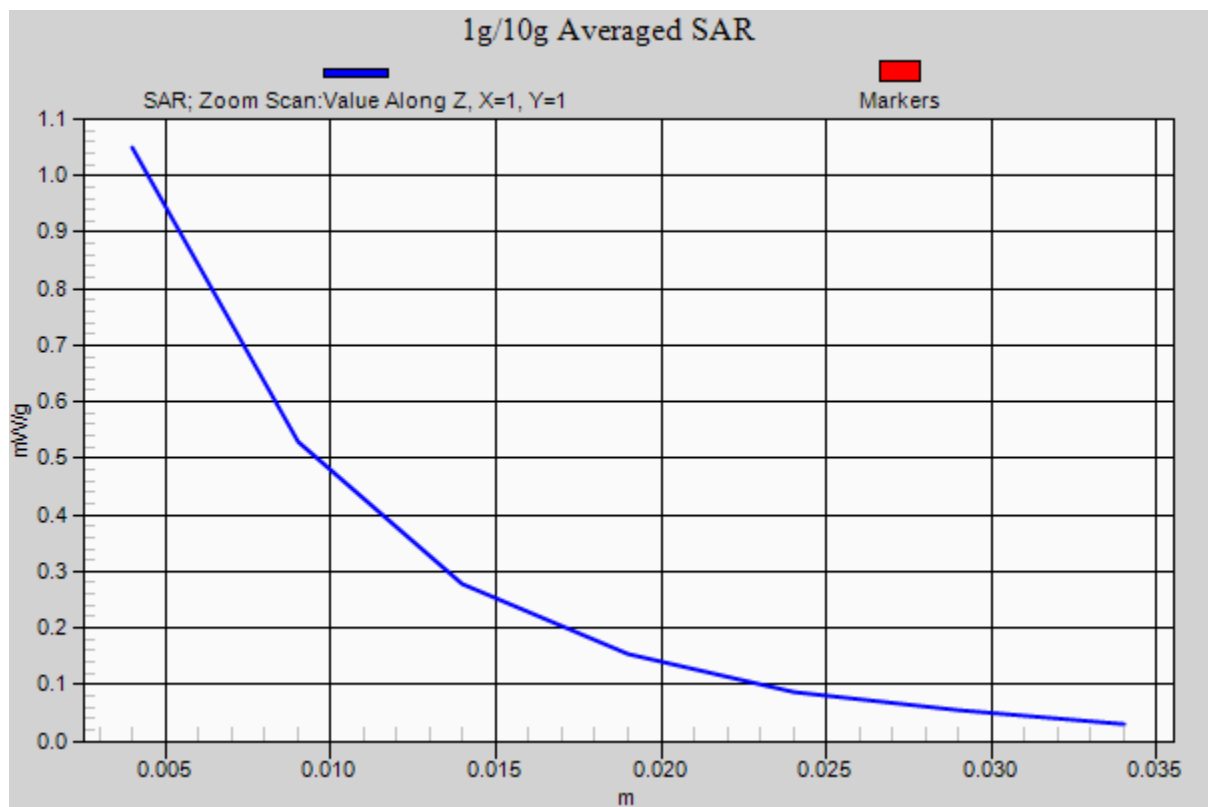
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 21.1 V/m; Power Drift = 0.100 dB

Peak SAR (extrapolated) = 2.32 W/kg

SAR(1 g) = 1.02 mW/g; SAR(10 g) = 0.443 mW/g

Maximum value of SAR (measured) = 1.05 mW/g



#10 GSM1900_GPRS 10_Verical Front_0.5cm_Ch512

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.829 mW/g

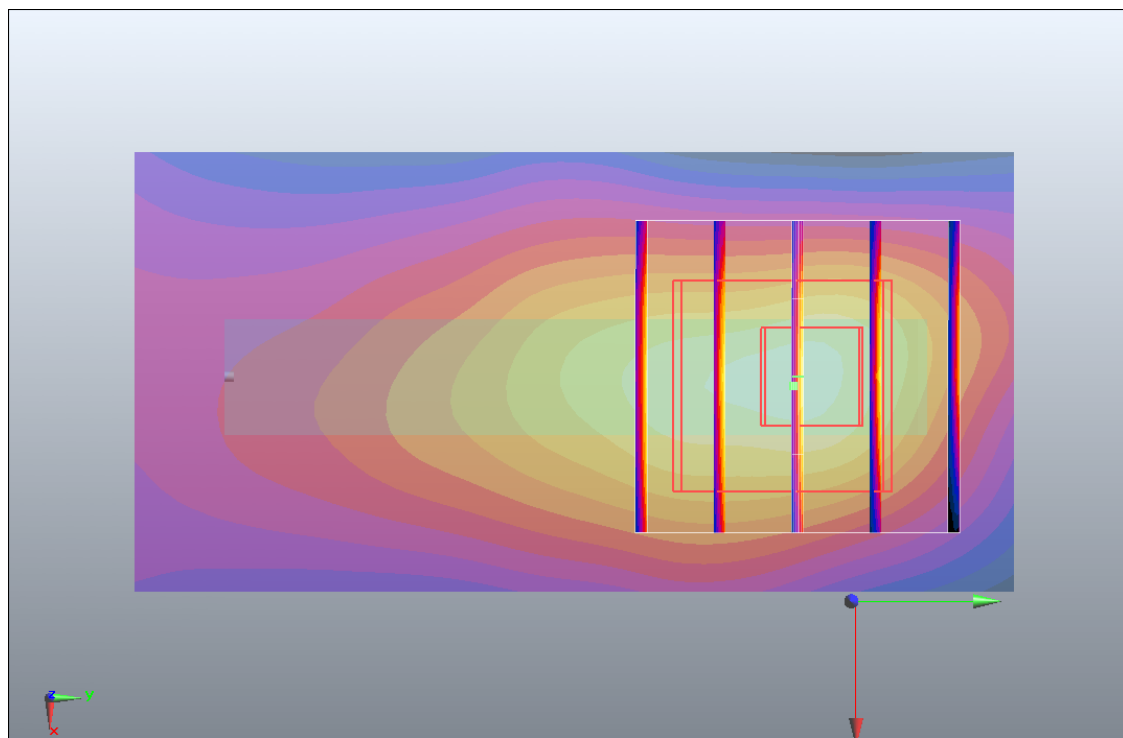
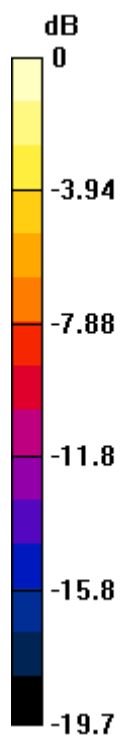
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 12.1 V/m; Power Drift = 0.064 dB

Peak SAR (extrapolated) = 1.64 W/kg

SAR(1 g) = 0.788 mW/g; SAR(10 g) = 0.355 mW/g

Maximum value of SAR (measured) = 0.949 mW/g



0 dB = 0.949mW/g

#11 GSM1900_GPRS 10_Veritical Back_0.5cm_Ch512

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2$ MHz; $\sigma = 1.44$ mho/m; $\epsilon_r = 53.9$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.126 mW/g

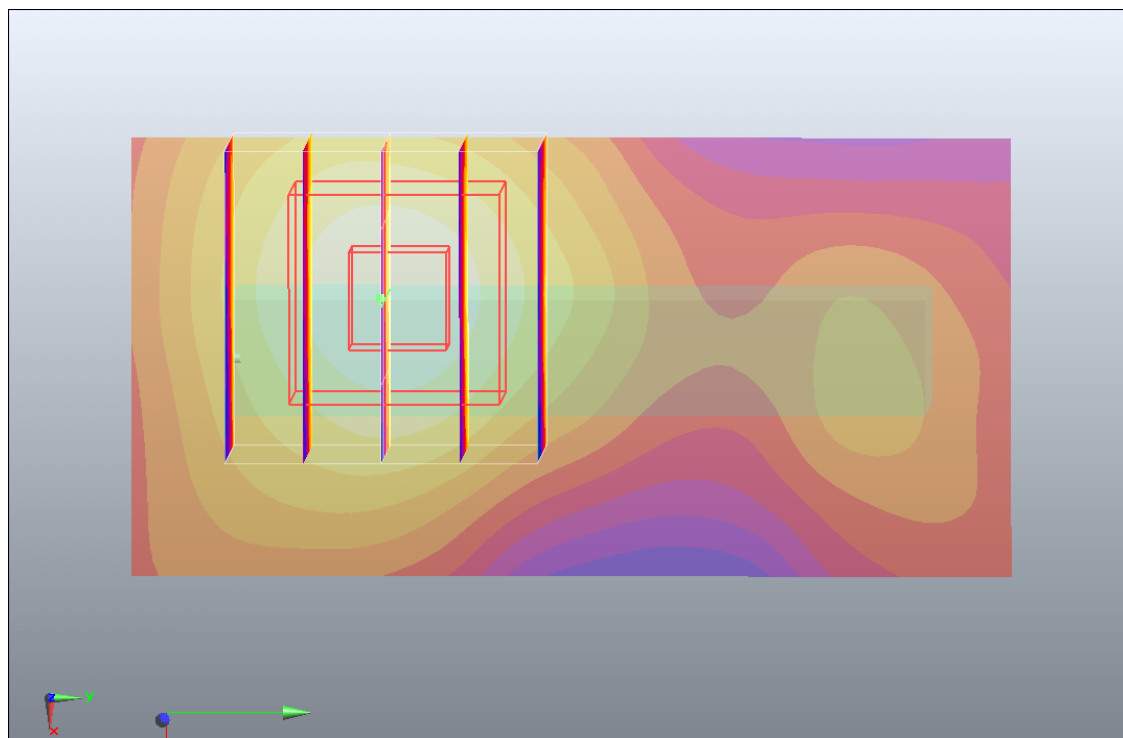
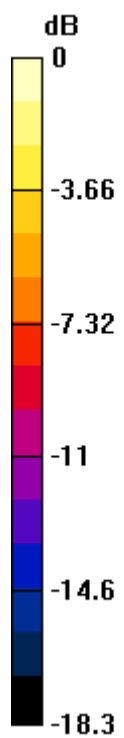
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.49 V/m; Power Drift = 0.093 dB

Peak SAR (extrapolated) = 0.204 W/kg

SAR(1 g) = 0.119 mW/g; SAR(10 g) = 0.066 mW/g

Maximum value of SAR (measured) = 0.131 mW/g



0 dB = 0.131mW/g

#12 GSM1900_GPRS 10_Tip_0.5cm_Ch512

DUT: 080503

Communication System: GPRS/EDGE 10; Frequency: 1850.2 MHz; Duty Cycle: 1:4

Medium: MSL_1900_100827 Medium parameters used: $f = 1850.2 \text{ MHz}$; $\sigma = 1.44 \text{ mho/m}$; $\epsilon_r = 53.9$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch512/Area Scan (41x31x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.361 mW/g

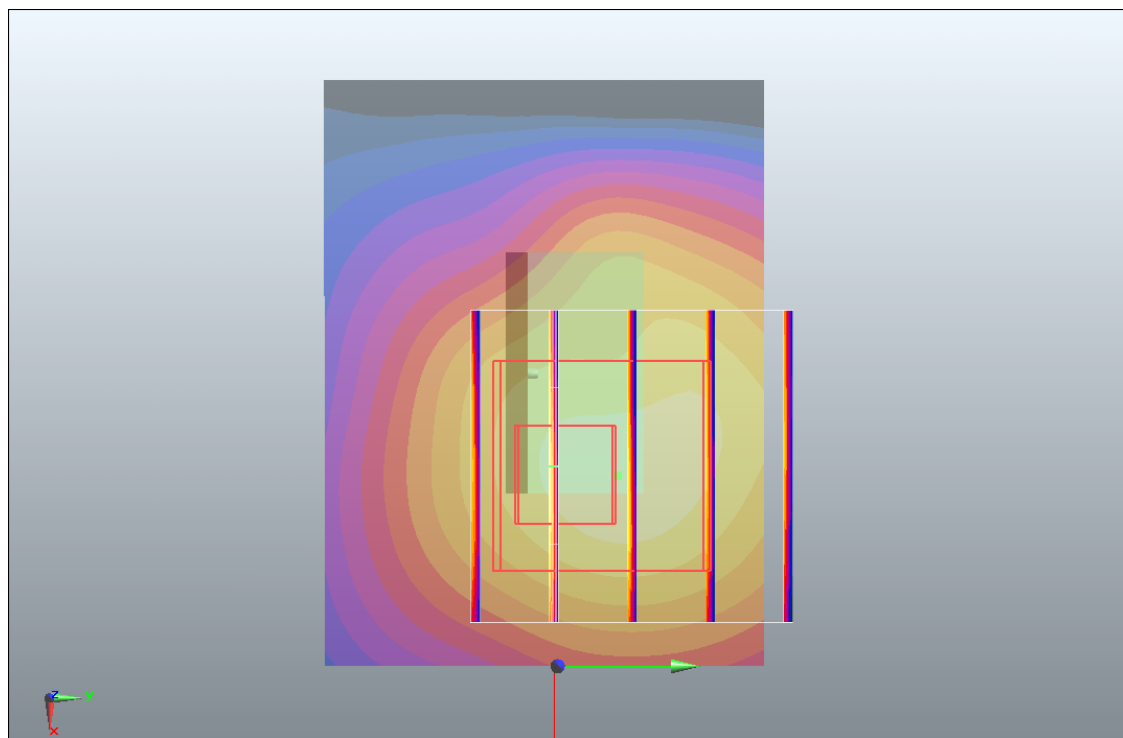
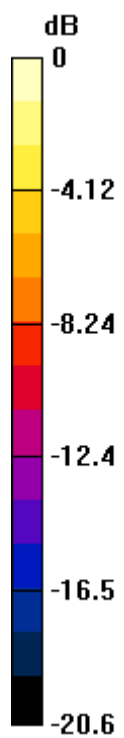
Ch512/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 12.8 V/m ; Power Drift = 0.129 dB

Peak SAR (extrapolated) = 0.801 W/kg

SAR(1 g) = 0.411 mW/g ; SAR(10 g) = 0.196 mW/g

Maximum value of SAR (measured) = 0.512 mW/g



0 dB = 0.512mW/g

#24 WCDMA V_RMC 12.2K_Horizontal Up_0.5cm_Ch4182

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4 \text{ MHz}$; $\sigma = 0.97 \text{ mho/m}$; $\epsilon_r = 56.1$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.383 mW/g

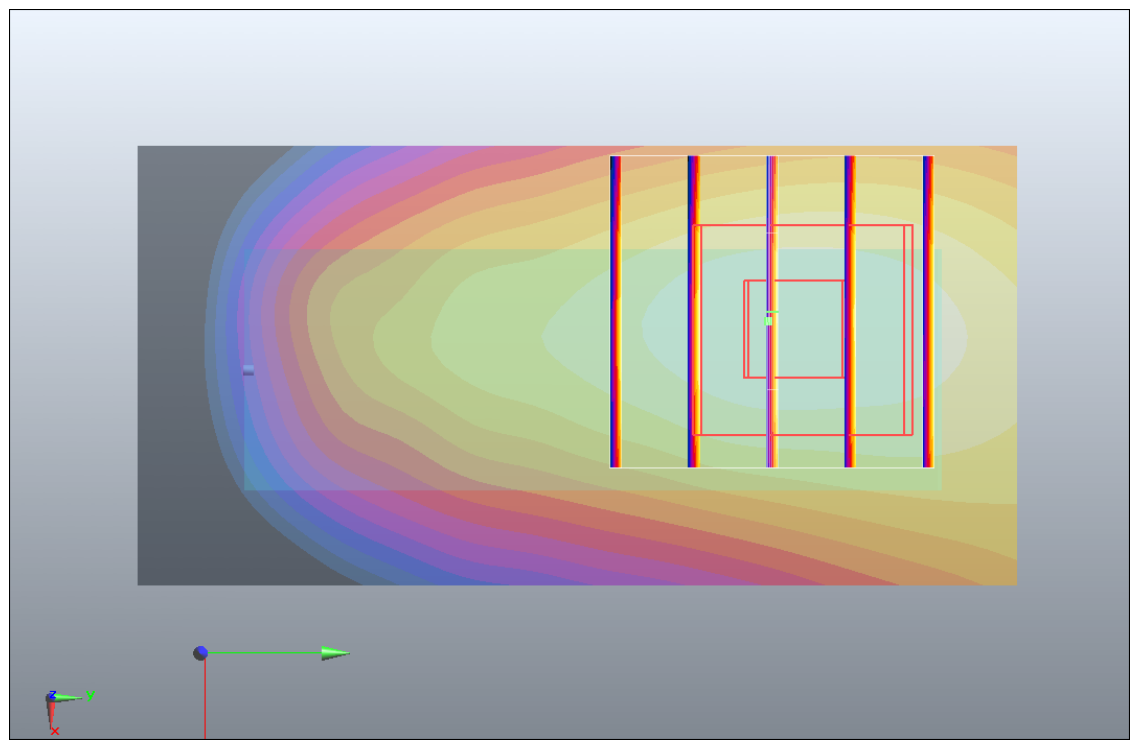
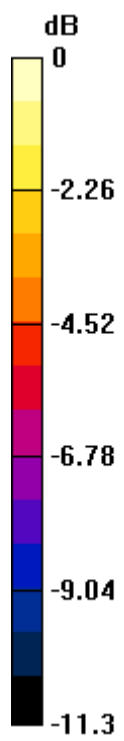
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 7.23 V/m ; Power Drift = -0.081 dB

Peak SAR (extrapolated) = 0.521 W/kg

SAR(1 g) = 0.357 mW/g ; SAR(10 g) = 0.236 mW/g

Maximum value of SAR (measured) = 0.380 mW/g



0 dB = 0.380mW/g

#24 WCDMA V_RMC 12.2K_Horizontal Up_0.5cm_Ch4182_2D

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 56.1$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.383 mW/g

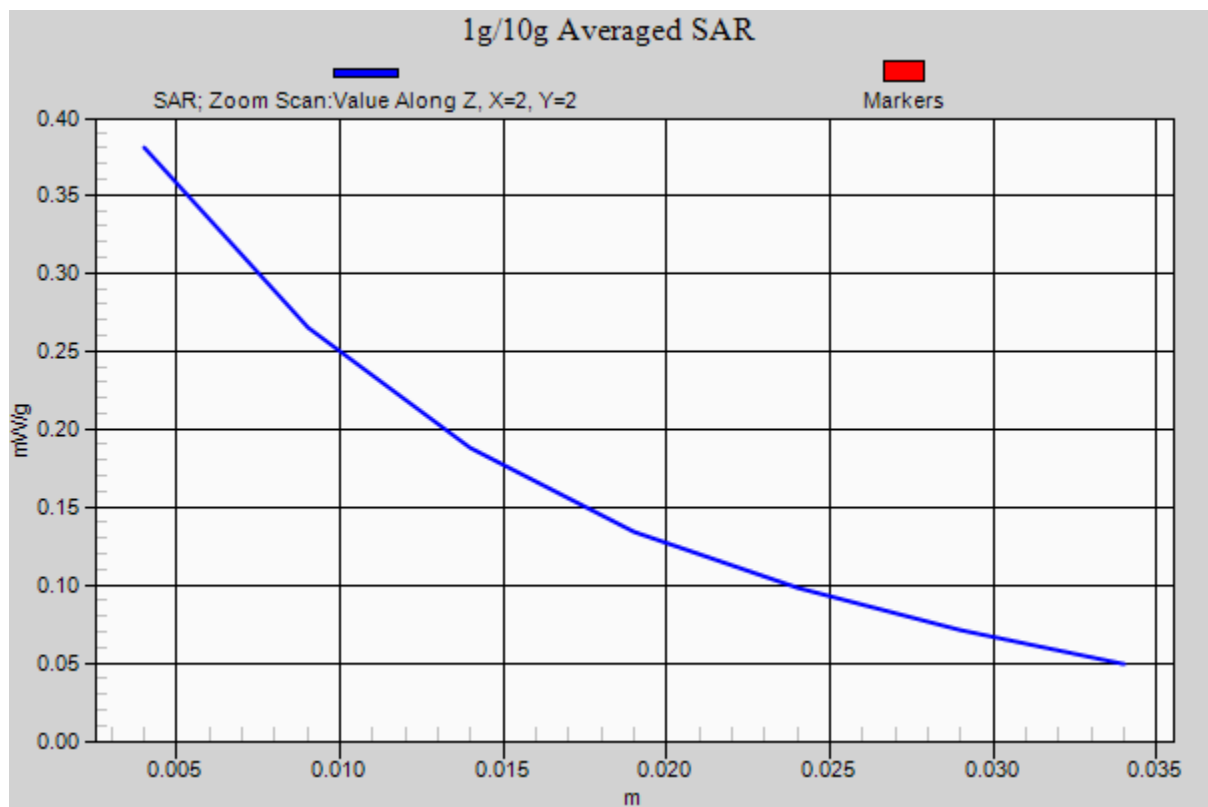
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.23 V/m; Power Drift = -0.081 dB

Peak SAR (extrapolated) = 0.521 W/kg

SAR(1 g) = 0.357 mW/g; SAR(10 g) = 0.236 mW/g

Maximum value of SAR (measured) = 0.380 mW/g



#25 WCDMA V_RMC 12.2K_Horizontal Down_0.5cm_Ch4182

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4 \text{ MHz}$; $\sigma = 0.97 \text{ mho/m}$; $\epsilon_r = 56.1$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.322 mW/g

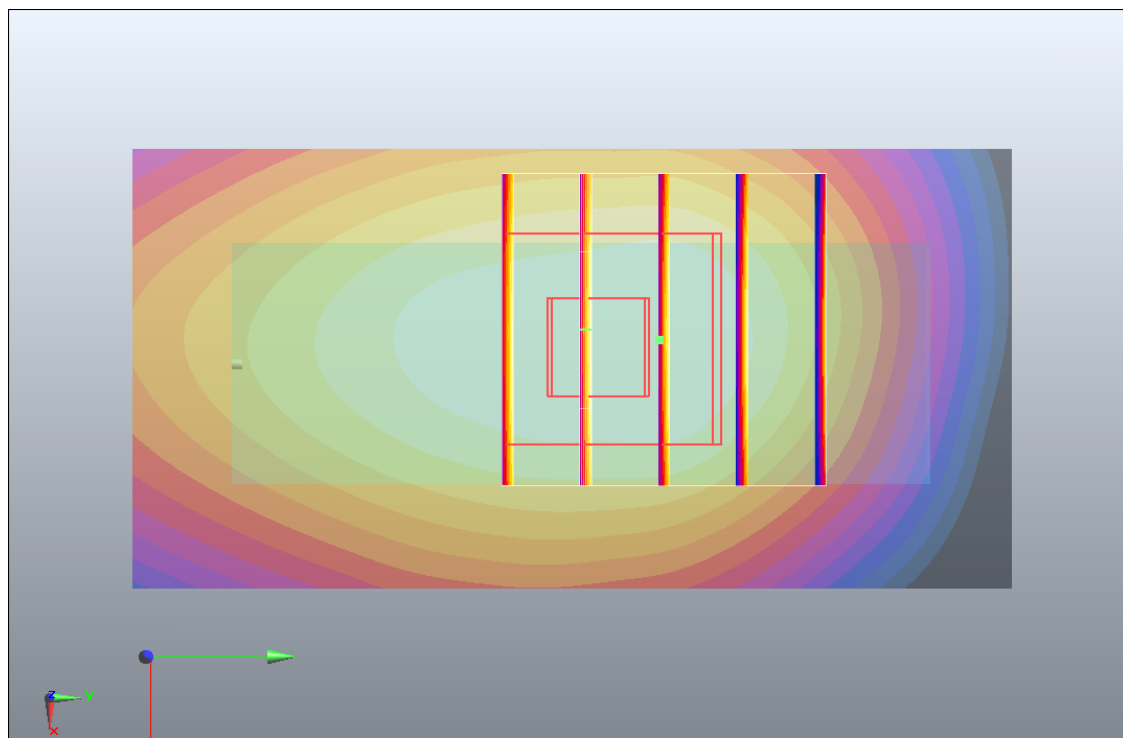
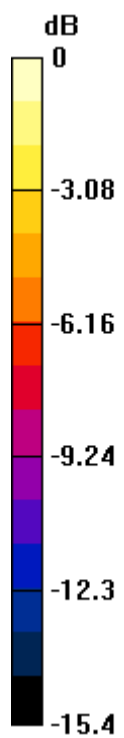
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 8.73 V/m ; Power Drift = -0.057 dB

Peak SAR (extrapolated) = 0.435 W/kg

SAR(1 g) = 0.272 mW/g ; SAR(10 g) = 0.179 mW/g

Maximum value of SAR (measured) = 0.292 mW/g



0 dB = 0.292mW/g

#26 WCDMA V_RMC 12.2K_Veritical Front_0.5cm_Ch4182

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4 \text{ MHz}$; $\sigma = 0.97 \text{ mho/m}$; $\epsilon_r = 56.1$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.303 mW/g

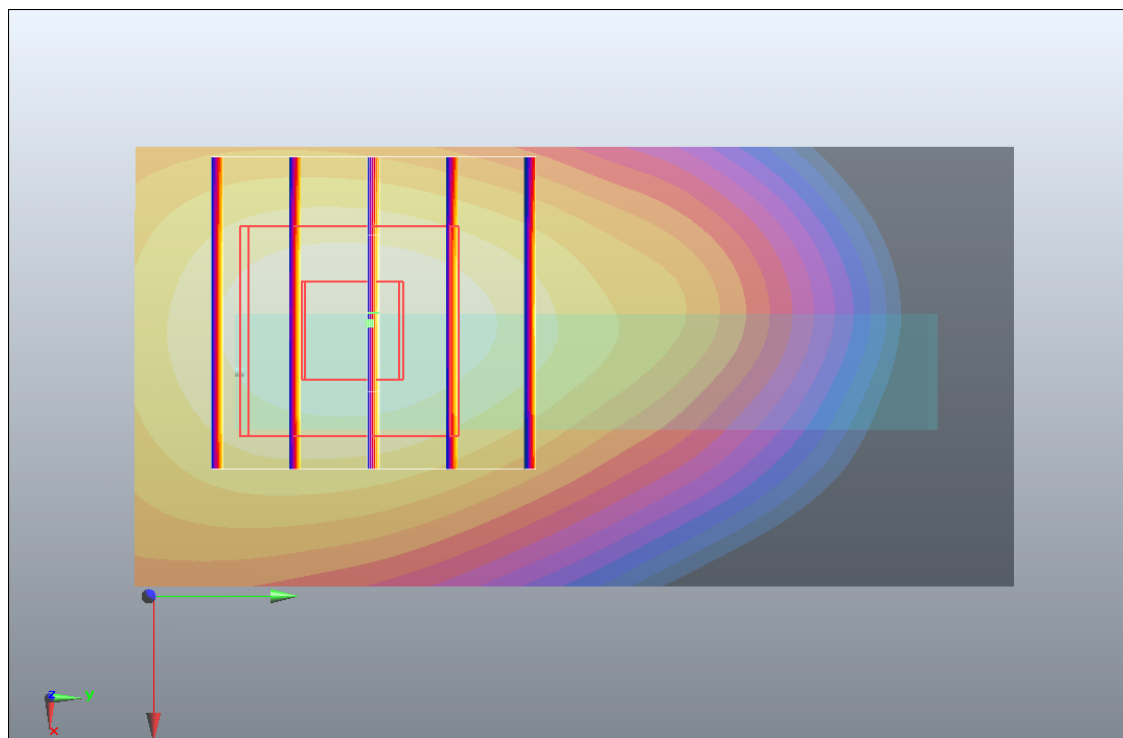
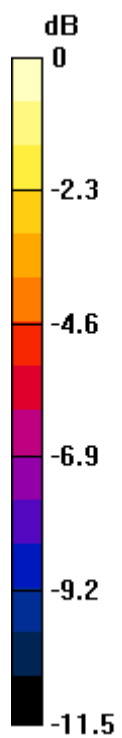
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 15.3 V/m ; Power Drift = -0.058 dB

Peak SAR (extrapolated) = 0.420 W/kg

SAR(1 g) = 0.282 mW/g ; SAR(10 g) = 0.183 mW/g

Maximum value of SAR (measured) = 0.299 mW/g



0 dB = 0.299mW/g

#27 WCDMA V_RMC 12.2K_Vertical Back_0.5cm_Ch4182

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 56.1$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.287 mW/g

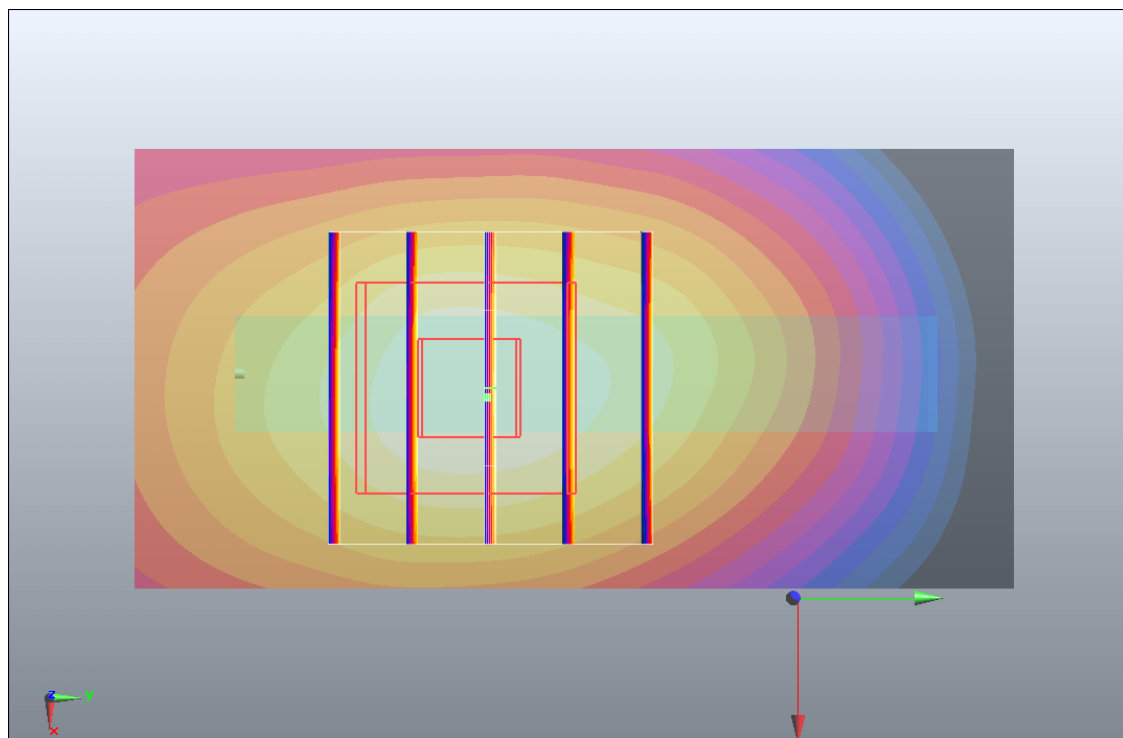
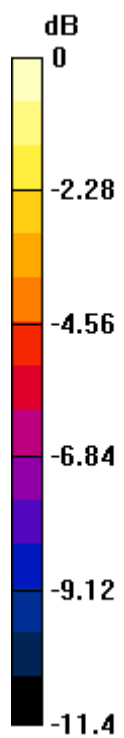
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.84 V/m; Power Drift = -0.078 dB

Peak SAR (extrapolated) = 0.399 W/kg

SAR(1 g) = 0.265 mW/g; SAR(10 g) = 0.169 mW/g

Maximum value of SAR (measured) = 0.287 mW/g



0 dB = 0.287mW/g

#28 WCDMA V_RMC 12.2K_Tip_0.5cm_Ch4182

DUT: 080503

Communication System: UMTS; Frequency: 836.4 MHz; Duty Cycle: 1:1

Medium: MSL_850_100829 Medium parameters used: $f = 836.4$ MHz; $\sigma = 0.97$ mho/m; $\epsilon_r = 56.1$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(8.22, 8.22, 8.22); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM2; Type: SAM; Serial: TP-1479
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch4182/Area Scan (41x31x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.039 mW/g

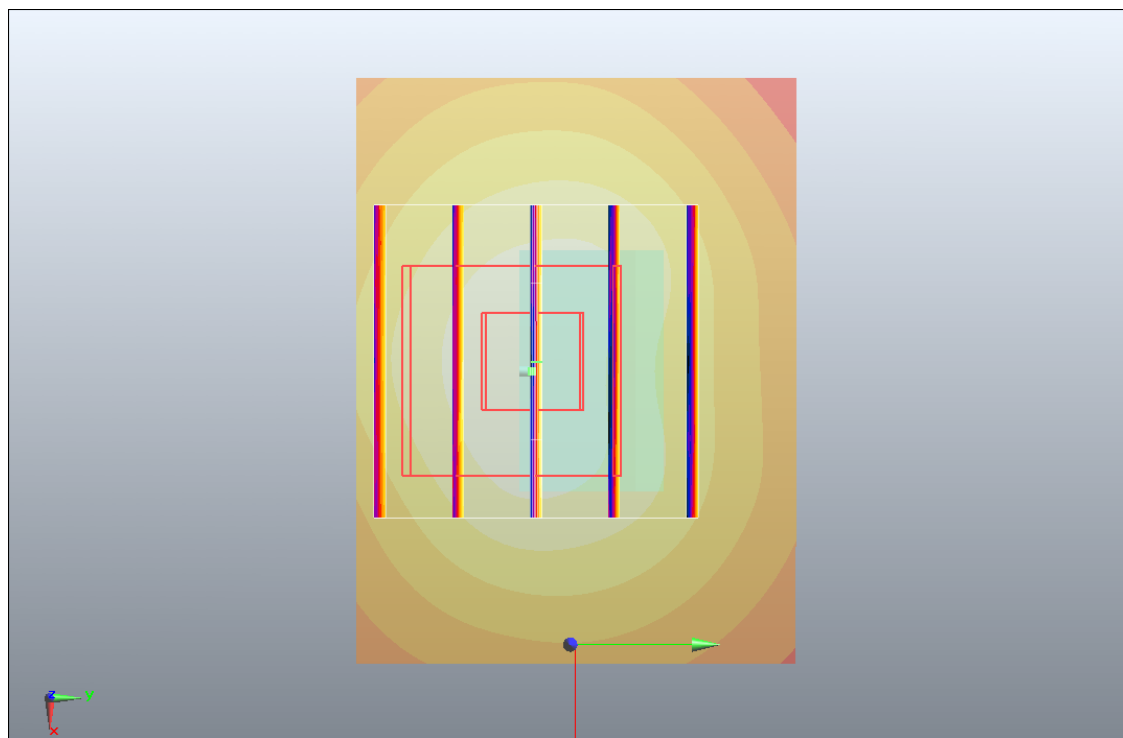
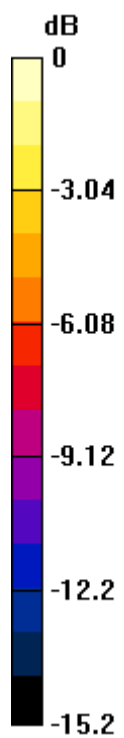
Ch4182/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.11 V/m; Power Drift = -0.134 dB

Peak SAR (extrapolated) = 0.067 W/kg

SAR(1 g) = 0.036 mW/g; SAR(10 g) = 0.021 mW/g

Maximum value of SAR (measured) = 0.040 mW/g



0 dB = 0.040mW/g

#01 WCDMA II_RMC 12.2K_Horizontal Up_0.5cm_Ch9400

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.986 mW/g

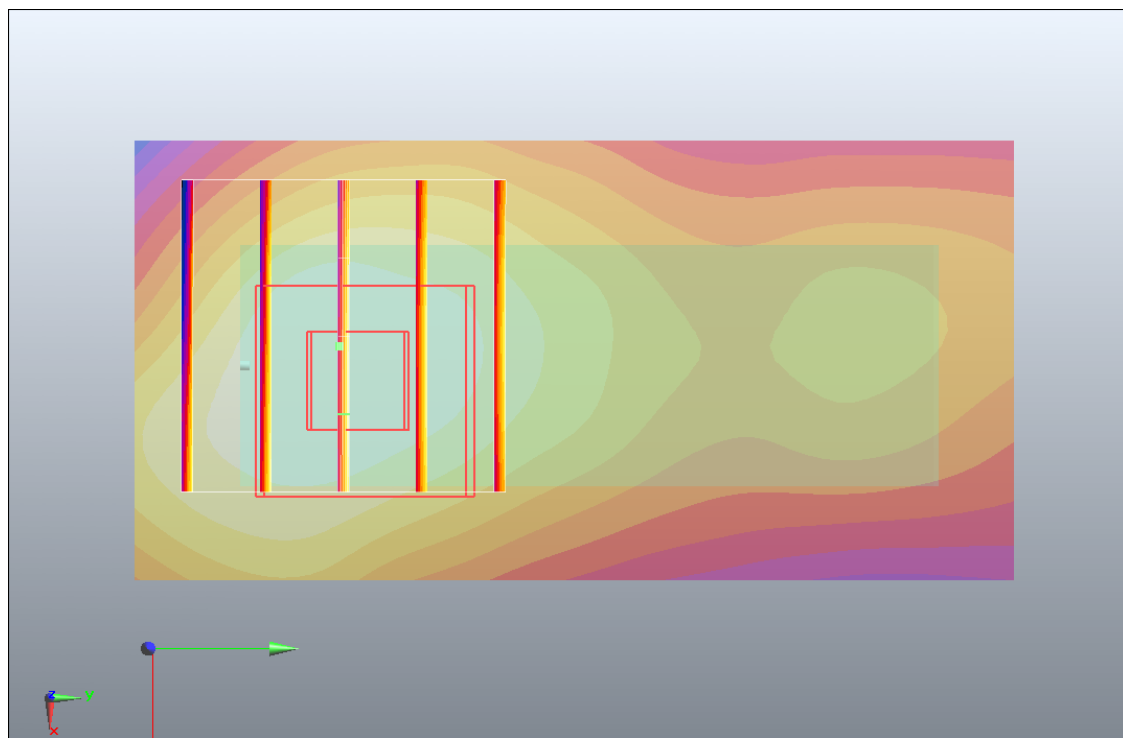
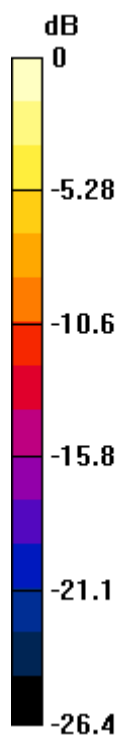
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 20.5 V/m ; Power Drift = -0.102 dB

Peak SAR (extrapolated) = 1.45 W/kg

SAR(1 g) = 0.738 mW/g ; SAR(10 g) = 0.382 mW/g

Maximum value of SAR (measured) = 0.835 mW/g



0 dB = 0.835mW/g

#02 WCDMA II_RMC 12.2K_Horizontal Down_0.5cm_Ch9400

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.632 mW/g

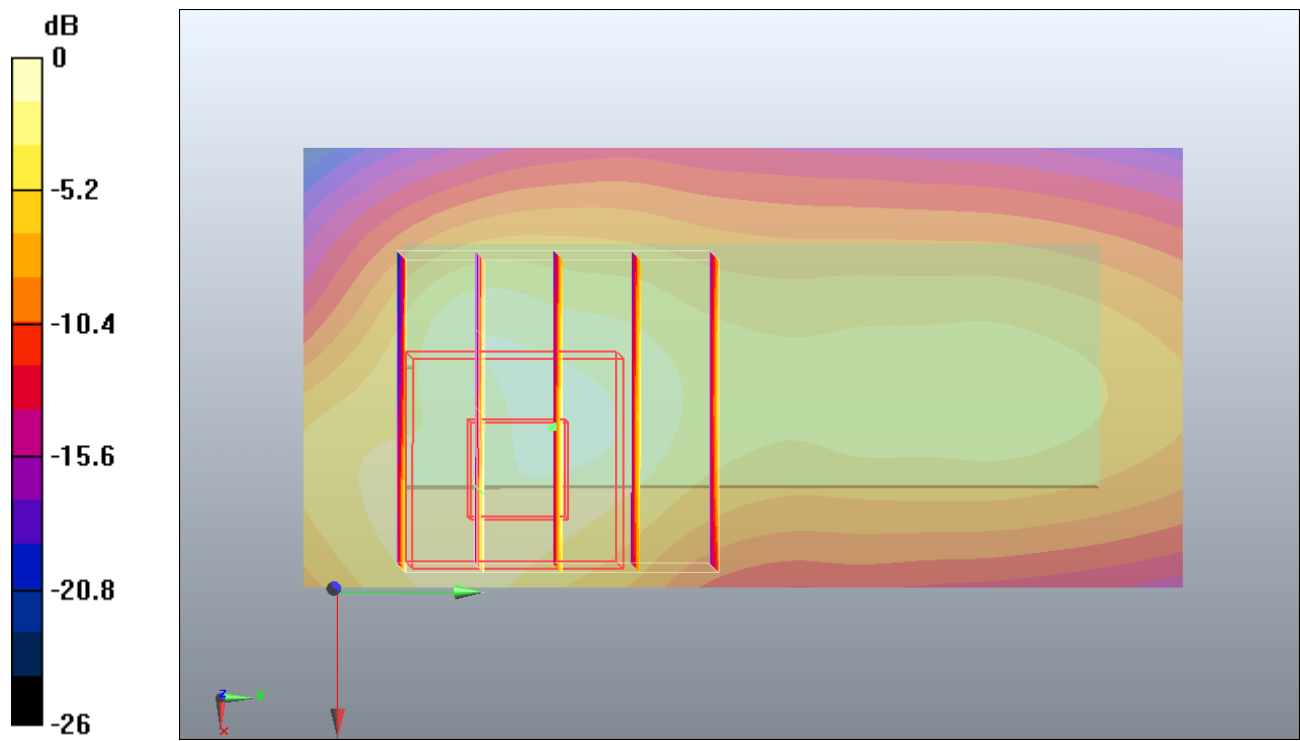
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.3 V/m ; Power Drift = 0.146 dB

Peak SAR (extrapolated) = 1.64 W/kg

SAR(1 g) = 0.774 mW/g ; SAR(10 g) = 0.371 mW/g

Maximum value of SAR (measured) = 0.844 mW/g



0 dB = 0.844mW/g

#02 WCDMA II_RMC 12.2K_Horizontal Down_0.5cm_Ch9400_2D

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (31x61x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.632 mW/g

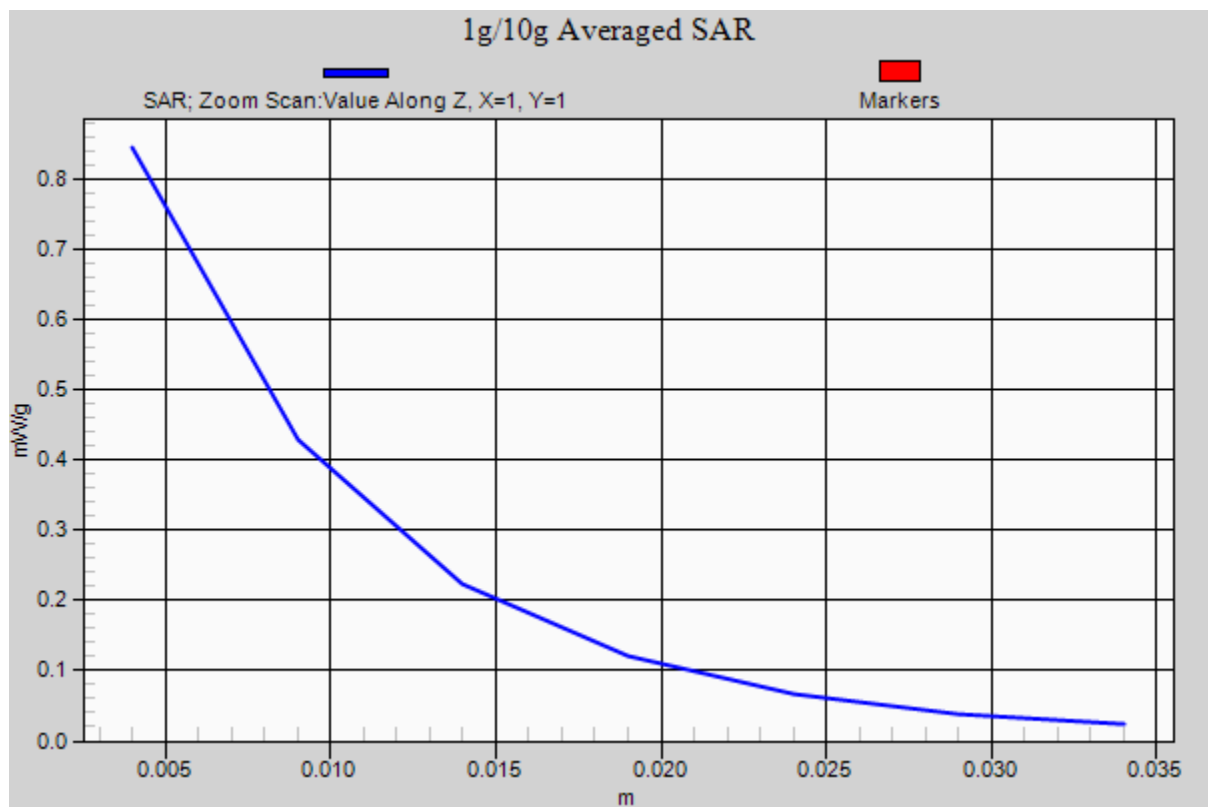
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 19.3 V/m ; Power Drift = 0.146 dB

Peak SAR (extrapolated) = 1.64 W/kg

SAR(1 g) = 0.774 mW/g ; SAR(10 g) = 0.371 mW/g

Maximum value of SAR (measured) = 0.844 mW/g



#03 WCDMA II_RMC 12.2K_Verical Front_0.5cm_Ch9400

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.48$ mho/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.491 mW/g

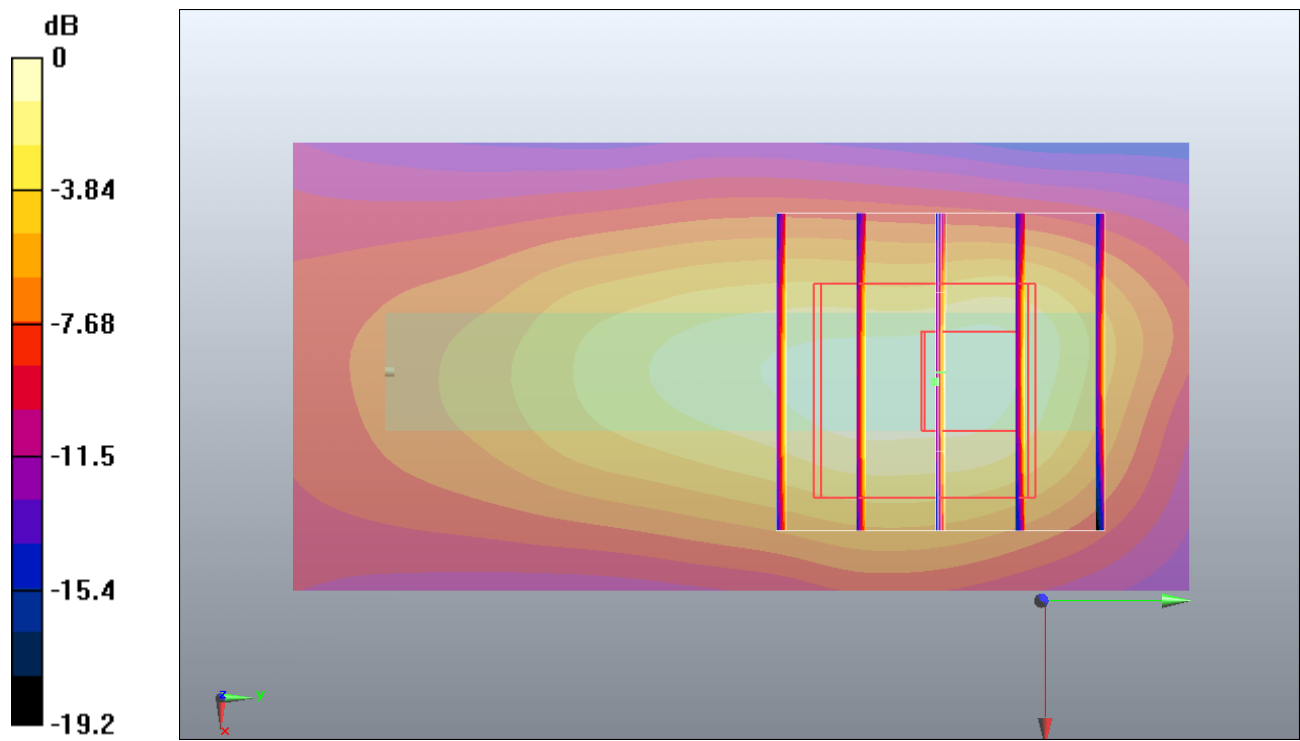
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.65 V/m; Power Drift = 0.058 dB

Peak SAR (extrapolated) = 0.857 W/kg

SAR(1 g) = 0.458 mW/g; SAR(10 g) = 0.226 mW/g

Maximum value of SAR (measured) = 0.516 mW/g



#04 WCDMA II_RMC 12.2K_Veritical Back_0.5cm_Ch9400

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880$ MHz; $\sigma = 1.48$ mho/m; $\epsilon_r = 53.8$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.6 °C; Liquid Temperature : 21.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (31x61x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.354 mW/g

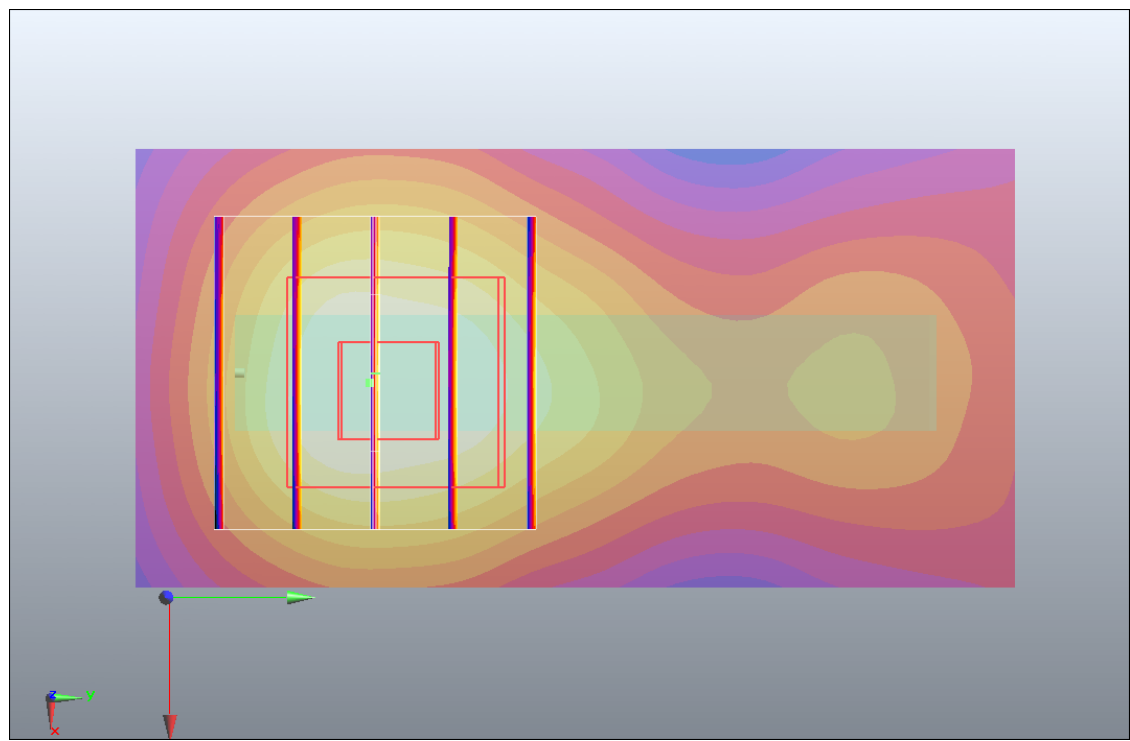
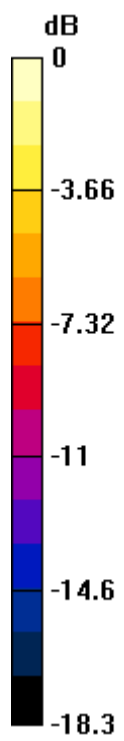
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 9.3 V/m; Power Drift = -0.061 dB

Peak SAR (extrapolated) = 0.468 W/kg

SAR(1 g) = 0.263 mW/g; SAR(10 g) = 0.139 mW/g

Maximum value of SAR (measured) = 0.292 mW/g



0 dB = 0.292mW/g

#05 WCDMA II_RMC 12.2K_Tip_0.5cm_Ch9400

DUT: 080503

Communication System: UMTS; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: MSL_1900_100827 Medium parameters used: $f = 1880 \text{ MHz}$; $\sigma = 1.48 \text{ mho/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature : 23.6°C ; Liquid Temperature : 21.5°C

DASY5 Configuration:

- Probe: EX3DV4 - SN3697; ConvF(7.04, 7.04, 7.04); Calibrated: 11/23/2009
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1210; Calibrated: 2009/11/16
- Phantom: SAM1; Type: SAM; Serial: TP-1477
- Measurement SW : DASY5, V5.2 Build 162; SEMCAD X Version 14.0 Build 57

Ch9400/Area Scan (41x31x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

Maximum value of SAR (interpolated) = 0.301 mW/g

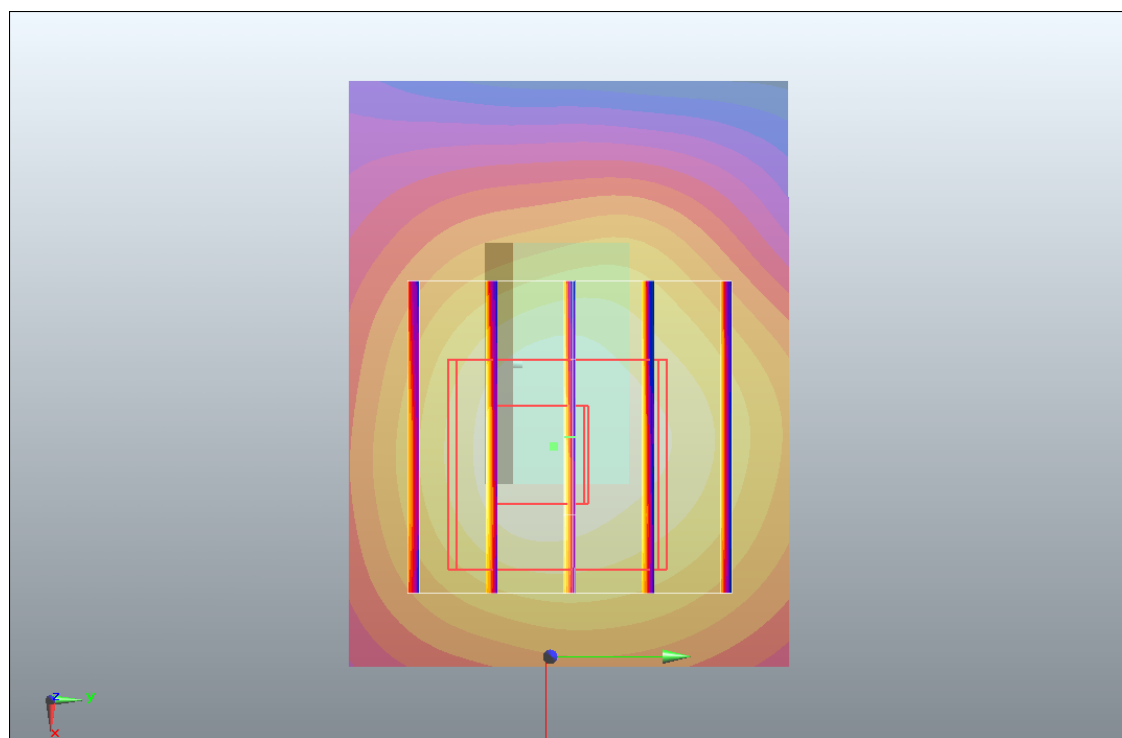
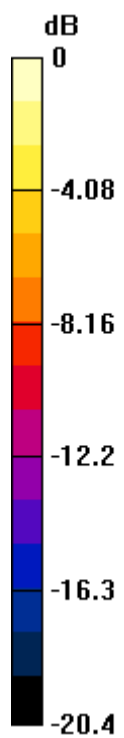
Ch9400/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 11 V/m ; Power Drift = -0.124 dB

Peak SAR (extrapolated) = 0.452 W/kg

SAR(1 g) = 0.249 mW/g ; SAR(10 g) = 0.123 mW/g

Maximum value of SAR (measured) = 0.263 mW/g



0 dB = 0.263mW/g



Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



Calibration Certificate of DASY

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



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

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

Accreditation No.: **SCS 108**

Client **Sporton (Auden)**

Certificate No: **D835V2-4d091_Nov09**

CALIBRATION CERTIFICATE

Object **D835V2 - SN: 4d091**

Calibration procedure(s) **QA CAL-05.v7**
Calibration procedure for dipole validation kits

Calibration date: **November 23, 2009**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	06-Oct-09 (No. 217-01086)	Oct-10
Power sensor HP 8481A	US37292783	06-Oct-09 (No. 217-01086)	Oct-10
Reference 20 dB Attenuator	SN: 5086 (20g)	31-Mar-09 (No. 217-01025)	Mar-10
Type-N mismatch combination	SN: 5047.2 / 06327	31-Mar-09 (No. 217-01029)	Mar-10
Reference Probe ES3DV3	SN: 3205	26-Jun-09 (No. ES3-3205_Jun09)	Jun-10
DAE4	SN: 601	07-Mar-09 (No. DAE4-601_Mar09)	Mar-10
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-09)	In house check: Oct-10

Calibrated by: **Jeton Kastrati** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Issued: November 24, 2009

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

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



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

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

Accreditation No.: **SCS 108**

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.

Measurement Conditions

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

DASY Version	DASY5	V5.2
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V4.9	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	835 MHz \pm 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.2 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 \pm 0.2) °C	41.6 \pm 6 %	0.89 mho/m \pm 6 %
Head TSL temperature during test	(22.0 \pm 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.38 mW / g
SAR normalized	normalized to 1W	9.52 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	9.60 mW /g \pm 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.56 mW / g
SAR normalized	normalized to 1W	6.24 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	6.28 mW /g \pm 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.2 ± 6 %	1.01 mho/m ± 6 %
Body TSL temperature during test	(21.8 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.55 mW / g
SAR normalized	normalized to 1W	10.2 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	9.80 mW / g ± 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.67 mW / g
SAR normalized	normalized to 1W	6.68 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	6.49 mW / g ± 16.5 % (k=2)

**Appendix****Antenna Parameters with Head TSL**

Impedance, transformed to feed point	52.0 Ω - 1.4 j Ω
Return Loss	- 32.3 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.5 Ω - 3.1 j Ω
Return Loss	- 29.2 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.406 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.

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	September 15, 2008

DASY5 Validation Report for Head TSL

Date/Time: 23.11.2009 10:32:03

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d091

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: HSL900

Medium parameters used: $f = 835$ MHz; $\sigma = 0.89$ mho/m; $\epsilon_r = 41.6$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.04, 6.04, 6.04); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

Pin=250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement

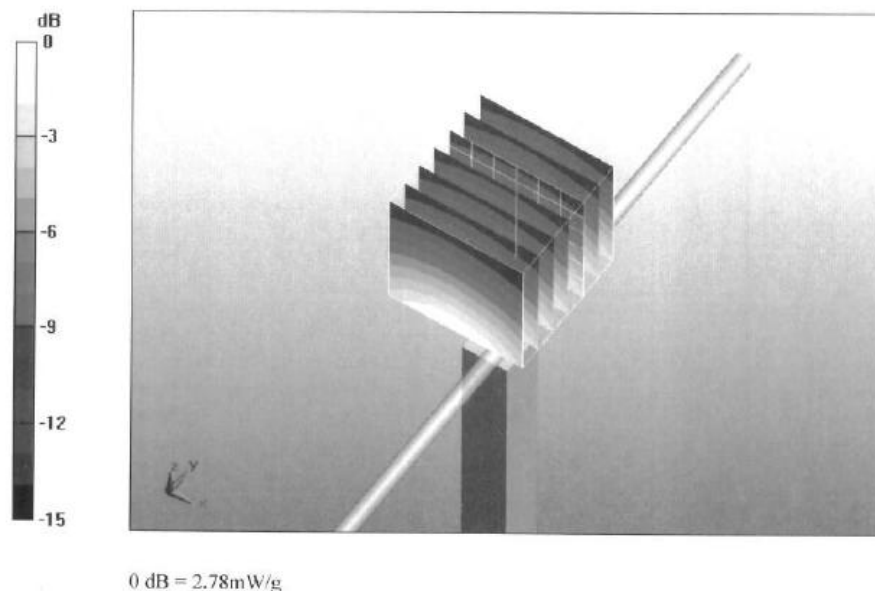
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 57.3 V/m; Power Drift = 0.020 dB

Peak SAR (extrapolated) = 3.56 W/kg

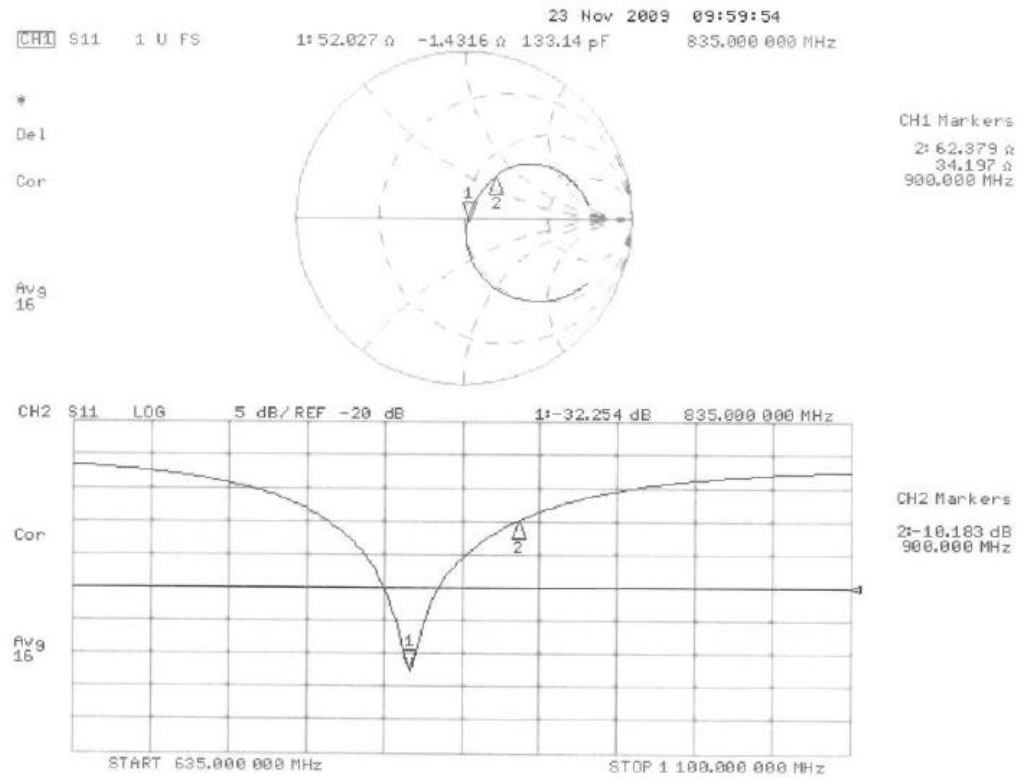
SAR(1 g) = 2.38 mW/g; SAR(10 g) = 1.56 mW/g

Maximum value of SAR (measured) = 2.78 mW/g





Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body

Date/Time: 16.11.2009 10:48:20

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN:4d091

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium: MSL900

Medium parameters used: $f = 835$ MHz; $\sigma = 1.01$ mho/m; $\epsilon_r = 53.2$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY5 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.97, 5.97, 5.97); Calibrated: 26.06.2009
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 07.03.2009
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- Measurement SW: DASY5, V5.2 Build 157; SEMCAD X Version 14.0 Build 57

Pin250 mW /d=15mm, dist=3.0mm (ES-Probe)/Zoom Scan (7x7x7)/Cube 0: Measurement

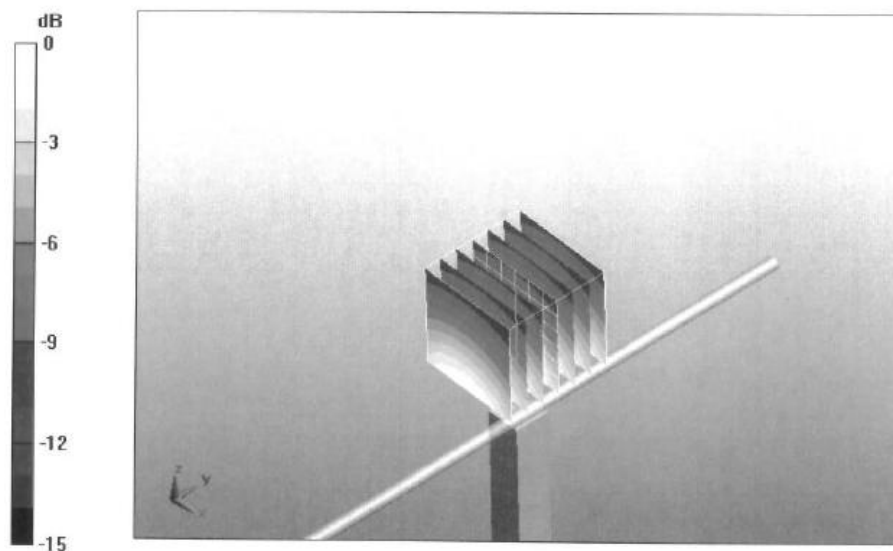
grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.7 V/m; Power Drift = 0.016 dB

Peak SAR (extrapolated) = 3.79 W/kg

SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.67 mW/g

Maximum value of SAR (measured) = 2.95 mW/g



0 dB = 2.95mW/g



Impedance Measurement Plot for Body TSL

