A Test Lab Techno. Corp. RF Testing Lab

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CNLA 認可編號：1330 ILAC MRA

SAR EVALUATION REPORT

Test Report No.：	05-0185-S-00-02-02
Applicant：	Giant Electronics Ltd.
FCC ID：	K7GSX700
Trade Name：	Motorola
Model Name：	SX700
EUT Type：	FRS & GMRS Two-Way Radio
Dates of Test：	Mar 24 - 25, 2005 – Apr 07, 2005
Test Environment：	Ambient Temperature： 22 ± 2 ℃
Relative Humidity：	＜ 60％
Test Specification：	ANSI/IEEE Std. C95.1-1992 IEEE Std. 1528-2003
Max. SAR：	0.354W/kg GMRS Body SAR 0.585 W/kg GMRS Face SAR 0.047 W/kg FRS Body SAR 0.071 W/kg FRS Face SAR (Condition: 50% Duty Cycle and positive power drift)
FCC Classification：	Part 95 Family Radio Face Held Transmitter (FRF)
FCC Rule Part(s)：	§2.1093;FCC/OET Bulletin 65 Supplement C [July 2001]
Test Lab :	Tao-Yuan Lab

1. The test operations have to be performed with cautious behavior, the test results are as attached.
2. The test results are under chamber environment of ATL. ATL does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples.
3. The measurement report has to be written approval of ATL. It may only be reproduced or published in full.

Eddie Chen **20050407**

Testing Center Manager

ATL Techno. Corp. RF Testing Lab

Contents

1. Description of Equipment Under Test (EUT)

Applicant：	**Giant Electronics Ltd.** 7/F., Elite Industrial Bldg., 135-137 Hoi Bun Road, Kwun Tong, Kowloon, Hong Kong
EUT Type：	FRS & GMRS Two-Way Radio
Trade Name：	Motorola
Model Name：	SX700
FCC ID：	K7GSX700
Test Device：	Production Unit
Tx Frequency：	462.5500 - 462.7250 MHz (GMRS) 467.5625 – 467.7125 MHz (FRS)
Max. RF Output Power：	0.63 W ERP GMRS 0.17 W ERP FRS
Max. SAR Measurement：	0.354 W/kg GMRS Body SAR (50% Duty Cycle) 0.585 W/kg GMRS Face SAR (50% Duty Cycle) 0.047 W/kg FRS Body SAR (50% Duty Cycle) 0.071 W/kg FRS Face SAR (50% Duty Cycle) **(Condition: 50% Duty Cycle and positive power drift)**
Antenna Type：	Fixed Type
Device Category：	Portable
RF Exposure Environment：	General Population / Uncontrolled
Battery Option：	Standard
Application Type：	Certification

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment / general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE Std. 1528-2003.

Figure 1. EUT Photo

2. Other Accessories

There is another handset and Belt-clip will be an accessory with this two-way radio.

Figure 2. EUT Photo With Two-Way Radio

3. Introduction

The A Test Lab Techno. Corp. RF Testing Laboratory has performed measurements of the maximum potential exposure to the user of **Giant Electronics Ltd. Trade Name：Motorola Model(s)：SX700**. The test procedures, as described in American National Standards, Institute C95.1 – 1992〔1〕, FCC OET Bulletin65-1997 were employed and they specify the maximum exposure limit of 1.6mW/g as averaged over any 1 gram of tissue for portable devices being used within 20cm of the used in the uncontrolled environment. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the equipment used are included within this test report.

4. SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dw) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Figure 2).

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

Figure 3. SAR Mathematical Equation

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

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

Where：

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = RMS electric field strength (V/m)

＊**Note**：

The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane〔2〕

5. SAR Measurement Setup

These measurements were performed with the automated near-field scanning system DASY4 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.025mm. Special E- and H-field probes have been developed for measurements close to material discontinuity, the sensors of which are directly loaded with a Schottky diode and connected via highly resistive lines (length = 300mm) to the data acquisition unit.

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Measurement Server is based on a PC/104 CPU board with a 166MHz low-power Pentium, 32MB chipdisk and 64MB RAM. The necessary circuits for communication with either the DAE3 electronic box as well as the 16-bit AD-converter system for optical detection and digital I/O interface are contained on the DASY4 I/O-board, which is directly connected to the PC/104 bus of the CPU board. The PC consists of the Intel Pentium 4 2.4GHz computer with Windows2000 system and SAR Measurement Software DASY4, Post Processor SEMCAD, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection…etc. is connected to the Electro-optical converter (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the Measurement Server.

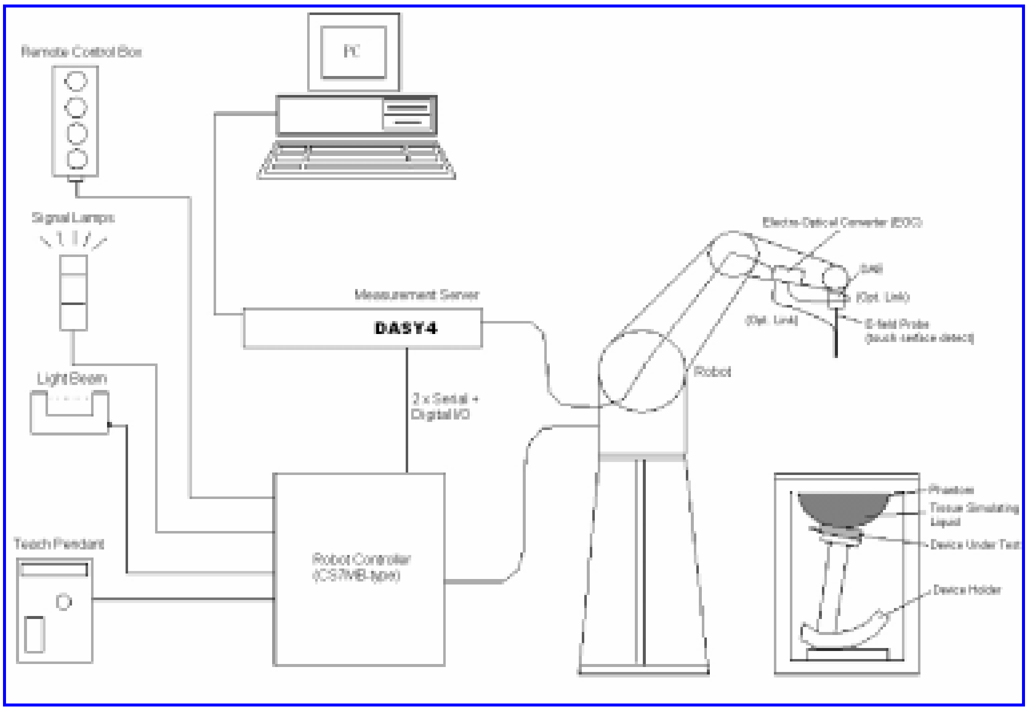

Figure 4. SAR Lab Test Measurement Setup

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in〔3〕.

6. System Components

6.1 DASY4 E-Field Probe System

The SAR measurements were conducted with the dosimetric probe ET3DV6 (manufactured by SPEAG), designed in the classical triangular configuration〔3〕and optimized for dosimetric evaluation. The probes is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped when reaching the maximum.

6.1.1 ET3DV6 E-Field Probe Specification

Construction	Symmetrical design with triangular core
	Built-in optical fiber for surface detection
	System (ET3DV6 only)
	Built-in shielding against static charges
	PEEK enclosure material
	(resistant to organic solvents, e.q., glycol)
Calibration	In air from 10 MHz to 2.5 GHz
	In brain and muscle simulating tissue at
	frequencies of 450MHz, 900MHz, 1.8GHz and 2.45GHz
	(accuracy ±8%)
	Calibration for other liquids and frequencies upon request
Frequency	10 MHz to > 6 GHz; Linearity: ±0.2 dB
	(30 MHz to 3 GHz)
Directivity	± 0.2 dB in brain tissue (rotation around probe axis)
	± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic Range	5 μW/g to > 100mW/g; Linearity: ±0.2dB
Surface Detection	± 0.2 mm repeatability in air and clear liquids
	over diffuse reflecting surface(ET3DV6 only)
Dimensions	Overall length: 330mm
	Tip length: 16mm
	Body diameter: 12mm
	Tip diameter: 6.8mm
	Distance from probe tip to dipole centers: 2.7mm
Application	General dosimetry up to 3GHz
	Compliance tests of mobile phones
	Fast automatic scanning in arbitrary phantoms

Figure 5.
ET3DV6 E-field Probe

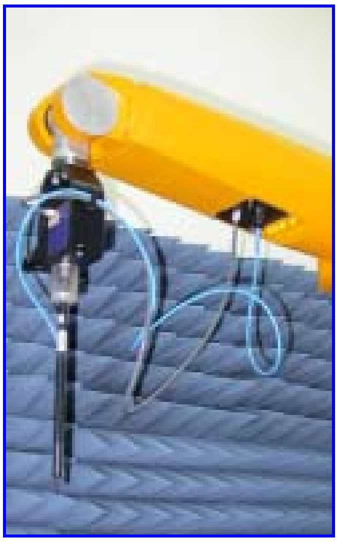

Figure 6.
Probe setup on robot

6.1.2 ET3DV6 E-Field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure described in〔4〕with accuracy better than ± 10%. The spherical isotropy was evaluated with the procedure described in〔5〕and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1GHz, and in a wave guide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

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

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

Where：

Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

Or

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

Where：

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

6.2 Data Acquisition Electronic (DAE) System

Cell Controller

Processor：	Intel Pentium 4
Clock Speed：	2.4GHz
Operating System：	Windows 2000 Professional

Data Converter

Features：	Signal Amplifier, multiplexer, A/D converter, and control logic
Software：	DASY4 v4.5 (Build 19) & SEMCAD v1.8 (Build 146)
Connecting Lines：	Optical downlink for data and status info
	Optical uplink for commands and clock

6.3 Robot

Positioner： Stäubli Unimation Corp. Robot Model: RX90L

Repeatability： ±0.025 mm

No. of Axis： 6

6.4 Measurement Server

Processor： PC/104 with a 166MHz low-power Pentium

I/O-board： Link to DAE3

16-bit A/D converter for surface detection system

Digital I/O interface

Serial link to robot

Direct emergency stop output for robot

6.5 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0, the Mounting Device (POM) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeat ably positioned according to the IEEE SCC34-SC2 and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, and flat phantom).

＊**Note**：A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations〔6〕. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Larger DUT cannot be tested using this device holder. Instead a support of bigger polystyrene cubes and thin polystyrene plates is used to position the DUT in all relevant positions to find and measure spots with maximum SAR values. Therefore those devices are normally only tested at the flat part of the SAM.

Figure 7. Device Holder

6.6 Phantom - SAM v4.0

The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, CENELEC 50361 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.

Figure 8. SAM Twin Phantom

Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	810×1000×500 mm (H×L×W)

Table 1. Specification of SAM v4.0

6.7 Data Storage and Evaluation

6.7.1 Data Storage

The DASY4 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 with

the extension .DA4. The postprocessing 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.

6.7.2 Data Evaluation

The DASY4 postprocessing 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	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	dcpi
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 multimeter 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：

E-field probes：

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

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)

µ V/(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

Hi = 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.

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

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.

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

$$P_{pwe} = \frac{E_{tot}^2}{3770} \quad \text{or} \quad P_{pwe} = \frac{H_{tot}^2}{37.7}$$

with P_{pwe} = equivalent power density of a plane wave in mW/cm^2

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

7. Test Equipment List

Manufacturer	Name of Equipment	Type / Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Filed Probe	ET3DV6	1530	Jan. 17, 2005	Jan. 17, 2006
SPEAG	450MHz System Validation Kit	D450V2	1021	Feb.01, 2005	Feb.01, 2007
SPEAG	Data Acquisition Electronics	DAE3	541	Apr. 26, 2004	Apr. 26, 2005
SPEAG	Device Holder	N/A	N/A	NCR	NCR
SPEAG	Phantom	SAM V4.0	1009	NCR	NCR
SPEAG	Robot	Staubli RX90L	F00/589B1/A/01	NCR	NCR
SPEAG	Software	DASY4 V4.5 Build 3	N/A	NCR	NCR
SPEAG	Software	SEMCAD V1.8 Build 146	N/A	NCR	NCR
SPEAG	Measurement Server	SE UMS 001 BA	1021	NCR	NCR
Agilent	Wireless Communication Test Set	8960(E5515C)	GB41450409	Jan.31,2005	Jan.31,2007
Agilent	S-Parameter Network Analyzer	8720ES	US39172472	May 18, 2004	May 18, 2005
Agilent	Dielectric Probe Kit	85070C	US99360094	NCR	NCR
Agilent	Power Meter	E4418C	GB40206143	May 18, 2004	May 17, 2005
Agilent	Power Sensor	8481H	3318A0779	July 3, 2004	July 3, 2005
Agilent	Signal Generator	8648C	3847A05201	July 13, 2004	July 13, 2005
Agilent	Dual Directional Coupler	778D	50334	NCR	NCR
Mini-Circuits	Power Amplifier	ZHL-42W-SMA	D111103#5	NCR	NCR

Table 2. Test Equipment List

8. Tissue Simulating Liquids

The Head and Muscle mixtures consist of a viscous gel using hydroxethylcellullouse (HEC) gelling agent and saline solution. Preservation with a bacteriacide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8720ES Network Analyzer.

INGREDIENT	FREQUENCY	
	HSL450 – Head (400-500MHz)	**MSL450- Muscle (400-500MHz)**
Water	38.91 %	46.21 %
HEC	0.25 %	0.18 %
Sugar	56.93 %	51.17 %
Preventol	0.12 %	0.08 %
Salt	3.79 %	2.34 %
Glycol monobutyl	0 %	0 %
Dielectric Parameters at 22°	f = 450 MHz $\varepsilon r = 43.5$,$\sigma = 0.87$ S/m	f = 450 MHz $\varepsilon r = 56.7$,$\sigma = 0.94$ S/m

Table 3. Recipes for Head & Muscle Tissue Simulating Liquids

IEEE SCC-34/SC-2 in 1528 recommended Tissue Dielectric Parameters

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in human head. Other head and body tissue parameters that have not been specified in 1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equation and extrapolated according to the head parameter specified in 1528.

Target Frequency	Head		Body	
(MHz)	ε_r	σ (S/m)	ε_r	σ (S/m)
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800 - 2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00
(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)				

Table 4. Tissue dielectric parameters for head and body phantoms

8.1 Liquid Confirmation

8.1.1 Parameters

Liquid Verify								
Ambient Temperature： 22±2 ℃；Relative Humidity：<60％								
Liquid Tyep	**Frequency**	**Temp (℃)**	**Parameters**	**Target Value**	**Measured Value**	**Deviation (%)**	**Limit (%)**	**Measured Date**
450 MHz Head	450MHz	21.2	εr	43.5	45.2	-3.90%	±5 %	Mar . 23, 2005
			σ	0.87	0.855	1.724 %	±5 %	
450 MHz Body	450MHz	21.3	εr	56.7	56.1	1.06 %	±5 %	Mar . 23, 2005
			σ	0.94	0.952	-1.27 %	±5 %	
450 MHz Body	450MHz	21.9	εr	56.7	55	3%	±5 %	Apr .07,2005
			σ	0.94	0.966	-2.69%	±5 %	

Table 5. Measured Tissue dielectric parameters for head and body phantoms

8.1.2 Liquid Depth

The liquid level was during measurement 15cm ±0.5cm.

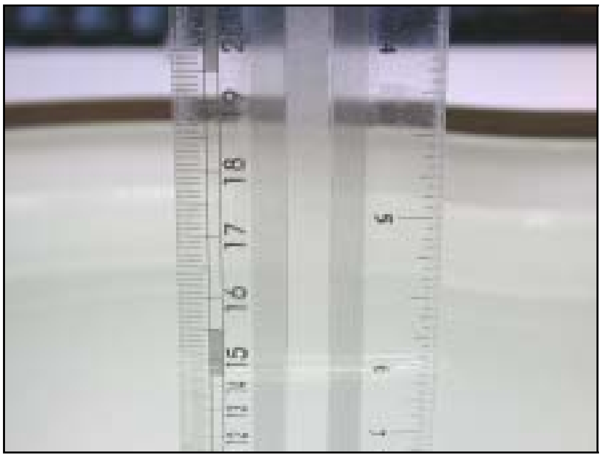

Figure 9. Head-Tissue-Simulating-Liquid 450MHz

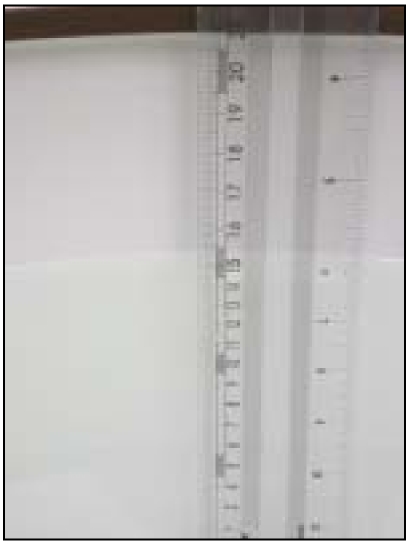

Figure 10. Muscle-Tissue-Simulating-Liquid 450MHz

9. Measurement Process

9.1 Device and Test Conditions

The Test Device was provided by **Giant Electronics Ltd.** for this evaluation. The spatial peak SAR values were assessed for the lowest, middle and highest channels defined by GMRS (Ch4=462.637MHz, Ch15=462.55MHz, Ch22=462.75MHz) / FRS (Ch8=467.563MHz, Ch11=467.637MHz, Ch14=467.712MHz) systems. The antenna(s), battery and accessories shall be those specified by the manufacturer. The battery shall be fully charged before each measurement and there shall be no external connections.

9.2 System Performance Check

9.2.1 Symmetric Dipoles for System Validation

Construction	Symmetrical dipole with l/4 balun enables measurement of feed point 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	450, 900, 1800, 2450MHz
Return Loss	> 20 dB at specified validation position
Power Capability	> 100 W (f < 1GHz); > 40 W (f > 1GHz)
Options	Dipoles for other frequencies or solutions and other calibration conditions are available upon request
Dimensions	D450V2：dipole length 270 mm; overall height 330 mm D900V2：dipole length 149 mm; overall height 330 mm D1800V2：dipole length 72 mm; overall height 300 mm D2450V2：dipole length 51.5 mm; overall height 300 mm

Figure 11. Validation Kit

9.2.2 Validation

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ± 10%. The validation was performed at 450MHz.

Validation kit	Mixture Type	SAR_{1g} [mW/g]	SAR_{10g} [mW/g]	Date of Calibration
D450V2-SN1021	Head	5.025	3.3	Feb 01, 2005
	Body	5.35	3.475	

Frequency (MHz)	Power (dBm)	SAR_{1g} (mW/g)	SAR_{10g} (mW/g)	Drift (dB)	Difference percentage		Date
					1g	10g	
450 (Head)	400mW	2.07	1.3	0.1	3.0	-1.5	Mar . 24-25,2005
	Normalize to 1 Watt	5.175	3.25				
450 (Body)	400mW	2.18	1.37	0.0	1.9	-1.4	Mar . 24-25,2005
	Normalize to 1 Watt	5.45	3.425				
450 (Body)	400mW	2.21	1.39	0.02	3.3	0	Apr. 07,2005
	Normalize to 1 Watt	5.525	3.475				

9.3 Dosimetric Assessment Setup

9.3.1 Handset Test Position - Head Position

A handset should be initially positioned with the earpiece region pressed against the ear spacer of a head phantom. For the SCC-34/SC-2 head phantom, the device should be positioned parallel to the "N-F" line defined along the base of the ear spacer that contains the "ear reference point". For interim head phantoms, the device should be positioned parallel to the cheek for maximum RF energy coupling. The "test device reference point" is aligned to the "ear reference point" on the head phantom and the "vertical centerline" is aligned to the "phantom reference plane". This is called the "initial ear position". While maintaining these three alignments, the body of the handset is gradually adjusted to each of the following positions for evaluating SAR：

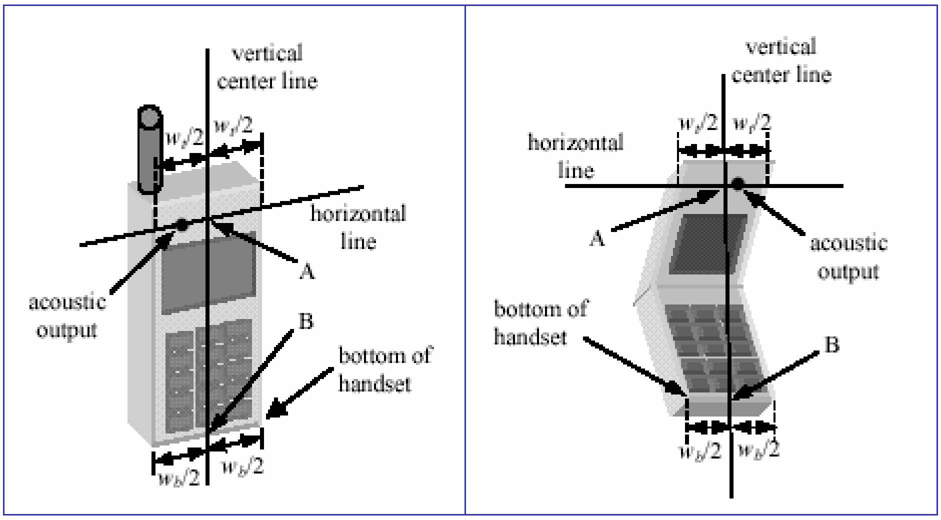

Figure 12. Handset vertical and horizontal Reference Lines
- Fixed Case & Clam Shell

1) "Cheek/Touch Position" — the device is brought toward the mouth of the head phantom by pivoting against the "ear reference point" or along the "N-F" line for the SCC-34/SC-2 head phantom.
This test position is established:
i) When any point on the display, keypad or mouthpiece portions of the handset is in contact with the phantom.
ii) (Or) when any portion of a foldout, sliding or similar keypad cover opened to its intended self-adjusting normal use position is in contact with the cheek or mouth of the phantom.
For existing head phantoms — when the handset loses contact with the phantom at the pivoting point, rotation should continue until the device touch the cheek of the phantom or breaks its last contact from the ear spacer.

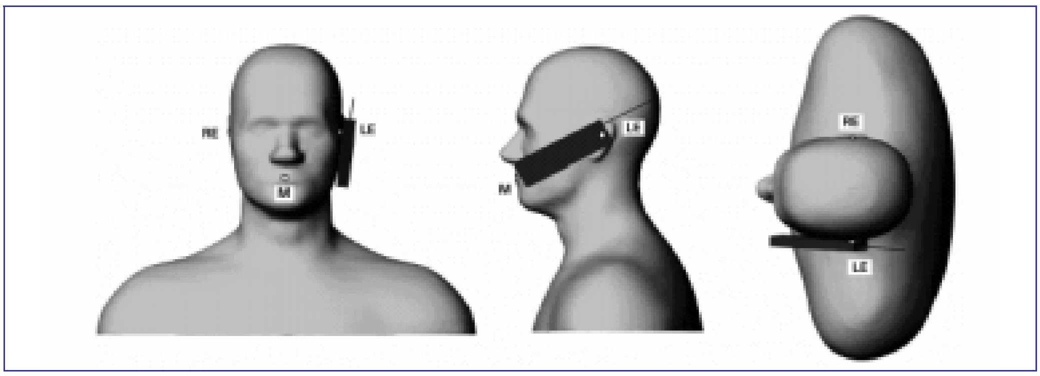

Figure 13. Phone Position 1, Cheek or Touch Position

2) "Ear/Tilt Position" — With the handset aligned in the "Cheek/Touch Position":
   i) If the earpiece of the handset is not in full contact with the phantom's ear spacer (in the "Cheek/Touch position") and the peak SAR location for the "Cheek/Touch" position is located at the ear spacer region or corresponds to the earpiece region of the handset, the device should be returned to the "initial ear position" by rotation it away from the mouth until the earpiece is in full contact with the ear spacer.
   ii) (Otherwise) the handset should be moved (translated) away from the cheek perpendicular to the line passes through both "ear reference points" (note: one of these ear reference points may not physically exist on a split head model) for approximate 2-3cm. While it is in this position, the handset is tilted away from the mouth with respect to the "test device reference point" by 15°. After the tilt, it is then moved (translated) back toward the head perpendicular to the line passes through both "ear reference points" until the device touches the phantom or the ear spacer. If the antenna touches the head first, the positioning process should be repeated with a tilt angle less than 15° so that the device and its antenna would touch the phantom simultaneously. This test position may require a device holder or positioner to achieve the translation and tilting with acceptable positioning repeatability.

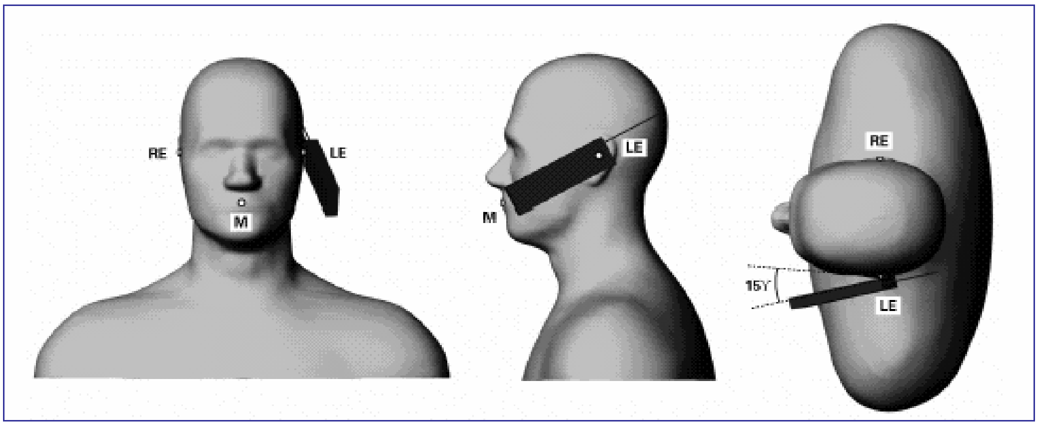

Figure 14. Phone Position 2, Tilted Position

9.3.2 Handset Test Position – Body-Worn

Body-Worn Configuration

Body–worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations. Devices with a headset output should be tested with a headset connected to the device.
Body-worn accessories may not always be supplied or available as options for some devices that are intended to be authorized for body-worn use. A separation distance of 1.5 cm between the back of the device and a flat phantom is recommended for testing body-worn SAR compliance under such circumstances.
For this test：

☐ The EUT is placed into the holster/belt clip and the holster is positioned against the surface of the phantom in a normal operating position.

■ Since this EUT doesn't supply any body-worn accessory to the end user, a distance of 1.5 cm was tested to confirm the necessary "minimum SAR separation distance".
(✳**Note**：this distance includes the 2 mm phantom shell thickness.)

9.3.3 Measurement Procedures

The evaluation was performed with the following procedures：

Surface Check： A surface check job gathers data used with optical surface detection. It determines the distance from the phantom surface where the reflection from the optical detector has its peak. Any following measurement jobs using optical surface detection will then rely on this value. The surface check performs its search a specified number of times, so that the repeatability can be verified.

Reference： The reference job measures the field at a specified reference position, at 4 mm from the selected section's grid reference point.

Area Scan： The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a finer measurement around the hot spot. The sophisticated interpolation routines can find the maximum locations even in relatively coarse grids. When an area scan has measured all reachable points, it computes the field maxima found in the scanned area, within a range of the global maximum. Any following zoom scan within the same procedure will then perform fine scans around these maxima. The area covered the entire dimension of the EUT and the horizontal grid spacing was 15 mm × 15 mm.

Zoom Scan： Zoom scans are used to assess the highest averaged SAR for cubic averaging volumes with 1 g and 10 g of simulated tissue. The zoom scan measures 5 x 5 x 7 points in a 32 x 32 x 30 mm cube whose base faces are centered around the maxima returned from a preceding area scan within the same procedure.

Drift： The drift job measures the field at the same location as the most recent reference job within the same procedure, with the same settings. The drift measurement gives the field difference in dB from the last reference measurement. Several drift measurements are possible for each reference measurement. This allows monitoring of the power drift of the device in the batch process.If the value changed by more than 5%, the evaluation was repeated.

9.4 Spatial Peak SAR Evaluation

The DASY4 software includes all numerical procedures necessary to evaluate the spatial peak SAR values. Based on the Draft: SCC-34, SC-2, WG-2 - Computational Dosimetry, IEEE P1529/D0.0 (Draft Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) Associated with the Use of Wireless Handsets - Computational Techniques), a new algorithm has been implemented. The spatial-peak SAR can be computed over any required mass.

The base for the evaluation is a "cube" measurement in a volume of (32x32x30)mm^3 (5x5x7 points). 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. If the 10g cube or both cubes are not entirely inside the measured volumes, the system issues a warning regarding the evaluated spatial peak values within the Postprocessing engine (SEMCAD). This means that if the measured volume is shifted, higher values might be possible. To get the correct values you can use a finer measurement grid for the area scan. In complicated field distributions, a large grid spacing for the area scan might miss some details and give an incorrectly interpolated peak location.
The entire evaluation of the spatial peak values is performed within the Postprocessing 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 three stages:

Interpolation and Extrapolation

The probe is calibrated at the center of the dipole sensors which 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.
In DASY4, the choice of the coordinate system defining the location of the measurement points has no influence on the uncertainty of the interpolation, Maxima Search and SAR extrapolation routines. The interpolation, Maxima Search and extrapolation routines are all based on the modified Quadratic Shepard's method [7].

10. Measurement Uncertainty

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental. However, we estimate the measurement uncertainties in SAR to be less than ± 27 % 〔8〕.
According to ANSI/IEEE C95.3〔9〕, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of ±1 to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least ±2dB can be expected.
According to CENELEC〔10〕, typical worst-case uncertainty of field measurements is ±5 dB. For well-defined modulation characteristics the uncertainty can be reduced to ±3 dB.

Source of Uncertainty	Uncertainty Value	Probability Distribution	Divisor	c_i	Standard Uncertainty ±1% (1-g)	v_i or V_{eff}
Type-A	0.9 %	Normal	1	1	0.9	9
Measurement System						
Probe Calibration	7 %	Normal	2	1	3.5	∞
Axial Isotropy	0.2dB	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	1.9	∞
Hemispherical Isotropy	9.6 %	Rectangular	$\sqrt{3}$	$\sqrt{0.5}$	3.9	∞
Spatial Resolution	0 %	Rectangular	$\sqrt{3}$	1	0	∞
Boundary Effect	11.0 %	Rectangular	$\sqrt{3}$	1	6.4	∞
Linearity	0.2dB	Rectangular	$\sqrt{3}$	1	2.7	∞
Detection Limit	1.0 %	Rectangular	$\sqrt{3}$	1	0.6	∞
Readout Electronics	1.0 %	Normal	1	1	1.0	∞
RF Ambient Conditions	3.0 %	Rectangular	$\sqrt{3}$	1	1.73	∞
Probe Positioner Mech. Const.	0.4 %	Rectangular	$\sqrt{3}$	1	0.2	∞
Probe Positioning	0.35 %	Rectangular	$\sqrt{3}$	1	0.2	∞
Extrapolation and Integration	3.9 %	Rectangular	$\sqrt{3}$	1	2.3	∞
Test sample Related						
Test sample Positioning	4.7 %	Normal	1	1	4.7	5
Device Holder Uncertainty	6.1 %	Normal	1	1	6.1	5
Drift of Output Power	5.0 %	Rectangular	$\sqrt{3}$	1	2.9	∞
Phantom and Setup						
Phantom Uncertainty (Including temperature effects)	4.0%	Rectangular	$\sqrt{3}$	1	2.3	∞
Liquid Conductivity (target)	5.0%	Rectangular	$\sqrt{3}$	0.6	1.7	∞
Liquid Conductivity (meas.)	10.0%	Rectangular	$\sqrt{3}$	0.6	3.4	∞
Liquid Permittivity (target)	5.0%	Rectangular	$\sqrt{3}$	0.6	1.7	∞
Liquid Permittivity (meas.)	5.0%	Rectangular	$\sqrt{3}$	0.6	1.7	∞
Combined standard uncertainty		RSS			13.5	88.7
Expanded uncertainty (Coverage factor = 2)		Normal (k=2)			27	

Table 6. Uncertainty Budget of DASY

11. SAR Test Results Summary

11.1 GMRS Face SAR -1.5CM Spacing

Ambient：

Temperature (℃)：	**22 ± 2**	Relative HUMIDITY (%)：	**< 60**

Liquid：

Mixture Type：	**HSL450**	Liquid Temperature (℃) ：	**21.2**
		Depth of liquid (cm)：	**15**

Measurement：

Crest Factor：	**1**	Probe S/N：	**1530**

Frequency		Moduction	Battery	Accessory	SAR1g[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
462.5500	15	FM	Moto	N/A	0.809	0.404	-1.61	-	22.1	21.2
462.6375	4	FM	Moto	N/A	0.987	0.493	-0.71	-	22.2	21.2
462.7250	22	FM	Moto	N/A	0.766	0.383	-1.34	-	22.1	21.2
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR1g[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR1g[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
462.55	15	0.809	0.404	-1.61	1.449	1.172	0.585
462.6375	4	0.987	0.493	-0.71	1.178	1.162	0.581
462.725	22	0.766	0.383	-1.34	1.361	1.043	0.521

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

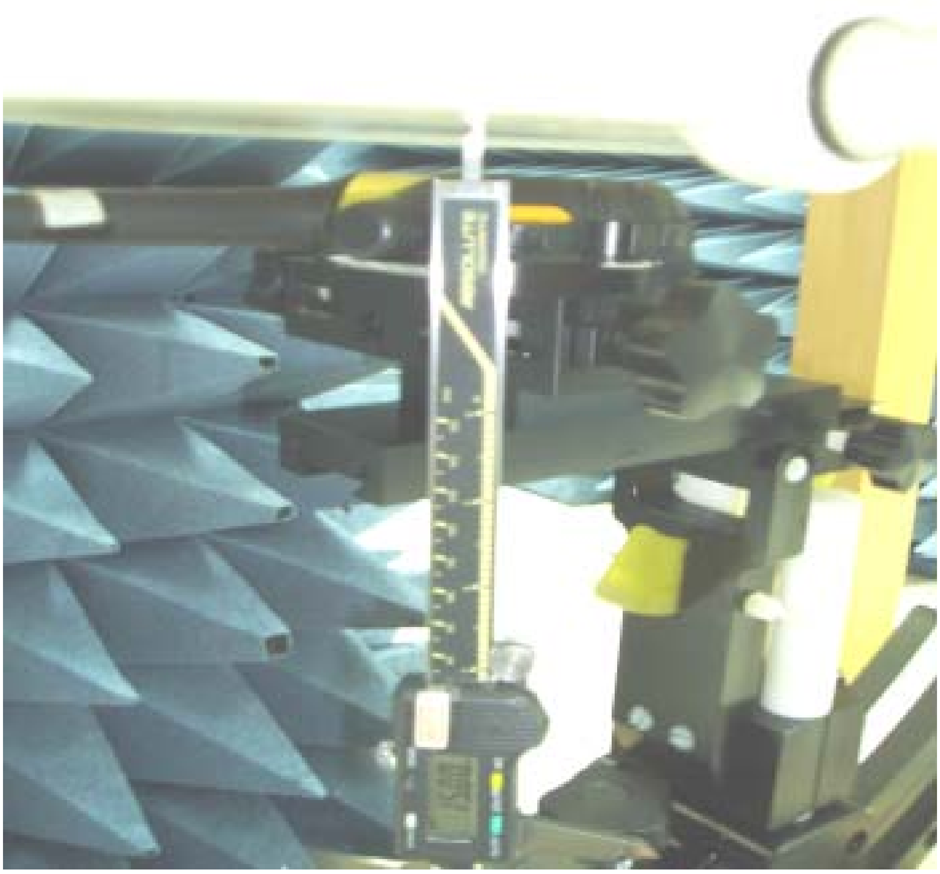

Figure 15. Figure 11.1 SAR Test Setup Face Position

11.2 FRS Face SAR -1.5 cm Spacing

Ambient：

Temperature (℃)： **22 ± 2**　　Relative HUMIDITY (%)： **< 60**

Liquid：

Mixture Type： **HSL450**　　Liquid Temperature (℃)： **21.2**

Depth of liquid (cm)： **15**

Measurement：

Crest Factor： **1**　　Probe S/N： **1530**

Frequency		Moduction	Battery	Accessory	SAR$_{1g}$[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
467.5625	8	FM	Moto	N/A	0.055	0.0275	-3.51	-	22.2	21.2
467.6375	11	FM	Moto	N/A	0.066	0.0330	-3.30	-	22.2	21.2
467.7125	14	FM	Moto	N/A	**0.067**	**0.0335**	-3.23	-	22.2	21.2
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR$_{1g}$[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR$_{1g}$[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
467.5625	8	0.055	0.0275	-3.51	2.244	0.123	0.062
467.6375	11	0.066	0.0330	-3.30	2.138	**0.141**	**0.071**
467.7125	14	**0.067**	**0.0335**	-3.23	2.104	0.141	0.070

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

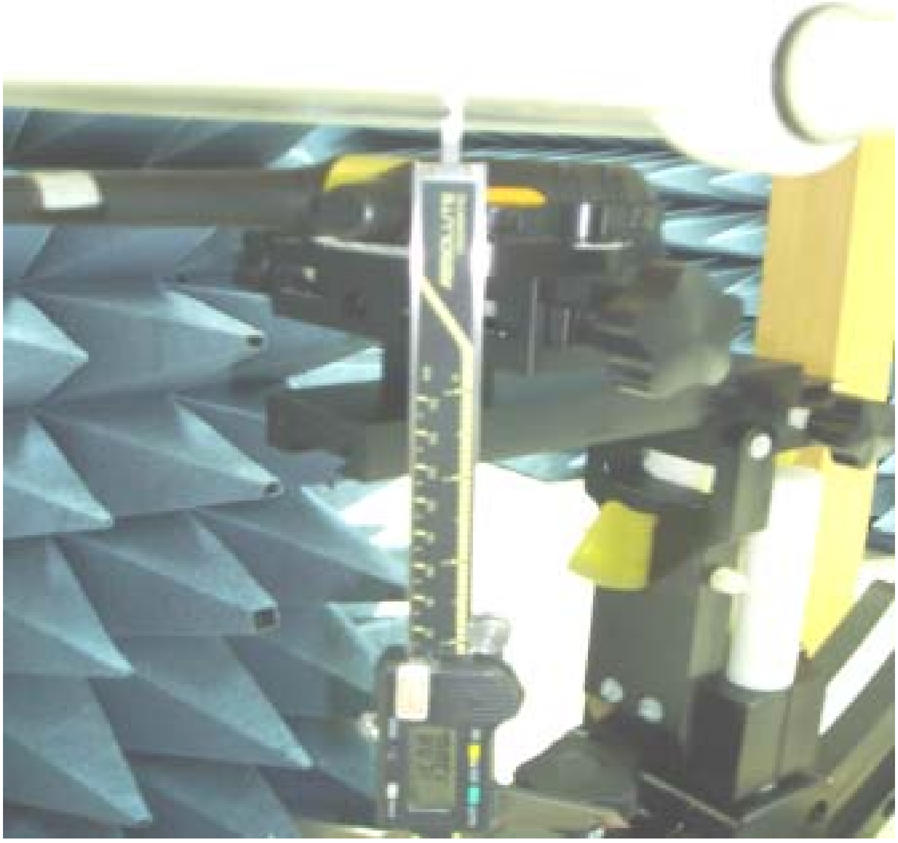

Figure 16. SAR Test Setup Face Position

11.3 GMRS Body SAR W /Belt –clip

Ambient：

Temperature (℃)： **22 ± 2** Relative HUMIDITY (%)： **< 60**

Liquid：

Mixture Type： **MSL450** Liquid Temperature (℃)： **21.3 / 21.9**

Depth of liquid (cm)： **15**

Measurement：

Crest Factor： **1** Probe S/N： **1530**

Frequency		Moduction	Battery	Accessory	SAR1g[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
462.5500	15	FM	Moto	Headset	0.302	0.151	-1.43	-	22.2	21.9
462.6375	4	FM	Moto	Headset	0.514	0.2570	-1.39	-	22.1	21.3
462.7250	22	FM	Moto	Headset	0.449	0.2245	-1.6	-	22.2	21.3
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR1g[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR1g[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
462.5500	15	0.302	0.151	-1.43	1.390	0.420	0.210
462.6375	4	0.514	0.2570	-1.39	1.377	0.708	0.354
462.7250	22	0.449	0.2245	-1.6	1.445	0.649	0.325

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

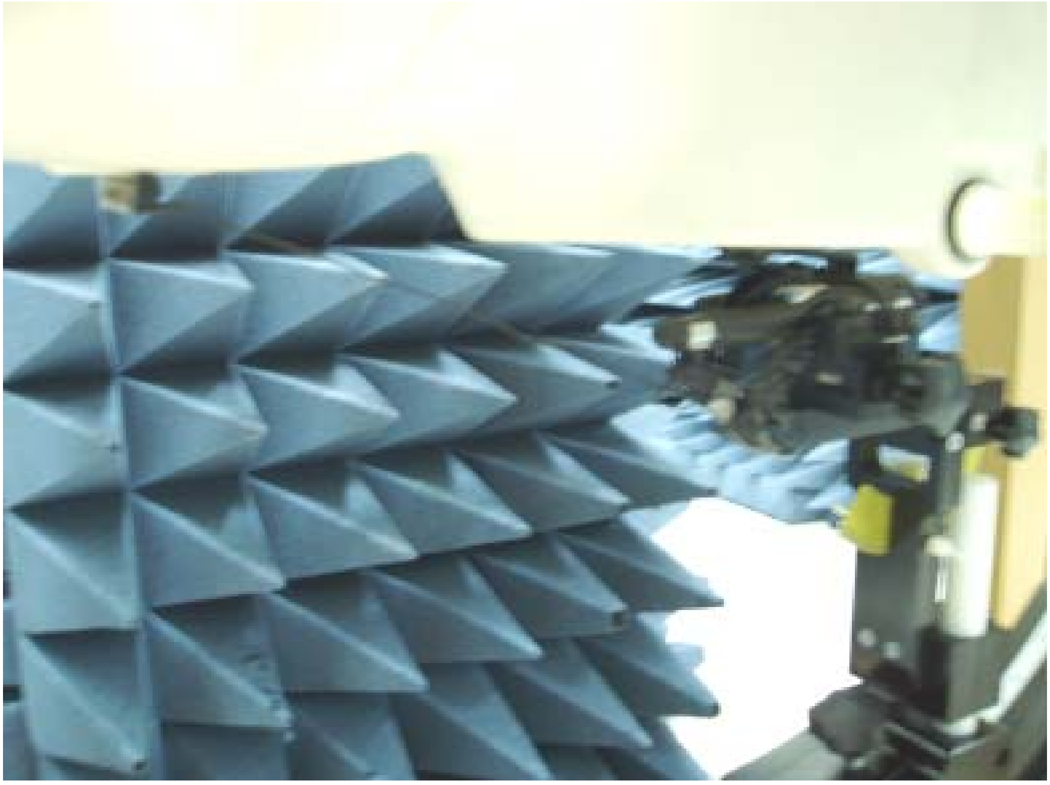

Figure 17. SAR Test Setup w / Belt Clip

11.4 FRS Body SAR w /Belt – clip

Ambient：

Temperature (℃)：	22 ± 2	Relative HUMIDITY (%)：	< 60

Liquid：

Mixture Type：	MSL450	Liquid Temperature (℃)：	21.3
		Depth of liquid (cm)：	15

Measurement：

Crest Factor：	1	Probe S/N：	1530

Frequency		Moduction	Battery	Accessory	SAR_{1g}[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
467.5625	8	FM	Moto	Headset	0.060	0.030	-1.27	-	22.0	21.3
467.6375	11	FM	Moto	Headset	0.044	0.022	-2.4	-	22.0	21.3
467.7125	14	FM	Moto	Headset	0.081	0.0405	-0.648	-	22.2	21.3
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR_{1g}[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR_{1g}[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
467.5625	8	0.060	0.030	-1.27	1.340	0.080	0.040
467.6375	11	0.044	0.022	-2.4	1.738	0.076	0.038
467.7125	14	0.081	0.0405	-0.648	1.161	0.094	0.047

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

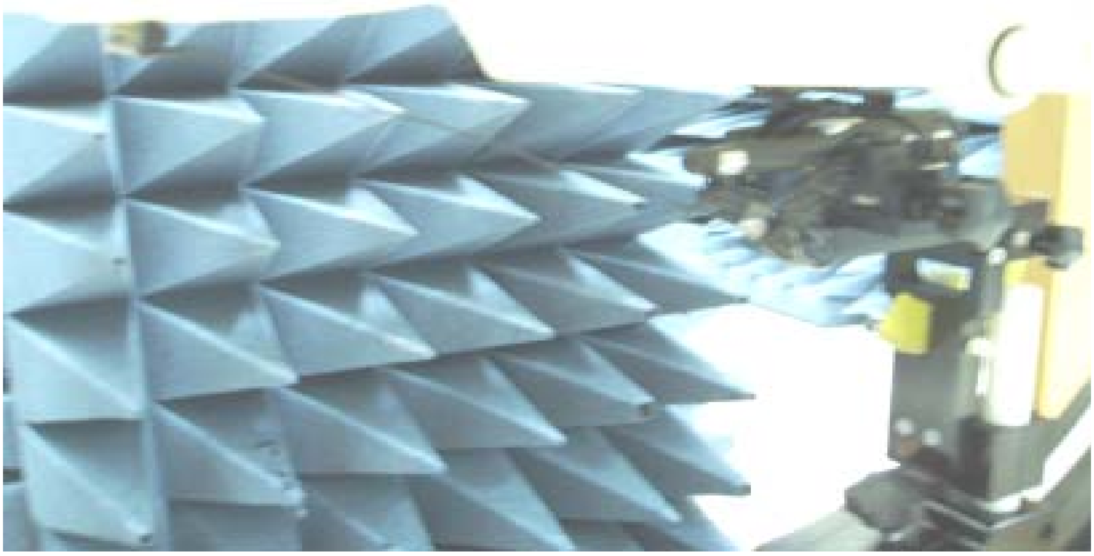

Figure 18. Body SAR Test Setup w / Belt Clip

11.5 GMRS Body SAR w/out Belt-clip -1.5 cm Spacing

Ambient：

Temperature (℃)： **22 ± 2** Relative HUMIDITY (%)： **< 60**

Liquid：

Mixture Type： **MSL450** Liquid Temperature (℃) ： **21.3**

Depth of liquid (cm)： **15**

Measurement：

Crest Factor： **1** Probe S/N： **1530**

Frequency		Moduction	Battery	Accessory	SAR_{1g}[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
462.6375	4	FM	Moto	N/A	0.578	0.289	-1.52	-	22.2	21.3
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR_{1g}[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR_{1g}[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
462.6375	4	0.578	0.289	-1.52	1.419	0.820	0.410

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

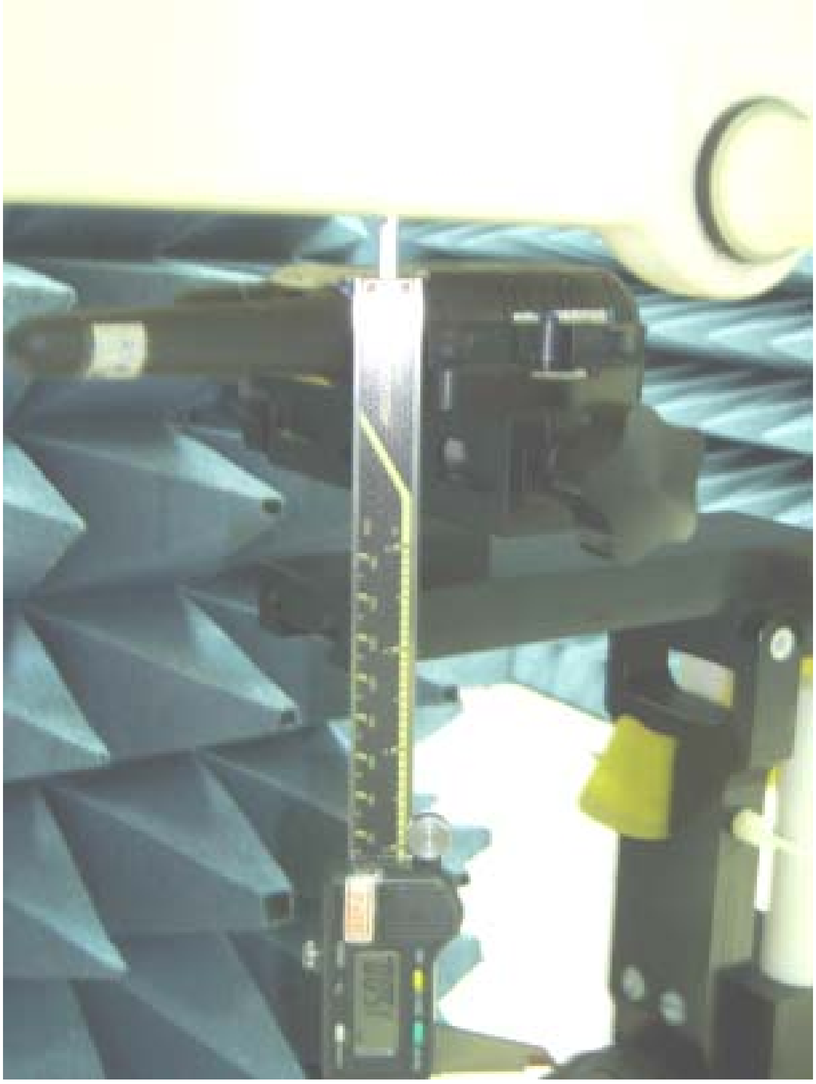

Figure 19. Body SAR Test Setup w / out Belt Clip

11.6 FRS Body SAR w/out Belt-clip -1.5 cm Spacing

Ambient：

Temperature (℃)： **22 ± 2** Relative HUMIDITY (%)： **< 60**

Liquid：

Mixture Type： **MSL450** Liquid Temperature (℃)： **21.3**

Depth of liquid (cm)： **15**

Measurement：

Crest Factor： **1** Probe S/N： **1530**

Frequency		Moduction	Battery	Accessory	SAR_{1g}[mW/g] Duty Cycle		Power Drift	Remark	Amb. Temp	Liq. Temp
MHz	Ch.				100%	50%				
467.6375	11	FM	Moto	N/A	0.078	0.039	-1.77	-	22.2	21.3
ANSI / IEEE C95.1 1992 - Safety Limit Spatial Peak Uncontrolled Exposure/General Population					Brain 1.6 W/kg (mW/g) Averaged over 1 gram					

◆ SAR values are scaled for the power drift

Frequency		SAR_{1g}[mW/g] Duty Cycle		power drift (dB)	+ power drift 10^(dB/10)	SAR_{1g}[mW/g] (include +power drift) Duty Cycle	
MHz	Ch.	100%	50%			100%	50%
467.6375	11	0.078	0.039	-1.77	1.503	0.117	0.059

SAR is basically proportional to average transmit power and duty cycle

(i.e. SAR = P x T where P is the average transmit power and T is the transmit duty cycle).

$SAR_{(unknown)} = SAR_{(know)} \times (P_x T_x / P_{(known)} T_{(known)})$

Where

P_x is the unknown power (i.e. the power at the highest drift)

T_x is the transmit duty cycle used at that unknown power.

If transmitter duty cycle is the same then it should be a relationship of P_x/P_{known})

Figure 20. Body SAR Test Setup w / out Belt Clip

11.7 ANSI/IEEE C95.1 – 1992 RF Exposure Limit

Human Exposure	Population Uncontrolled Exposure (W/kg) or (mW/g)	Occupational Controlled Exposure (W/kg) or (mW/g)
Spatial Peak SAR* (Brain)	1.60	8.00
Spatial Peak SAR** (Whole Body)	0.08	0.40
Spatial Peak SAR*** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 7. Safety Limits for Partial Body Exposure

Notes：

***** The Spatial Peak value of the SAR averaged over any 1 gram of tissue.
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

****** The Spatial Average value of the SAR averaged over the whole – body.

******* The Spatial Peak value of the SAR averaged over any 10 grams of tissue.
(defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Population / Uncontrolled Environments： are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Occupational / Controlled Environments： are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

12. Conclusion

The SAR test values found for the portable mobile phone **Giant Electronics Ltd. Trade Name：Motorola Model(s)：SX700**, are below the maximum recommended level of 1.6 W/kg (mW/g).

13. References

[1] ANSI/IEEE C95.1-1991, "*American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300KHz to 100GHz",* New York: IEEE, Aug. 1992.

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[4] K. Poković, T. Schmid, and N. Kuster, "*Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequency*", in ICECOM'97, Dubrovnik, October 15-17, 1997, pp.120-124.

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[7] Robert J. Renka, "*Multivariate Interpolation Of Large Sets Of Scattered Data*", University of North Texas ACM Transactions on Mathematical Software, vol. 14, no. 2, June 1988 , pp. 139-148.

[8] N. Kuster, R. Kastle, T. Schmid, *Dosimetric evaluation of mobile communications equipment with known precision*, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[9] ANSI/IEEE C95.3-1991, "*IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave,* New York: IEEE, Aug. 1992.

[10] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), *Human Exposure to Electromagnetic Fields High-frequency*: 10KHz-300GHz, Jan. 1995.

Appendix A – System Performance Check

Date/Time: 3/24/2005 10:09:27

Test Laboratory: A Test Lab Techno Corp.

System Performance Check at 450MHz_Head_20050324_

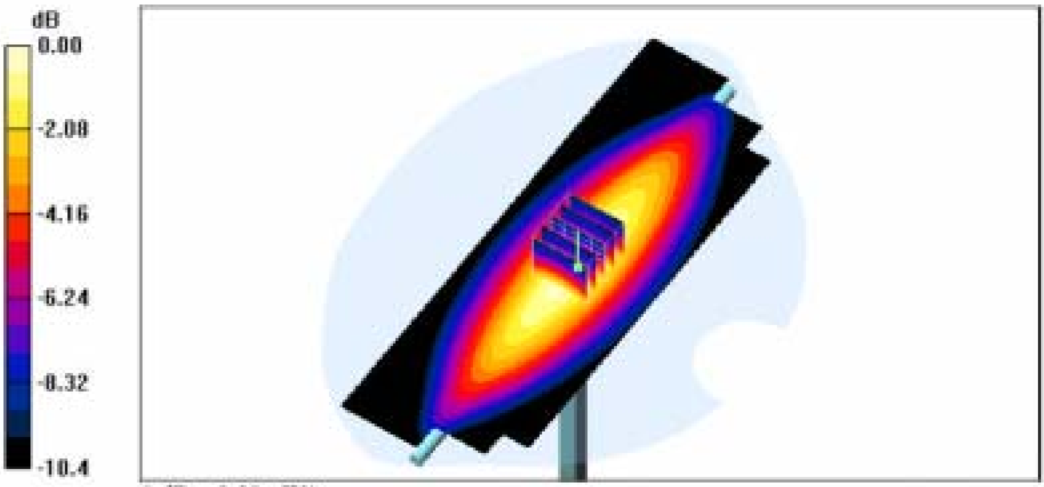
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1021

Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used: f = 450 MHz; s = 0.855 mho/m; e_r = 45.2;
Conductivity=1000kg/m3;Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (61x181x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.19 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 51.0 V/m; Power Drift = 0.071 dB
Peak SAR (extrapolated) = 3.62 W/kg
SAR(1 g) = 2.07 mW/g; SAR(10 g) = 1.3 mW/g
Maximum value of SAR (measured) = 2.23 mW/g



0 dB = 2.23mW/g

Head-Tissue-Simulating-Liquid 450MHz (2005/03/24)

Date/Time: 3/24/2005 4:04:33

Test Laboratory: A Test Lab Techno Corp.

System Performance Check at 450MHz_Body_20050324_

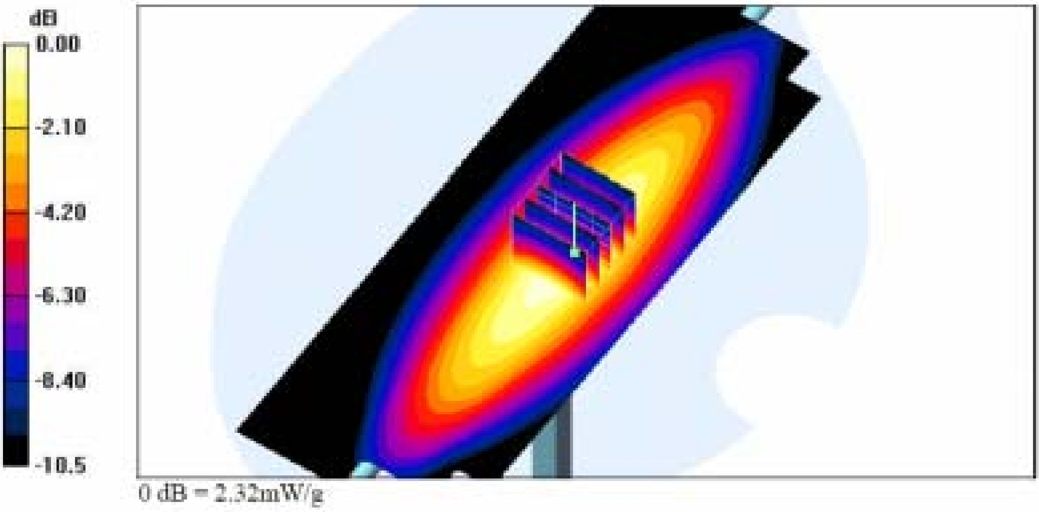
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1021

Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used: f = 450 MHz; s = 0.953 mho/m; e_r = 56.1;
Conductivity=1000 kg/m3;Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (61x181x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.33 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 43.2 V/m; Power Drift = 0.023 dB
Peak SAR (extrapolated) = 3.88 W/kg
SAR(1 g) = 2.18 mW/g; SAR(10 g) = 1.37 mW/g
Maximum value of SAR (measured) = 2.32 mW/g



0 dB = 2.32mW/g

Muscle-Tissue-Simulating-Liquid 450MHz (2005/03/24)

Date/Time: 04/07/2005 03:04:33

Test Laboratory: A Test Lab Techno Corp.

System Performance Check at 450MHz_Body_20050407_

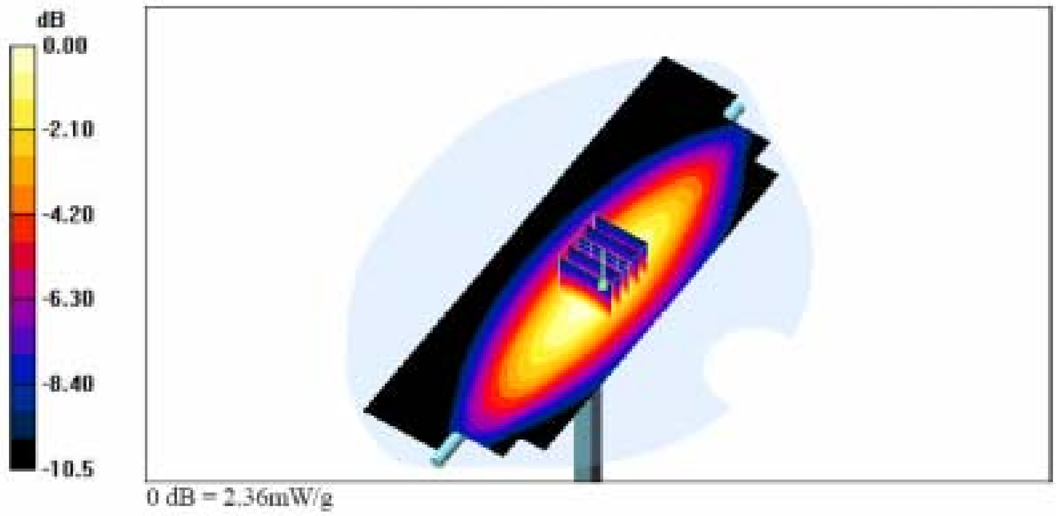
DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1021

Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used: f = 450 MHz; s = 0.966 mho/m; e_r = 55.5;
Conductivity=1000kg/m3;Phantom section: Flat Section

DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (61x181x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.37 mW/g

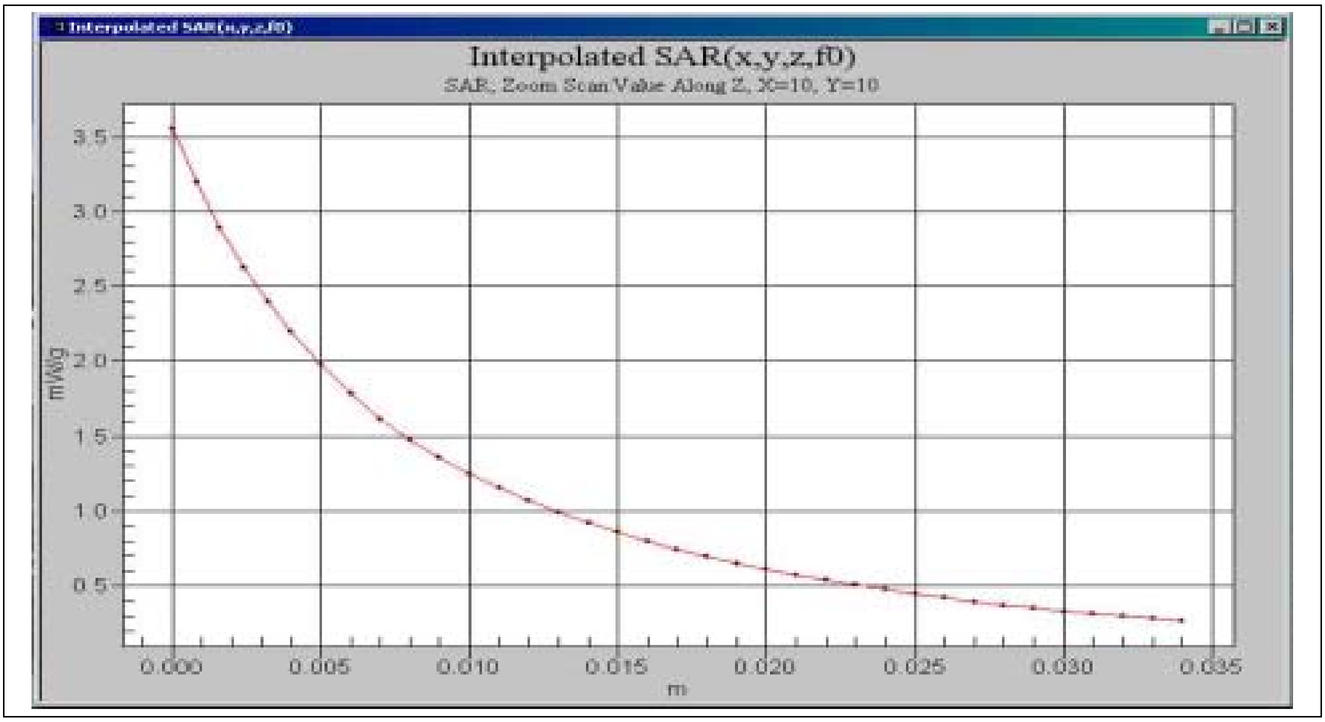
Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 43.2 V/m; Power Drift = 0.023 dB
Peak SAR (extrapolated) = 3.93 W/kg
SAR(1 g) = 2.21 mW/g; SAR(10 g) = 1.39 mW/g
Maximum value of SAR (measured) = 2.36 mW/g



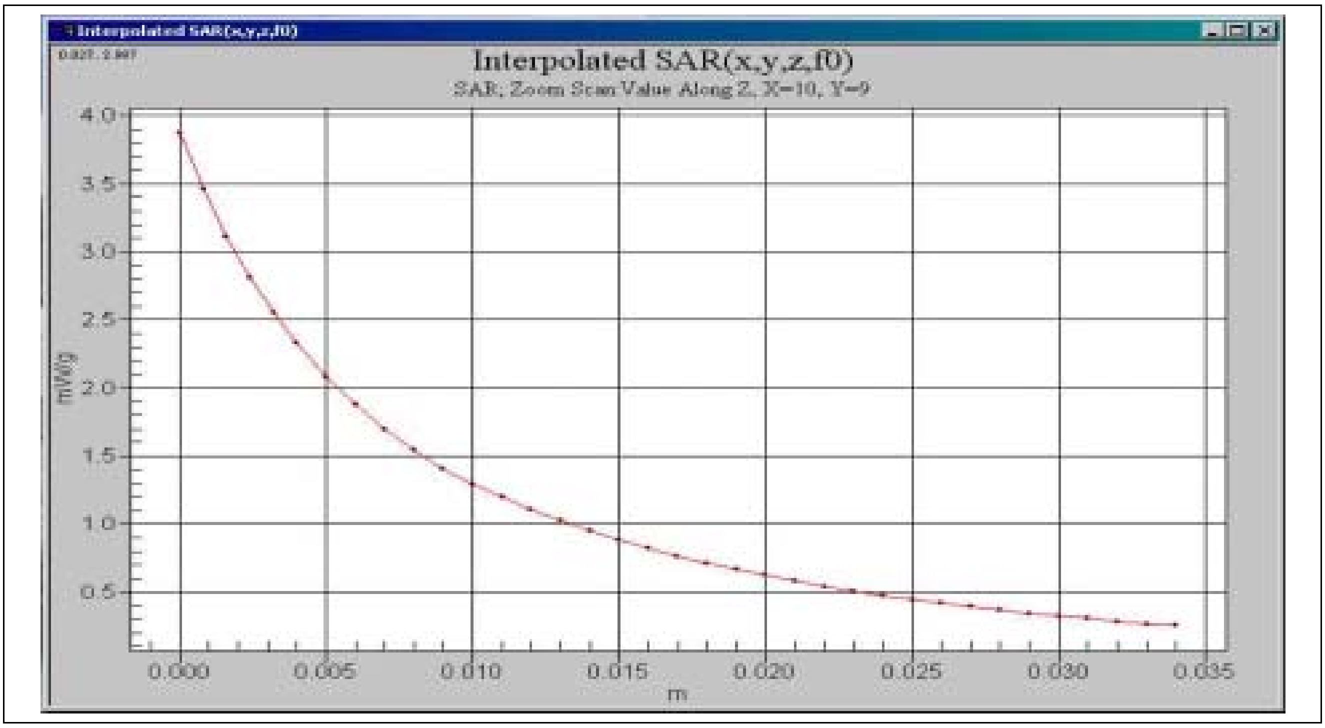
0 dB = 2.36mW/g

Muscle-Tissue-Simulating-Liquid 450MHz (2005/04/07)

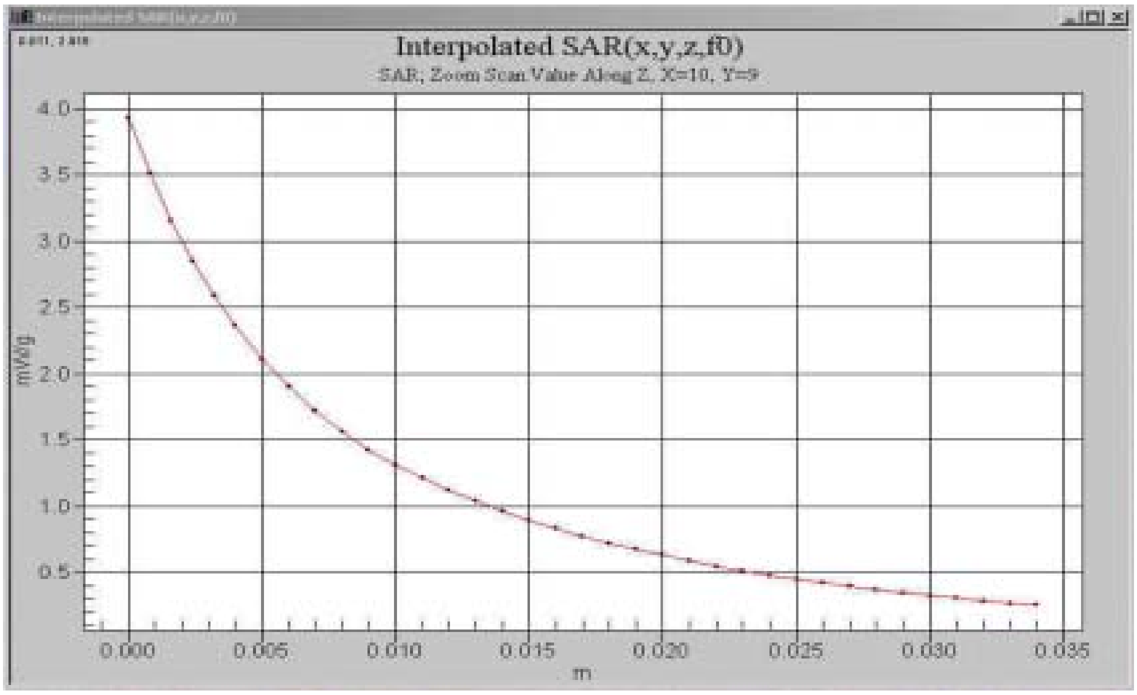
Z-axis Plot of System Performance Check



Head-Tissue-Simulating-Liquid 450MHz (2005/03/24)



Muscle-Tissue-Simulating-Liquid 450MHz (2005/03/24)



Muscle-Tissue-Simulating-Liquid 450MHz (2005/04/07)

Appendix B – SAR Measurement Data

Date/Time: 3/24/2005 11:58:27

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH15_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.55 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 462.55 MHz; s = 0.856 mho/m; e_r = 45.7;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

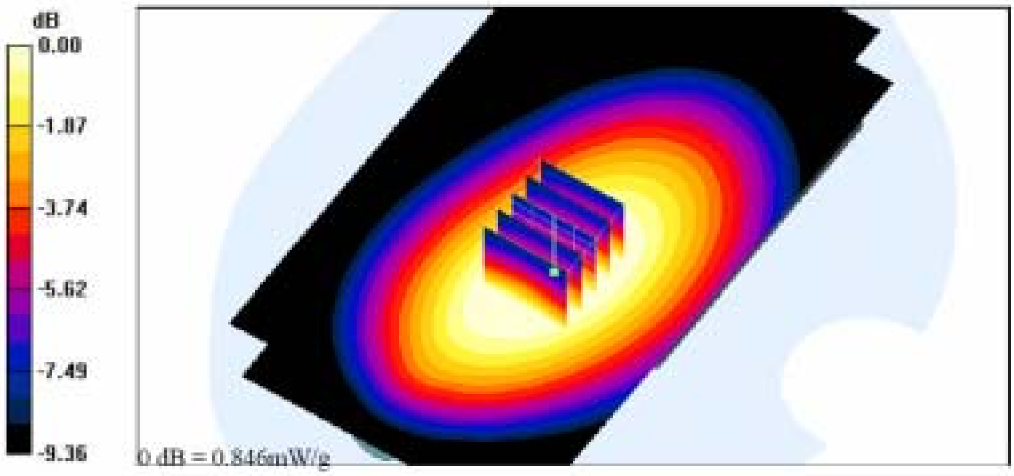
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x151x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.02 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.8 V/m; Power Drift = -1.61 dB
Peak SAR (extrapolated) = 1.27 W/kg
SAR(1 g) = 0.809 mW/g; SAR(10 g) = 0.561 mW/g

Maximum value of SAR (measured) = 0.846 mW/g



SAR Test Result for GMRS Face SAR -1.5 cm Spacing-Channel 15

Date/Time: 3/24/2005 12:24:02 ;

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH4_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.637 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 462.637 MHz; s = 0.857 mho/m; e_r = 45.7; Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

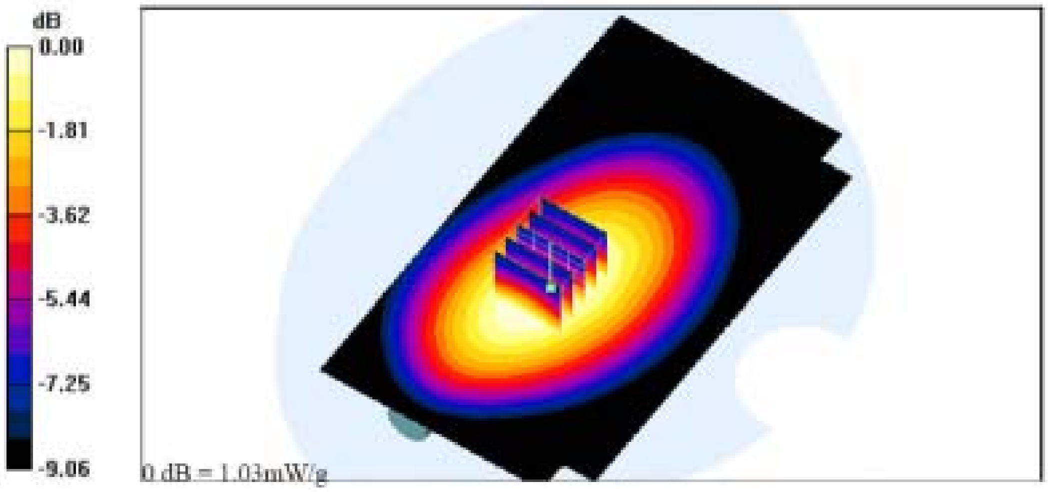
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 1.09 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.0 V/m; Power Drift = -0.710 dB
Peak SAR (extrapolated) = 1.51 W/kg
SAR(1 g) = 0.987 mW/g; SAR(10 g) = 0.689 mW/g

Maximum value of SAR (measured) = 1.03 mW/g



SAR Test Result for GMRS Face SAR -1.5 cm Spacing-Channel 4

Date/Time: 3/24/2005 12:51:29

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS C22_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.75 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 462.75 MHz; s = 0.857 mho/m; ϵ_r = 45.7;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

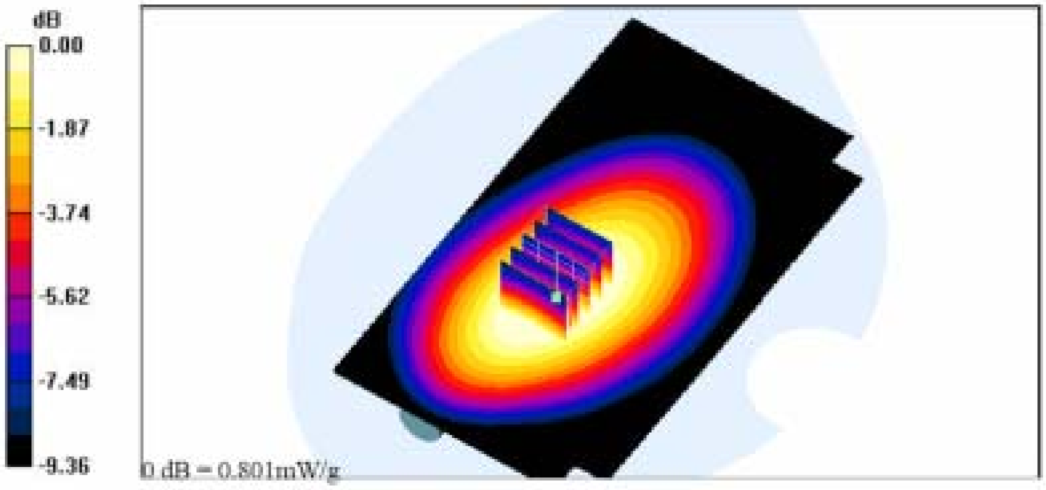
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.919 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.7 V/m; Power Drift = -1.34 dB
Peak SAR (extrapolated) = 1.18 W/kg
SAR(1 g) = 0.766 mW/g; SAR(10 g) = 0.532 mW/g

Maximum value of SAR (measured) = 0.801 mW/g



SAR Test Result for GMRS Face SAR -1.5 cm Spacing-Channel 22

Date/Time: 3/24/2005 1:45:15

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH8_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.563 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 467.563 MHz; s = 0.86 mho/m; e_r = 45.6;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

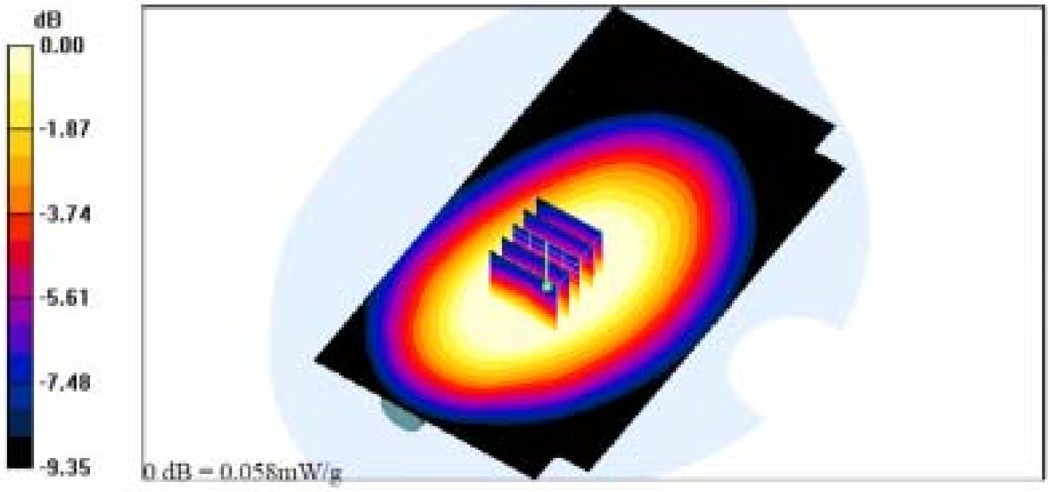
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.084 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.7 V/m; Power Drift = -3.51 dB
Peak SAR (extrapolated) = 0.084 W/kg
SAR(1 g) = 0.055 mW/g; SAR(10 g) = 0.039 mW/g

Maximum value of SAR (measured) = 0.058 mW/g



SAR Test Result for FRS Face SAR -1.5 cm Spacing-Channel 8

Date/Time: 3/24/2005 2:13:46

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH11_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.637 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 467.637 MHz; s = 0.86 mho/m; ε_r = 45.6; Conductivity=1000kg/m^3 ;Phantom section: Flat Section

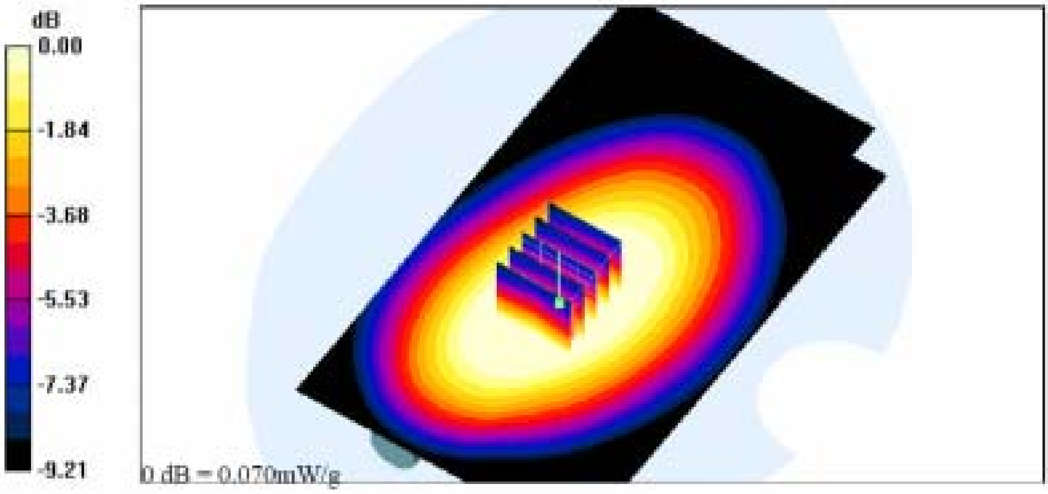
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.099 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.4 V/m; Power Drift = -3.30 dB
Peak SAR (extrapolated) = 0.101 W/kg
SAR(1 g) = 0.066 mW/g; SAR(10 g) = 0.046 mW/g

Maximum value of SAR (measured) = 0.070 mW/g



SAR Test Result for FRS Face SAR -1.5 cm Spacing-Channel 11

Date/Time: 3/24/2005 2:42:52

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH14_20050324_15 mm_Brain_

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.712 MHz;Duty Cycle: 1:1
Medium: Head 450MHz Medium parameters used (interpolated): f = 467.712 MHz; s = 0.86 mho/m; e_r = 45.6;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

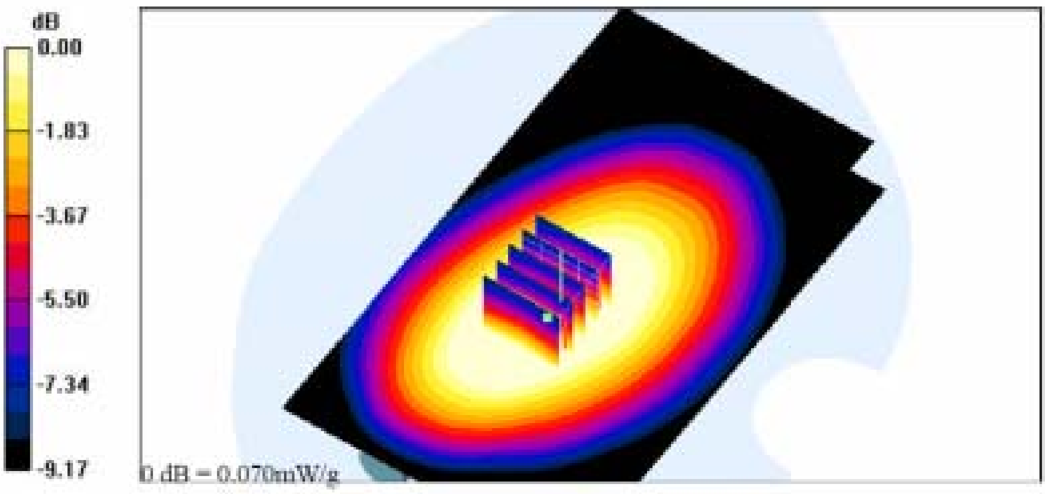
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.27, 7.27, 7.27); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (81x141x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.100 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 11.7 V/m; Power Drift = -3.23 dB
Peak SAR (extrapolated) = 0.101 W/kg
SAR(1 g) = 0.067 mW/g; SAR(10 g) = 0.047 mW/g

Maximum value of SAR (measured) = 0.070 mW/g



SAR Test Result for FRS Face SAR -1.5 cm Spacing-Channel 14

Date/Time: 4/7/2005 4:07:36

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH15_20050407_headset_muscle

DUT: Motorola SX700; Type: Two way radio; Serial:

Communication System: GMRS; Frequency: 462.55 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 462.55 MHz; s = 0.975 mho/m; e_r = 55.2;
Conductivity=1000 kg/m^3 ;
Phantom section: Flat Section

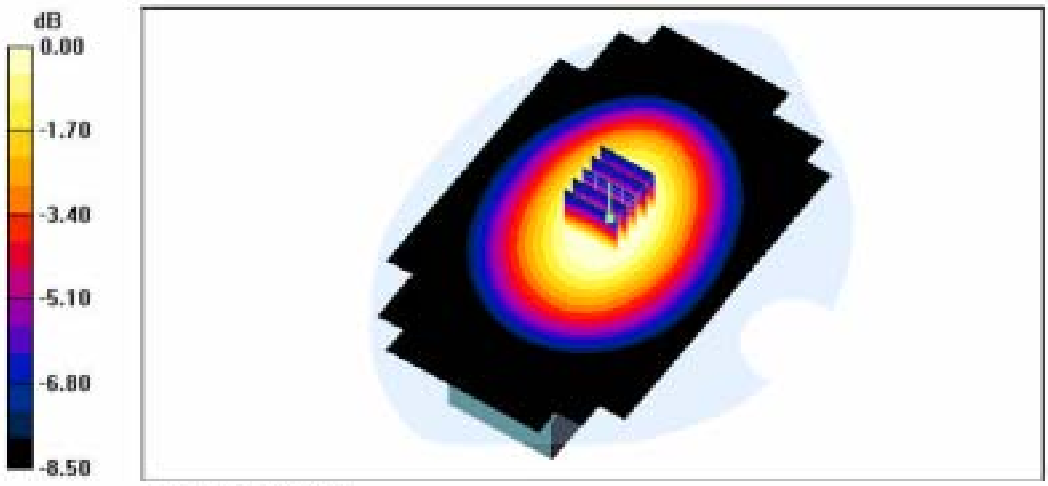
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.366 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.7 V/m; Power Drift = -1.43 dB
Peak SAR (extrapolated) = 0.453 W/kg
SAR(1 g) = 0.302 mW/g; SAR(10 g) = 0.216 mW/g

Maximum value of SAR (measured) = 0.315 mW/g



0 dB = 0.315mW/g

SAR Test Result for GMRS Body SAR w / Belt –clip Channel 15

Date/Time: 3/25/2005 1:58:16

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH4_20050324_headset_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.637 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 462.637 MHz; s = 0.965 mho/m; e_r = 55.9;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

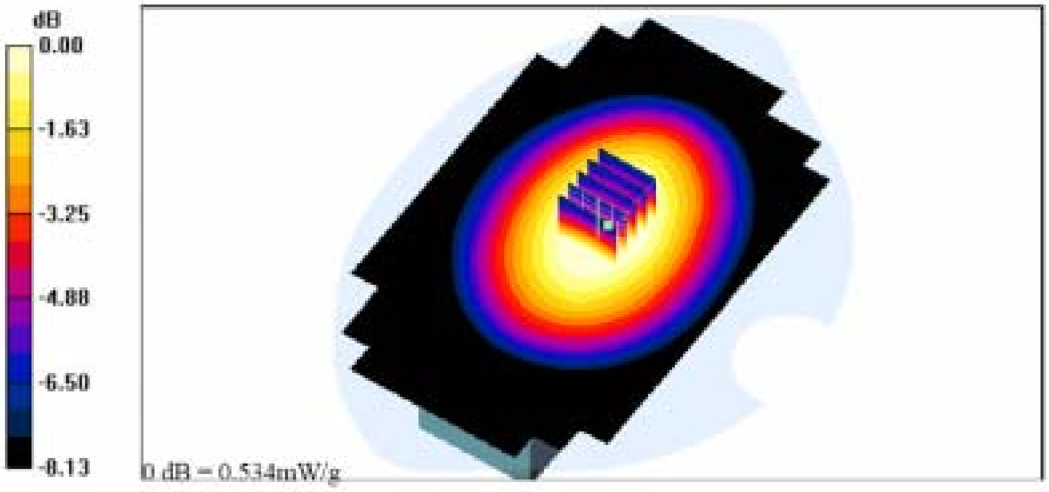
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.601 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.2 V/m; Power Drift = -1.39 dB
Peak SAR (extrapolated) = 0.771 W/kg
SAR(1 g) = 0.514 mW/g; SAR(10 g) = 0.371 mW/g

Maximum value of SAR (measured) = 0.534 mW/g



SAR Test Result for GMRS Body SAR w / Belt –clip Channel 4

Date/Time: 3/25/2005 2:26:15

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH22_20050324_headset_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.75 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 462.75 MHz; s = 0.965 mho/m; e_r = 55.9;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

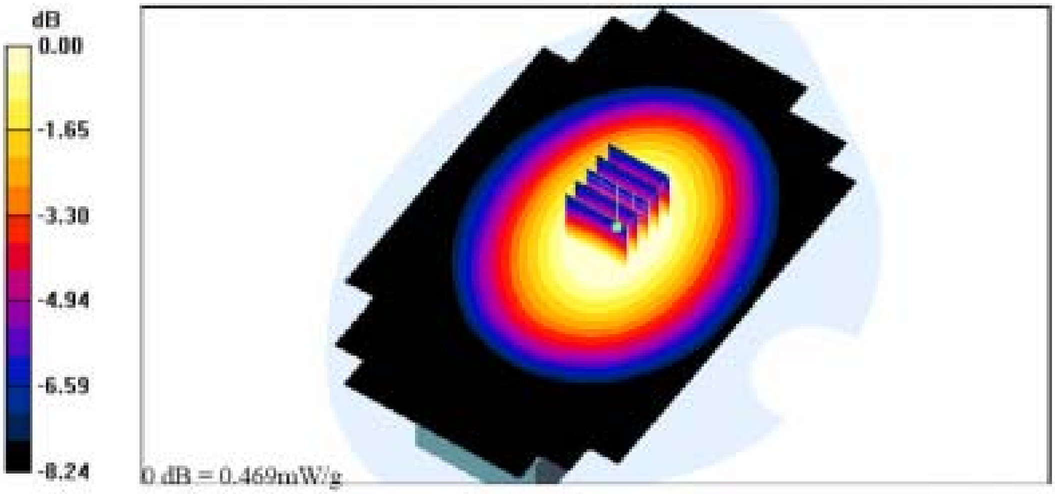
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.539 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.8 V/m; Power Drift = -1.60 dB
Peak SAR (extrapolated) = 0.649 W/kg
SAR(1 g) = 0.449 mW/g; SAR(10 g) = 0.327 mW/g

Maximum value of SAR (measured) = 0.469 mW/g



SAR Test Result for GMRS Body SAR w / Belt –clip Channel 22

Date/Time: 3/25/2005 12:46:38

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH8_20050324_headset_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.563 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 467.563 MHz; s = 0.967 mho/m; e_r = 55.8;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

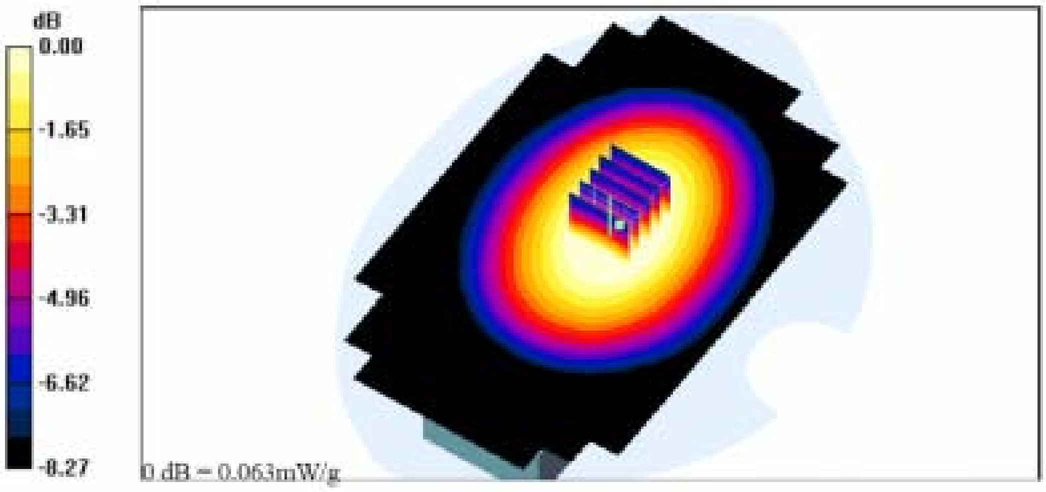
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.073 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.76 V/m; Power Drift = -1.27 dB
Peak SAR (extrapolated) = 0.088 W/kg
SAR(1 g) = 0.060 mW/g; SAR(10 g) = 0.044 mW/g

Maximum value of SAR (measured) = 0.063 mW/g



SAR Test Result for FRS Body SAR w / Belt –clip Channel 8

Date/Time: 3/25/2005 12:15:32

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH11_20050324_headset_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.637 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 467.637 MHz; s = 0.967 mho/m; e_r = 55.8; Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

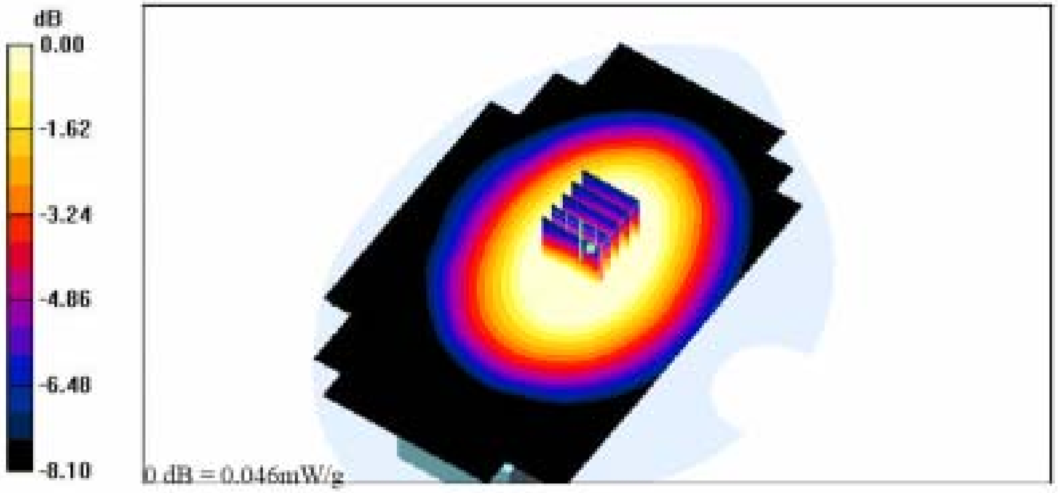
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.064 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.35 V/m; Power Drift = -2.40 dB
Peak SAR (extrapolated) = 0.064 W/kg
SAR(1 g) = 0.044 mW/g; SAR(10 g) = 0.032 mW/g

Maximum value of SAR (measured) = 0.046 mW/g



SAR Test Result for FRS Body SAR w / Belt –clip Channel 11

Date/Time: 3/24/2005 11:42:27

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH14_20050324_headset_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.712 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 467.712 MHz; s = 0.967 mho/m; e_r = 55.8;
Conductivity=1000kg/m^3 ;Phantom section: Flat Section

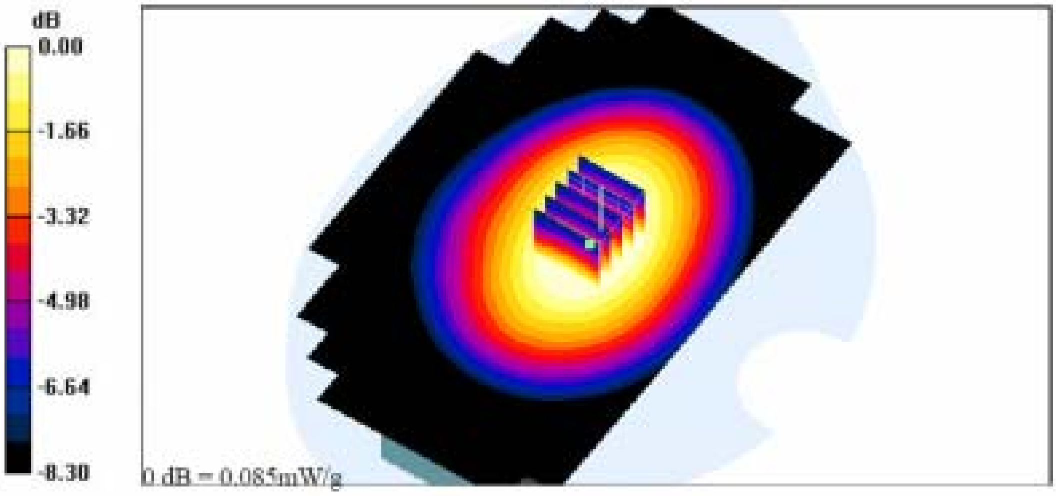
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.097 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.80 V/m; Power Drift = -0.648 dB
Peak SAR (extrapolated) = 0.119 W/kg
SAR(1 g) = 0.081 mW/g; SAR(10 g) = 0.059 mW/g

Maximum value of SAR (measured) = 0.085 mW/g



SAR Test Result for FRS Body SAR w / Belt –clip Channel 14

Date/Time: 3/25/2005 3:08:18

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_GMRS CH4_20050324_15 mm_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: GMRS; Frequency: 462.637 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 462.637 MHz; s = 0.965 mho/m; e_r = 55.9;
Conductivity=1000 kg/m^3 ;Phantom section: Flat Section

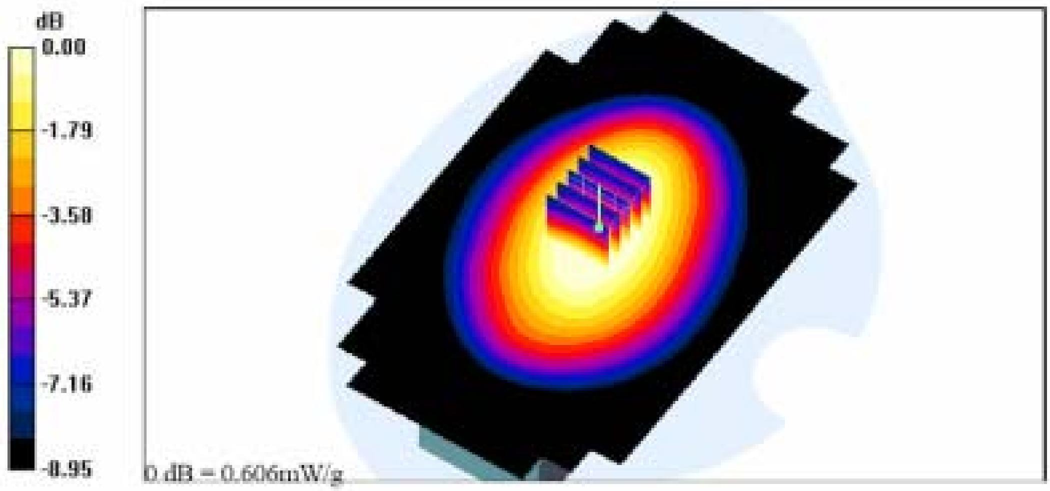
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.687 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 26.7 V/m; Power Drift = -1.52 dB
Peak SAR (extrapolated) = 0.884 W/kg
SAR(1 g) = 0.578 mW/g; SAR(10 g) = 0.412 mW/g

Maximum value of SAR (measured) = 0.606 mW/g



SAR Test Result for GMRS Body SAR w / out Belt –clip -1.5cm Channel 4

Date/Time: 3/25/2005 3:38:47

Test Laboratory: A Test Lab Techno Corp.

05-0185-S_Motorola SX700_Flat_FRS CH11_20050324_15 mm_muscle

DUT: Motorola SX700; Type: Two way radio;

Communication System: FRS; Frequency: 467.637 MHz;Duty Cycle: 1:1
Medium: Body 450MHz Medium parameters used (interpolated): f = 467.637 MHz; s = 0.967 mho/m; e_r = 55.8;
Conductivity=1000kg/m^3 ;Phantom section: Flat Section

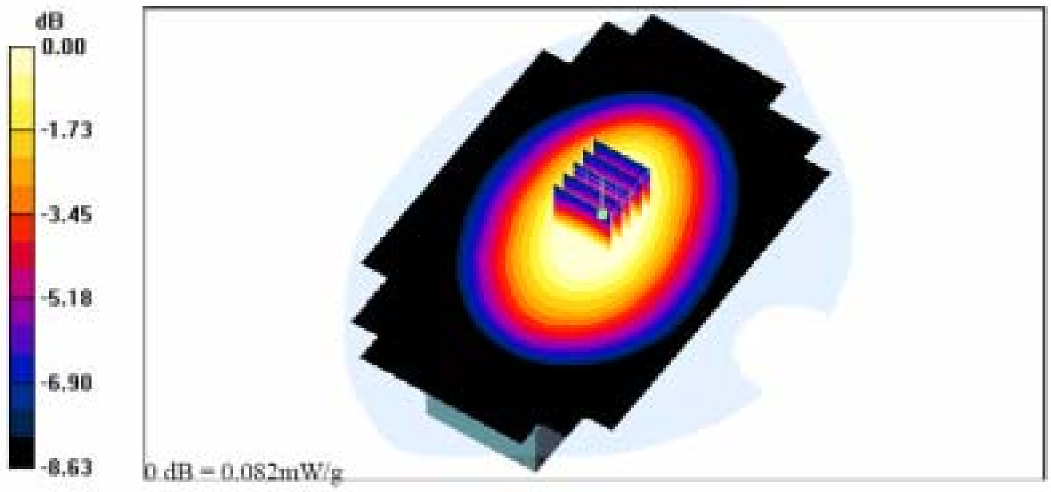
DASY4 Configuration:
- Probe: ET3DV6 - SN1530-LF; ConvF(7.19, 7.19, 7.19); Calibrated: 1/17/2005
- Sensor-Surface: 4mm (Mechanical And Optical Surface Detection)
- Electronics: DAE3 Sn541; Calibrated: 4/26/2004
- Phantom: SAM 12; Type: SAM v4.0; Serial: TP:1009
- Measurement SW: DASY4, V4.5 Build 19; Postprocessing SW: SEMCAD, V1.8 Build 146

Flat/Area Scan (101x161x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (interpolated) = 0.099 mW/g

Flat/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.5 V/m; Power Drift = -1.77 dB
Peak SAR (extrapolated) = 0.120 W/kg
SAR(1 g) = 0.078 mW/g; SAR(10 g) = 0.056 mW/g

Maximum value of SAR (measured) = 0.082 mW/g



SAR Test Result for FRS Body SAR w / out Belt –clip -1.5cm Channel 11

Appendix C – Dipole Calibration

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

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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **Auden**

Certificate No: **D450V2-1021_Feb05**

CALIBRATION CERTIFICATE

Object	D450V2 - SN: 1021
Calibration procedure(s)	QA CAL-15.v4 Calibration Procedure for dipole validation kits below 800 MHz
Calibration date:	February 1, 2005
Condition of the calibrated item	In Tolerance

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference Probe ET3DV6	SN 1507	28-Oct-04 (SPEAG, No. ET3-1507_Oct04)	Oct-05
DAE4	SN: 901	29-Jun-04 (SPEAG, No. DAE4-901_Jun04)	Jun-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Laboratory Technician	[signature]
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: February 1, 2005

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

Certificate No: D450V2-1021_Feb05 Page 1 of 9

Calibration Laboratory of
Schmid & Partner
Engineering AG
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S Swiss Calibration Service

Accredited by the Swiss Federal Office of Metrology and Accreditation
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
ConF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4 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.

Certificate No: D450V2-1021_Feb05 Page 2 of 9

Measurement Conditions

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

DASY Version	DASY4	V4.3
Extrapolation	Advanced Extrapolation	
Phantom	Flat Phantom V4.4	Shell thickness: 6 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Area Scan resolution	dx, dy = 15 mm	
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	45.1 ± 6 %	0.87 mho/m ± 6 %
Head TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	condition	
SAR measured	398 mW input power	2.01 mW / g
SAR normalized	normalized to 1W	5.05 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**5.13 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	398 mW input power	1.32 mW / g
SAR normalized	normalized to 1W	3.32 mW / g
SAR for nominal Head TSL parameters [1]	normalized to 1W	**3.36 mW / g ± 17.6 % (k=2)**

[1] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

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Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.6 ± 6 %	0.96 mho/m ± 6 %
Body TSL temperature during test	(22.0 ± 0.2) °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	condition	
SAR measured	398 mW input power	2.14 mW / g
SAR normalized	normalized to 1W	5.38 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**5.26 mW / g ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	398 mW input power	1.39 mW / g
SAR normalized	normalized to 1W	3.49 mW / g
SAR for nominal Body TSL parameters [2]	normalized to 1W	**3.43 mW / g ± 17.6 % (k=2)**

[2] Correction to nominal TSL parameters according to d), chapter "SAR Sensitivities"

Certificate No: D450V2-1021_Feb05 Page 4 of 9

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	55.4 Ω - 6.5 jΩ
Return Loss	- 21.9 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	52.6Ω - 8.3 jΩ
Return Loss	- 21.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.993 ns

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.
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 4, 2004

Shin-Tien Lab：No. 99, An-Chung Rd., Hsin-Tien City, Taipei Hsien, Taiwan R.O.C.
Tel：886-(0)2-82122828 / Fax：886-(0)2-82122829
Tao-Yuan Lab：No. 19, Lane 772, Ho-Ping Rd., Pa-Te City, Taoyuan Hsien, Taiwan R.O.C.
Tel：886-(0)3-363-1901 / Fax：886-(0)3-3635002

DASY4 Validation Report for Head TSL

Date/Time: 02/01/05 11:33:32

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1021
Program Name: Unnamed Program

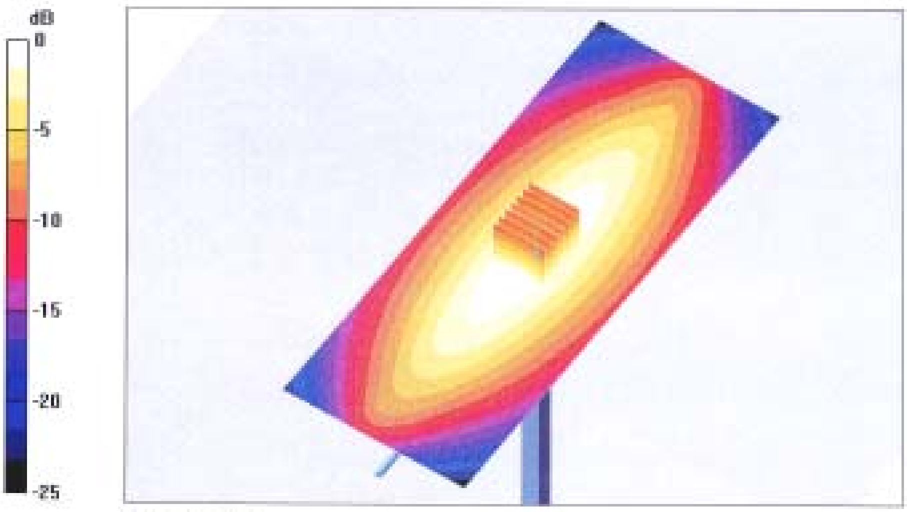
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: HSL450 Medium parameters used: f = 450 MHz; σ = 0.87 mho/m; ε_r = 45.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.94, 6.94, 6.94); Calibrated: 10/26/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn901; Calibrated: 6/29/2004
- Phantom: Flat Phantom 4.4; Type: Flat Phantom 4.4; Serial: TP:1002
- Measurement SW: DASY4, V4.4 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 136

d=15mm, Pin=398mW/Area Scan (71x181x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.11 mW/g

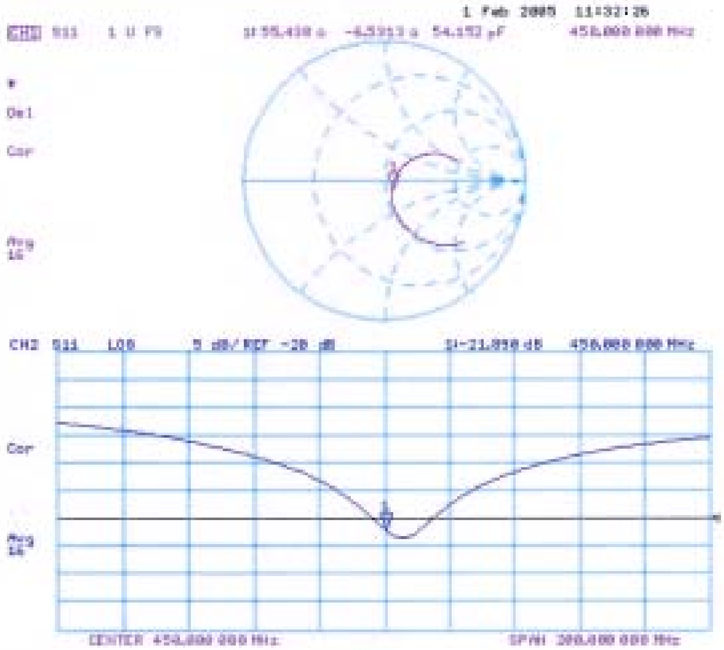
d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 51.1 V/m; Power Drift = -0.1 dB
Peak SAR (extrapolated) = 3.23 W/kg
SAR(1 g) = 2.01 mW/g; SAR(10 g) = 1.32 mW/g
Maximum value of SAR (measured) = 2.15 mW/g



0 dB = 2.15mW/g

Certificate No: D450V2-1021_Feb05 Page 6 of 9

Impedance Measurement Plot for Head TSL



DASY4 Validation Report for Body TSL

Date/Time: 02/01/05 15:02:01

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V2; Serial: D450V2 - SN:1021
Program Name: System Performance Check at 450 MHz

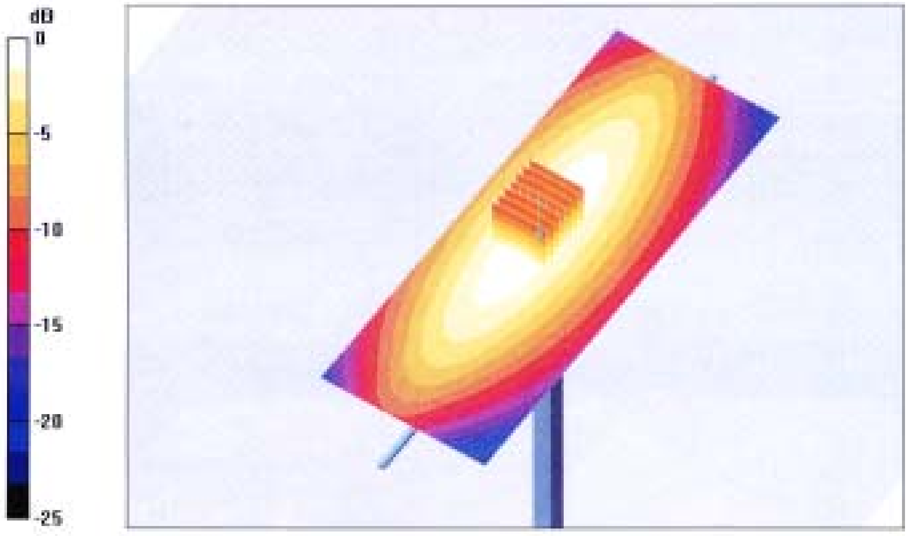
Communication System: CW; Frequency: 450 MHz;Duty Cycle: 1:1
Medium: MSL450 Medium parameters used: f = 450 MHz; σ = 0.96 mho/m; ε_r = 55.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.84, 6.84, 6.84); Calibrated: 10/26/2004
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn901; Calibrated: 6/29/2004
- Phantom: Flat Phantom 4.4; Type: Flat Phantom 4.4; Serial: TP:1002
- Measurement SW: DASY4, V4.4 Build 13; Postprocessing SW: SEMCAD, V1.8 Build 136

d=15mm, Pin=398mW/Area Scan (61x161x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (interpolated) = 2.24 mW/g

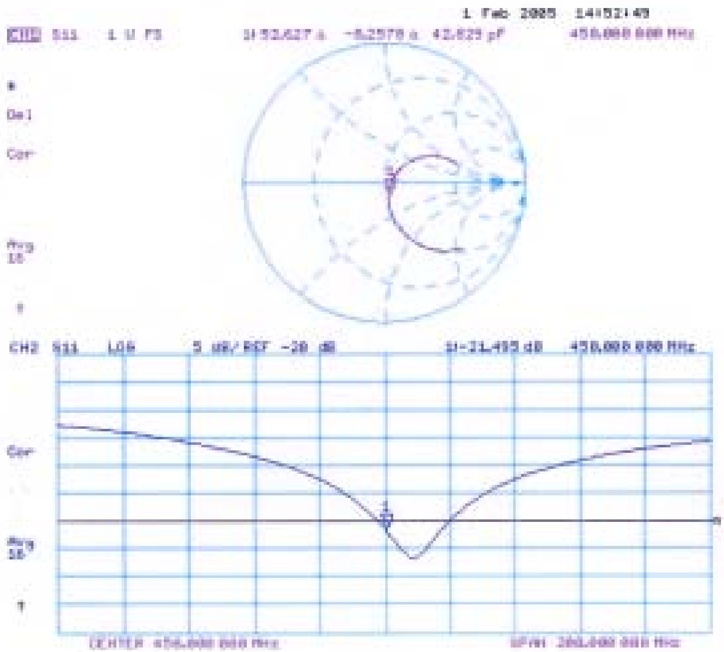
d=15mm, Pin=398mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 48.8 V/m; Power Drift = -0.0 dB
Peak SAR (extrapolated) = 3.54 W/kg
SAR(1 g) = 2.14 mW/g; SAR(10 g) = 1.39 mW/g
Maximum value of SAR (measured) = 2.28 mW/g



0 dB = 2.28mW/g

Certificate No: D450V2-1021_Feb05 Page 8 of 9

Impedance Measurement Plot for Body TSL



Certificate No: D450V2-1021_Feb05 Page 9 of 9

Appendix D – Probe Calibration

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

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Accreditation No.: SCS 108

Client **Auden** | Certificate No: **ET3-1530_Jan05**

CALIBRATION CERTIFICATE

Object	ET3DV6 - SN:1530 **(Additional Conversion Factors)**
Calibration procedure(s)	QA CAL-12.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 17, 2004
Condition of the calibrated item	In Tolerance

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	5-May-04 (METAS, No. 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No. 251-00388)	May-05
Reference 3 dB Attenuator	SN: S5054 (3c)	10-Aug-04 (METAS, No. 251-00403)	Aug-05
Reference 20 dB Attenuator	SN: S5086 (20b)	3-May-04 (METAS, No. 251-00389)	May-05
Reference 30 dB Attenuator	SN: S5129 (30b)	10-Aug-04 (METAS, No. 251-00404)	Aug-05
Reference Probe ES3DV2	SN: 3013	7-Jan-05 (SPEAG, No. ES3-3013_Jan05)	Jan-06
DAE4	SN: 617	29-Sep-04 (SPEAG, No. DAE4-617_Sep04)	Sep-05

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8648C	US3642U01700	4-Aug-99 (SPEAG, in house check Dec-03)	In house check: Dec-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Nov-04)	In house check: Nov 05

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Technical Manager	
Approved by:	Fin Bomholt	R&D Director	

Issued: January 19, 2005

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Certificate No: ET3-1530_Jan05 Page 1 of 5

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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
NORMx,y,z	sensitivity in free space
ConF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
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) CENELEC EN 50361, "Basic standard for the measurement of Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz - 3 GHz), July 2001

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (no uncertainty required). DCP does not depend on frequency nor media.
- *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.

Certificate No: ET3-1530_Jan05 Page 2 of 5

ET3DV6 SN:1530 January 17, 2005

Probe ET3DV6

SN:1530

Additional Conversion Factors

Manufactured:	July 15, 2000
Last calibrated:	September 1, 2004
Recalibrated:	January 17, 2005

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: ET3-1530_Jan05 Page 3 of 5

DASY - Parameters of Probe: ET3DV6 SN:1530

Sensitivity in Free Space[A] | Diode Compression[B]

NormX	**1.44** ± 10.1%	$\mu V/(V/m)^2$	DCP X	**95** mV
NormY	**1.47** ± 10.1%	$\mu V/(V/m)^2$	DCP Y	**95** mV
NormZ	**1.45** ± 10.1%	$\mu V/(V/m)^2$	DCP Z	**95** mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 5.

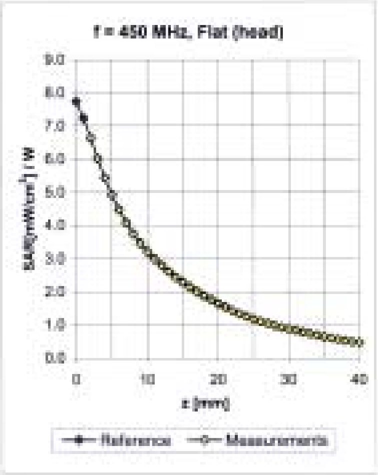
Sensor Offset

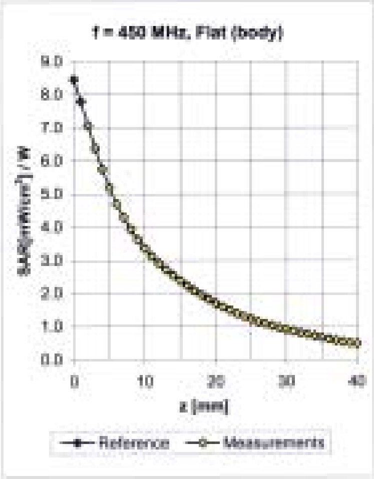
Probe Tip to Sensor Center **2.7** mm

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 Page 5).
[B] Numerical linearization parameter: uncertainty not required.

Conversion Factor Assessment





f [MHz]	Validity [MHz][c]	TSL	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
450	± 50 / ± 100	Head	43.5 ± 5%	0.87 ± 5%	0.17	2.00	7.27 ± 13.3% (k=2)
450	± 50 / ± 100	Body	56.7 ± 5%	0.94 ± 5%	0.14	1.82	7.19 ± 13.3% (k=2)

[c] The validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2). The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

Appendix E – Data Acquisition Electronic (DAE) Calibration

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

Client Auden

CALIBRATION CERTIFICATE

Object(s)	DAE3 - SD 000 D03 AA - SN: 541
Calibration procedure(s)	QA CAL-06.v7 Calibration procedure for the data acquisition unit (DAE)
Calibration date:	26.04.2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date	Scheduled Calibration
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03	Sep-04

	Name	Function	Signature
Calibrated by:	Philipp Storchenegger	Technician	P. St.
Approved by:	Fin Bomholt	R&D Director	F. Bomholt

Date issued: 26.04.2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

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1. DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.......+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	404.738	404.586	404.348
Low Range	3.95132	3.93433	3.97979
Connector Angle to be used	in DASY System	296 °	

High Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	200000	200000.3	0.00
Channel X	+ Input	20000	19997.5	-0.01
Channel X	- Input	20000	-19993.7	-0.03
Channel Y	+ Input	200000	199999.5	0.00
Channel Y	+ Input	20000	19995.5	-0.02
Channel Y	- Input	20000	-19998.2	-0.01
Channel Z	+ Input	200000	200000	0.00
Channel Z	+ Input	20000	19996.8	-0.02
Channel Z	- Input	20000	-19995.1	-0.02

Low Range		Input (μV)	Reading (μV)	Error (%)
Channel X	+ Input	2000	1999.95	0.00
Channel X	+ Input	200	200.08	0.04
Channel X	- Input	200	-200.46	0.23
Channel Y	+ Input	2000	2000.07	0.00
Channel Y	+ Input	200	200.15	0.07
Channel Y	- Input	200	-199.84	-0.08
Channel Z	+ Input	2000	2000.04	0.00
Channel Z	+ Input	200	199.12	-0.44
Channel Z	- Input	200	-201.33	0.67

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Reading (μV)	Low Range Reading (μV)
Channel X	200	10.14	8.76
	- 200	-7.92	-9.44
Channel Y	200	-0.13	-0.13
	- 200	-0.64	-1.48
Channel Z	200	-0.33	0.30
	- 200	-1.32	-2.05

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3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (µV)	Channel Y (µV)	Channel Z (µV)
Channel X	200	-	1.57	0.38
Channel Y	200	1.15	-	3.56
Channel Z	200	-1.23	-0.99	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15913	16186
Channel Y	15730	15569
Channel Z	15932	17108

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (µV)	min. Offset (µV)	max. Offset (µV)	Std. Deviation (µV)
Channel X	0.24	-0.44	0.87	0.24
Channel Y	-2.29	-3.41	-1.33	0.33
Channel Z	-0.82	-1.95	0.03	0.33

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance

	Zeroing (MOhm)	Measuring (MOhm)
Channel X	0.2000	199.8
Channel Y	0.2001	202.7
Channel Z	0.2000	203.0

8. Low Battery Alarm Voltage

typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption

typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.0	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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