Specific Absorption Rate (SAR) Test Report
for
Tottori SANYO Electric Co., Ltd.
on the
Cellular Phone
Model: DMC201

Test Report: J99013163_SAR
Date of Report: May 28, 1999

NVLAP Laboratory Code 200201-0
Accredited for testing to FCC Parts 15

Tested by:	C. K. Li	
Prepared by:	C. K. Li	

Table of Contents

1 JOB DESCRIPTION

1.1 Client Information

The EUT has been tested at the request of

Company: Tottori SANYO Electric Co., Ltd.
7-101 Tachikawa-cho, Tottori-shi,
Tottori, Japan

Name of contact: Kazutuki Yoshida (Technical)
Hikaru Saito (Non-Technical)
US Telephone: (408) 446-7866
US Fax: (408) 725-8527

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	AMPS/CDMA Cellular Phone		
Trade Name	Tottori SANYO	Model No.	DMC201
FCC ID	NRNDMC200	S/N No.	Not labelled
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band (uplink)	AMPS:824-849 MHz CDMA:824-848.3 MHz	System	AMPS CDMA

EUT Antenna Description			
Type	Monopole	Configuration	Fixed
Dimensions	106 mm (L)	Gain	Not provided
Location	Left, Top		

Use of Product : Voice communications

Manufacturer: SAME as above.

Production is planned: [X] Yes, [ ] No

EUT receive date: 3/20/99

EUT received condition: Good condition prototype

Test start date: 5/27/99

Test end date: 3/28/99

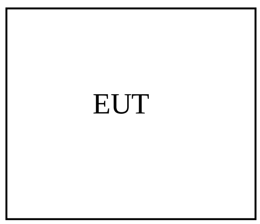
1.3 Test plan reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C to OET Bulletin 65

1.4 System test configuration

1.4.1 System block diagram & Support equipment

The diagram shown below details test configuration of the equipment under test .



S:	Shielded	**U:**	Unshield	**F:**	With Ferrite Core

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
None					

1.4.2 Test Position

The EUT was configured for testing in a typical fashion (as a customer would normally use it), and in the confines as outlined in C95.1 (1992) and Supplement C of OET 65 (1998). The EUT was placed in the intended use position, i.e. CENELEC 80^{o} position. This position is defined by a reference plane and a line. The reference plane of the head is given by three points, the auditory canal opening of both ears and center of the closed mouth. The reference line of the EUT is defined by the line which connects the center of the ear piece with the center of the bottom of the case and lies on the surface of the case facing the phantom. The reference line of the EUT lies in the reference plane of the head. The center of the ear piece of the EUT is place at the entry of the auditory canal. The angle between the reference line of the phone and the line connecting both auditory canal openings is 80^{o}. Please refer to figure 1 below for the position details:

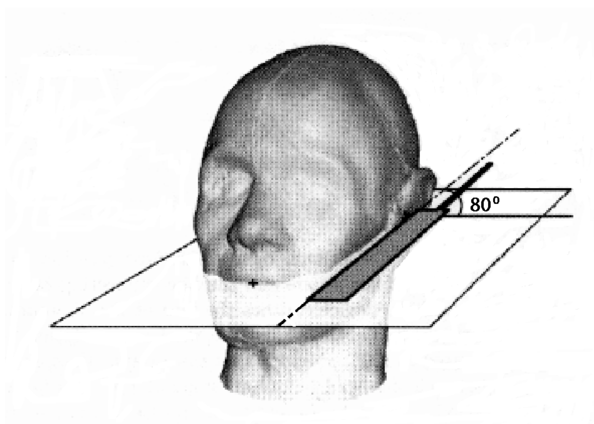


Figure 1: Intended use position

1.4.3 Test Condition

During tests, the worst case data (max. RF coupling) was determined with following conditions:

EUT Antenna	Extended and Retracted	Orientation	N/A
Usage	Left-Hand and Right –Hand	Distance between antenna axis at the joint and the liquid surface:	22.4 mm
Simulating human hand	Not Used	EUT Battery	Fully Charged
Power output	26.4-26.5 dBm antenna port at AMPS mode (Maximum)		

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer. Tests were performed at AMPS mode (600mW) only which transmitts at higher power than CDMA mode (230 mW).

Antenna port power measurement was performed, with the HP 435A power meter, before and after the SAR tests to ensure that the EUT operated at the highest power level.

1.5 Modifications required for compliance

No modifications were implemented by Intertek Testing Services.

1.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

2 SAR EVALUATION

2.1 SAR Limits

The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

EXPOSURE (General Population/Uncontrolled Exposure environment)	**SAR (W/kg)**
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

2.2 Configuration Photographs

Worst-Case SAR measurement
at 849 MHz, Antenna out, AMPS mode

Right-Hand Usage

2.3 System Verification

Prior to the assessment, the system was verified to the ±5% of the specifications by using the system validation kit. The validation was performed at 900 MHZ.

Validation kit	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)
D900V2, S/N #: 013	3.92	3.90

2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the ear point and used as a reference value for the assessing the power drop.

b. The SAR distribution at the exposed side of the head was measured at a distance of 4.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

c. Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

   I) The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   ii) The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y and z directions). The volume was integrated with the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

   iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

d. Re-measurement of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

2.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

Trade Name:	Tottori SANYO	**Model No.:**	DMC201
Serial No.:	Not labelled	**Test Engineer:**	CK LI

TEST CONDITIONS			
Ambient Temperature	23 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	CW
Output Power Before SAR Test	26.4 to 26.6 dBm	Output Power After SAR Test	26.4 to 26.6 dBm
Test Duration	23 Min.	Number of Battery Change	1

Right-Hand Usage				
Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR_{1g} (mW/g)
824 MHz	AMPS	1	Fully Extended	1.42
		1	Fully Retracted	0.927
836 MHz	AMPS	1	Fully Extended	1.41
		1	Fully Retracted	1.06
849 MHz	AMPS	1	Fully Extended	1.42
		1	Fully Retracted	1.19

Left-Hand Usage [d)]				
Channel	Operating Mode	Duty Cycle ratio	Antenna Position	Measured SAR_{1g} (mW/g)
849 MHz	AMPS	1	Fully Extended	1.28
		1	Fully Retracted	1.04

Note:
a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included
d) Test was repeated at worst case frequency found in Right hand usage configuration.

3.1 TEST EQUIPMENT

3.2 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system which is package optimized for dosimetric evaluation of mobile radios [3]. The following major equipment/components were used for the SAR evaluations:

SAR Measurement System			
EQUIPMENT	SPECIFICATIONS	S/N #	CAL. DATE
Robot	**Stäubi RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ET3DV5**	1333	03/18/99
	Frequency Range: 10 MHZ to 6 GHz Linearity: ± 0.2 dB Directivity: ± 0.1 dB in brain tissue		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 M		
Phantom	**Generic Twin V3.0**	N/A	N/A
	Type: Generic Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.1 mm Capacity: 20 liter Ear spacer: 4 mm (between EUT ear piece and tissue simulating liquid)		
Simulated Tissue	**Mixture**	N/A	04/12/99
	Please see section 6.2 for details		
Power Meter	**HP** 435A w/ 8481H sensor	1312A01255	02/1/99
	Frequency Range: 100kHz to 18 GHz Power Range: 300µW to 3W		

3.2 Brain Tissue Simulating Liquid

Ingredient	**Frequency** (800 – 900 MHz)
Water	40.3 %
Sugar	56.0 %
Salt	2.5 %
HEC	1.0 %
Bactericide	0.2 %

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

Frequency (MHZ)	$_r$ *	*(mho/m)	**(kg/m$^{3)}$
900	41.9± 5%	0.835 ± 10%	1000

* *worst case uncertainty of the HP 85070A dielectric probe kit*
** *worst case assumption*

3.3 E-Field Probe Calibration

Probes were calibrated by the manufacturer in the TEM cell ifi 110. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix C.

3.4 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [5] and the NIST 1297 [6] documents and is given in the following table. The extended uncertainty (K=2) was assessed to be 23.5 %

UNCERTAINTY BUDGET				
Uncertainty Description	**Error**	**Distrib.**	**Weight**	**Std.Dev.**
Probe Uncertainty				
Axial isotropy	±0.2 dB	U-shape	0.5	±2.4 %
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %
Isotropy from gradient	±0.5 dB	U-shape	0	
Spatial resolution	±0.5 %	Normal	1	±0.5 %
Linearity error	±0.2 dB	Rectang.	1	±2.7 %
Calibration error	±3.3 %	Normal	1	±3.3 %
SAR Evaluation Uncertainty				
Data acquisition error	±1 %	Rectang.	1	±0.6 %
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %
Conductivity assessment	±10 %	Rectang.	1	±5.8 %
Spatial Peak SAR Evaluation Uncertainty				
Extrapol boundary effect	±3 %	Normal	1	±3 %
Probe positioning error	±0.1 mm	Normal	1	±1 %
Integrat. And cube orient	±3 %	Normal	1	±3 %
Cube shape inaccuracies	±2 %	Rectang.	1	±1.2 %
Device positioning	±6 %	Normal	1	±6 %
Combined Uncertanties				**±11.7 %**

3.5 Measurement Traceability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

4.0 WARNING LABEL INFORMATION - USA

Not Applicable

5.0 REFERENCES

[1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 Ghz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY 10017, 1992

[2] Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

[5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

[6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institude of Standards and Technology, 1994.

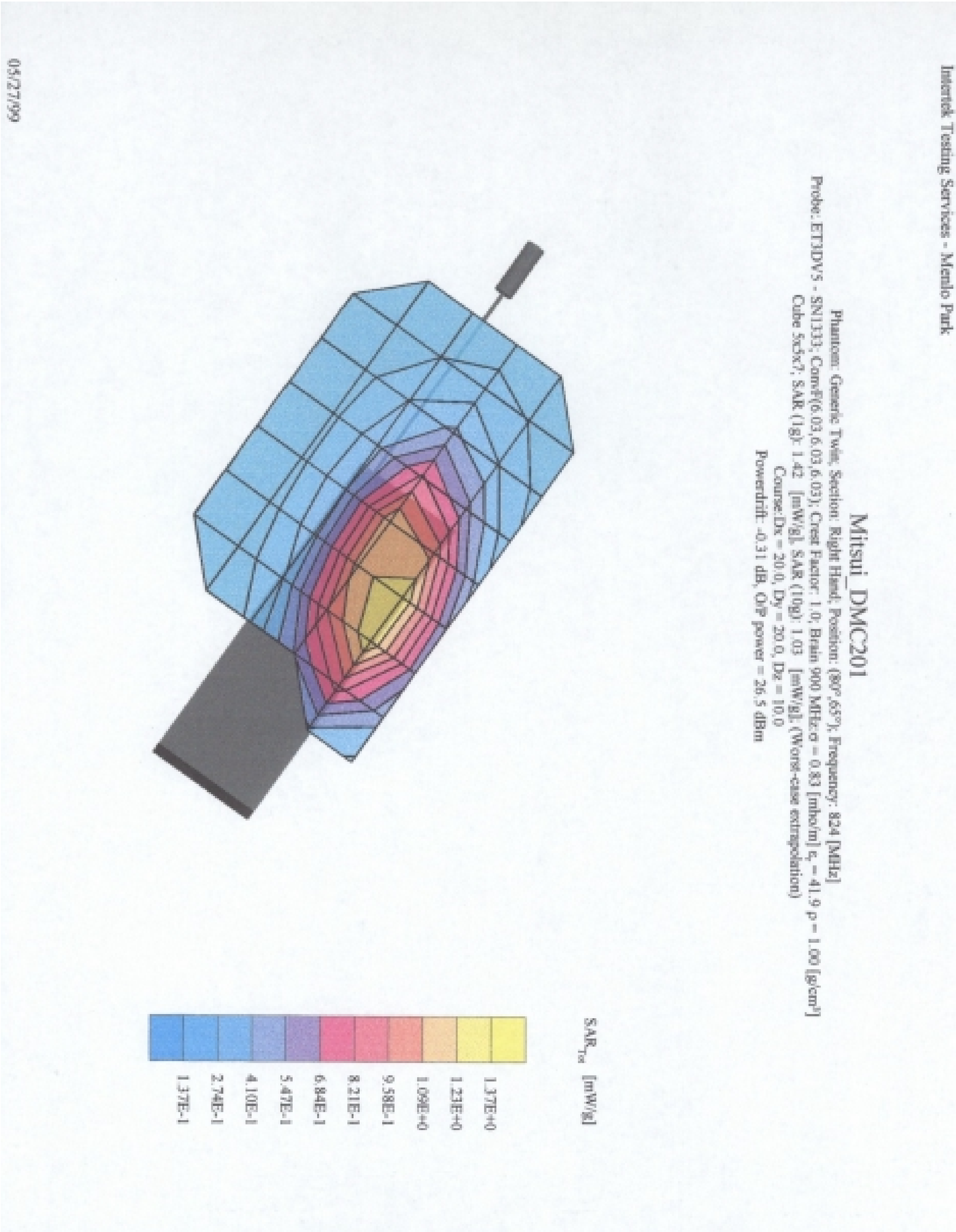
APPENDIX A - SAR EVALUATION DATA

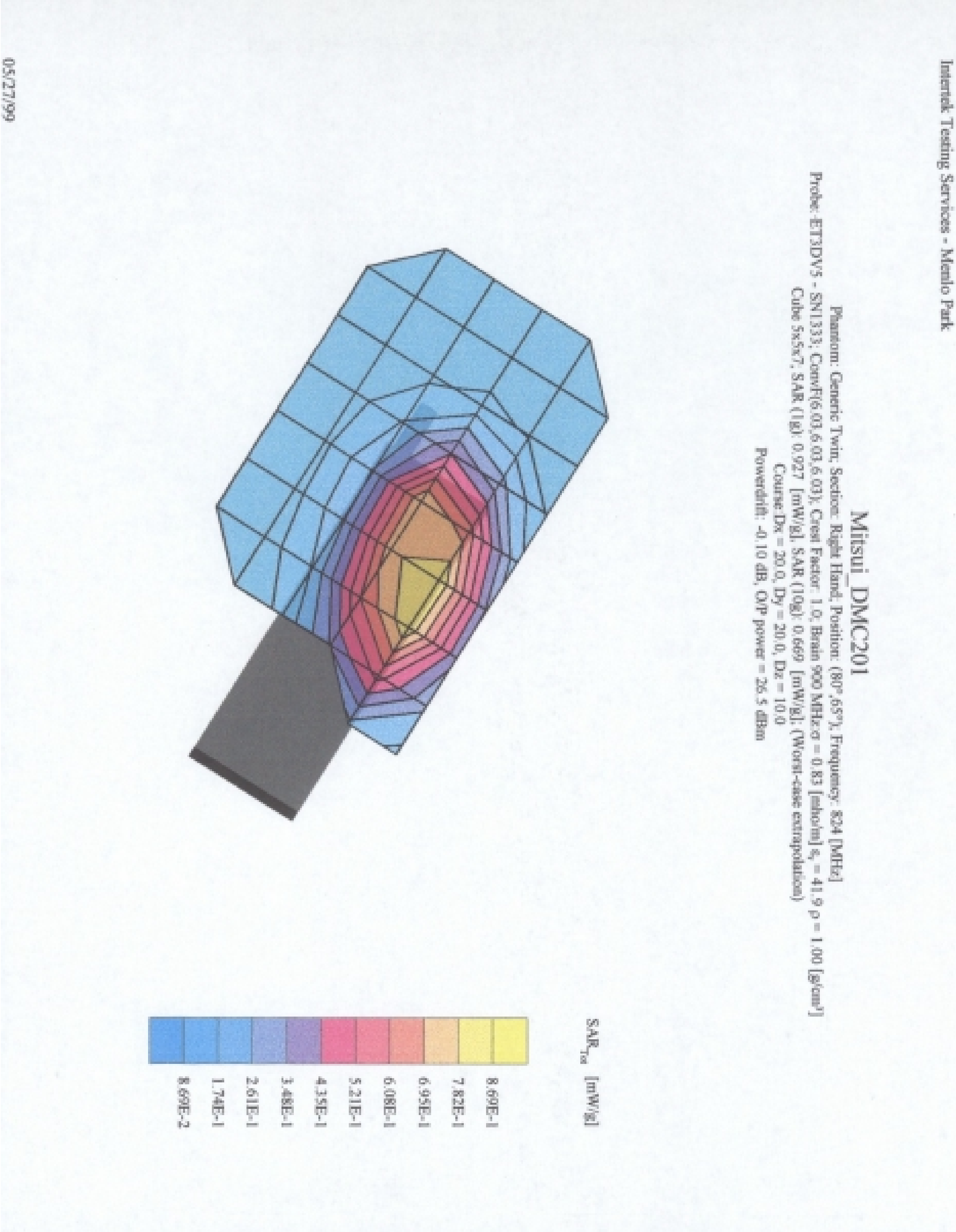
Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

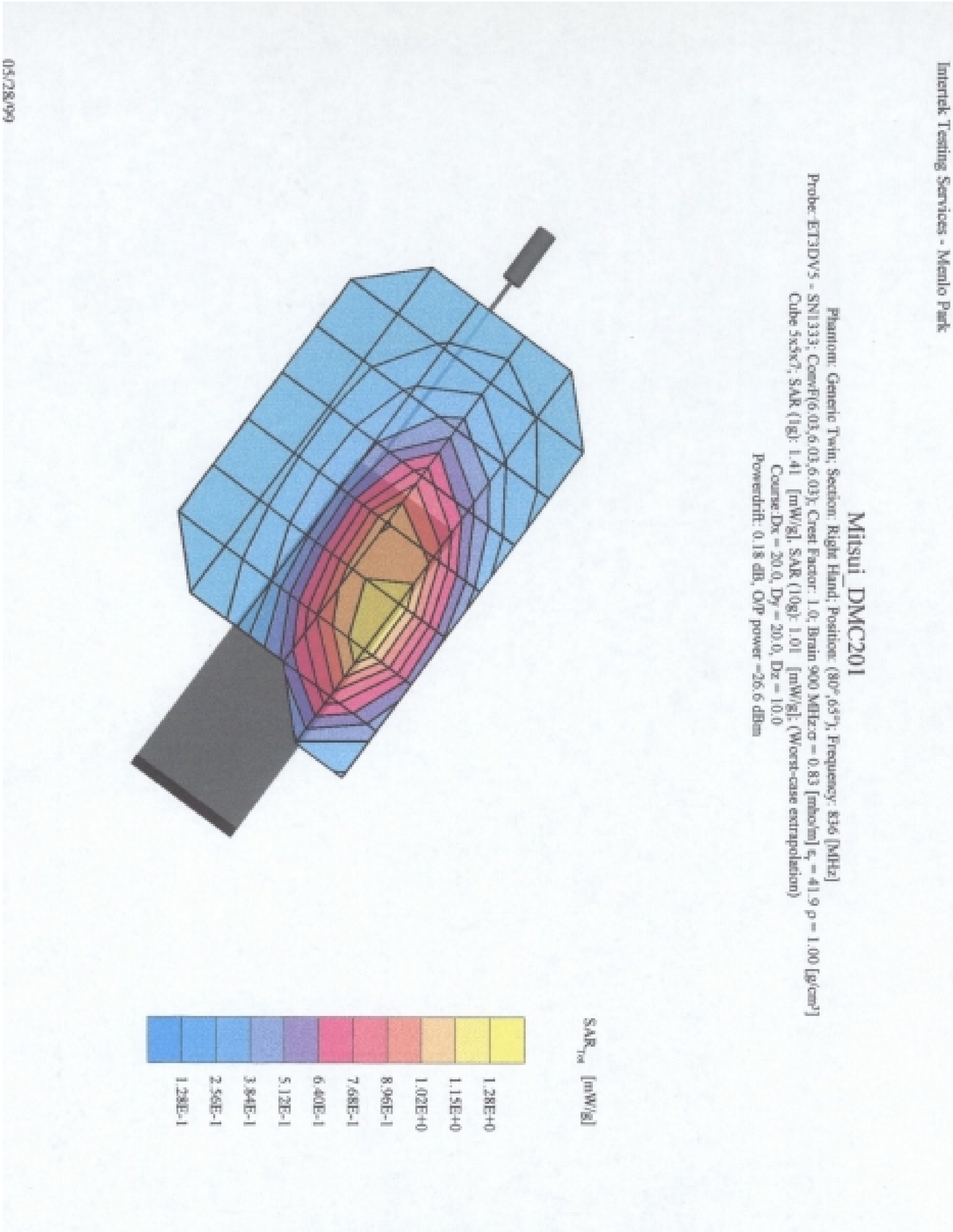
Powerdrift is the measurement of power drift of the device over one complete SAR scan.

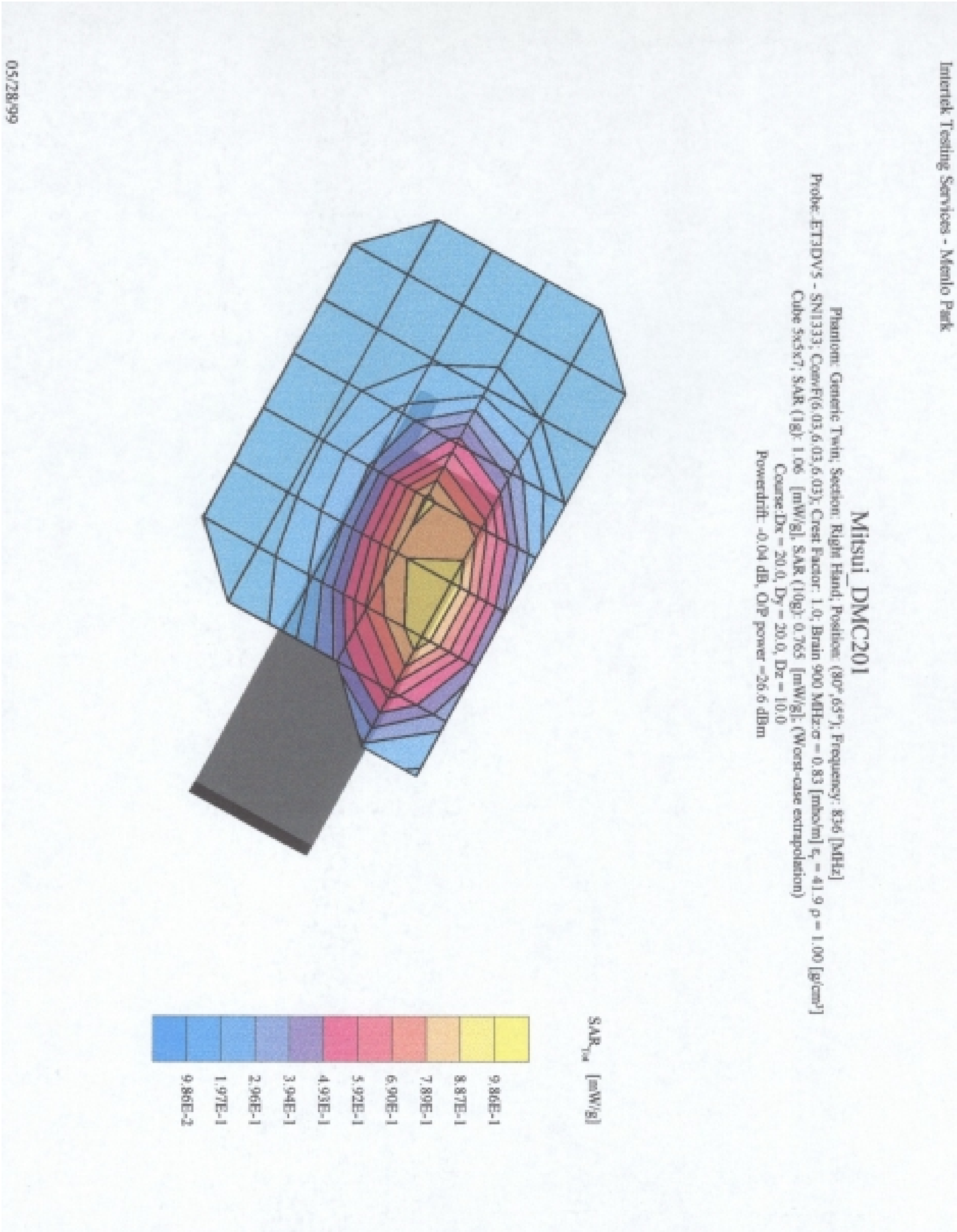
APPENDIX B - E-FIELD PROBE CALIBRATION DATA

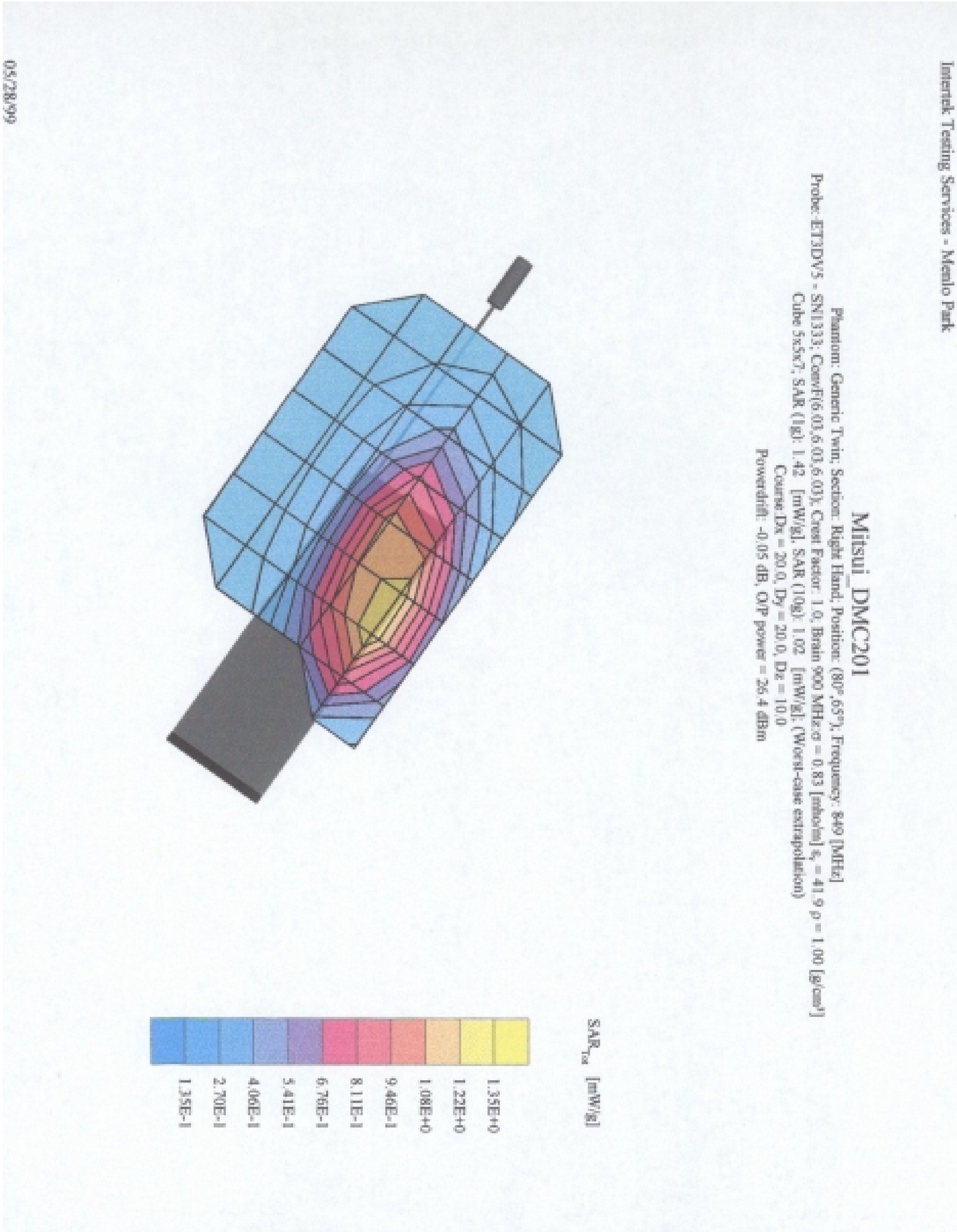
See attached pages.


Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0; Brain 900 MHz: σ = 0.83 [mho/m] ε_r = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 1.42 [mW/g], SAR (10g): 1.03 [mW/g]; (Worst-case extrapolation)
Course:Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.31 dB, O/P power = 26.5 dBm
SAR_Tot [mW/g]
1.37E+0
1.23E+0
1.09E+0
9.58E-1
8.21E-1
6.84E-1
5.47E-1
4.10E-1
2.74E-1
1.37E-1
05/27/99

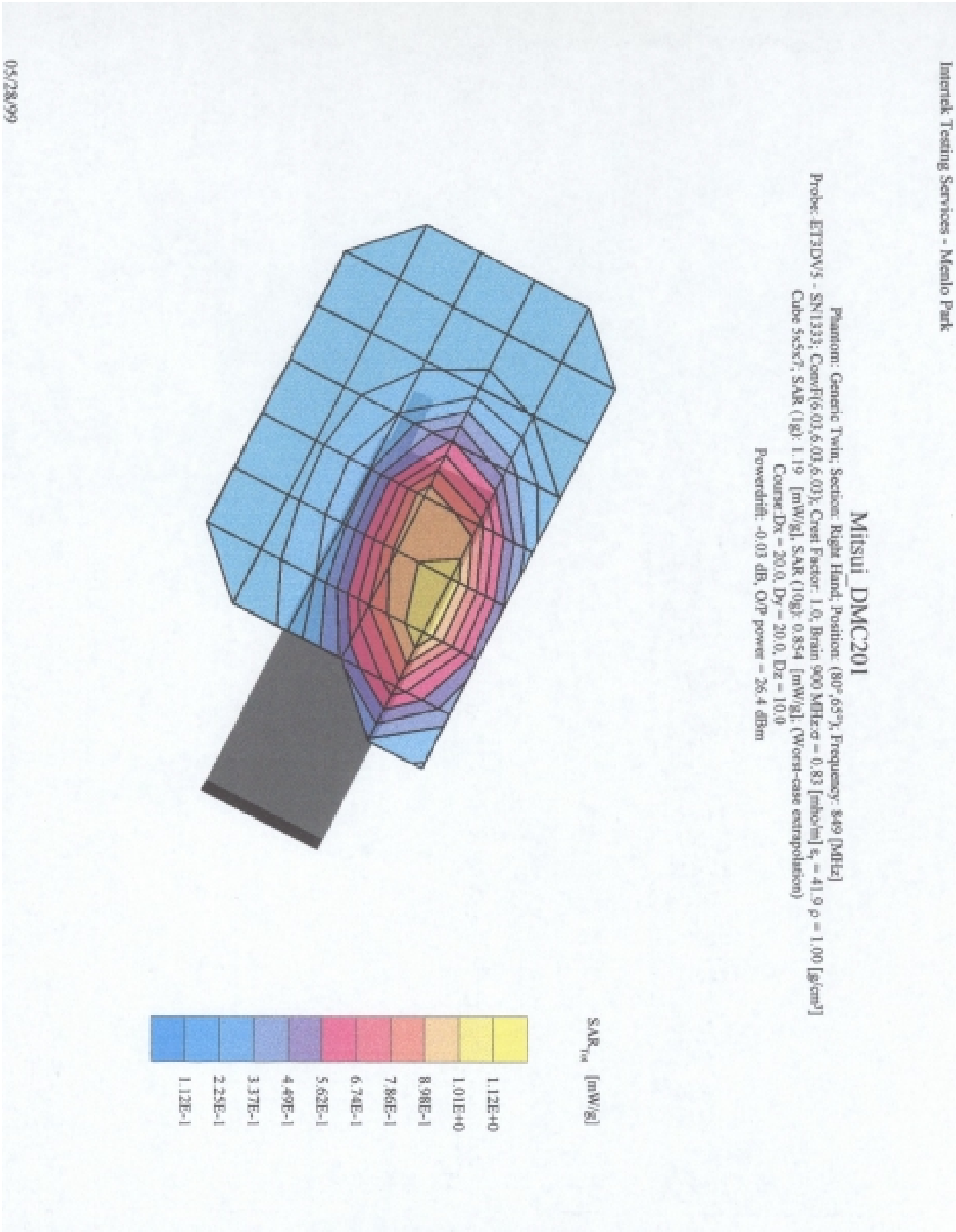

Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 824 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0; Brain 900 MHz σ = 0.83 [mho/m] εr = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 0.927 [mW/g], SAR (10g): 0.669 [mW/g]; (Worst-case extrapolation)
Course Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.10 dB, O/P power = 26.5 dBm
SAR Tot [mW/g]
8.69E-1
7.82E-1
6.95E-1
6.08E-1
5.21E-1
4.35E-1
3.48E-1
2.61E-1
1.74E-1
8.69E-2
05/27/99


Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 836 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0; Brain 900 MHz:σ = 0.83 [mho/m] εr = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 1.41 [mW/g], SAR (10g): 1.01 [mW/g]; (Worst-case extrapolation)
Course:Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.18 dB, O/P power =26.6 dBm
SARTot [mW/g]
1.28E+0
1.15E+0
1.02E+0
8.96E-1
7.68E-1
6.40E-1
5.12E-1
3.84E-1
2.56E-1
1.28E-1
05/28/99


Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 836 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0; Brain 900 MHz: σ = 0.83 [mho/m] εr = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 1.06 [mW/g], SAR (10g): 0.765 [mW/g]; (Worst-case extrapolation)
Course:Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.04 dB, O/P power =26.6 dBm
SAR Tot [mW/g]
9.86E-1
8.87E-1
7.89E-1
6.90E-1
5.92E-1
4.93E-1
3.94E-1
2.96E-1
1.97E-1
9.86E-2
05/28/99



Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0, Brain 900 MHz: σ = 0.83 [mho/m] ε, = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 1.42 [mW/g], SAR (10g): 1.02 [mW/g]; (Worst-case extrapolation)
Course:Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB, O/P power = 26.4 dBm
SAR Tot [mW/g]
1.35E+0
1.22E+0
1.08E+0
9.46E-1
8.11E-1
6.76E-1
5.41E-1
4.06E-1
2.70E-1
1.35E-1
05/28/99


Intertek Testing Services - Menlo Park
Mitsui_DMC201
Phantom: Generic Twin; Section: Right Hand; Position: (80°,65°); Frequency: 849 [MHz]
Probe: ET3DV5 - SN1333; ConvF(6.03,6.03,6.03); Crest Factor: 1.0; Brain 900 MHz σ = 0.83 [mho/m] εr = 41.9 ρ = 1.00 [g/cm³]
Cube 5x5x7; SAR (1g): 1.19 [mW/g], SAR (10g): 0.854 [mW/g], (Worst-case extrapolation)
Course:Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.03 dB, O/P power = 26.4 dBm
SAR_Tot [mW/g]
1.12E+0
1.01E+0
8.98E-1
7.86E-1
6.74E-1
5.62E-1
4.49E-1
3.37E-1
2.25E-1
1.12E-1
05/28/99

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