

Specific Absorption Rate (SAR) Test Report

for

Matsushita Electric Works, Ltd.

on the

Emergency Portable Cellular Telephone

Model Number: PSD

Test Report: 30171762a

Date of Report: January 14, 2002

Date of Revision: April 19, 2002

Job #: 3017176

Date of Test: January 7 & 11, 2002

Total No of Pages Contained in this Report: 38



Warnock Hersey





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Review Date: 4/19/02

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TABLE OF CONTENTS

1.0	JOB DESCRIPTION	2
1.1	Client Information	2
1.2	Equipment under test (EUT)	2
1.3	Test Plan Reference	2
1.4	System Test Configuration	3
1.4.1	System Block Diagram & Support equipment	3
1.4.2	Test Position	4
1.4.3	Test Condition	6
1.5	Modifications required for compliance.....	6
1.6	Additions, deviations and exclusions from standards.....	6
2.0	SAR EVALUATION.....	7
2.1	SAR Limits.....	7
2.2	Configuration Photographs	8
2.3	System Verification	14
2.4	Evaluation Procedures	14
2.5	Test Results	15
3.0	TEST EQUIPMENT.....	17
3.1	Equipment List	17
3.2	Muscle Tissue Simulating Liquid.....	18
3.3	E-Field Probe Calibration	18
3.4	Measurement Uncertainty	19
3.5	Measurement Tractability	19
4.0	WARNING LABEL INFORMATION - USA.....	20
5.0	REFERENCES	21
6.0	DOCUMENT HISTORY.....	22
	APPENDIX A - SAR Evaluation Data.....	23
	APPENDIX B - E-Field Probe Calibration Data.....	30

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

1.0 JOB DESCRIPTION**1.1 Client Information**

The PSD has been tested at the request of:

Company: Matsushita Electric Works, Ltd
1048, Kadoma
Osaka, 571-8686
Japan
Name of contact: Mr. Akira Ohya
Telephone: +81-6-6906-0473
Fax: +81-6-6906-0520

1.2 Equipment under test (EUT)**Product Descriptions:**

Equipment	Emergency Portable Cellular Telephone		
Trade Name	Matsushita Electric Works, Ltd.	P/N.	PSD
FCC ID	HHV20011107	S/N No.	17407801777
Category	Portable	RF Exposure	Uncontrolled Environment
Frequency Band	824-849 MHz	System	AMPS

EUT Antenna Description			
Type	Monopole	Configuration	Fixed
Dimensions	17.4mm (L),	Gain	2.14 dBi
Location	Right side top		

Use of Product : Emergency calls.
Manufacturer: Shintom Co., Ltd.
Production is planned: [X] Yes, [] No
EUT receive date: January 3, 2002
EUT received condition: Good working condition prototype
Test start date: January 3, 2002
Test end date: January 11, 2002

1.3 Test Plan Reference

FCC rule part 2.1093, FCC Docket 96-326 & Supplement C (Edition 01 - 01) to OET Bulletin 65

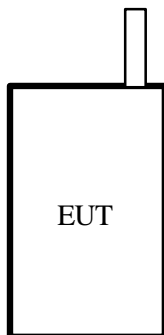
Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

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.



No Support Equipment was used. The test sample was operated in a test mode that allows control of the transmitter without the need to place actual phone calls. For the purposes of this test the device is commanded to test mode and manually set to the proper channel, transmitter power level and transmit mode of operation. The device was then placed in the SAR measurement system with a fully charged battery.

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

1.4.2 Test Position

Three test configurations were used to show compliance with the FCC RF human exposure requirements. In all configurations, the PSD was configured for testing in a typical fashion (as a customer would normally use it). Due to the application and usage of the product, SAR measurements with the human head region are not necessary.

The intended use position is as follows:

1. Hands-free operation by using belt clip. The phone is attached to user's body.
2. Holding the phone with the hand away from user's head.
3. Hands-free operation with the phone placed away from the user, i.e. on a desk, etc.

The phone does not contain an ear piece that allows the user to position the phone against the head as with a typical phone. The phone uses a loud speaker positioned below the area of where a typical ear piece would be located. The intended use position is to hold the unit by the hand with the entire front side of the phone (speaker and microphone) towards the user or to attach the unit to the body with a belt clip.

Table 1 below describes the setup and condition:

Table 1, Equipment Setup	
Configuration	Description
A	<ul style="list-style-type: none">• Antenna in horizontal position The Phone Touching the Phantom• Simulating close proximity of human hand holding the Phone• Distance of Antenna axis from Phantom 12.0 mm
B	<ul style="list-style-type: none">• Antenna in horizontal position, The Belt Clip touching Phantom• Simulating close proximity of human body• Distance of Antenna axis from Phantom 24.4 mm

Figure 1a: Configuration A

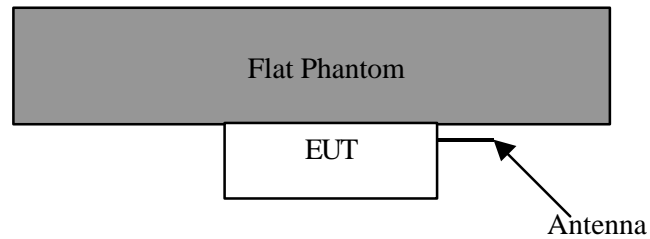
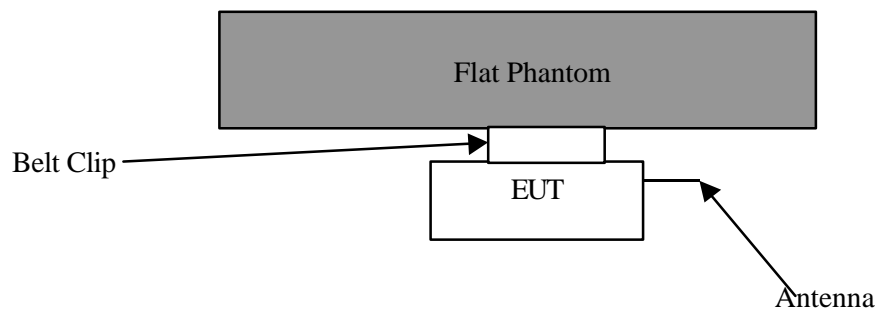


Figure 1b Configuration B



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

1.4.3 Test Condition

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

EUT Antenna	Fixed length		
Usage	Body Configuration	Distance between antenna axis at the joint and the liquid surface:	
		In Configuration A	12.0 mm
		In Configuration B	24.4 mm
Simulating human Body/Head	Body	EUT Battery	Unit is powered by two CR123A Lithium Batteries .
Power output (conducted)	Frequency (MHz)	Power output dBm	
	824	26.87	
	836	26.52	
	849	25.79	

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer. The antenna port power level was furnished by the manufacturer.

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.

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.0 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

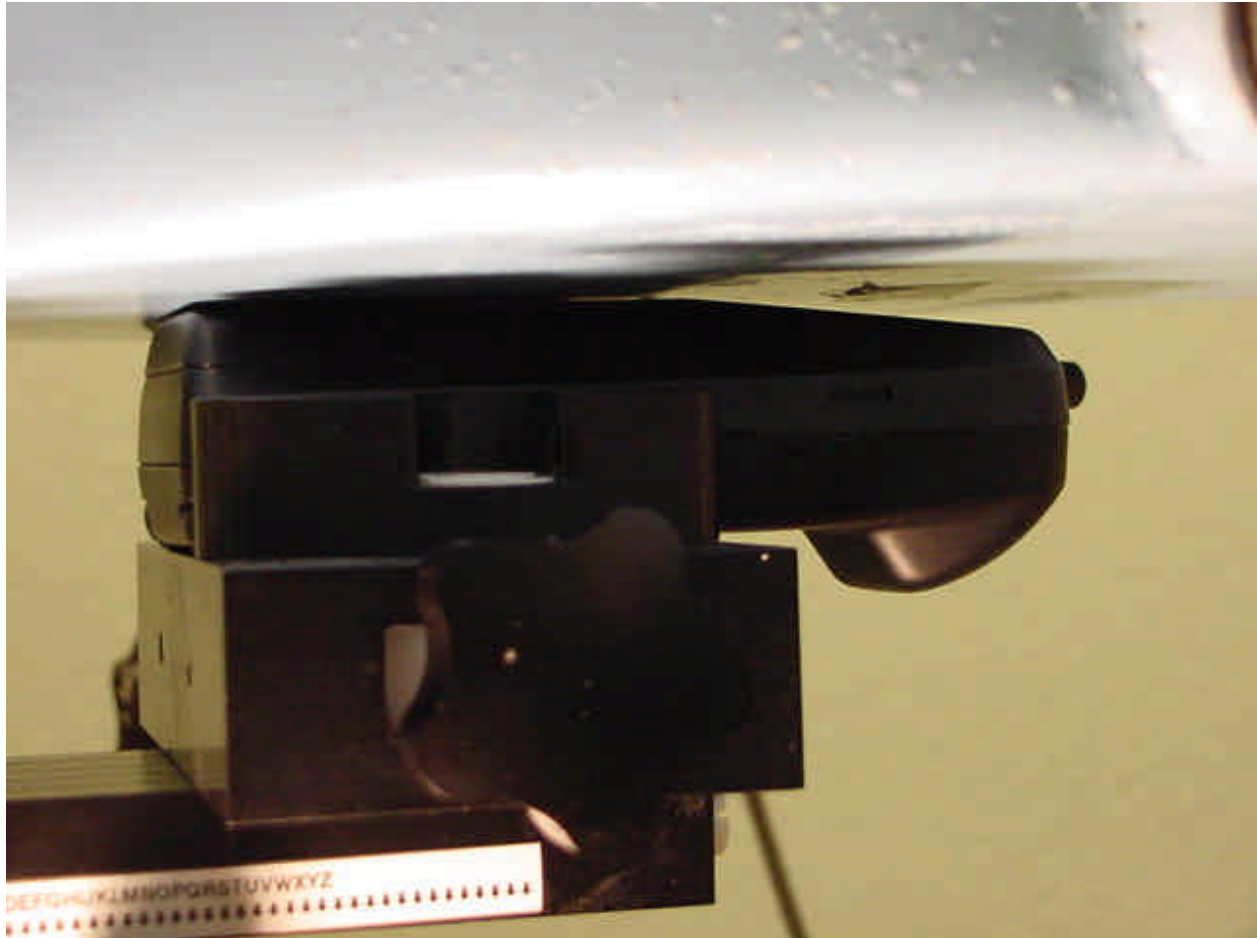
Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs

SAR measurement Test Setup

(Configuration A)



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs (Continued)

SAR measurement Test Setup

(Configuration B)



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs (Continued)

EUT Photo



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs (Continued)

EUT Photo



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs (Continued)

EUT Photo



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.2 Configuration Photographs (Continued)

EUT Photo



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

2.3 System Verification

Prior to the assessment, the system was verified to the $\pm 5\%$ of the specifications by using the system validation kit. The validation was performed at 900MHz.

Validation kit	Targeted SAR _{1g} (mW/g)	Measured SAR _{1g} (mW/g)
D900V2, S/N #: 0013	2.77	2.97

2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

- a. SAR was measured at a fixed location above the reference point and used as a reference value for the assessing the power drop.
- b. The SAR distribution at the exposed side of the flat Phantom was measured at a distance of 30 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 straightforward 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-measurements 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.

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

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.

Matsushita Electric Works, Ltd, Model No: PSD
 FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

Measurement Results

Trade Name:	Matsushita Electric Works, Ltd.	Model No.:	PSD
Serial No.:	17407801777	Test Engineer:	Suresh Kondapalli

TEST CONDITIONS			
Ambient Temperature	23.5 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	CW
Test Duration	20 Min. each test	Number of Battery Change	Every Scan

Configuration A (Phone Touching Phantom)				
Frequency MHz	Operating Mode	Duty Cycle ratio	Measured SAR _{10g} (mW/g)	Plot Number
824	CW	1	1.58	4
836	CW	1	1.57	5
849	CW	1	1.53	6

Configuration B (Phone with the belt clip)				
Frequency MHz	Operating Mode	Duty Cycle ratio	Measured SAR _{1g} (mW/g)	Plot Number
824	CW	1	1.41	1
836	CW	1	1.45	2
849	CW	1	1.39	3

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

Matsushita Electric Works, Ltd, Model No: PSD
 FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

3.0 TEST EQUIPMENT

3.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system, which is a 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 #	LAST CAL. DATE
Robot	Stäubli RX60L	597412-01	N/A
	Repeatability: $\pm 0.025\text{mm}$ Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	ET3DV5	1333	04/13/01
	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: $1\mu\text{V}$ to $>200\text{mV}$ Input offset Voltage: $< 1\mu\text{V}$ (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	01/07/02
	Please see section 6.2 for details		
Power Meter	HP 8900D w/ 84811A sensor	3607U00673	08/08/01
	Frequency Range: 100kHz to 18 GHz Power Range: $300\mu\text{W}$ to 3W		

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

3.2 Muscle Tissue Simulating Liquid

Ingredient	Frequency (800-900 MHz)
Water	52.4 %
Sugar	45.0 %
Salt	1.4 %
Bactericide	0.1 %
HEC	1.0 %

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)	ϵ_r *	σ *(mho/m)	ρ^{**} (kg/m ³)
836	55.2	0.97	1000

* Worst case uncertainty of the HP 85070A dielectric probe kit

** Worst case assumption

3.3 E-Field Probe Calibration

The manufacturer in the TEM cells ifi 110 calibrated probes. 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.

Matsushita Electric Works, Ltd, Model No: PSD
 FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

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 Uncertainties				±11.7 %

3.5 Measurement Tractability

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

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

4.0 WARNING LABEL INFORMATION - USA

For body-worn operation, this phone has been tested and meets the FCC RF Exposure guidelines when used in hands or with the belt clip supplied or designated for this product. Use of other belt clip or close to the head may not ensure compliance with FCC RF Exposure guidelines.

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

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, “Dosimetric 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. Taylor and Chris E. Kuyatt, “Guidelines for evaluating and expressing the uncertainty of NIST measurement results”, Tech. Rep., National Institute of Standards and Technology, 1994.

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

6.0 DOCUMENT HISTORY

Revision/ Job Number	Writer Initials	Date	Change
1.0 /3017176	SS	January 14, 2002	Original document
1.0/3017176a	SS	April 19, 2002	Pages 16, 24 to 29

Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

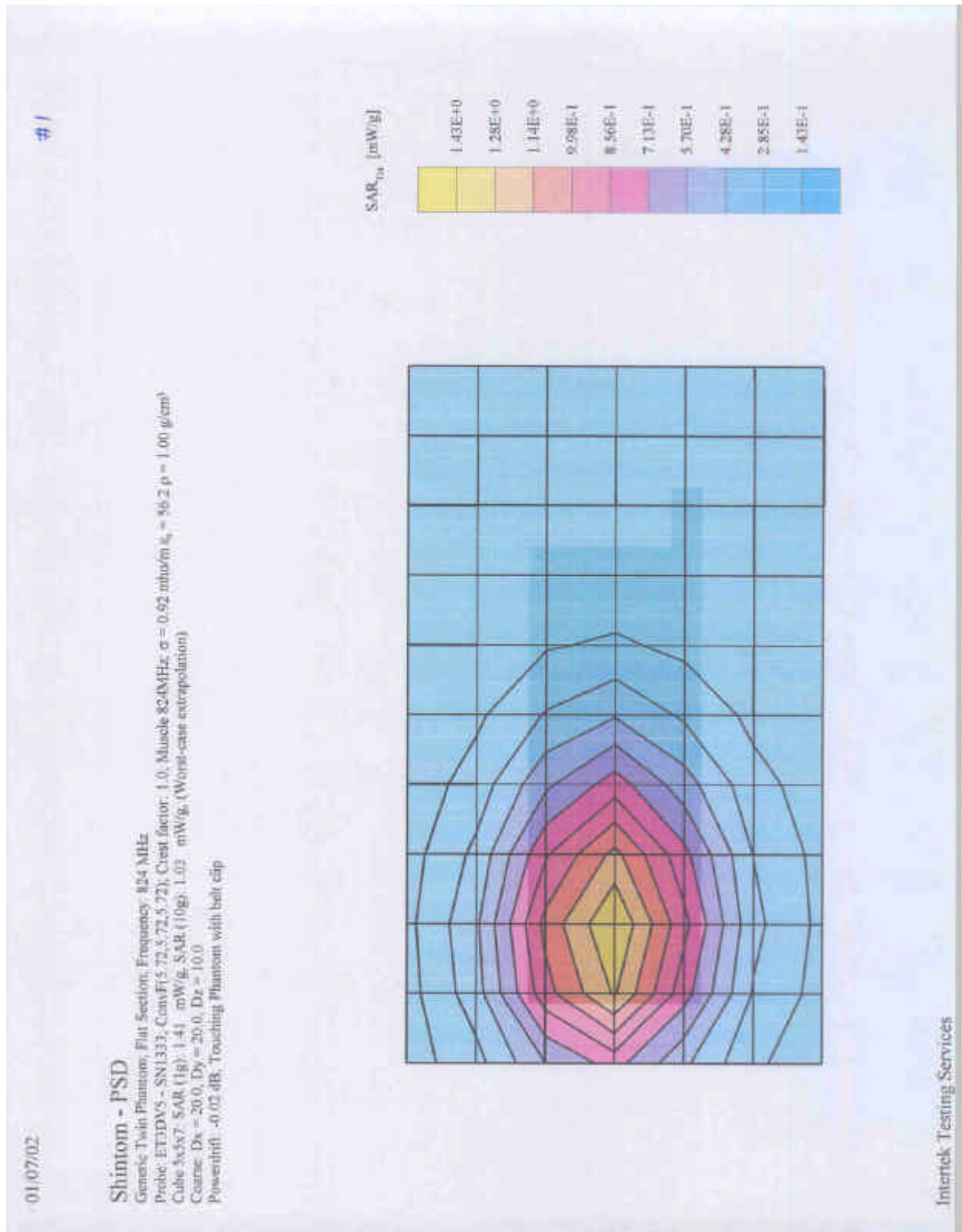
APPENDIX A - SAR Evaluation Data

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.

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

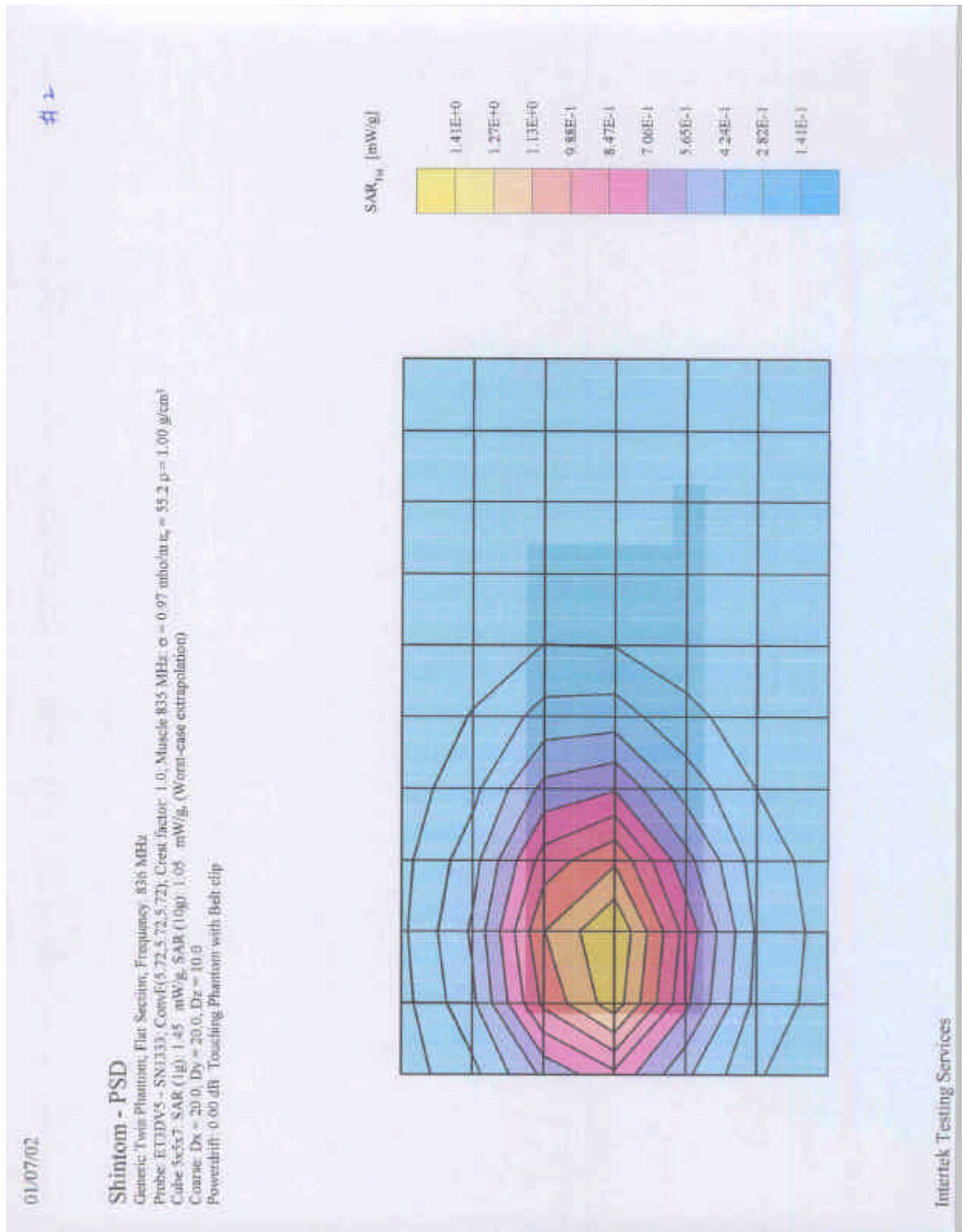
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FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002



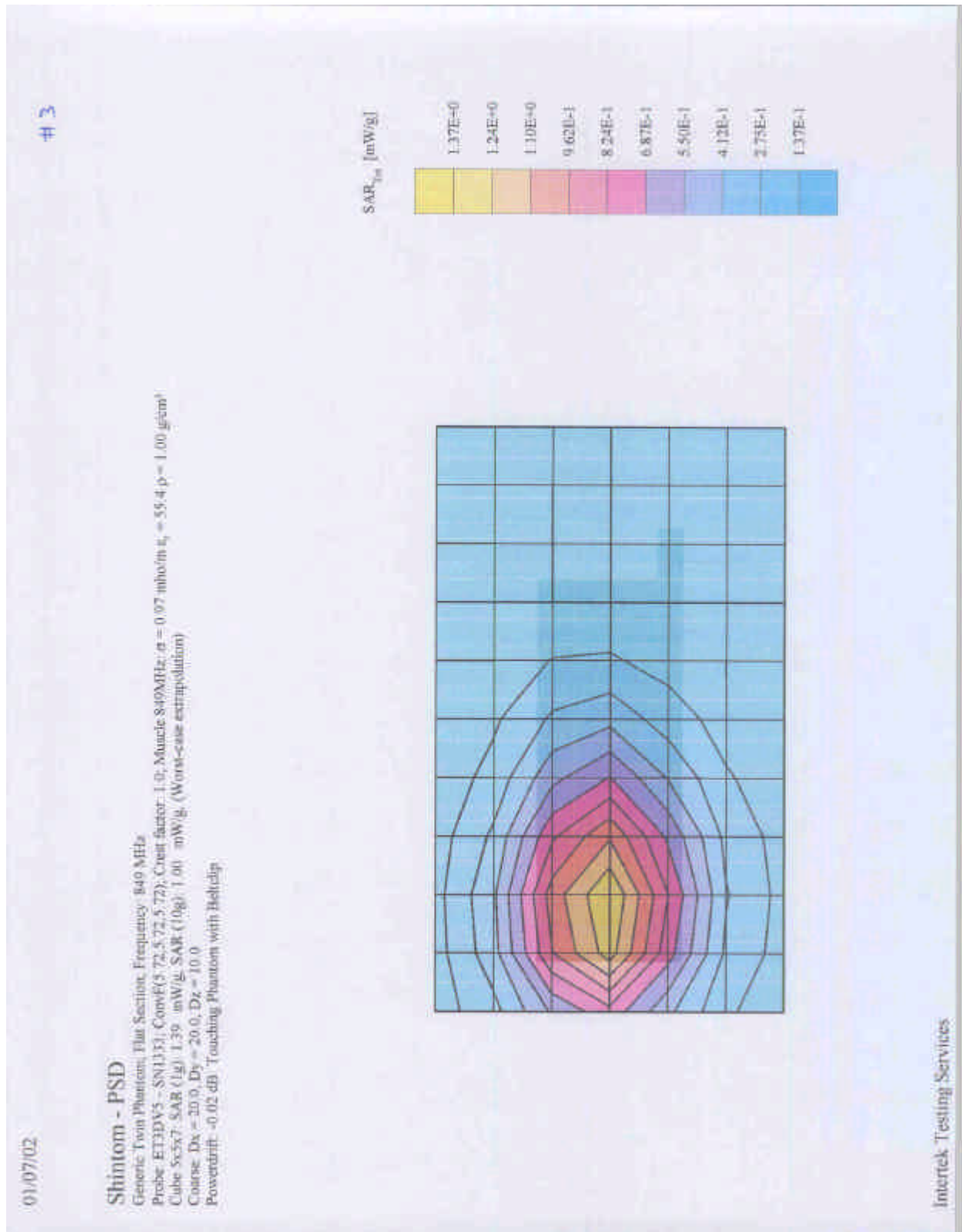
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Date of Test: January 7 & 11, 2002



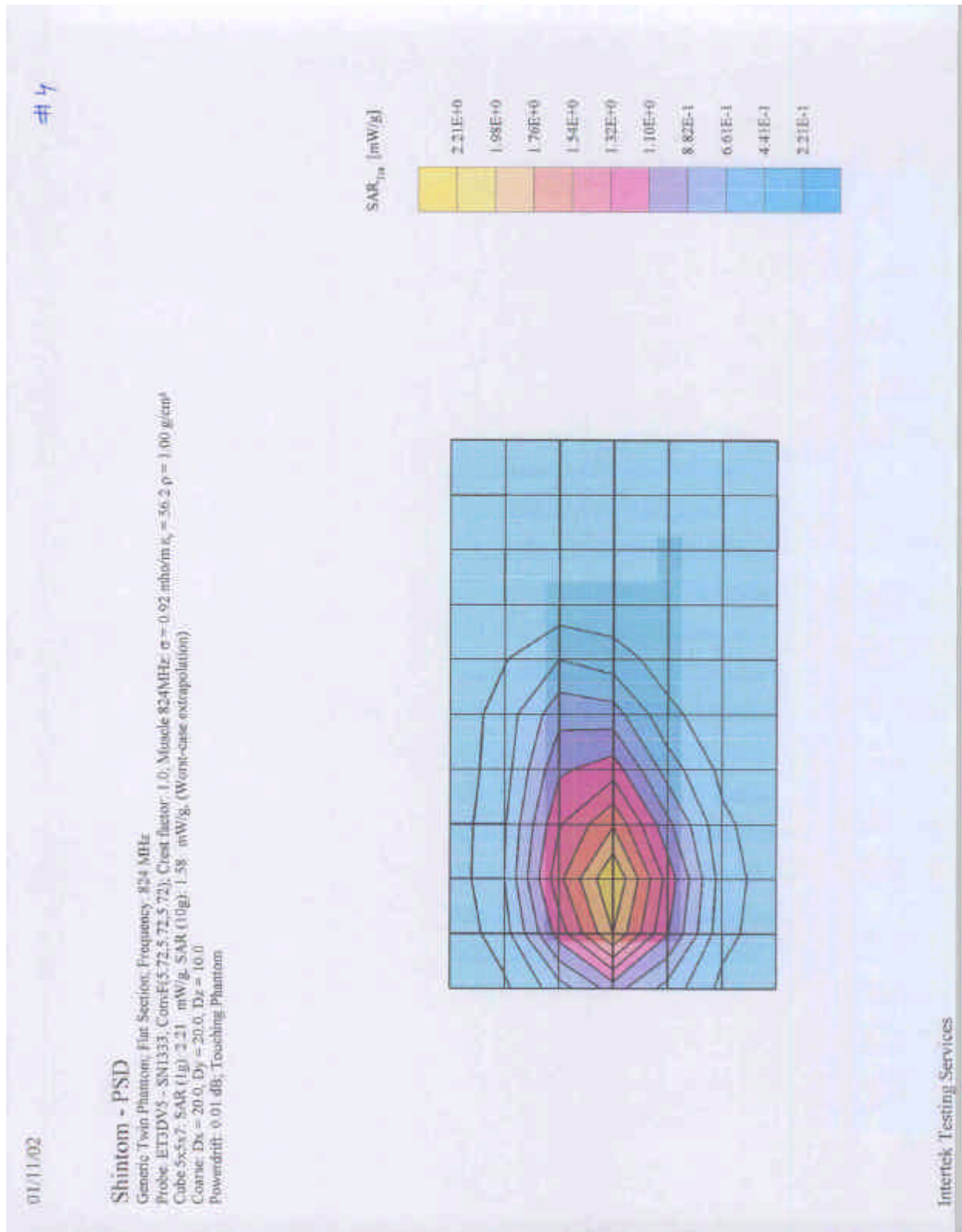
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FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002



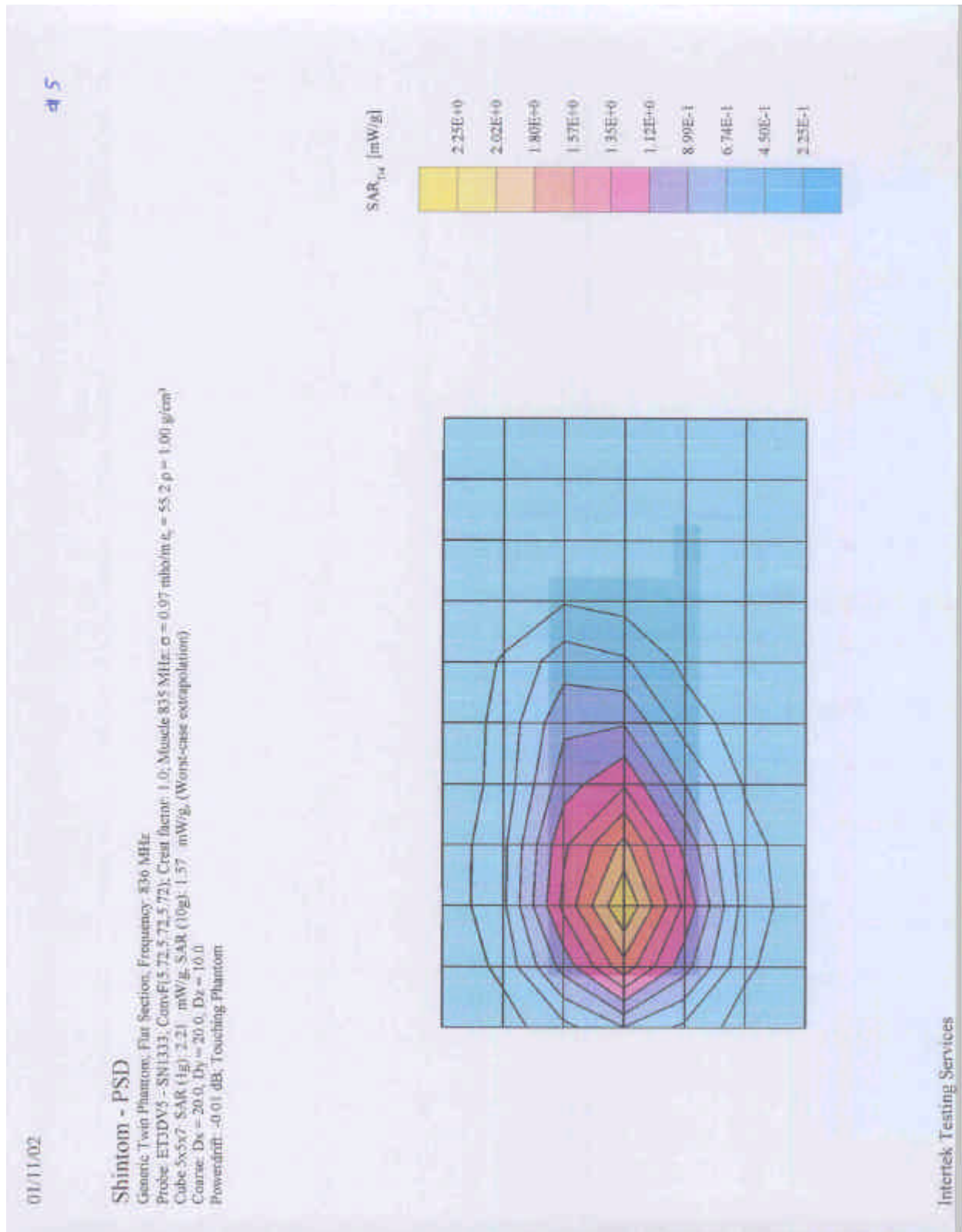
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FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002



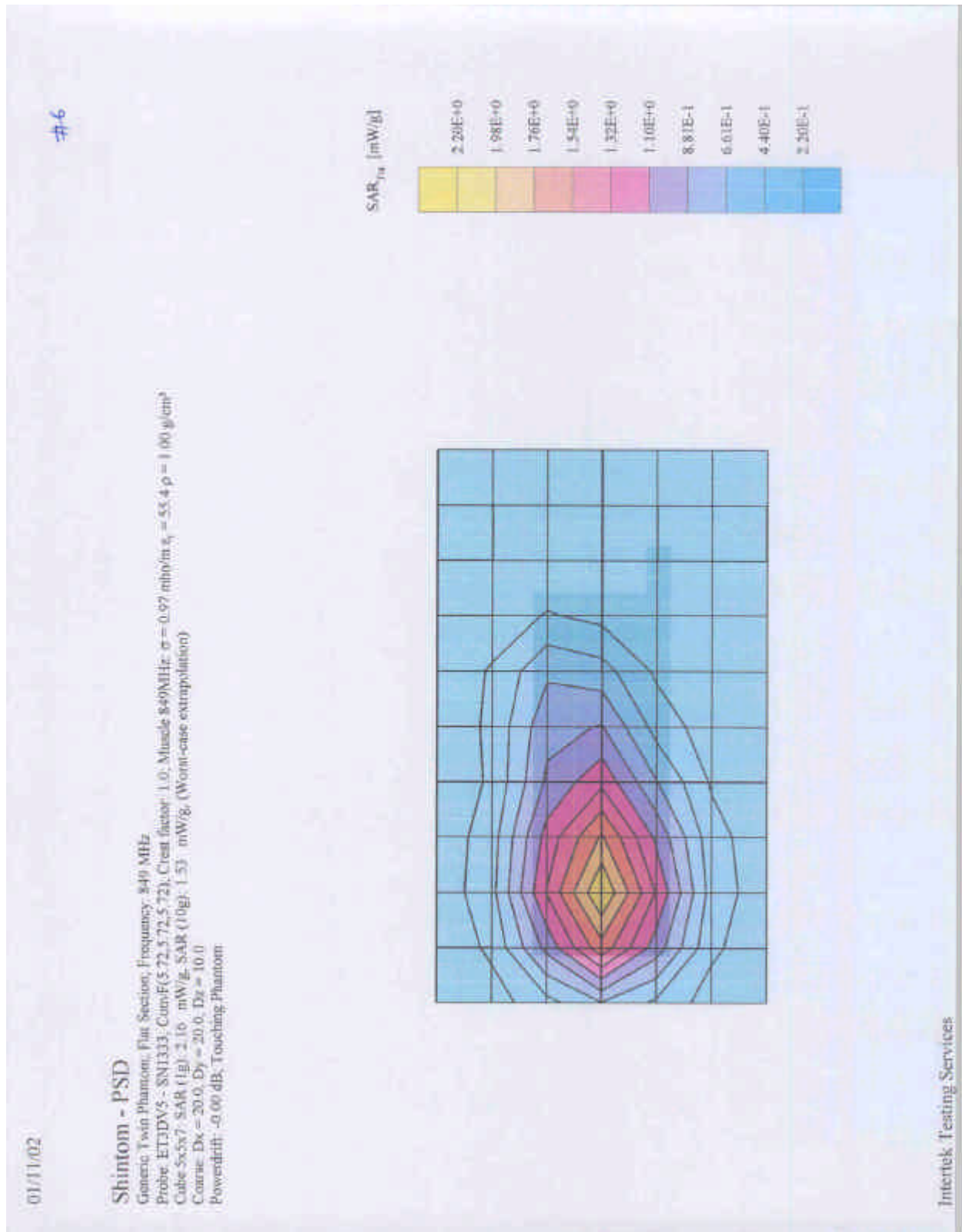
Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002



Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

APPENDIX B - E-Field Probe Calibration Data

See attached.



**Schmid & Partner
Engineering AG**

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV5

Serial Number:

1333

Place of Calibration:

Zurich

Date of Calibration:

April 23, 2001

Calibration Interval:

12 months

Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:

Nicola Mesana

Approved by:

Shari Katja



Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

Probe ET3DV5

SN:1333

Manufactured:	December 20, 1997
Last calibration:	April 10, 2000
Recalibrated:	April 23, 2001

Calibrated for System DASY3

ET3DV5 SN:1333

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	2.37 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	2.38 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	2.33 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	100 mV
DCP Y	100 mV
DCP Z	100 mV

Sensitivity in Tissue Simulating Liquid

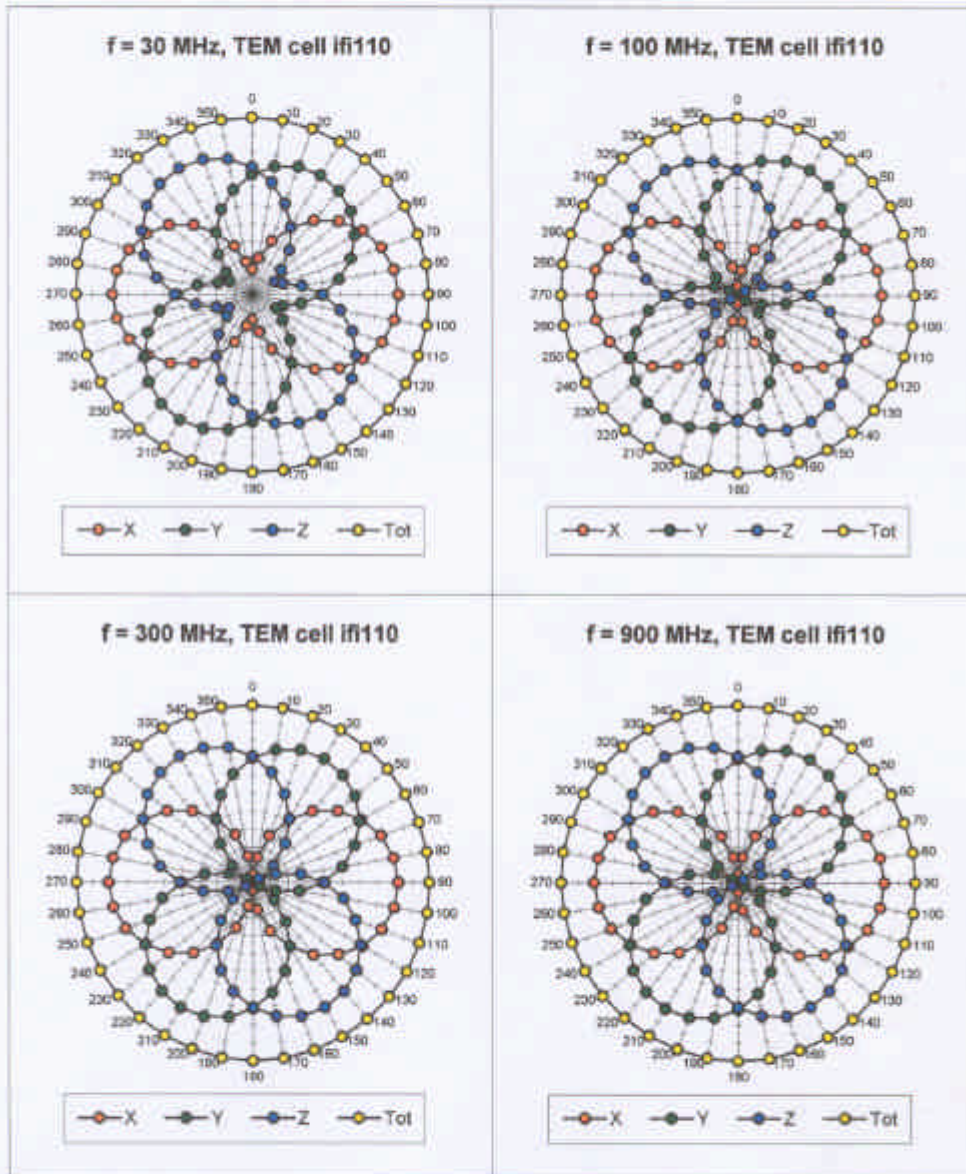
Head	450 MHz	$\epsilon_r = 43.5 \pm 5\%$	$\sigma = 0.87 \pm 10\% \text{ mho/m}$
ConvF X	6.25	extrapolated	Boundary effect:
ConvF Y	6.25	extrapolated	Alpha 0.19
ConvF Z	6.25	extrapolated	Depth 3.06
Head	900 MHz	$\epsilon_r = 42 \pm 5\%$	$\sigma = 0.97 \pm 10\% \text{ mho/m}$
ConvF X	5.83	$\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	5.83	$\pm 7\%$ (k=2)	Alpha 0.38
ConvF Z	5.83	$\pm 7\%$ (k=2)	Depth 2.70
Brain	1500 MHz	$\epsilon_r = 41 \pm 5\%$	$\sigma = 1.32 \pm 10\% \text{ mho/m}$
ConvF X	5.27	interpolated	Boundary effect:
ConvF Y	5.27	interpolated	Alpha 0.63
ConvF Z	5.27	interpolated	Depth 2.23
Brain	1800 MHz	$\epsilon_r = 41 \pm 5\%$	$\sigma = 1.69 \pm 10\% \text{ mho/m}$
ConvF X	4.99	$\pm 7\%$ (k=2)	Boundary effect:
ConvF Y	4.99	$\pm 7\%$ (k=2)	Alpha 0.75
ConvF Z	4.99	$\pm 7\%$ (k=2)	Depth 1.99

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.6 \pm 0.2	mm

ET3DV5 SN:1333

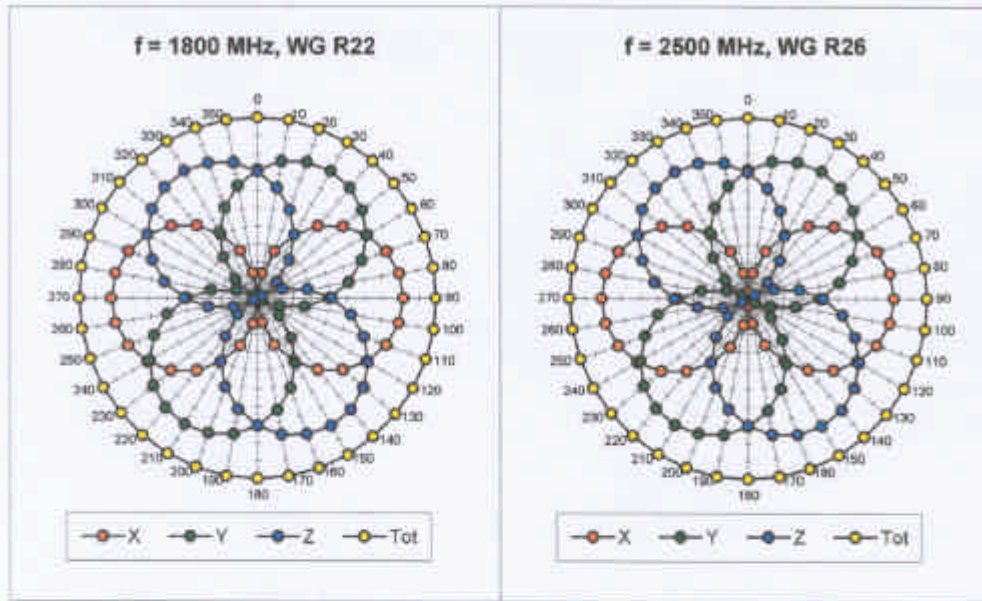
Receiving Pattern (ϕ), $\theta = 0^\circ$



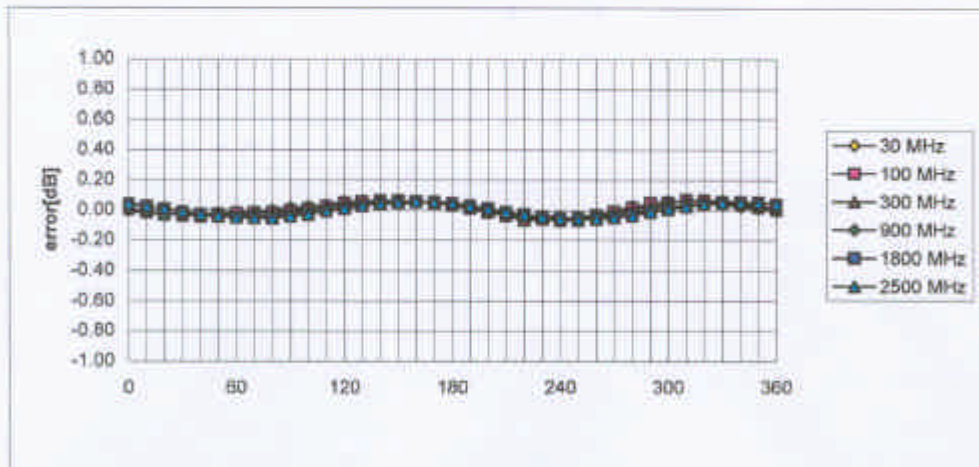
Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

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Isotropy Error (ϕ), $\theta = 0^\circ$

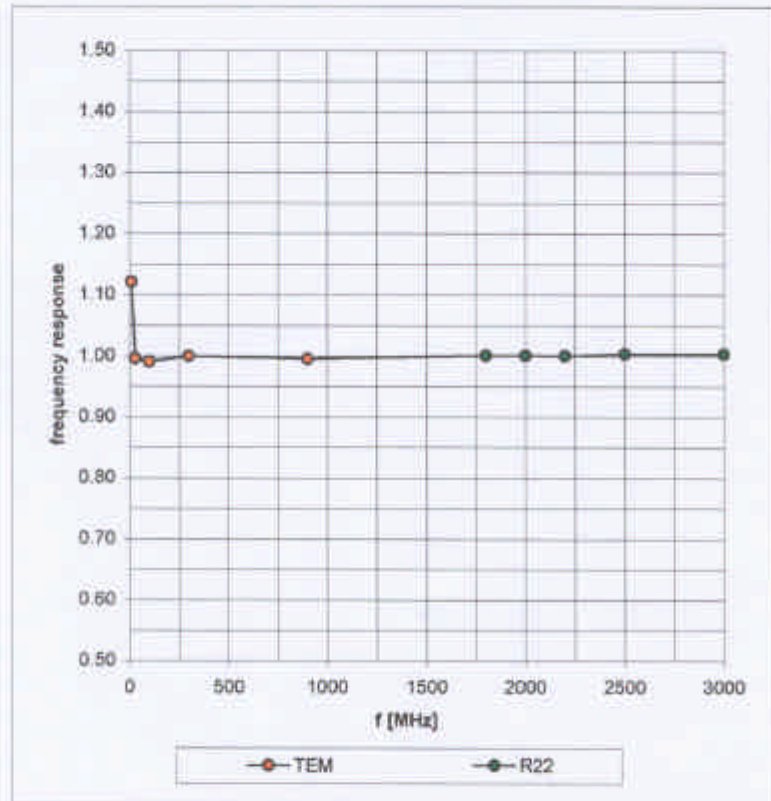


Matsushita Electric Works, Ltd, Model No: PSD
FCC ID: HHV20011107

Date of Test: January 7 & 11, 2002

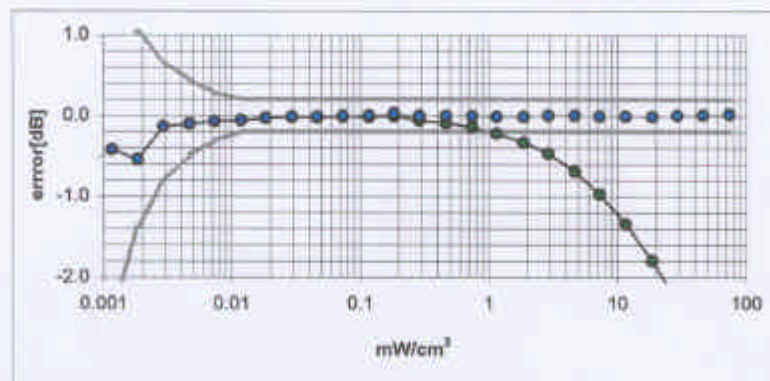
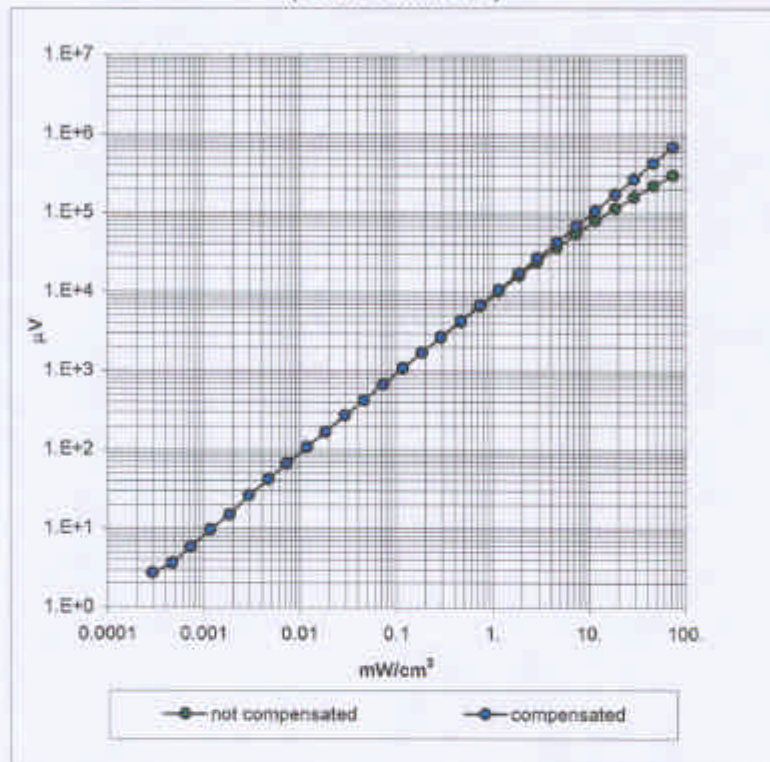
ET3DV5 SN:1333

Frequency Response of E-Field (TEM-Cell:ifi110, Waveguide R22)



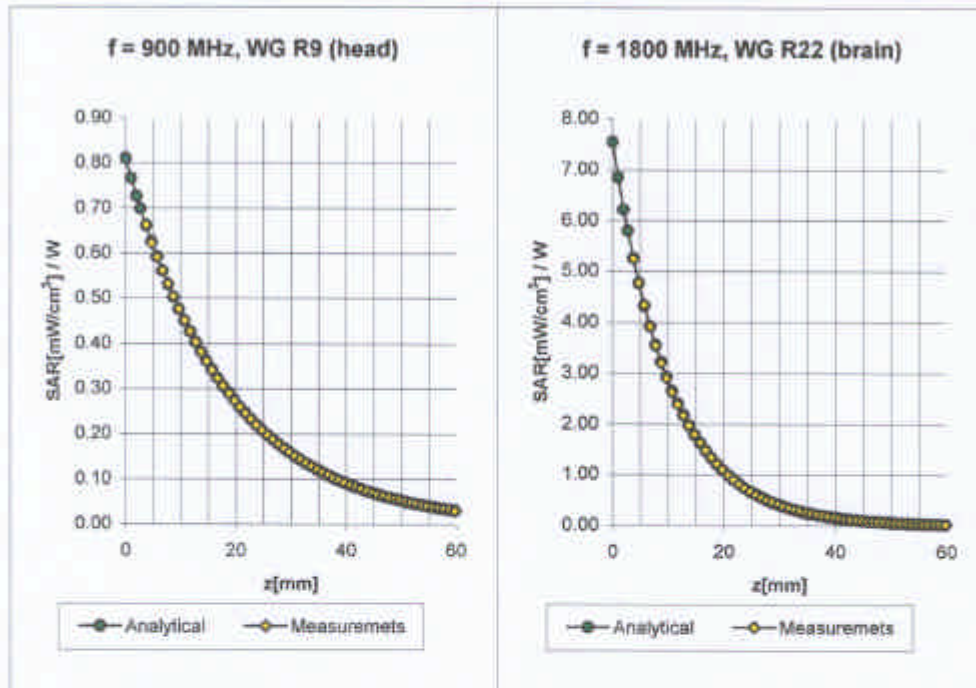
ET3DV5 SN:1333

Dynamic Range $f(\text{SAR}_{\text{brain}})$ (TEM-Cell:ifi110)



ET3DV5 SN:1333

Conversion Factor Assessment



Head 900 MHz $\epsilon_r = 42 \pm 5\%$ $\sigma = 0.97 \pm 10\%$ mho/m

ConvF X **5.83** $\pm 7\%$ (k=2)
ConvF Y **5.83** $\pm 7\%$ (k=2)
ConvF Z **5.83** $\pm 7\%$ (k=2)

Boundary effect:
Alpha **0.38**
Depth **2.70**

Brain 1800 MHz $\epsilon_r = 41 \pm 5\%$ $\sigma = 1.69 \pm 10\%$ mho/m

ConvF X **4.99** $\pm 7\%$ (k=2)
ConvF Y **4.99** $\pm 7\%$ (k=2)
ConvF Z **4.99** $\pm 7\%$ (k=2)

Boundary effect:
Alpha **0.75**
Depth **1.99**