Specific Absorption Rate (SAR) Test Report
for
Wireless Link
on the
Fixed Wireless Cellular Desktop Phone
Models: FWT-8000

Test Report: 20369332
Date of Report: Febuary 7, 2001

Total number of pages in report: 26 + Data Sheets

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

Tested by:	Suresh Kondapalli Test Engineer	
Reviewed by:	David Chernomordik EMC Site Manager	

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1.0 Job description

1.1 Client Information

The EUT has been tested at the request of:

Company: Wireless Link.
Address: 1909 Milmont Drive
Milpitas, CA 95035
USA
Name of contact: Mr.. Eric Maxon
Telephone: (408) 719-1100
Fax: (408) 719-9646

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	Fixed Wireless Cellular Desktop Phone		
Trade Name	Wireless Link	Model No.	FWT-8000
FCC ID	NJIFW8000	S/N No.	Not Labeled
Category		RF Exposure	Uncontrolled
Frequency Band (uplink)	824-849 kHz	System	AMPS TDMA

EUT Antenna Description			
Type	Monopole	Configuration	Fixed
Dimensions	195 mm	Gain	0 dBi
Location	Left side		

Use of Product : The Fixed Wireless Cellular Desktop Phone is a stand-alone telephone with diital TDMA and analog AMPS cellular transceiver radio system built-in. It provides extended telephone service bringing subscriber wireless access to a cellular network.

Manufacturer: SAME as above.

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

EUT receive date: January 29, 2001

EUT received condition: Good condition prototype

Test start date: January 29 to Febuary 2, 2001

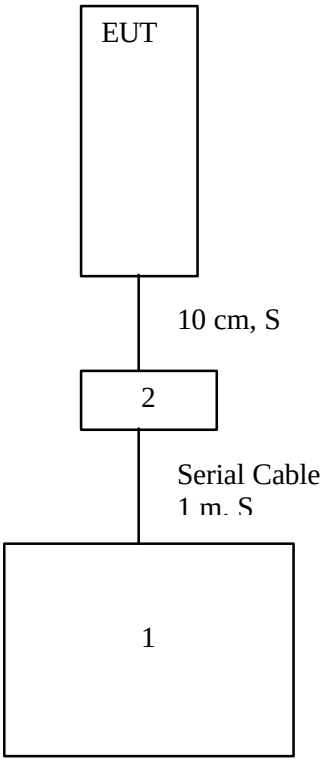
Test end date: January 29 to Febuary 2, 2001

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



Item #	Description	Model No.	Serial No.
1	IBM Laptop PC	Think Pade 390E	18JKI
2	Wireless Link Connector Box	N/A	N/A

1.4.2 Test Position

The FWT-8000 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 FWT-8000 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 FWT-8000 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 FWT-8000 lies in the reference plane of the head. The center of the ear-piece of the FWT-8000 is placed 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:

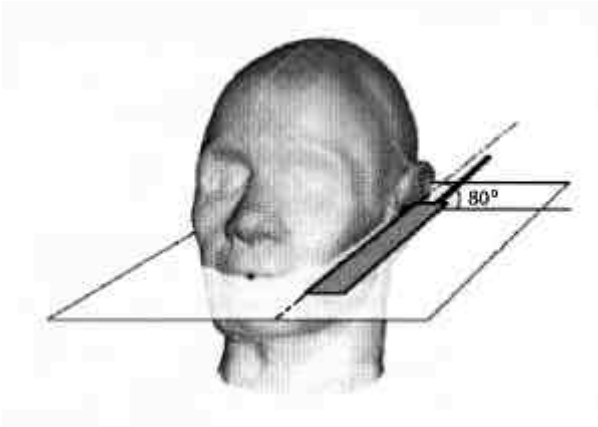


Figure 1: Intended use position

Additionally, the FWT-8000 was tested in a second position from the normal 80^{o} angle between the reference line of the phone and the line connecting both auditory canal openings. The center of the ear piece of the FWT-8000 is placed at the entry of the auditory canal. The angle between the reference line of the phone and the line connecting both auditory canal openings was adjusted from 80 ^{o} to the angle where two points of the phone were in contact with the phantom (ear hole and cheek).

Data pages indicate the position of the FWT-8000 during testing. The first position of 80 ^{o} has data pages labeled ‘1 point touch’. The second position has data pages labeled ‘2 point touch’.

Due to the position of the FWT-8000’s antenna being located on the right side of the phone, the left hand section of the phantom was used for measuring the low, middle, and high channels in the 1 point touch and 2 point touch positions. The channel and position from the left hand section having the highest SAR was also tested in the right hand section of the phantom.

1.4.3 Test Condition

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

Trade Name:	Wireless Link	**Model No.:**	FWT-8000
Serial No.:	Not Labeled	**Test Engineer:**	Suresh Kondapalli

TEST CONDITIONS			
Ambient Temperature	23 °C	Relative Humidity	55 %
Test Signal Source	Test Mode	Signal Modulation	AMPS TDMA
Output Power Before SAR Test AMPS TDMA	 27.8dBm 27.8dBm	Output Power After SAR Test	 27.8dBm 27.8dBm
Test Duration	23 Min.	Number of Battery Change	1

EUT Position: Middle Antenna 5 cm from Phantom				
Channel MHz	Operating Mode	Duty Cycle ratio	Measured SAR_{10g} (mW/g)	Plot Number
824.04	AMPS	1	0.355	1
836.55	AMPS	1	0.243	2
848.97	AMPS	1	0.291	3
824.04	TDMA	3	0.18	4
836.55	TDMA	3	0.117	5
848.97	TDMA	3	0.142	6

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer. Tests were performed in GSM mode.

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.

2.0 SAR EVALUATION

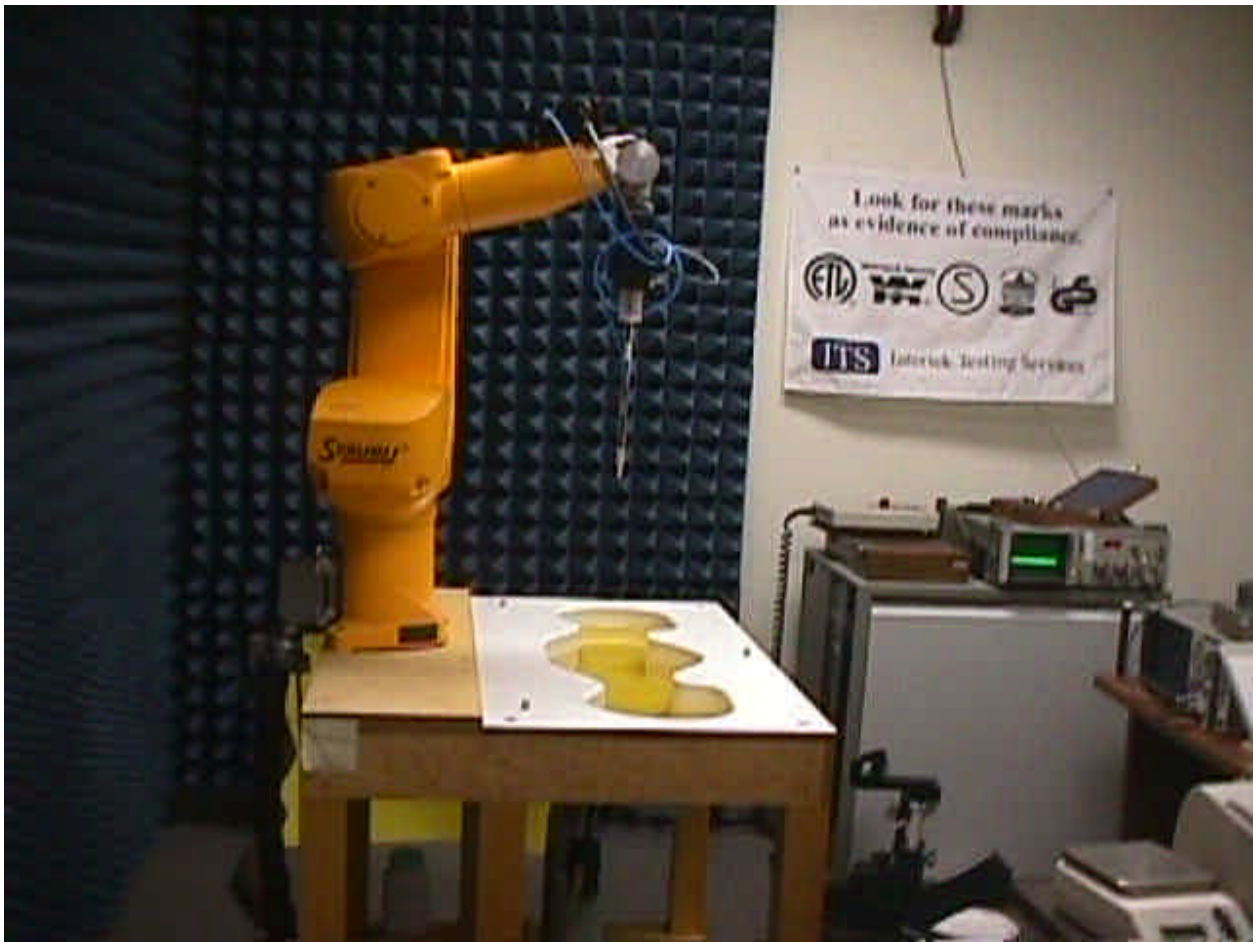
2.1 SAR Limits

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

2.2 Configuration Photographs

SAR measurement Test Setup

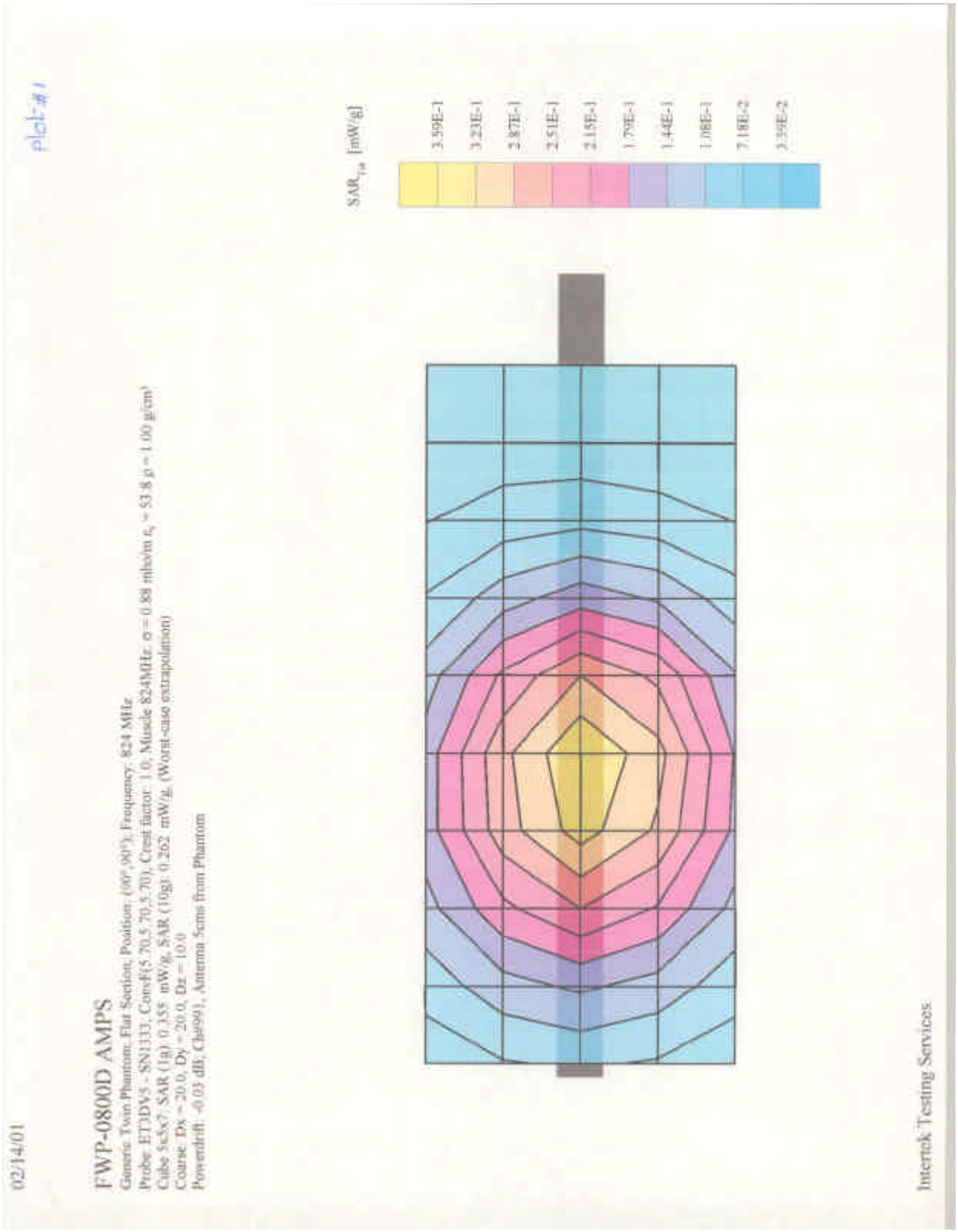


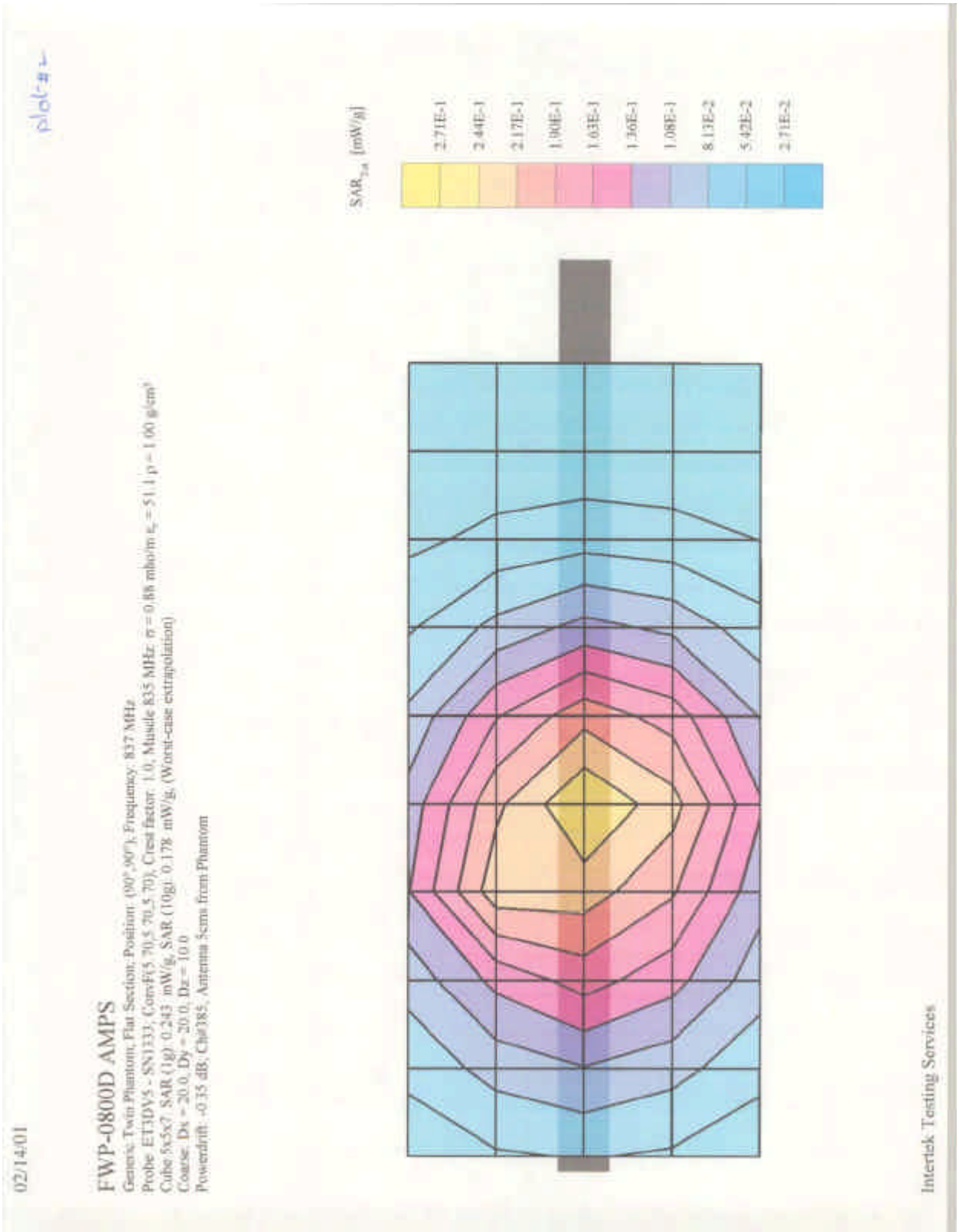
2.2 Configuration Photographs Continued

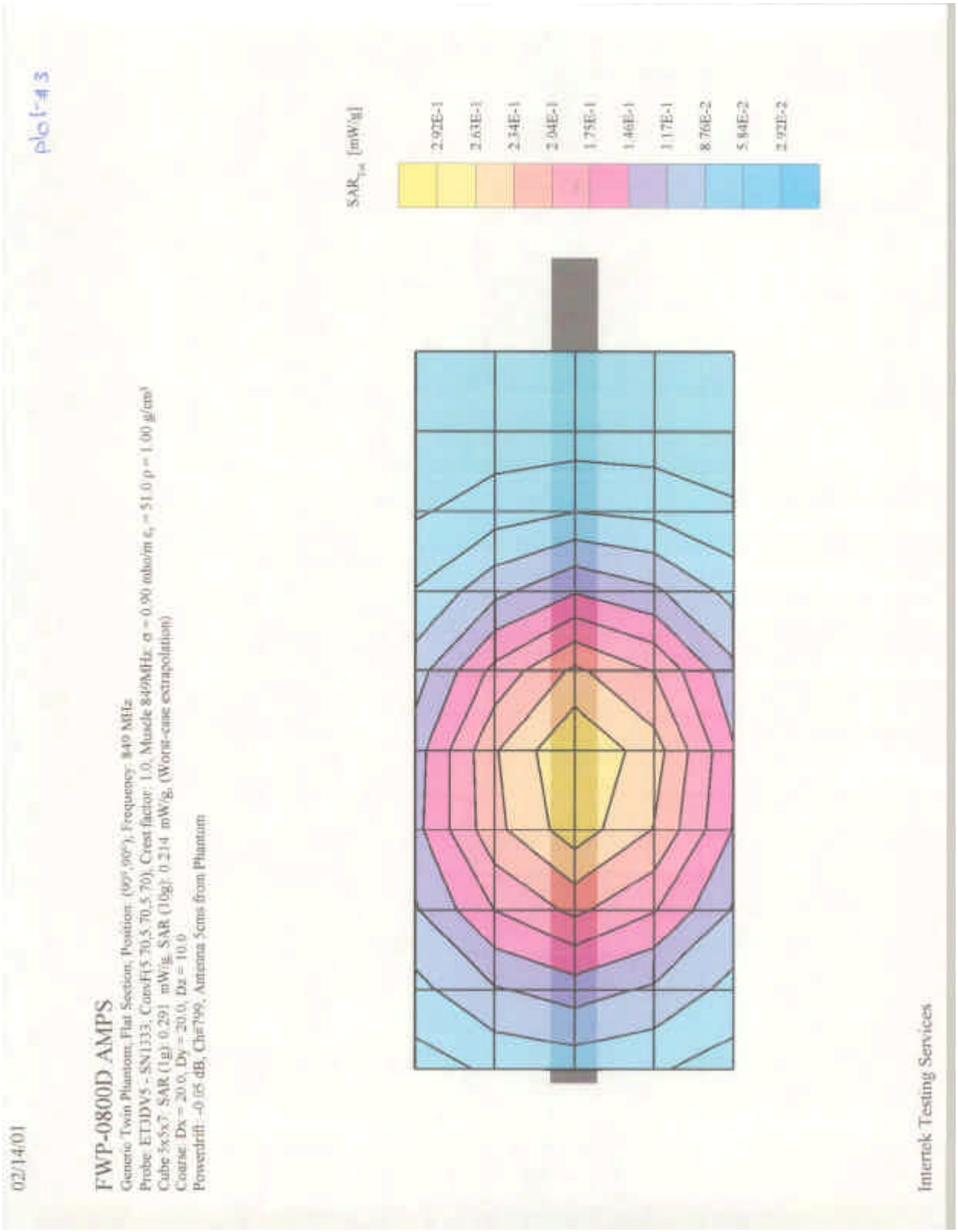
SAR Measurement Test Setup

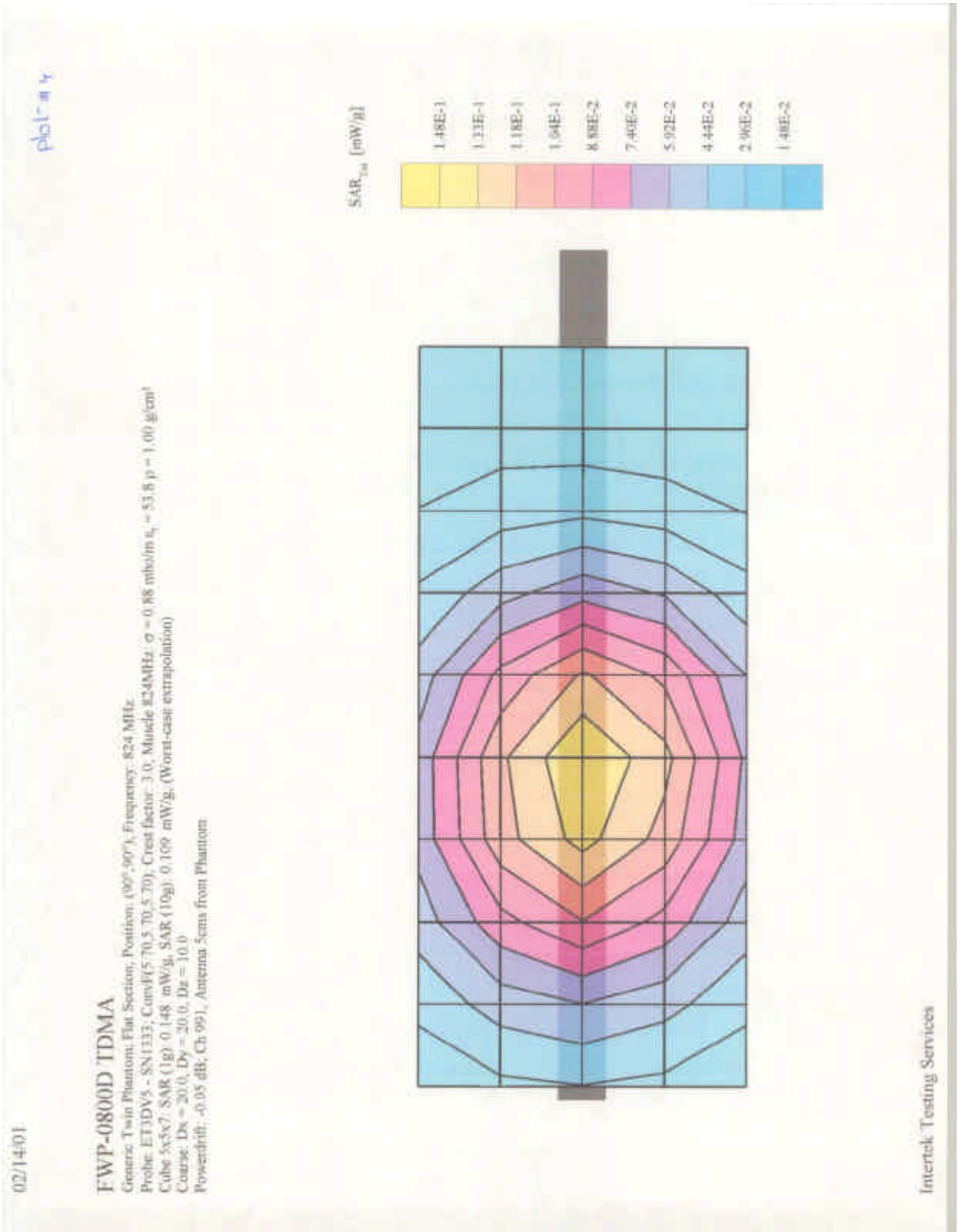
2.2 Configuration Photographs Continued

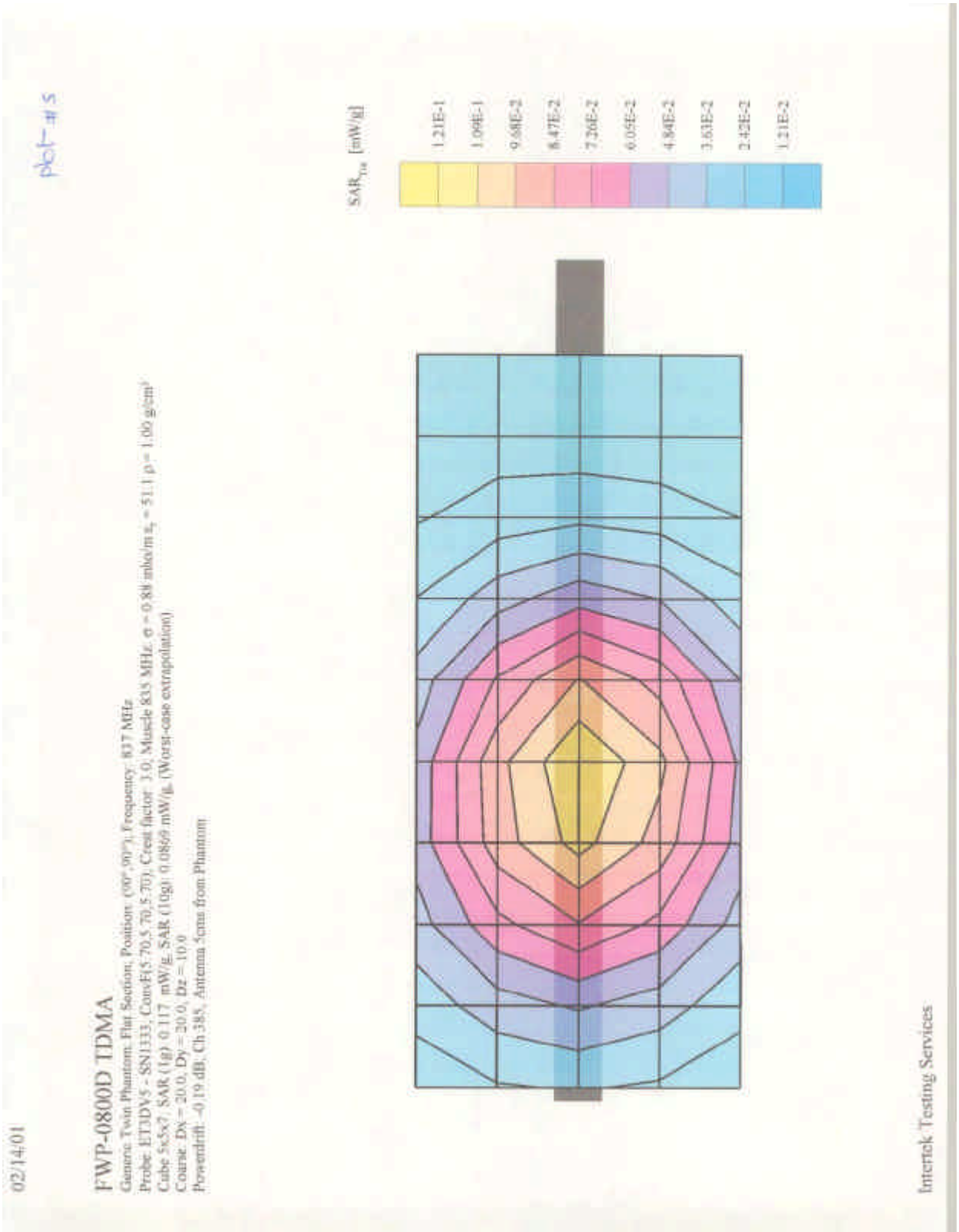
EUT PHOTO

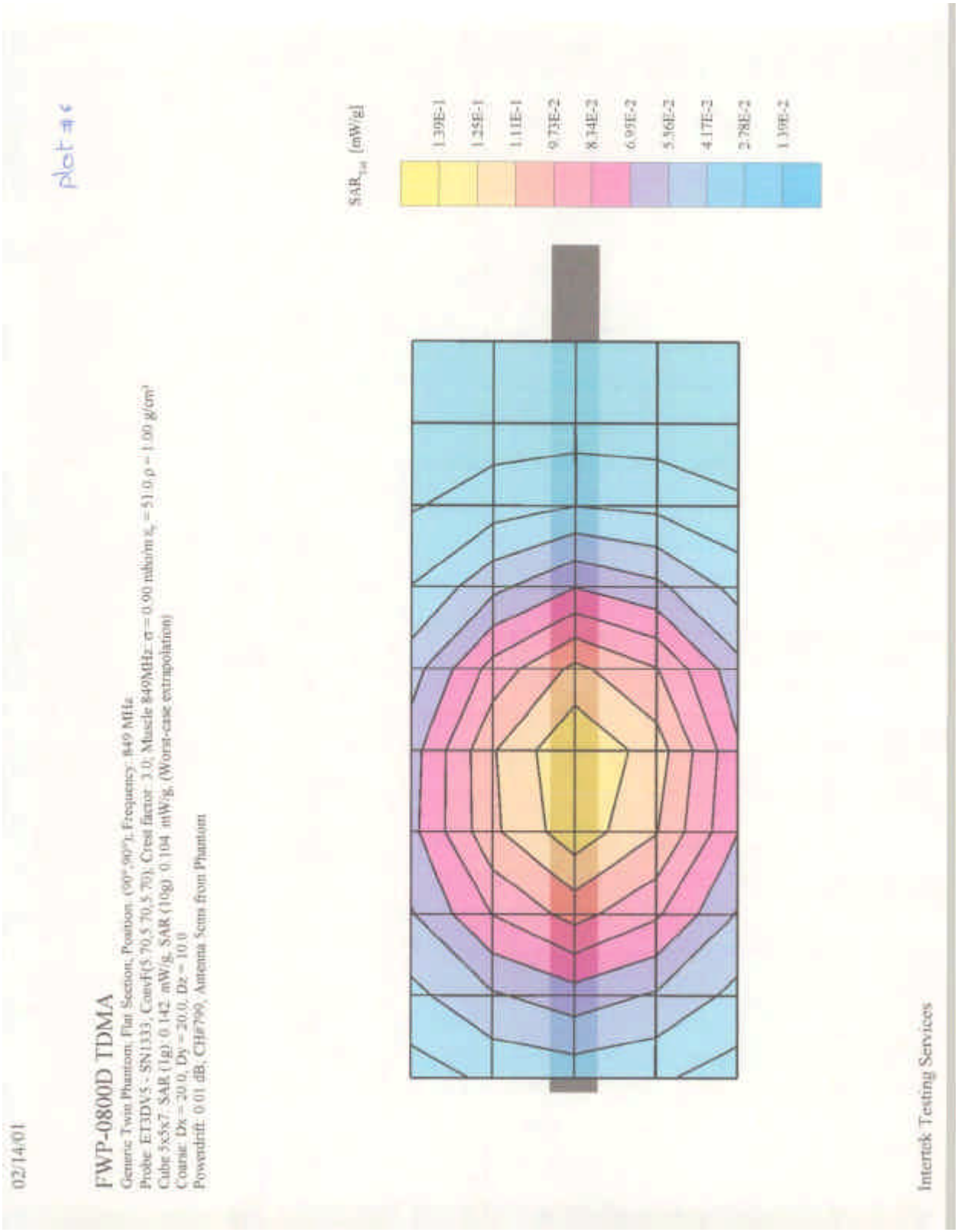

plot #1
02/14/01
FWP-0800D AMPS
Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 824 MHz
Probe: ET3DV5 - SN1333; ConvF(5.70,5.70,5.70); Crest factor: 1.0; Muscle 824MHz: σ = 0.88 mho/m ε_r = 53.8 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.355 mW/g, SAR (10g): 0.262 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.03 dB, Cb#99), Antenna 5cms from Phantom
SAR1g [mW/g]
3.55E-1
3.23E-1
2.87E-1
2.51E-1
2.15E-1
1.79E-1
1.44E-1
1.08E-1
7.18E-2
3.59E-2
Intertek Testing Services


plot #1
02/14/01
FWP-0800D AMPS
Generic Twin Phantom; Flat Section; Position: (90°, 90°); Frequency: 837 MHz
Probe ET3DV5 - SN1333; ConvF(5.70,5.70,5.70); Crest factor: 1.0; Muscle 835 MHz: σ = 0.88 mho/m ε_r = 51.1 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.243 mW/g, SAR (10g): 0.178 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.35 dB; Ch#385; Antenna 5cms from Phantom
SAR1-g (mW/g)
2.71E-1
2.44E-1
2.17E-1
1.90E-1
1.63E-1
1.36E-1
1.08E-1
8.13E-2
5.42E-2
2.71E-2
Intertek Testing Services


plot 43
FWP-0800D AMPS
Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 849 MHz
Probe: ET3DV5 - SN1333; ConvF(5.70,5.70,5.70); Crest factor: 1.0; Muscle 849MHz: σ = 0.90 mho/m ε_r = 51.0 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.291 mW/g; SAR (10g): 0.214 mW/g; (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB, Che7990, Antenna 5cms from Phantom
02/14/01
SAR1g [mW/g]
2.92E-1
2.63E-1
2.34E-1
2.04E-1
1.75E-1
1.46E-1
1.17E-1
8.76E-2
5.84E-2
2.92E-2
Intertek Testing Services


plot 4
02/14/01
FWP-0800D TDMA
Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 824 MHz
Probe: ET3DV5 - SN1333; ConvF(5.70,5.70,5.70); Crest factor: 3.0; Muscle 824MHz: σ = 0.88 mho/m ε_r = 53.8 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.148 mW/g, SAR (10g): 0.109 mW/g, (Worst-case extrapolation)
Course: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.05 dB; Ch 991, Antenna 5cms from Phantom
SAR_1st [mW/g]
1.48E-1
1.33E-1
1.18E-1
1.04E-1
8.88E-2
7.40E-2
5.92E-2
4.44E-2
2.96E-2
1.48E-2
Intertek Testing Services


plot # 5
SAR$_{1g}$ [mW/g]
1.21E-1
1.09E-1
9.68E-2
8.47E-2
7.26E-2
6.05E-2
4.84E-2
3.63E-2
2.42E-2
1.21E-2
FWP-0800D TDMA
Genoa: Twin Phantom: Flat Section; Position: (90°,90°); Frequency: 837 MHz
Probe: ET3DV5 - SN1333; ConvF(5.70,5.70,5.70); Crest factor: 3.0; Muscle 835 MHz: σ = 0.88 mho/m ε$_r$ = 51.1 ρ = 1.00 g/cm^3
Cube 5x5x7: SAR (1g): 0.117 mW/g, SAR (10g): 0.0869 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.19 dB, Ch 385, Antenna 5cms from Phantom
02/14/01
Intertek Testing Services


plot #6
02/14/01
FWP-0800D TDMA
Generic Twin Phantom; Flat Section; Position: (90°,90°); Frequency: 849 MHz
Probe: ET3DV5 - SN1333; Conv(5.70,5.70,5.70); Crest factor: 3.0; Muscle 849MHz: σ = 0.90 mho/m ε_r = 51.0 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.142 mW/g, SAR (10g): 0.104 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.01 dB; CH#799; Antenna 5cms from Phantom
SAR_tot (mW/g)
1.39E-1
1.25E-1
1.11E-1
9.73E-2
8.34E-2
6.95E-2
5.56E-2
4.17E-2
2.78E-2
1.39E-2
Intertek Testing Services

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	3.89

2.1 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. Based on 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-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.

2.4 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.

3.0 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 #	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	04/10/00
	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	02/14/01
	Please see section 6.2 for details		
Power Meter	**HP 8900D** w/ 84811A sensor	3607U00673	08/01/00
	Frequency Range: 100kHz to 18 GHz Power Range: 300µW to 3W		

3.2 Tissue Simulating Liquid

Muscle	
Ingredient	**Frequency** (800 – 900 MHz)
Water	54.05 %
Sugar	45.05 %
Salt	0.1 %
Bactericide	0.8%

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$^{3)}$
835	51.1± 5%	1.0 ± 10%	1000

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

Note: The amount of each ingredient specified in the tables are not the exact amounts of the final test solution. The final test solution was adjusted by adding small amounts of either water, sugar, and/or salt to calibrate the solution to meet the proper dielectric parameters.

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 B.

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

See attached users manual.

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.

6.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / 20369332	CS	Febuary 7, 2001	Original document