Specific Absorption Rate (SAR) Test Report
for
Glenayre Electronics Inc.
on the
900 MHz Wireless Messaging Module for Handspring Visor PDA
Model: @ctive Link

Report #: J20014404_SAR
Date of Report: May 30, 2000

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

Tested by:	Xi-Ming Yang	Xi-Ming Yang
Reviewed by:	David Chernomordik	David Chernomordik

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1 JOB DESCRIPTION

1.1 Client Information

Company: Glenayre Electronics Inc.
Address: 5935 Carnegie Boulevard
Charlotte, North Carolina 28209
Name of contact: Louie Sanguinetti
Telephone: (408) 653-2247
Fax: (408) 653-1543

1.2 Equipment under test (EUT)

Product Descriptions:

Equipment	900 MHz Wireless Messaging Module for Handspring Visor PDA		
Trade Name	**Glenayre**	**Model No.**	@ctive Link
FCC ID	Not Labeled	**S/N No.**	C_8
Category	Portable	**RF Exposure**	Uncontrolled Environment
Frequency Band (uplink)	896-902 MHz	**System**	FSK

EUT Antenna Description			
Type	Helical	Configuration	Internal, Fixed
Dimensions		Gain	1.76 dBi
Location	Inside plastic enclosure, top middle		

The @ctiveLink plugs into a 68-pin expansion slot on the back of the PDA. It communicates using the Motorola ReFlex 25 or ReFlex 50 two-way paging protocol. The module functions whether it is connected or unconnected to the PDA.

Use of Product : Data communications

Manufacturer: SAME as above.

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

EUT receive date: 5/23/00

EUT received condition: Good working condition, prototype

Test start date: 5/23/00

Test end date: 5/23/00

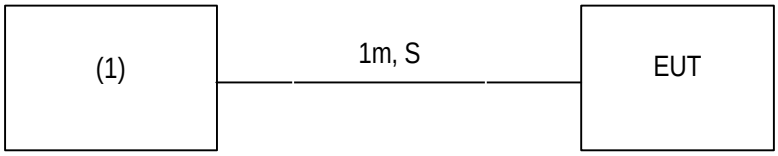
1.3 Test plan reference

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 .




EUT Face Up


EUT Face Down


EUT With PDA


EUT With PDA

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

Support equipment					
Equp. #	**Equipment**	**Manufacturer**	**Model #**	**S/N #**	**FCC ID**
1	Power Supplies	Topward Electric Instrument	TPS-4000	917003	N/A

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. touching the human body or hand. Please refer to figure 1 below for the position details:

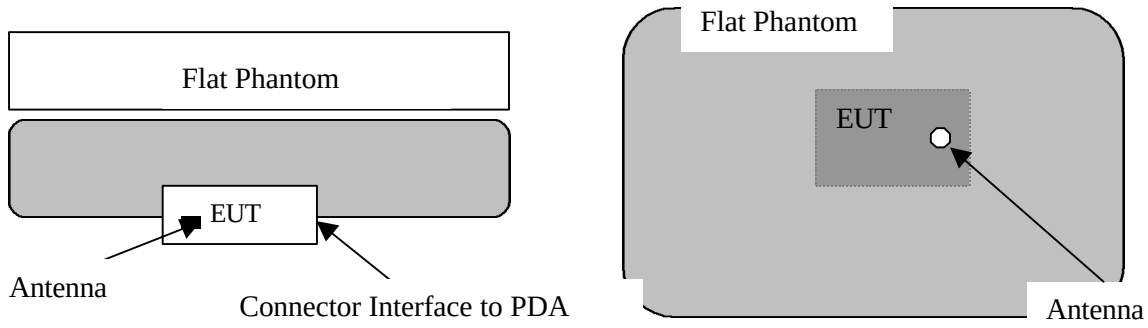


Figure 1: Intended use position

1.4.3 Test Condition

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

EUT Antenna	Fixed	Orientation	N/A
Usage	Body-worn and hand-held	Distance between base of EUT and the liquid surface:	2 mm
Simulating human hand	Not Used	EUT Battery	DC Power Supply
Power output	1W conducted, 50% duty cycle (0.1 sec on and 0.1 sec off)		

The spatial peak SAR values were accessed for lowest and highest operating channels defined by the manufacturer. Tests were performed at test mode at 1W conducted with 50% duty cycle (0.1 sec On and 0.1 sec Off) to reduce over heat the EUT. Care was taken to ensure that performance of the EUT power amplifier would not be degrade using CW test mode. A peak radiated field strength test was performed in both CW and pulse (50 % duty cycle) modes, and data show that peak power output in both operation modes were the same.

Radiated emission measurement was performed, 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

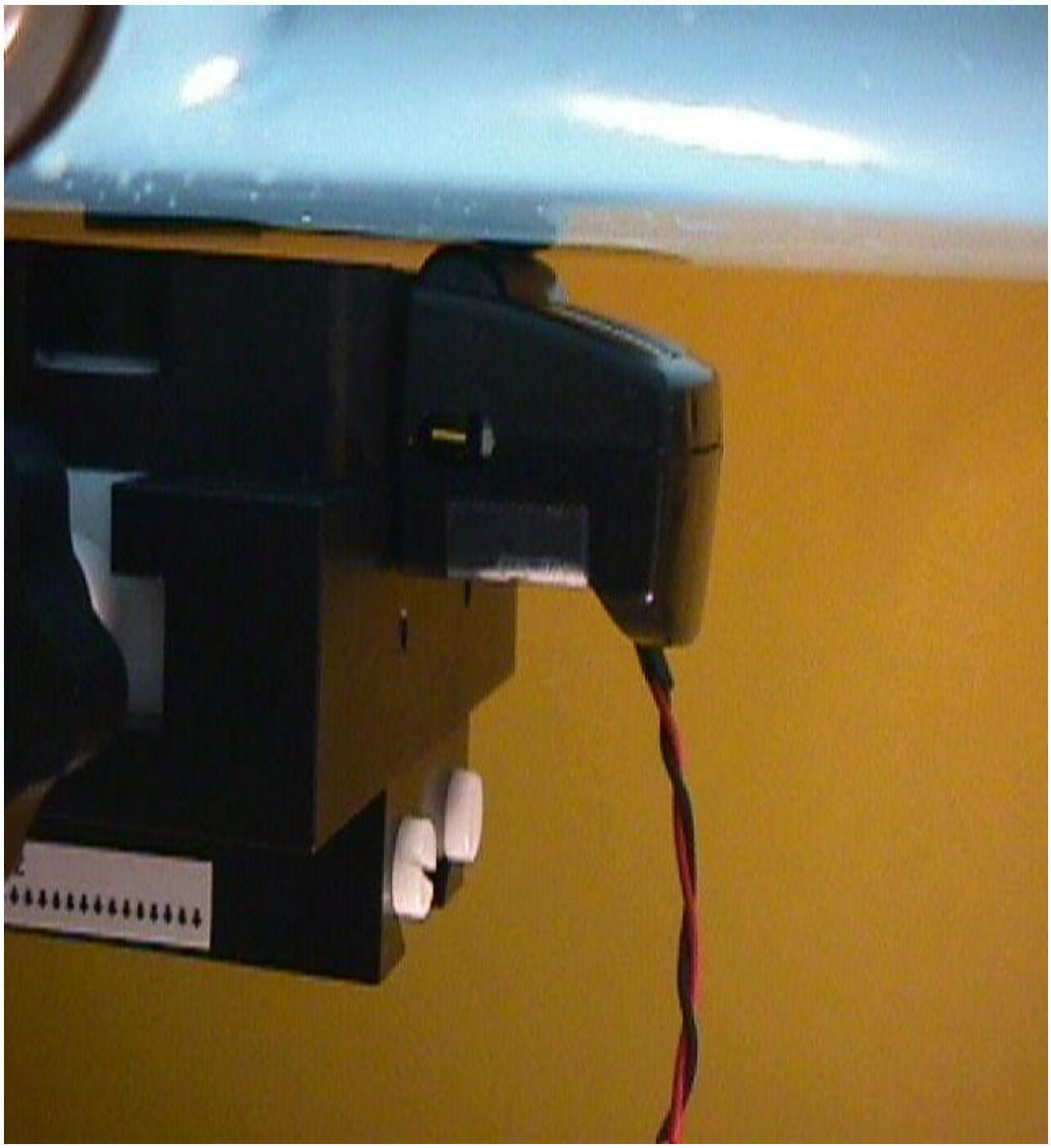
The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

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

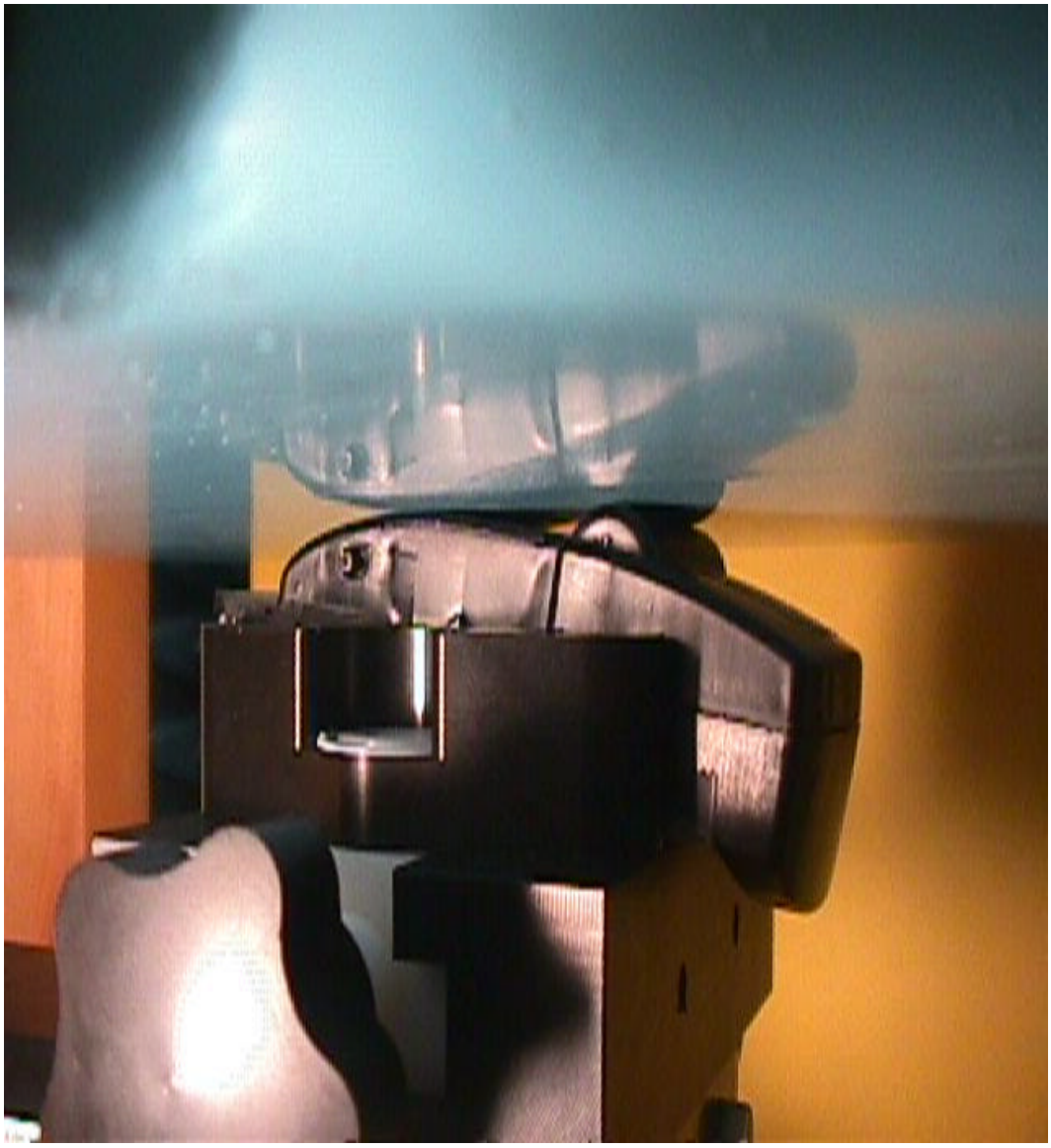
Face Up

Configuration Photographs – Continued



Face Down

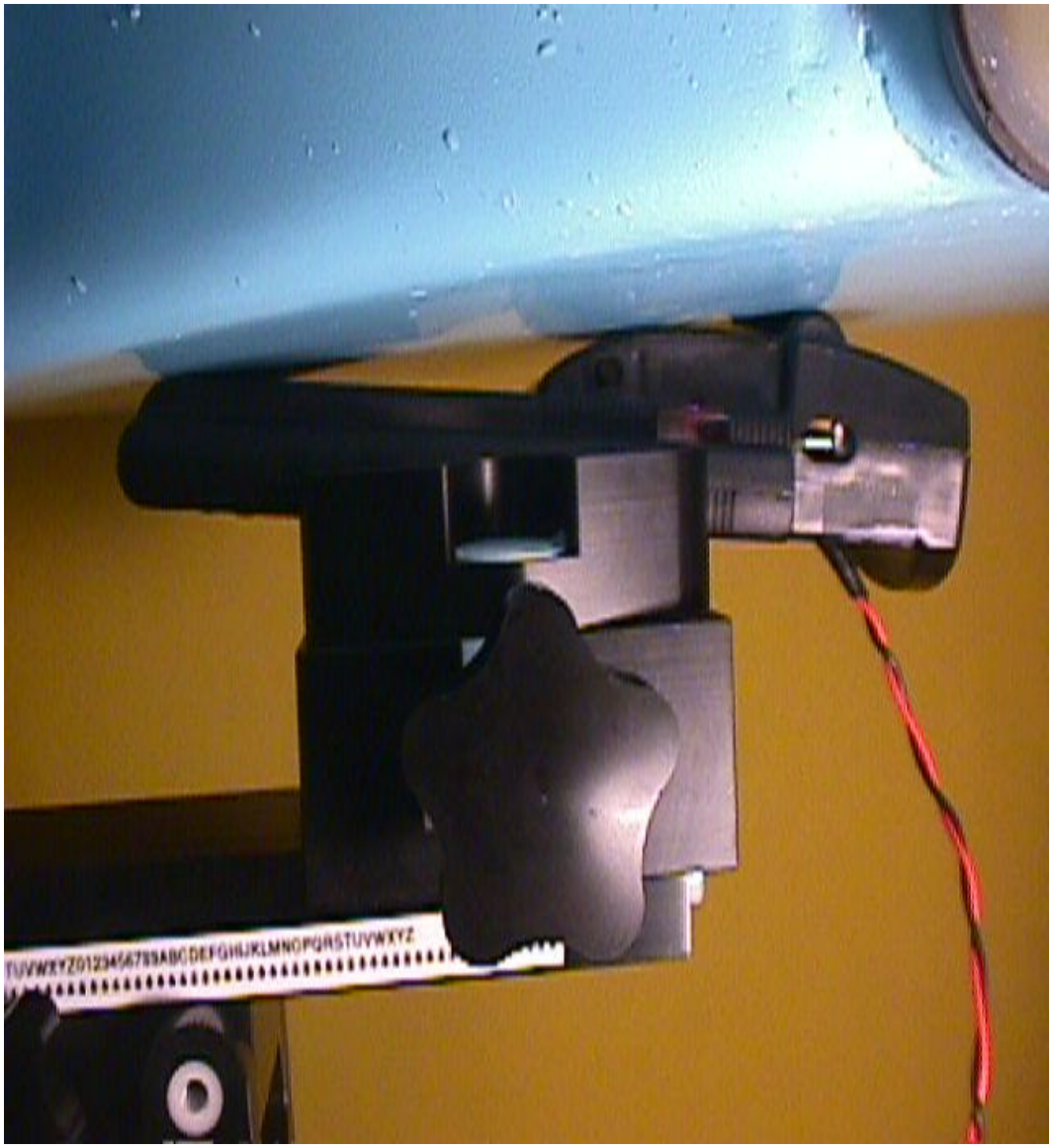
Configuration Photographs – Continued



Face Down Low Section

Face Down Up Section

With PDA Face Up



With PDA Face Down

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	4.03	3.97

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 2.0 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.

The maximum spatial peak SAR values average over 1g assessed in "touch" position was 3.04 mW/g (per measured data) for the tested unit when tested in test mode. In actual usage, the average transmission is only 23.7% (per Glenayre calculation), please refer to the manufacturer justification in section 8 of this report. In considering the 23.7% duty cycle to the measured SAR data, the maximum SAR is 1.44 mW/g and the unit is in compliance with the requirements of the FCC for body requirements.

The maximum spatial peak SAR values average over 10g assessed in "touch" position was 1.99 mW/g (per measured data) for the tested unit when tested in test mode. In considering the 23.7% duty cycle to the measured SAR data, the maximum SAR is 0.94 mW/g and the unit is in compliance with the requirements of the FCC for hands and feet requirements.

Trade Name:	Glenayre	Model No.:	@ctive Link
Serial No.:		Test Engineer:	XM Yang

TEST CONDITIONS			
Ambient Temperature	23.8 °C	Relative Humidity	48 %
Test Signal Source	Test Mode	Modulation	50% Duty Cycle
Output Power Before SAR Test	1.0 W	Output Power After SAR Test	1.0 W
Test Duration	25 Min.	Number of Battery Change	DC power supply

Usage (Touch Position)					
Plot #	Position	Frequency MHz	Measured Conducted Power (W)	Measured SAR $_{1g}$ (mW/g)	Measured SAR $_{10g}$ (mW/g)
1	Face up	896	1.0	3.04	1.99
2	Face up	901	1.0	2.88	1.87
3	Face down up section	901	1.0	3.03	1.59
4	Face down low section	901	1.0	2.14	1.42
5	Face up	902	1.0	2.94	1.90
6	Face up w/PDA	896	1.0	2.67	1.05
7	Face down w/PDA	896	1.0	1.38	0.91
8	Face up w/PDA	901	1.0	2.23	0.97
9	Face down w/PDA	901	1.0	1.29	0.85
10	Face up w/PDA	902	1.0	2.16	0.89

Note: a) Worst case data were reported
b) With 50% Duty cycle
c) Uncertainty of the system is not included

SAR results with Duty Cycle				
Plot #	**Measured SAR_{1g} (mW/g)**	**Calculated SAR_{1g} for 23.7% Duty Cycle relative to 50% in test mode (mW/g)**	**Measured SAR_{10g} (mW/g)**	**Calculated SAR_{10g} for 23.7% Duty Cycle relative to 50% in test mode (mW/g)**
1	3.04	1.44	1.99	0.94
2	2.88	1.37	1.87	0.89
3	3.03	1.44	1.59	0.75
4	2.14	1.02	1.42	0.67
5	2.94	1.40	1.90	0.90
6	2.67	1.27	1.05	0.50
7	1.38	0.66	0.91	0.43
8	2.23	1.06	0.97	0.46
9	1.29	0.61	0.85	0.40
10	2.16	1.03	0.89	0.42

3 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 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	Stäubli 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 3.2 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 Muscle Tissue Simulating Liquid

Ingredient	Frequency (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)	ε*	σ*(mho/m)	ρ**(kg/m^3)
900	55.8± 5%	0.98 ± 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 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.

4 WARNING LABEL INFORMATION - USA

Not applicable.

5 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 Institute of Standards and Technology, 1994.

6 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.