

SAR EVALUATION REPORT

For

GENEX TELECOM CO., LTD.

6F FARMAX B/D 796-27 Bangbae-Dong, Seocho-Gu,
Seoul, 137-830, Korea

FCC ID: PM3GX80

2004-03-11

This Report Concerns: <input checked="" type="checkbox"/> Original Report	Equipment Type: Transceiver, VHF, PTT
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Report No.: R0402182S	
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SUMMARY

The US Federal Communications Commission has released the report and order "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1].

The order requires routine SAR evaluation prior to equipment authorization of portable transmitter devices, including portable telephones. For consumer products, the applicable limit is 1.6 mW/g as recommended by the ANSI/IEEE standard C95.3-1992 [6] for an uncontrolled environment and 8 mW/g for occupational population (Paragraph 65). According to the Supplement C of OET Bulletin 65 (01-2001) "Evaluating Compliance with FCC Guide-lines for Human Exposure to Radio frequency Electromagnetic Fields", released on Jun 29, 2001 by the FCC, the device should be evaluated at maximum output power (radiated from the antenna) under "worst-case" conditions for normal or intended use, incorporating normal antenna operating positions, device peak performance frequencies and positions for maximum RF energy coupling.

This report describes the methodology and results of experiments performed on wireless data terminal. The objective was to determine if there is RF radiation and if radiation is found, what is the extent of radiation with respect to safety limits. SAR (Specific Absorption Rate) is the measure of RF exposure determined by the amount of RF energy absorbed by human body (or its parts) – to determine how the RF energy couples to the body or head which is a primary health concern for body worn devices. The limit below which the exposure to RF is considered safe by regulatory bodies in North America is 1.6 mW/g for uncontrolled environment and 8 mW/g for occupational population average over 1 gram of tissue mass.

The test configurations were laid out on a specially designed test fixture to ensure the reproducibility of measurements. Each configuration was scanned for SAR. Analysis of each scan was carried out to characterize the above effects in the device.

The investigation was limited to the worst-case scenario from the device usage point of view. For the clarity of data analysis, and clarity of presentation, only one tissue simulation was used for the head and body simulation. This means that if SAR was found at the headset position, the magnitude of SAR would be overestimated comparing to SAR to a headset placed in the ear region.

There was no SAR of any concern measured on the device for any of the investigated configurations, please see following table for testing result summary:

Ambient Temperature (°C): 23.0
Relative Humidity (%): 49.3

Worst case SAR reading

EUT position	Frequency (MHz)	Conducted Power (W)	Test Type	Antenna Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)		Limit (mW/g)	Plot #
								100%	50% duty cycle		
2.5 cm head separation to phantom	163	4.875	Face-held	Built-in	head	flat	none	0.105	0.0525	8	1
back in touch with phantom	163	4.875	Body worn	Built-in	body	flat	Belt Clip and Headset	0.100	0.0500	8	2

1 - REFERENCE

- [1] Federal Communications Commission, \Report and order: Guidelines for evaluating the environmental effects of radiofrequency radiation", Tech. Rep. FCC 96-326, FCC, Washington, D.C. 20554, 1996.
- [2] David L. Means Kwok Chan, Robert F. Cleveland, \Evaluating compliance with FCC guidelines for human exposure to radiofrequency electromagnetic fields", Tech. Rep., Federal Communication Commission, O_ce of Engineering & Technology, Washington, DC, 1997.
- [3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-field scanning system for dosimetric assessments", IEEE Transactions on Microwave Theory and Techniques, vol. 44, pp. 105{113, Jan. 1996.
- [4] Niels Kuster, Ralph K.astle, and Thomas Schmid, \Dosimetric evaluation of mobile communications equipment with known precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp. 645{652, May 1997.
- [5] CENELEC, \Considerations for evaluating of human exposure to electromagnetic fields (EMFs) from mobile telecommunication equipment (MTE) in the frequency range 30MHz - 6GHz", Tech. Rep., CENELEC, European Committee for Electrotechnical Standardization, Brussels, 1997.
- [6] ANSI, ANSI/IEEE C95.1-1992: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, The Institute of Electrical and Electronics Engineers, Inc., New York, NY 10017, 1992.
- [7] Katja Pokovic, Thomas Schmid, and Niels Kuster, \Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies", in ICECOM _ 97, Dubrovnik, October 15{17, 1997, pp. 120-24.
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- [9] Volker Hombach, Klaus Meier, Michael Burkhardt, Eberhard K. uhn, and Niels Kuster, \The depen-dence of EM energy absorption upon human head modeling at 900 MHz", IEEE Transactions on Microwave Theory and Techniques, vol. 44, no. 10, pp. 1865-1873, Oct. 1996.
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- [12] W. H. Press, S. A. Teukolsky, W. T. Vetterling, and B. P. Flannery, Numerical Receipes in C, The Art of Scientific Computing, Second Edition, Cambridge University Press, 1992.Dosimetric Evaluation of Sample device, month 1998 9
- [13] NIS81 NAMAS, \The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddington, Middlesex, England, 1994.
- [14] Barry N. Taylor and Christ E. Kuyatt, \Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994. Dosimetric Evaluation of Sample device, month 1998 10

2 - TESTING EQUIPMENT

2.1 Equipment List & Calibration Info

Equipment Type	Model	Manufacturer	Serial No.	Cal. Date
Amplifier, Power	2HL-2-8	Mini-Circuits		N/R
Amplifier, Pre	8449B	Agilent	3008A01978	3/8/2004
Amplifier, Pre, microwave	8449B	HP	3008A00277	3/14/2001
Amplifier, RF Power	503L	ENI	285	N/R
Analyzer, Network	8752C	HP	3410A02356	8/11/2002
Analyzer, Radio Communication	MT88024	Anritsu	84442	9/10/2002
Analyzer, Spectrum , RF	8566A	HP	2240A01930	N/R
Antenna, Dipole	D-1800-S-2	Aprel	BCL-049	3/6/2003
Antenna, Dipole	D-2450-S-1	Aprel	BCL-141	N/R
Antenna, Dipole	D450V2	N/A	1010	1/24/2003
Antenna, Dipole	D900V2	N/A	122	10/3/2003
Antenna, Dipole	DS100V2	N/A	1001	8/18/2003
Antenna, Logperiodic		HTM	N/A	N/R
Calibrator, Digital	ST-089	Electronic Digital Caliper	211371	N/R
CDMA MS test set	E6393A	Agilent	JP1MJ00416	3/7/2003
Controller		STAUBLI	F01/5J72A1/A/01	N/R
DASY3 Professional Dosimetric System	DASY3	SPEAG	N/A	N/R
Generator, Signal	8657A	HP	3217A04699	8/23/2002
Generator, Signal	83650B	HP	3614A00276	1/29/2004
Meter, Power	E4419B	Agilent	MY4121511	10/25/2001
Probe, Dielectric Kit	85070A	Agilent	N/A	self
Probe, Dummy	ET3DV6	SPEAG	1604	N/R
Probe, SPEAG E-Field	ES3DV2	SPEAG	3019	10/9/2003
Robot RX60L	RX60L	SPEAG	F00/5H31A1/A/01	N/R
Scale, Weight	ACS-3D	AI	603101182	N/R
Scale, Weight	MS-7400	Measurement Specialties	N/A	N/R
Sensor, Power	E4412A	Agilent	US384885142	10/17/2002
Sensor, SPEAG Light Alignment	SPEAG Light Alignment Sensor	SPEAG	278	N/R
SPEAG Generic Twin Phantom	SPEAG Generic Twin Phantom	SPEAG	N/A	N/R

2.2 Equipment Calibration Certificate

Please see the attached file.

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

Client Bay Area Comp. Lab (BACL)

CALIBRATION CERTIFICATE

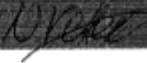
Object(s)	ES3DV2 - SN:3019
Calibration procedure(s)	QA.CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	October 9, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

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 (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293674	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03
RF generator HP 8684C	US3642U01700	4-Aug-00 (SPEAG, In house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

Calibrated by:	Name	Function	Signature
	Nico Waller	Technician	
Approved by:	Katja Pokorny	Laboratory Director	

Date issued: October 9, 2003

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.

Schmid & Partner Engineering AG

s p e a g

Zeughausstrasse 43, 8004 Zurich, Switzerland
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Probe ES3DV2

SN: 3019

Manufactured: December 5, 2002
Last calibration: July 12, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ES3DV2 SN: 3019

July 12, 2003

DASY - Parameters of Probe: ES3DV2 SN: 3019**Sensitivity in Free Space****Diode Compression**

NormX	1.03 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	99
NormY	1.12 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	99
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	99

Sensitivity in Tissue Simulating LiquidHead 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.4 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.4 $\pm 9.5\%$ (k=2)	Alpha 0.68
ConvF Z	6.4 $\pm 9.5\%$ (k=2)	Depth 1.11

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\% \text{ mho/m}$

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.0 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.0 $\pm 9.5\%$ (k=2)	Alpha 0.21
ConvF Z	5.0 $\pm 9.5\%$ (k=2)	Depth 2.78

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	4.3	1.8
SAR _{be} [%] With Correction Algorithm	0.0	0.1

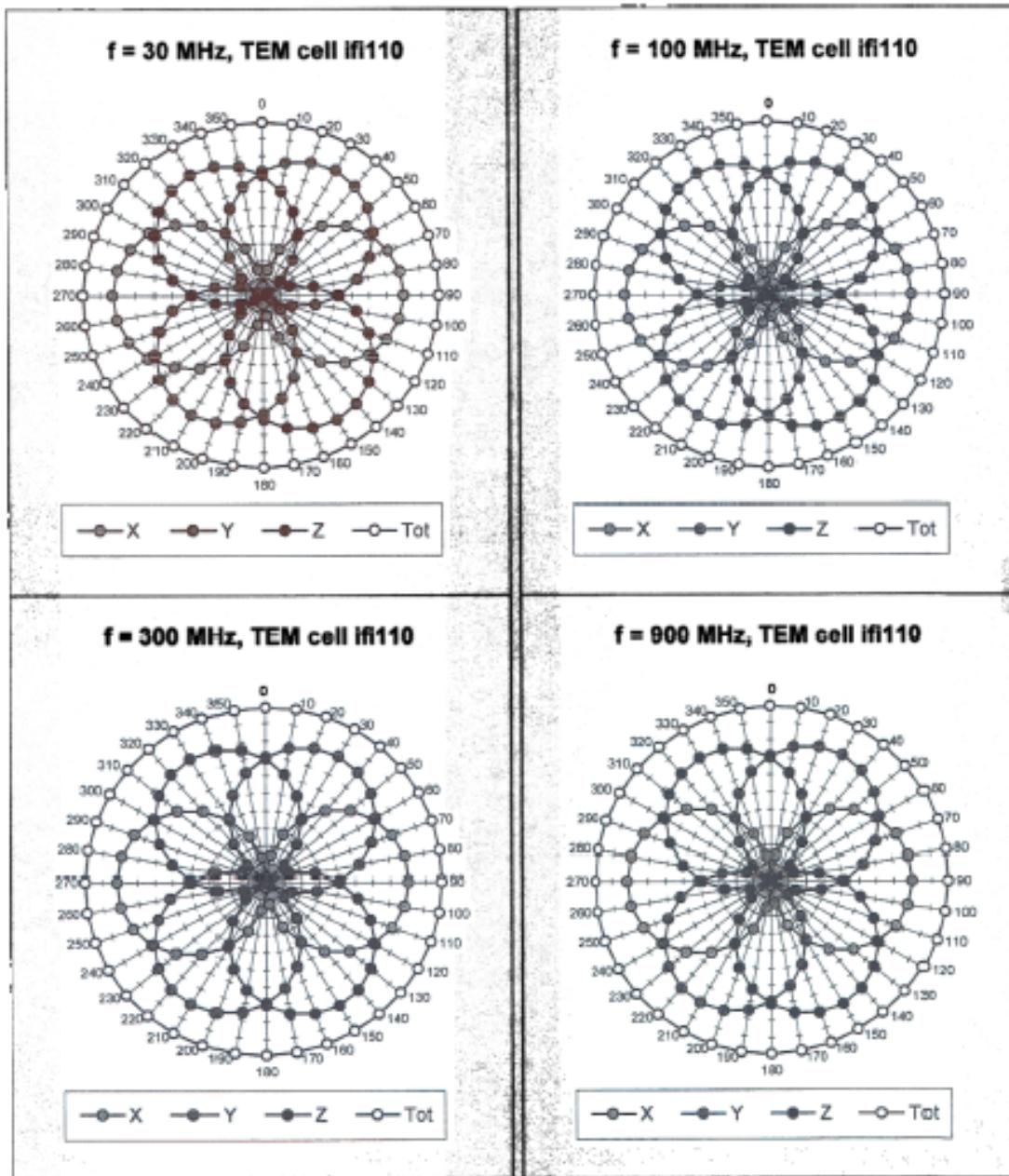
Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	7.4	5.0
SAR _{be} [%] With Correction Algorithm	0.0	0.1

Sensor OffsetProbe Tip to Sensor Center **2.1** mm

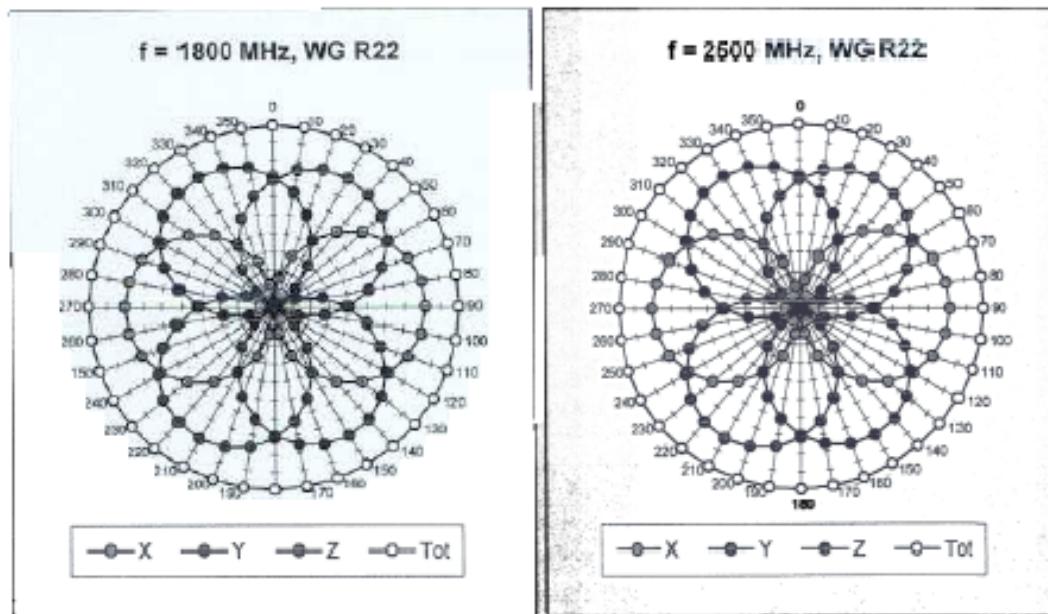
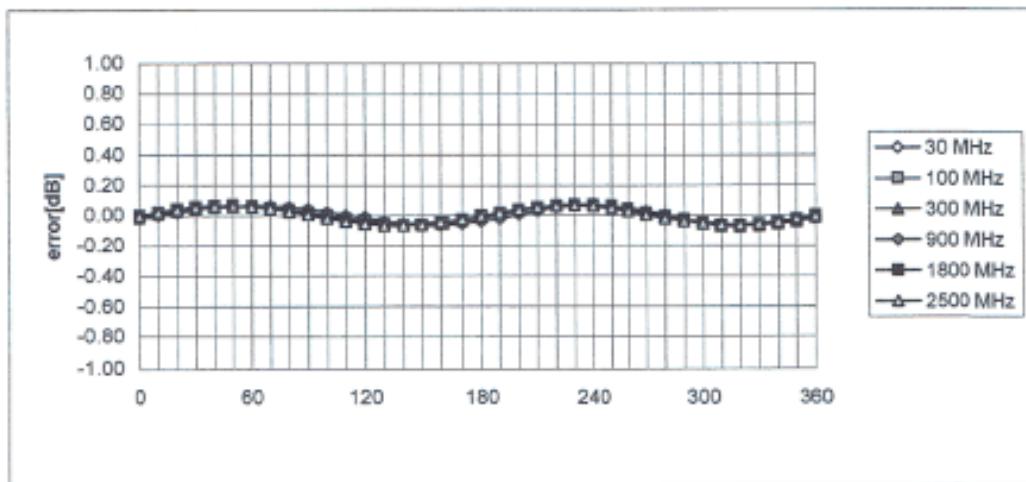
ES3DV2 SN: 3019

July 12, 2003

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

ES3DV2 SN: 3019

July 2003

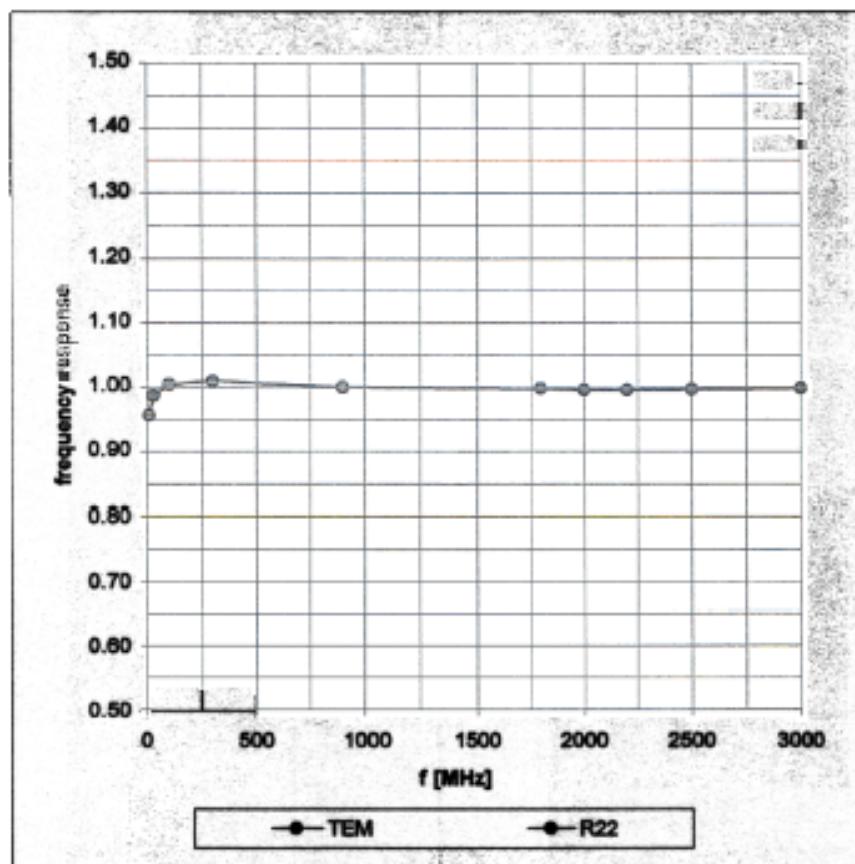
**Isotropy Error (ϕ), $\theta = 0^\circ$** 

ES3DV2 SN: 3019

July 12, 2003

Frequency Response of E-Field

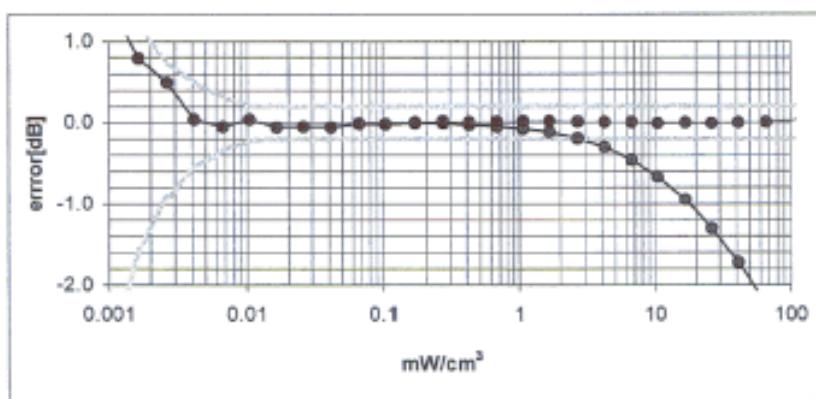
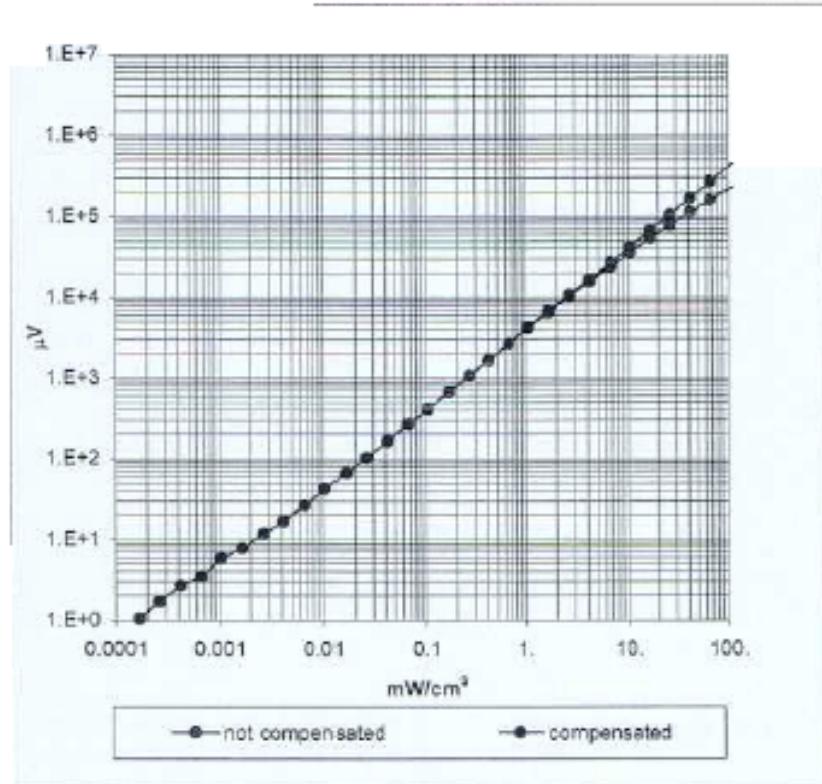
(TEM-Cell:ff110, Waveguide R22)



ES3DV2 SN: 3019

July 12, 2003

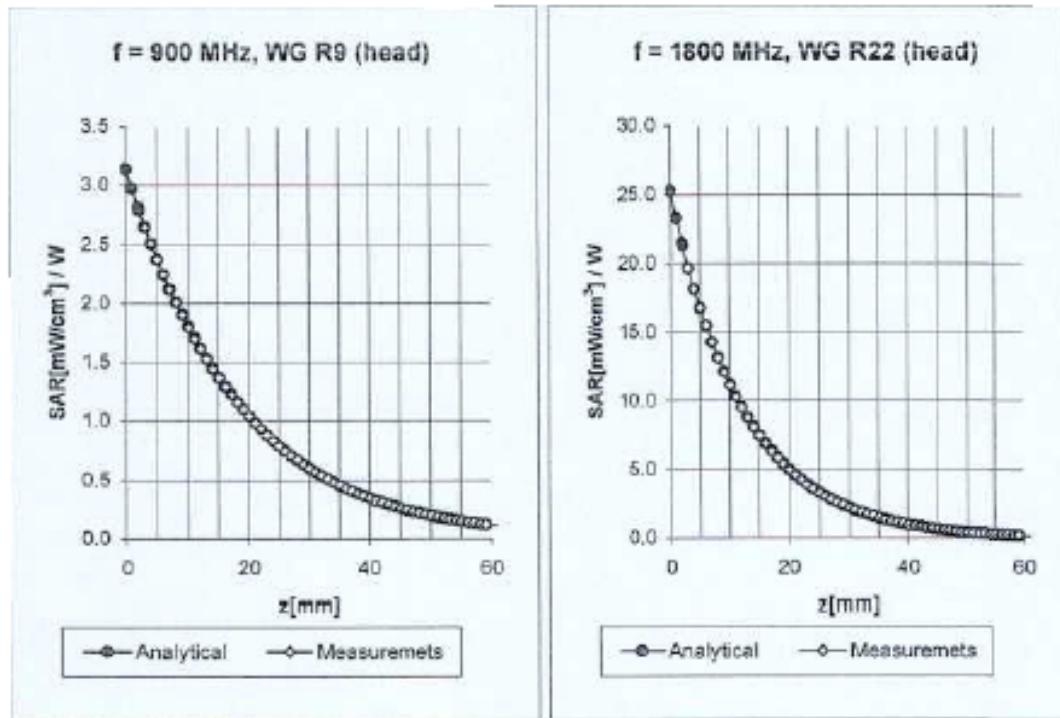
Dynamic Range f(SAR_{brain}) (Waveguide R22)



ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

Valid for $f=800-1000$ MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.4 $\pm 9.5\%$ ($k=2$)	Boundary effect:
ConvF Y	6.4 $\pm 9.5\%$ ($k=2$)	Alpha 0.68
ConvF Z	6.4 $\pm 9.5\%$ ($k=2$)	Depth 1.11

1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\% \text{ mho/m}$

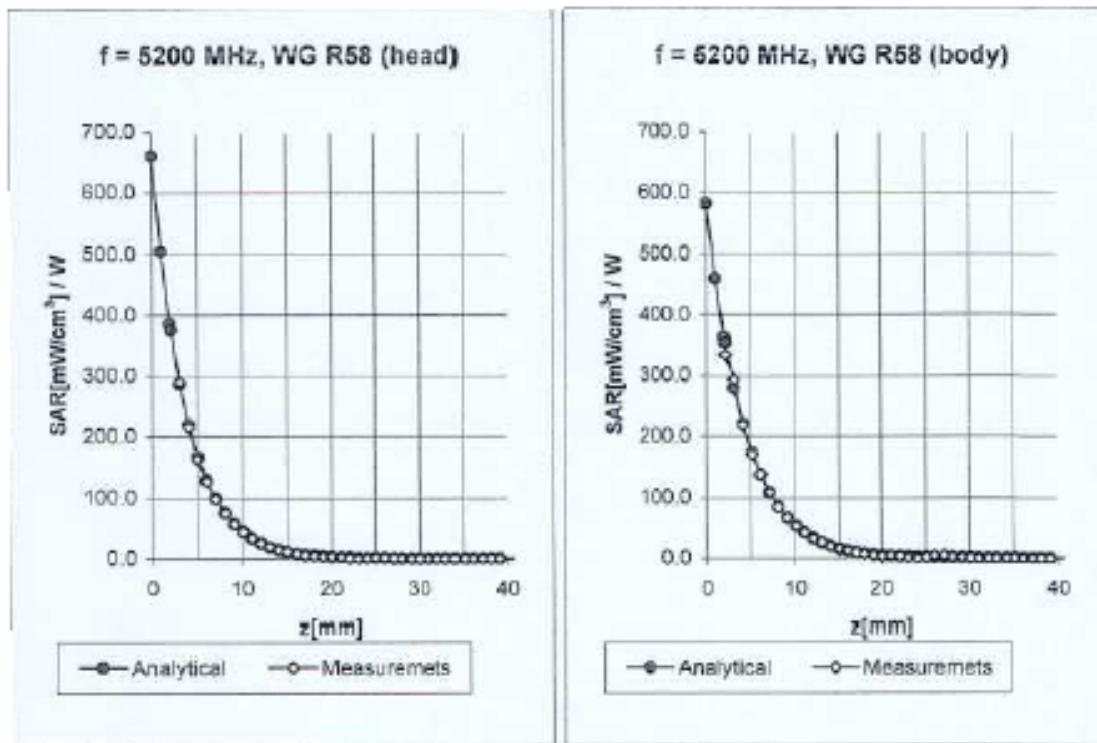
Valid for $f=1710-1910$ MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.0 $\pm 9.5\%$ ($k=2$)	Boundary effect:
ConvF Y	5.0 $\pm 9.5\%$ ($k=2$)	Alpha 0.21
ConvF Z	5.0 $\pm 9.5\%$ ($k=2$)	Depth 2.78

ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



Head 5200 MHz $\epsilon_r = 36.0 \pm 5\%$ $\sigma = 4.66 \pm 5\% \text{ mho/m}$

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	2.3 $\pm 14.6\%$ (k=2)	Boundary effect:
ConvF Y	2.3 $\pm 14.6\%$ (k=2)	Alpha 1.05
ConvF Z	2.3 $\pm 14.6\%$ (k=2)	Depth 1.50

Body 5200 MHz $\epsilon_r = 49.0 \pm 5\%$ $\sigma = 5.30 \pm 5\% \text{ mho/m}$

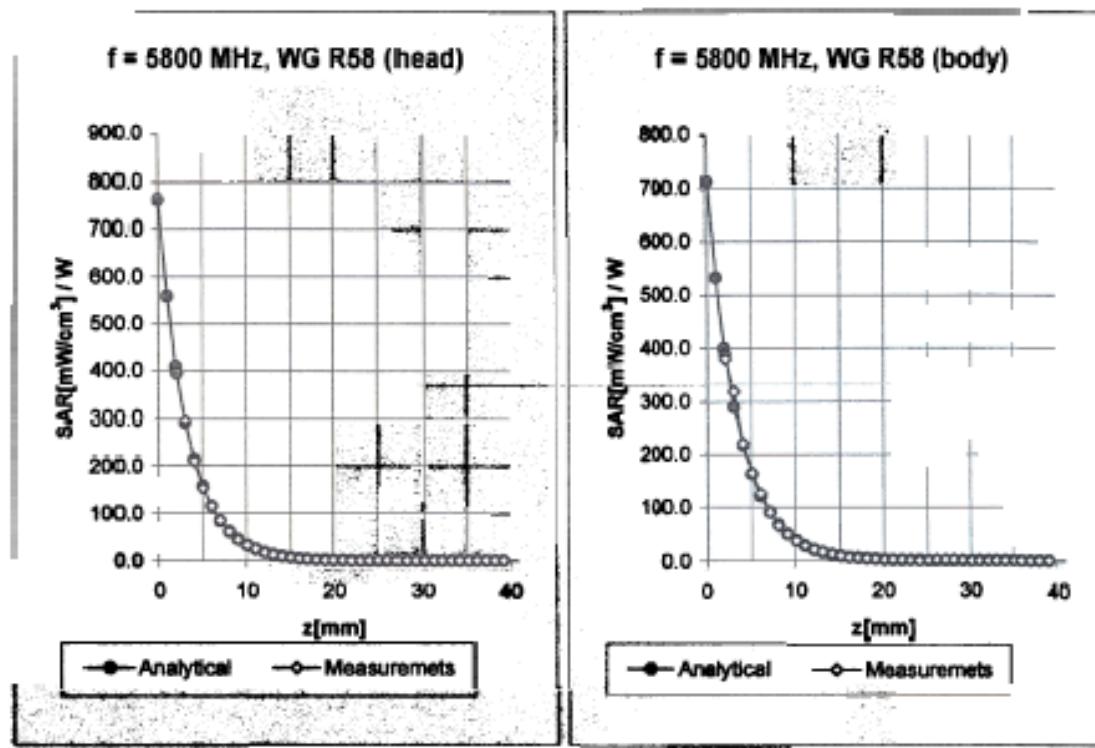
Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	1.4 $\pm 14.6\%$ (k=2)	Boundary effect:
ConvF Y	1.4 $\pm 14.6\%$ (k=2)	Alpha 1.01
ConvF Z	1.4 $\pm 14.6\%$ (k=2)	Depth 1.85

ES3DV2 SN: 3019

July 12, 2003

Conversion Factor Assessment



Head 5800 MHz $\epsilon_r = 35.3 \pm 5\%$ $\sigma = 5.27 \pm 5\% \text{ mho/m}$

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X **1.8** $\pm 14.6\%$ (k=2)

Boundary effect:

ConvF Y **1.8** $\pm 14.6\%$ (k=2)

Alpha **0.90**

ConvF Z **1.8** $\pm 14.6\%$ (k=2)

Depth **1.90**

Body 5800 MHz $\epsilon_r = 48.2 \pm 5\%$ $\sigma = 6.00 \pm 5\% \text{ mho/m}$

Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X **1.2** $\pm 14.6\%$ (k=2)

Boundary effect:

ConvF Y **1.2** $\pm 14.6\%$ (k=2)

Alpha **1.18**

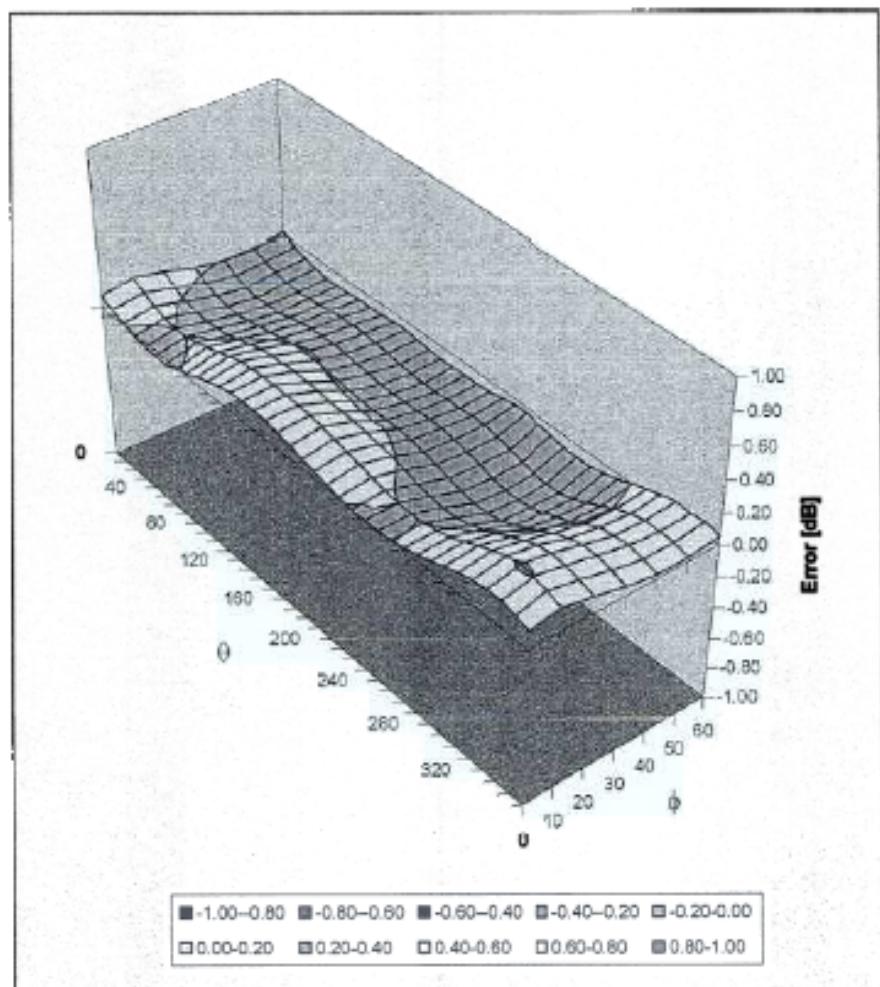
ConvF Z **1.2** $\pm 14.6\%$ (k=2)

Depth **1.65**

ES3DV2 SN: 3019

July 12, 2003

Deviation from Isotropy in HSL

Error ($\theta\phi$), f = 900 MHz

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Probe ES3DV2

SN:3019

Additional Conversion Factors

Manufactured: December 5, 2002
Last calibration: July 12, 2003
Add. calibration: October 9, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

Page 1 of 6

DASY - Parameters of Probe: ES3DV2 SN:3019**Sensitivity in Free Space**

NormX	1.05 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.14 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	0.98 $\mu\text{V}/(\text{V}/\text{m})^2$

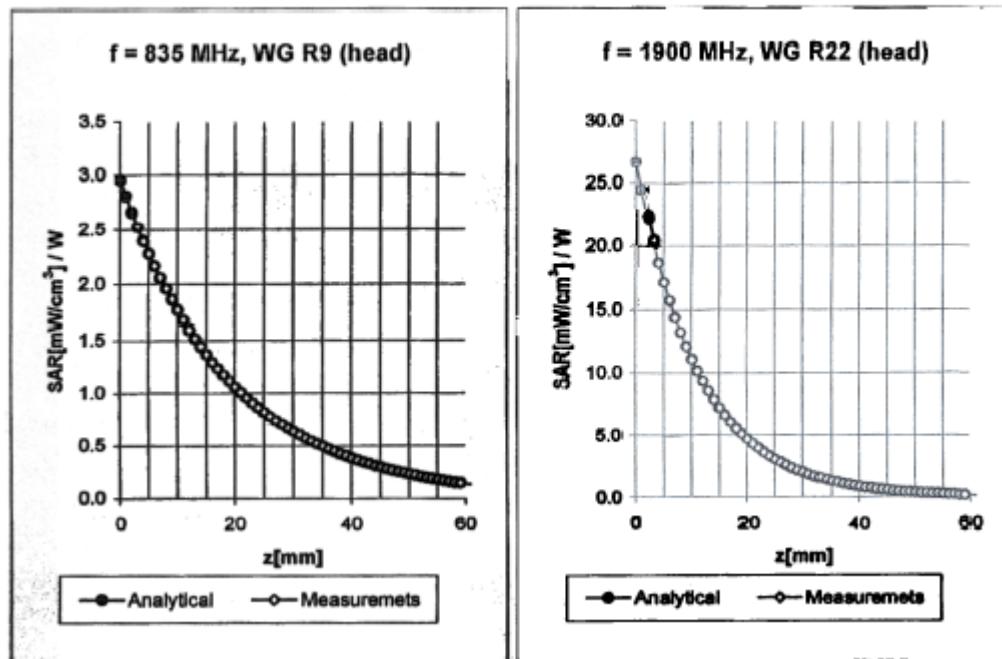
Diode Compression

DCP X	99
DCP Y	99
DCP Z	99

Sensor Offset

Probe Tip to Sensor Center	2.1	mm
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Conversion Factor Assessment



Head **835 MHz** $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.90 \pm 5\% \text{ mho/m}$

Valid for $f=793\text{-}877 \text{ MHz}$ with Head Tissue Simulating Liquid according to EN 60361, P1528-200X

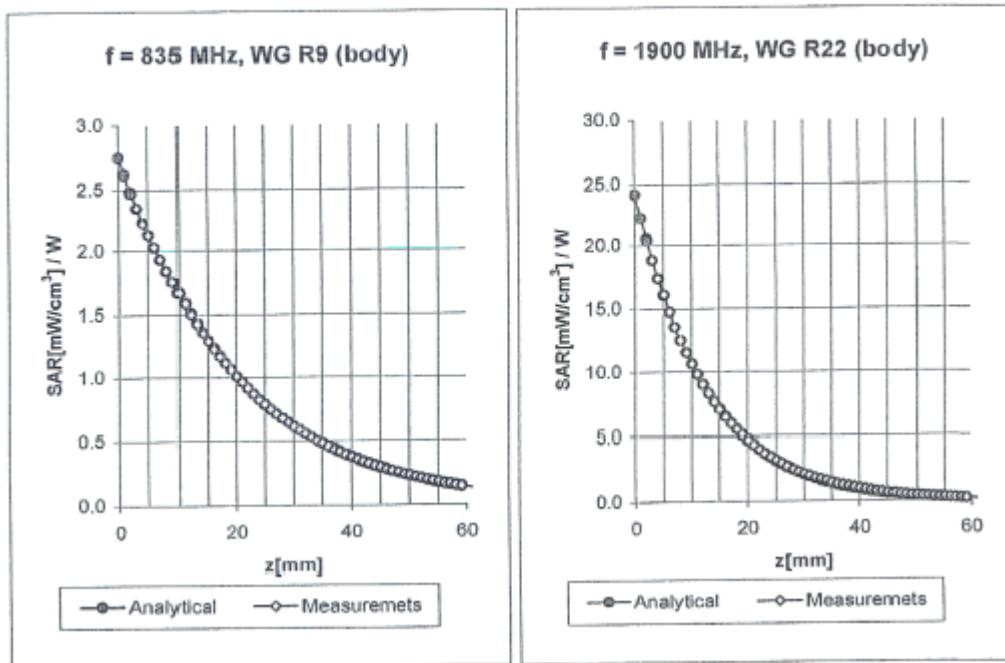
ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha 0.35
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth 1.46

Head **1900 MHz** $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\% \text{ mho/m}$

Valid for $f=1805\text{-}1995 \text{ MHz}$ with Head Tissue Simulating Liquid according to EN 60361, P1528-200X

ConvF X	4.7 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.7 $\pm 9.5\%$ (k=2)	Alpha 0.22
ConvF Z	4.7 $\pm 9.5\%$ (k=2)	Depth 3.48

Conversion Factor Assessment



Body 835 MHz $\epsilon_r = 55.2 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

Valid for $f=793\text{-}877 \text{ MHz}$ with Body Tissue Simulating Liquid according to OET 65 Suppl. C

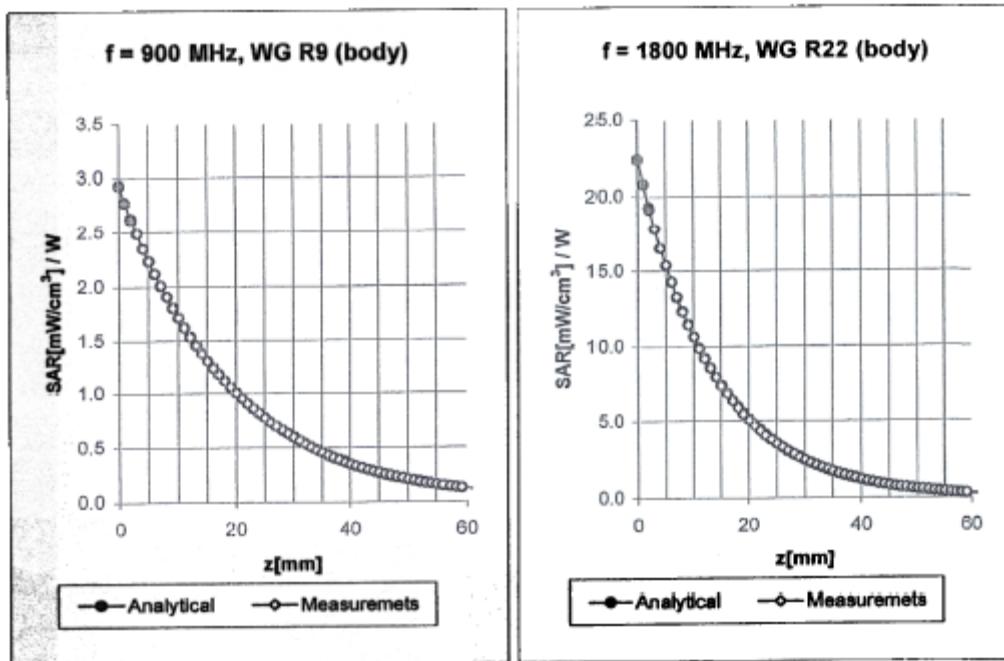
ConvF X	6.1 $\pm 9.5\%$ ($k=2$)	Boundary effect:
ConvF Y	6.1 $\pm 9.5\%$ ($k=2$)	Alpha 0.24
ConvF Z	6.1 $\pm 9.5\%$ ($k=2$)	Depth 2.00

Body 1900 MHz $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

Valid for $f=1805\text{-}1995 \text{ MHz}$ with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.6 $\pm 9.5\%$ ($k=2$)	Boundary effect:
ConvF Y	4.6 $\pm 9.5\%$ ($k=2$)	Alpha 0.24
ConvF Z	4.6 $\pm 9.5\%$ ($k=2$)	Depth 2.64

Conversion Factor Assessment



Body 900 MHz $\epsilon_r = 55.0 \pm 5\%$ $\sigma = 1.05 \pm 5\% \text{ mho/m}$

Valid for f=855-945 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

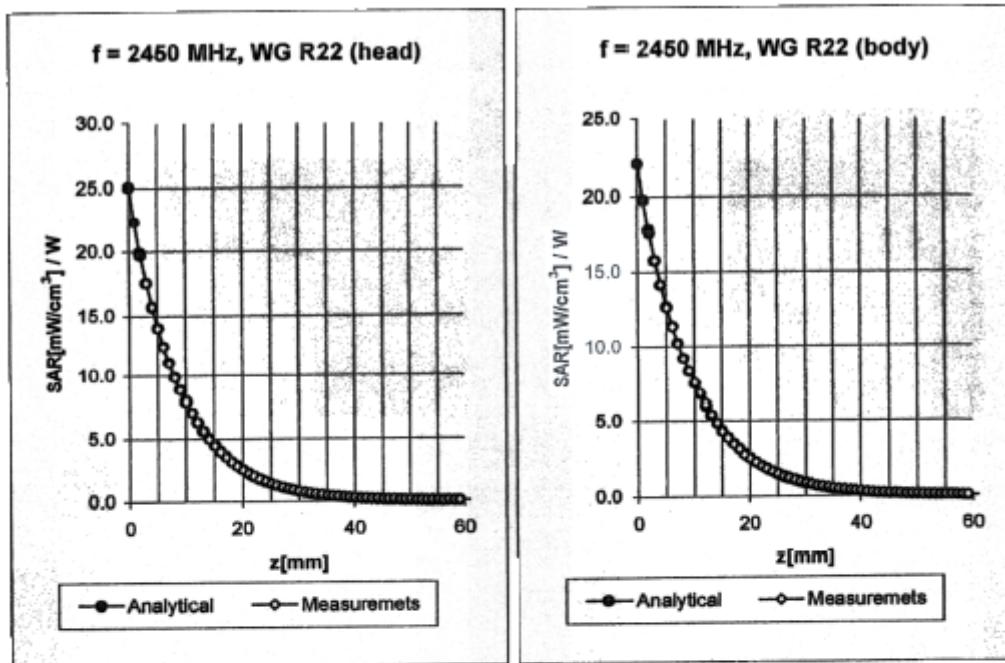
ConvF X	6.1 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.1 $\pm 9.5\%$ (k=2)	Alpha 0.27
ConvF Z	6.1 $\pm 9.5\%$ (k=2)	Depth 1.82

Body 1800 MHz $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

Valid for f=1710-1890 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.7 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	4.7 $\pm 9.5\%$ (k=2)	Alpha 0.23
ConvF Z	4.7 $\pm 9.5\%$ (k=2)	Depth 2.99

Conversion Factor Assessment

**Head****2450 MHz** $\epsilon_r = 39.2 \pm 5\%$ $\sigma = 1.80 \pm 5\% \text{ mho/m}$ Valid for $f=2400-2500 \text{ MHz}$ with Head Tissue Simulating Liquid according to EN 60361, P1528-200X

ConvF X	4.5 $\pm 9.5\%$ (k=2)
ConvF Y	4.5 $\pm 9.5\%$ (k=2)
ConvF Z	4.5 $\pm 9.5\%$ (k=2)

Boundary effect:	
Alpha	0.40
Depth	1.62

Body**2450 MHz** $\epsilon_r = 52.7 \pm 5\%$ $\sigma = 1.95 \pm 5\% \text{ mho/m}$ Valid for $f=2400-2500 \text{ MHz}$ with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.2 $\pm 9.5\%$ (k=2)
ConvF Y	4.2 $\pm 9.5\%$ (k=2)
ConvF Z	4.2 $\pm 9.5\%$ (k=2)

Boundary effect:	
Alpha	0.32
Depth	1.98

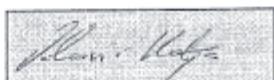
Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Additional Conversion Factors for Dosimetric E-Field Probe

Type:	ES3DV2
Serial Number:	3019
Place of Assessment:	Zurich
Date of Assessment:	October 13, 2003
Probe Calibration Date:	October 9, 2003

Schmid & Partner Engineering AG hereby certifies that conversion factor(s) of this probe have been evaluated on the date indicated above. The assessment was performed using the FDTD numerical code SEMCAD of Schmid & Partner Engineering AG. Since the evaluation is coupled with measured conversion factors, it has to be recalculated yearly, i.e., following the re-calibration schedule of the probe. The uncertainty of the numerical assessment is based on the extrapolation from measured value at 900 MHz or at 1800 MHz.

Assessed by:



ES3DV2-SN:3019

October 13, 2003

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 1 245 9700, Fax +41 1 245 9779
info@speag.com, http://www.speag.com

Dosimetric E-Field Probe ES3DV2 SN:3019Conversion factor (\pm standard deviation)

150 MHz	ConvF	8.7 ± 8%	$\epsilon_r = 52.3 \pm 5\%$ $\sigma = 0.76 \pm 5\% \text{ mho/m}$ (head tissue)
150 MHz	ConvF	8.3 ± 8%	$\epsilon_r = 61.9 \pm 5\%$ $\sigma = 0.80 \pm 5\% \text{ mho/m}$ (body tissue)
450 MHz	ConvF	7.4 ± 8%	$\epsilon_r = 43.5 \pm 5\%$ $\sigma = 0.87 \pm 5\% \text{ mho/m}$ (head tissue)
450 MHz	ConvF	7.3 ± 8%	$\epsilon_r = 56.7 \pm 5\%$ $\sigma = 0.94 \pm 5\% \text{ mho/m}$ (body tissue)

ES3DV2-SN:3019**October 13, 2003**

Body 300MHz Liquid Validation, Ambient Temp = 23 Deg
Temp = 22 Deg C, 02/27/04

C, Liquid

Frequency	ϵ'	ϵ''
250000000.0000	62.9694	59.0873
252000000.0000	62.7726	58.9872
254000000.0000	62.2796	58.5881
256000000.0000	61.9802	58.2200
258000000.0000	61.5673	58.0186
260000000.0000	61.3789	58.0550
262000000.0000	61.0359	57.9858
264000000.0000	61.0512	57.4999
266000000.0000	60.5267	57.2257
268000000.0000	60.1457	56.8963
270000000.0000	60.0084	56.9473
272000000.0000	59.8159	56.7775
274000000.0000	59.6795	56.7007
276000000.0000	59.5000	56.3212
278000000.0000	59.4018	56.2661
280000000.0000	59.0695	55.7134
282000000.0000	58.8717	55.6648
284000000.0000	58.7038	55.5829
286000000.0000	58.4484	55.6155
288000000.0000	58.2340	55.4389
290000000.0000	58.1924	55.3267
292000000.0000	57.7748	55.2795
294000000.0000	57.7273	54.9101
296000000.0000	57.7319	54.8188
298000000.0000	57.5380	54.5536
300000000.0000	57.3669	54.1667
302000000.0000	57.3396	54.3352
304000000.0000	57.3829	54.1388
306000000.0000	57.2805	53.9426
308000000.0000	57.1268	53.4671
310000000.0000	57.0938	53.3555
312000000.0000	56.8606	53.8334
314000000.0000	56.8683	53.8920
316000000.0000	56.9805	53.8812
318000000.0000	56.9803	53.5673
320000000.0000	56.9759	53.5260
322000000.0000	57.0401	53.2927
324000000.0000	57.0145	53.3019
326000000.0000	57.0253	53.0880
328000000.0000	57.1373	53.8910
330000000.0000	57.1462	53.6730
332000000.0000	57.2556	53.6145
334000000.0000	57.5497	53.4789
336000000.0000	57.3988	53.5525
338000000.0000	57.6983	53.2848
340000000.0000	57.5748	52.3554
342000000.0000	57.6470	52.1816
344000000.0000	57.6868	52.0313
346000000.0000	57.7692	52.9456
348000000.0000	57.7817	52.7929
350000000.0000	57.8391	52.7209

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.90$$

where $f = 300$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$\epsilon'' = 54.1667 \times 10^6$$

Head 300MHz Liquid Validation, Ambient Temp = 23 Deg C, Liquid Temp=22 Deg C,
02/27/04

Frequency	ϵ'	ϵ''
250000000.0000	45.8096	58.2373
252000000.0000	45.4442	57.9489
254000000.0000	45.5520	57.8249
256000000.0000	45.3876	57.6420
258000000.0000	45.5813	57.6379
260000000.0000	45.5476	56.4392
262000000.0000	45.4397	56.5689
264000000.0000	45.5312	56.9192
266000000.0000	45.4675	56.0286
268000000.0000	45.3919	56.4747
270000000.0000	45.6740	56.4562
272000000.0000	45.5602	55.3258
274000000.0000	45.5822	54.7417
276000000.0000	45.5435	54.7149
278000000.0000	45.6237	53.0572
280000000.0000	45.7583	53.9556
282000000.0000	45.8941	52.3961
284000000.0000	45.8527	52.2100
286000000.0000	45.9535	52.1018
288000000.0000	45.9505	52.5626
290000000.0000	45.5039	51.1259
292000000.0000	45.9988	51.9010
294000000.0000	45.9592	51.2402
296000000.0000	45.1881	50.8231
298000000.0000	45.0788	50.4521
300000000.0000	45.8681	50.5568
302000000.0000	44.1054	50.3469
304000000.0000	44.2290	49.8082
306000000.0000	44.6943	49.5187
308000000.0000	44.5843	49.9647
310000000.0000	44.0167	48.9628
312000000.0000	44.7922	48.9101
314000000.0000	44.9869	48.5520
316000000.0000	44.8925	48.7546
318000000.0000	44.2085	47.8386
320000000.0000	44.7453	47.6497
322000000.0000	44.9961	47.2333
324000000.0000	44.0000	47.7332
326000000.0000	43.5152	47.5405
328000000.0000	43.3221	46.8603
330000000.0000	43.1447	46.0482
332000000.0000	43.6791	46.0291
334000000.0000	43.4235	46.8197
336000000.0000	43.0881	46.4350
338000000.0000	42.6842	45.3201
340000000.0000	42.4796	45.7657
342000000.0000	42.3537	45.4793
344000000.0000	42.0578	45.7397
346000000.0000	42.9177	44.4252
348000000.0000	42.6216	44.6879
350000000.0000	42.3446	44.5515

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.84$$

where $f = 300$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$\epsilon'' = 50.5568 \times 10^6$$

Body 150MHz Liquid Validation, Ambient Temp=23 Deg C, Liquid Temp=22 Deg C,
02/27/04

Frequency	e'	e''
100000000.0000	60.2727	129.7509
102000000.0000	61.4284	127.4252
104000000.0000	61.1751	125.1113
106000000.0000	60.6863	122.5681
108000000.0000	60.6871	120.9838
110000000.0000	61.2101	119.2561
112000000.0000	60.5360	118.3089
114000000.0000	61.3016	115.6822
116000000.0000	60.9956	114.0641
118000000.0000	60.7760	112.8192
120000000.0000	61.3646	110.5656
122000000.0000	60.8232	109.0078
124000000.0000	61.1246	107.4066
126000000.0000	61.3496	106.1644
128000000.0000	60.7655	104.7526
130000000.0000	61.0726	103.4888
132000000.0000	60.7448	102.2729
134000000.0000	60.7814	101.1047
136000000.0000	61.0140	100.2125
138000000.0000	60.6682	99.1840
140000000.0000	60.9729	98.0178
142000000.0000	60.5691	96.7624
144000000.0000	60.5966	96.2624
146000000.0000	60.2737	93.0987
148000000.0000	60.6745	95.2958
150000000.0000	60.1615	93.1882
152000000.0000	60.0397	92.3643
154000000.0000	60.0462	91.6448
156000000.0000	59.9153	90.9002
158000000.0000	59.9807	90.2101
160000000.0000	60.0415	89.4994
162000000.0000	59.6673	88.7052
164000000.0000	59.6488	88.6019
166000000.0000	59.6667	87.6696
168000000.0000	59.5966	86.9284
170000000.0000	59.1871	86.2952
172000000.0000	59.4493	85.5319
174000000.0000	59.0934	84.9929
176000000.0000	58.9863	84.3361
178000000.0000	58.6711	83.6172
180000000.0000	58.5987	83.2195
182000000.0000	58.7378	82.5085
184000000.0000	58.6364	82.0036
186000000.0000	58.3188	81.5680
188000000.0000	58.5523	80.8832
190000000.0000	58.6037	80.5660
192000000.0000	58.2112	79.9654
194000000.0000	58.1078	79.5126
196000000.0000	58.0675	79.0610
198000000.0000	57.9703	78.5188
200000000.0000	57.6939	78.1010

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.78$$

where $f = 150$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$\epsilon'' = 93.1882 \times 10^6$$

Head 150MHz Liquid Validation, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 02/27/04

Frequency	ϵ'	ϵ''
100000000.0000	54.7062	121.7092
1020000000.0000	54.4674	119.0434
1040000000.0000	54.3697	116.7841
1060000000.0000	54.1035	114.9823
1080000000.0000	54.4170	112.7181
1100000000.0000	54.1532	110.5170
1120000000.0000	53.6402	108.8859
1140000000.0000	54.2447	107.0579
1160000000.0000	53.8131	105.3590
1180000000.0000	53.6222	103.3510
1200000000.0000	53.5693	101.8934
1220000000.0000	53.6520	99.9639
1240000000.0000	53.5450	98.4907
1260000000.0000	53.3053	97.7788
1280000000.0000	53.3364	96.2364
1300000000.0000	53.1783	95.6633
1320000000.0000	52.6844	94.3874
1340000000.0000	53.1363	93.1675
1360000000.0000	53.0954	92.5426
1380000000.0000	52.5817	91.8107
1400000000.0000	53.1723	91.5085
1420000000.0000	52.5539	90.2326
1440000000.0000	53.1635	89.3050
1460000000.0000	52.4290	88.5739
1480000000.0000	52.9737	88.4790
1500000000.0000	52.7786	88.3278
1520000000.0000	51.7667	87.6324
1540000000.0000	51.8412	86.4010
1560000000.0000	51.7440	86.4440
1580000000.0000	51.5558	85.5189
1600000000.0000	51.5268	84.6774
1620000000.0000	51.2463	84.1178
1640000000.0000	51.0589	83.1097
1660000000.0000	51.1334	82.9946
1680000000.0000	50.6895	80.4671
1700000000.0000	50.4837	79.5629
1720000000.0000	50.3387	78.5356
1740000000.0000	50.2079	77.6504
1760000000.0000	49.7846	77.0671
1780000000.0000	49.6670	76.4355
1800000000.0000	49.3855	75.6345
1820000000.0000	49.4215	75.0179
1840000000.0000	49.1479	74.0710
1860000000.0000	49.0001	73.3894
1880000000.0000	48.9640	72.8544
1900000000.0000	48.7451	72.3800
1920000000.0000	48.4248	71.4745
1940000000.0000	48.6204	70.7522
1960000000.0000	48.1902	70.2289
1980000000.0000	48.1395	69.6483
2000000000.0000	48.0724	69.2005

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.74$$

where $f = 150$

$$\epsilon_0 = 8.854 \times 10^{-12}$$

$$\epsilon'' = 88.3278 \times 10^6$$

3 - EUT DESCRIPTION

Serial Number: 00000001

Applicant: GENEX TELECOM CO., LTD.

Product Description: Transceiver, PTT Portable 2-Way Radio

FCC ID: PM3GX80

Transmitter Frequency: 430.9875 – 469.9875 MHz

Maximum Output Power: 4.875 W

Dimension: 9.9”L x 2.5”W x 1.75”H

RF Exposure environment: Occupational Population

Applicable Standard: FCC CFR 47, Part 90

Application Type: Certification

¹ Specific Absorption Rate (SAR) is a measure of the rate of energy absorption due to exposure to an RF transmitting source (wireless portable device).

² IEEE/ANSI Std. C95.3-2002 limits are used to determine compliance with FCC ET Docket 93-62.

Note: The test data was good for test sample only. It may have deviation for other test samples.

4 - SYSTEM TEST CONFIGURATION

4.1 Justification

The system was configured for testing according to ANSI C63.4-2001.

4.2 EUT Exercise Procedure

The EUT exercising program used during SAR testing was designed to exercise the various system components in a manner similar to a typical use. The EUT was tested by pushing the PTT bottom during the testing.

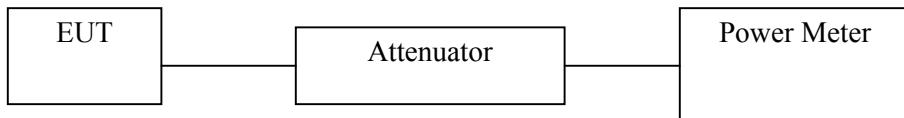
4.3 Equipment Modifications

No modifications were made to the EUT.

5 - CONDUCTED OUTPUT POWER MEASUREMENT

5.1 Measurement Procedure

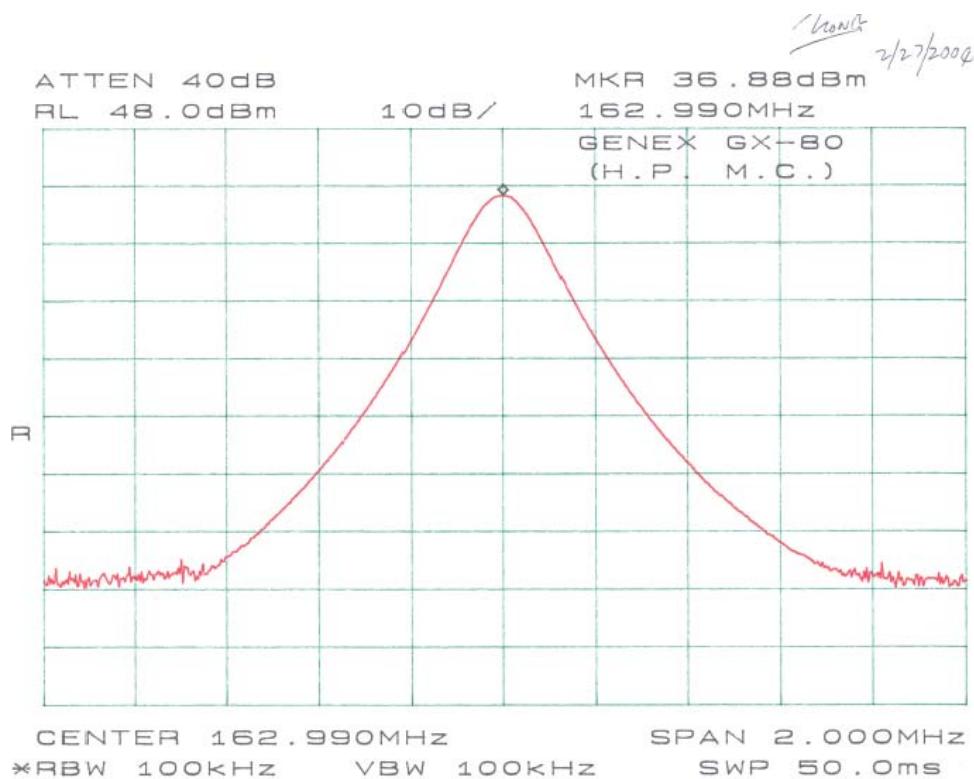
1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.



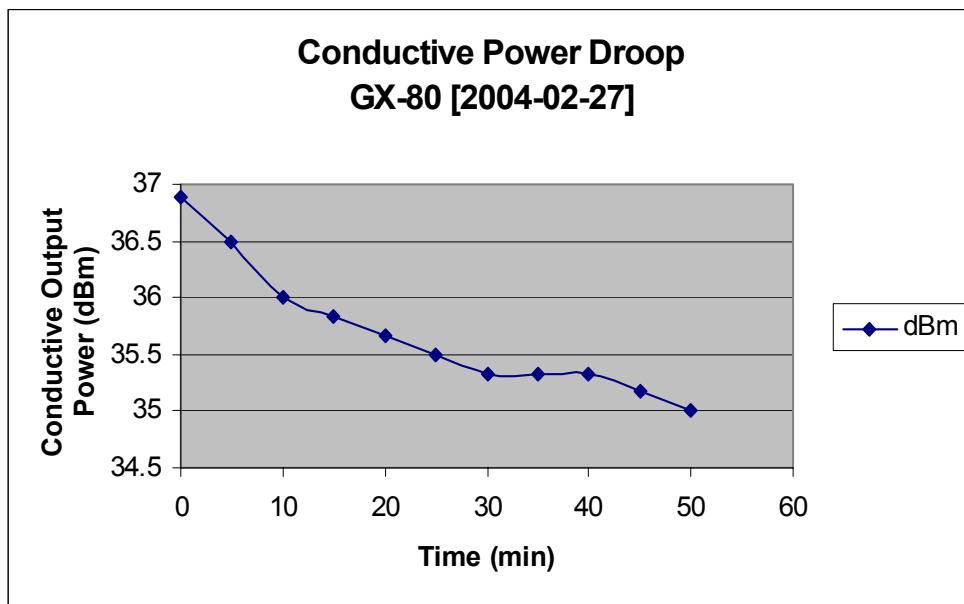
5.2 Test Results

Channel	Frequency in MHz	Output Power in dBm	Output Power in W
Middle	162.990	36.388	4.875

Note: The power output may depend on the intended use of the EUT. For all tests, the EUT was set to maximum conditions.



5.3 Test Results of Power Droop



6 - DOSIMETRIC ASSESSMENT SETUP

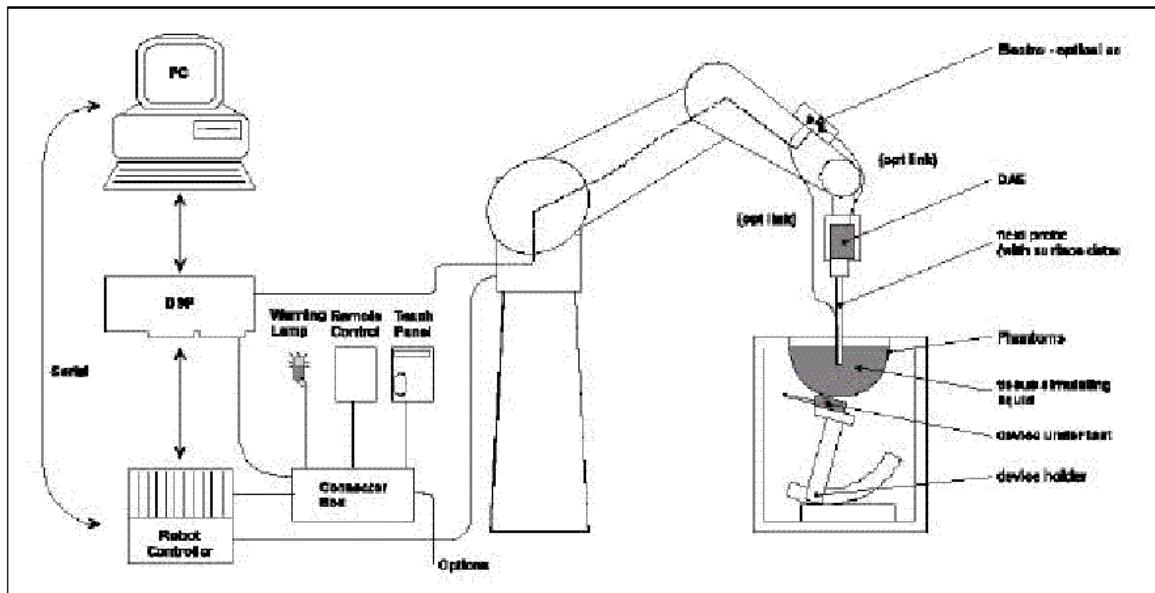
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than $\pm 0.02\text{mm}$. 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 to the data acquisition unit. The system is described in detail in [3].

The SAR measurements were conducted with the dosimetric probe ET3DV2 SN: 3019 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than $\pm 10\%$. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than $\pm 0.25\text{dB}$.

The phantom used was the 'Generic Twin Phantom" described in [4]. The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in accordance with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	55.2	42.0	55.9	39.9	53.3	39.8	53.6
Conductivity (s/m)	0.85	0.83	0.91	0.97	1.0	0.98	1.42	1.52	1.88	1.81

6.1 Measurement System Diagram



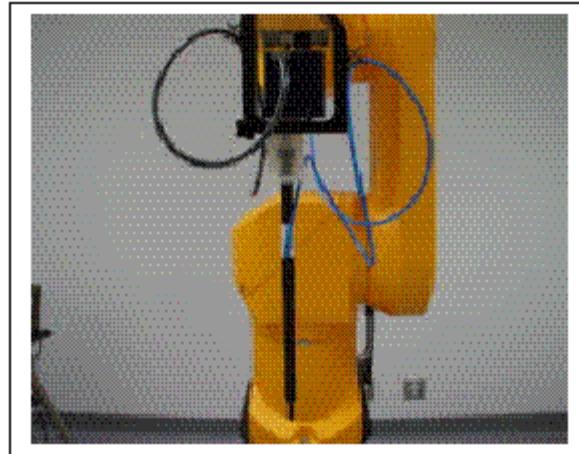
The DASY3 system for performing compliance tests consist of the following items:

1. A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
2. An arm extension for accommodating the data acquisition electronics (DAE).
3. A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
4. A data acquisition electronic (DAE), which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
5. A unit to operate the optical surface detector, which is connected to the EOC. The Electro-optical coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the PC plug-in card. The functions of the PC plug-in card based on a DSP is to perform the time critical task such as signal filtering, surveillance of the robot operation fast movement interrupts.
6. A computer operating Windows 95 or larger
7. DASY3 software
8. Remote control with teaches pendant and additional circuitry for robot safety such as warning lamps, etc.
9. The generic twin phantom enabling testing left-hand and right-hand usage.
10. The device holder for handheld EUT.
11. Tissue simulating liquid mixed according to the given recipes (see Application Note).
12. System validation dipoles to validate the proper functioning of the system.

6.2 System Components

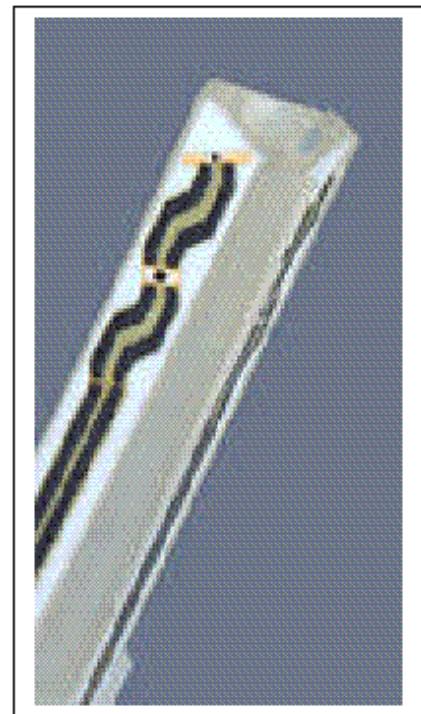
ET3DV6 Probe Specification

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



Photograph of the probe

The SAR measurements were conducted with the dosimetric probe ET3DV6 designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe 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 DASY3 software reads the reflection during a software approach and looks for the maximum using a 2 nd order fitting. The approach is stopped when reaching the maximum.



Inside view of
 ET3DV6 E-field Probe

E-Field Probe Calibration Process

Each probe is calibrated according to a dosimetric assessment procedure described in [6] with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in [7] and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, 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 1 GHz, and in a waveguide above 1 GHz 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 dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

Data Evaluation

The DASY3 software 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 Parameter:	-Sensitivity	Norm _i , a _{i0} , a _{i1} , a _{i2}
	-Conversion Factor	ConvFi
	-Diode compression point	Dcp _i
Device parameter:	-Frequency	f
	-Crest Factor	cf
Media parameter:	-Conductivity	σ
	-Density	ρ

These parameters must be set correctly in the software. They can either be found in the component documents or be imported into the software from the configuration files issued for the DASY3 components. In the direct measuring mode of the multi-meter 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:

$$V_i = U_i + (U_i)^2 \cdot cf / dcp_i$$

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:

$$\text{E-field probes: } E_i = \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConF}}}$$

$$\text{H-field probes: } H_i = \sqrt{V_i \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}}$$

With
 V_i = compensated signal of channel i (i = x, y, z)
 Norm_i = sensor sensitivity of channel i (i = x, y, z)
 $\mu\text{V}/(\text{V}/\text{m})^2$ for E-field probes
 ConF = 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
 H_i = diode compression point (DASY parameter)

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{\text{tot}} = \text{Square Root} [(E_x)^2 + (E_y)^2 + (E_z)^2]$$

The primary field data are used to calculate the derived field units.

$$\text{SAR} = (E_{\text{tot}})^2 \cdot \sigma / (\rho \cdot 1000)$$

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/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.

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

$$P_{\text{pwe}} = (E_{\text{tot}})^2 / 3770 \text{ or } P_{\text{pwe}} = (H_{\text{tot}})^2 \cdot 37.7$$

With
 P_{pwe} = equivalent power density of a plane wave in mW/cm³
 E_{tot} = total electric field strength in V/m
 H_{tot} = total magnetic field strength in V/m

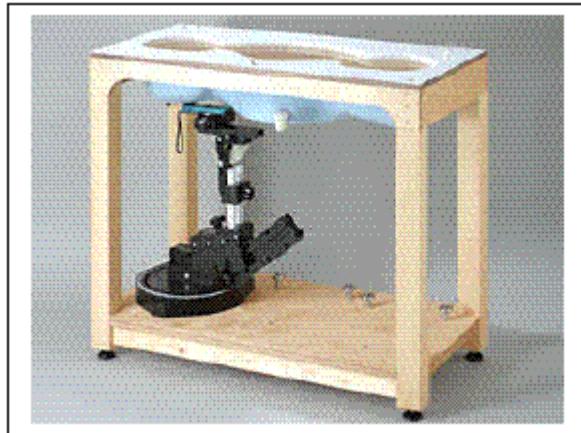
Generic Twin Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users [9][10]. 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 the evaporation of the liquid. Reference markings on the Phantom allows the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot.

Shell Thickness 2 ± 0.1 mm

Filling Volume Approx. 20 liters

Dimensions 810 x 1000 x 500 mm (H x L x W)



Generic Twin Phantom

Device Holder

In combination with the Generic Twin Phantom V3.0, the Mounting Device 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 repeatedly positioned according to the FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, 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 [10]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.



Device Holder

6.3 Measurement Uncertainty

The uncertainty budget has been determined for the DASY3 measurement system according to the NIS81 [13] and the NIST1297 [14] documents and is given in the following Table.

Measurement Uncertainty Analysis per IEEE P1528-2002									
Description	Section	Reported Variance (%)	Probability Distribution type	Divisor	Ci (1g)	Ui (1g)	Vi	welc/satt series term	
Probe Calibration	E.2.1	4.80	N	1	1	4.80	1.00E+09	5.30842E-07	
Axial isotropy	E.2.2	4.70	R	1.732	0.707107	1.92	1.00E+09	1.35563E-08	
Hemispherical isotropy	E.2.2	9.60	R	1.732	0.707107	3.92	1.00E+09	2.35957E-07	
Boundary effects	E.2.3	8.30	R	1.732	1	4.79	1.00E+09	5.27377E-07	
Linearity	E.2.4	4.70	R	1.732	1	2.71	1.00E+09	5.4225E-08	
System Detection Limit	E.2.5	1.00	R	1.732	1	0.58	1.00E+09	1.11124E-10	
Readout Electronics	E.2.6	0.00	N	1	1	0.00	1.00E+09	0	
Response time	E.2.7	0.00	R	1.732	1	0.00	1.00E+09	0	
Integration time	E.2.8	0.00	R	1.732	1	0.00	1.00E+09	0	
RF Ambient conditions	E.6.1	3.00	R	1.732	1	1.73	1.00E+09	9.00106E-09	
Probe positioning mechanical tolerance	E.6.2	0.40	R	1.732	1	0.23	1.00E+09	2.84478E-12	
Probe positioning wrt phantom shell	E.6.3	2.90	R	1.732	1	1.67	1.00E+09	7.8596E-09	
Extra/inter-polation & integration algorithms for max SAR evaluation	E.5.2	3.90	R	1.732	1	2.25	1.00E+09	2.57079E-08	
Test sample positioning	8, E.4.2	6.00	R	1.732	1	3.46	1.00E+09	1.44017E-07	
Device holder distance tolerance	E.4.1	5.00	N	1	1	5.00	1.00E+09	0.000000625	
Output power and SAR drift measurement	8, E.6.6.2	5.00	R	1.732	1	2.89	1.00E+09	6.94526E-08	
Phantom uncertainty, shell thickness tolerance	E.3.1	4.00	R	1.732	1	2.31	1.00E+09	2.84478E-08	
Liquid conductivity, deviation from target values	E.3.2	5.00	R	1.732	0.64	1.85	1.00E+09	1.16522E-08	
Liquid conductivity, measurement uncertainty	E.3.3	5.00	N	1	0.64	3.20	5	20.97152	
Liquid permitivity, deviation from target values	E.3.2	5.00	R	1.732	0.6	1.73	1.00E+09	9.00106E-09	
Liquid permitivity, measurement uncertainty	E.3.3	5.00	N	1	0.6	3.00	5	16.2	
									689
Probe isotropy sensitivity coefficient	0.5								
Combined Standard Uncertainty							12.65	%	
Expanded Uncertainty, 95% confidence		k=	2.004				25.34	%	

7 - SYSTEM EVALUATION

7.1 Simulated Tissue Liquid Parameter Confirmation

The dielectric parameters were checked prior to assessment using the HP85070A dielectric probe kit. The dielectric parameters measured are reported in each correspondent section:

7.2 Evaluation Procedures

Maximum Search

The maximum search is automatically performed after each coarse scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacings. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations.

Extrapolation

The extrapolation can be used in z-axis scans with automatic surface detection. The SAR values can be extrapolated to the inner phantom surface. The extrapolation distance is the sum of the probe sensor offset, the surface detection distance and the grid offset. The extrapolation is based on fourth order polynomial functions. The extrapolation is only available for SAR values.

Boundary Corrections

The correction of the probe boundary effect in the vicinity of the phantom surface can be done in two different ways. In the standard (worse case) evaluation, the boundary effect is reduced by different weights for the lowest measured points in the extrapolation routine. The result is a slight overestimation of the extrapolated SAR values (2% to 8%) depending on the SAR distribution and gradient. The advanced evaluation makes a full compensation of the boundary effect before doing the extrapolation. This is only possible of probes with specifications on the boundary effect.

Peak Search for 1g and 10g cube averaged SAR

The 1g and 10g peak evaluations are only available for the predefined cube 4x4x7 and cube 5x5x7 scans. The routine are verified and optimized for the grid dimensions used in these cube measurements. The measured volume of 32x32x35mm contains about 35g of tissue. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation get all points within the measured volume in a 1mm grid (35000 points). In the last step, a 1g cube is place numerically into the volume and its averaged SAR is calculated. This cube is the moved around until the highest averaged SAR is found. This last procedure is repeated for a 10g cube. If the highest SAR is found at the edge of the measured volume, the system will issue a warning; higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

7.3 System Accuracy Verification

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of $\pm 10\%$. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

IEEE P1528 recommended reference value

Frequency (MHz)	1 g SAR	10 g SAR	Local SAR at surface (above feed point)	Local SAR at surface (v=2cm offset from feed point)
300	3.0	2.0	4.4	2.1
450	4.9	3.3	7.2	3.2
835	9.5	6.2	14.1	4.9
900	10.8	6.9	16.4	5.4
1450	29.0	16.0	50.2	6.5
1800	38.1	19.8	69.5	6.8
1900	39.7	20.5	72.1	6.6
2000	41.1	21.1	74.6	6.5
2450	52.4	24.0	104.2	7.7
3000	63.8	25.7	140.2	9.5

Validation Dipole SAR Reference Test Result for Body (300 MHz)

Validation Measurement	SAR @ 100 mW Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 100 mW Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	0.376	3.76	0.255	2.55
Test 2	0.378	3.78	0.256	2.56
Test 3	0.380	3.80	0.258	2.58
Test 4	0.385	3.85	0.261	2.61
Test 5	0.384	3.84	0.261	2.61
Test 6	0.383	3.83	0.261	2.61
Test 7	0.382	3.82	0.260	2.60
Test 8	0.381	3.81	0.259	2.59
Test 9	0.379	3.79	0.258	2.58
Test 10	0.379	3.79	0.257	2.57
Average	0.381	3.81	0.259	2.59

System validation result

2004-03-11

Ambient Temperature (°C): 23.0

Relative Humidity (%): 49.3

Simulant	Freq [MHz]	Parameters	Liquid Temp [°C]	Target Value	Measured Value	Deviation [%]	Limits [%]
Body	300	ϵ	22	58.2	57.4	-1.37	± 5
		σ	22	0.92	0.90	-2.17	± 5
		1g SAR	22	3.81	3.85	1.05	± 10
Head	300	ϵ	22	45.3	45.9	1.32	± 5
		σ	22	0.87	0.84	-3.45	± 5
		1g SAR	22	3.00	3.00	0.00	± 10

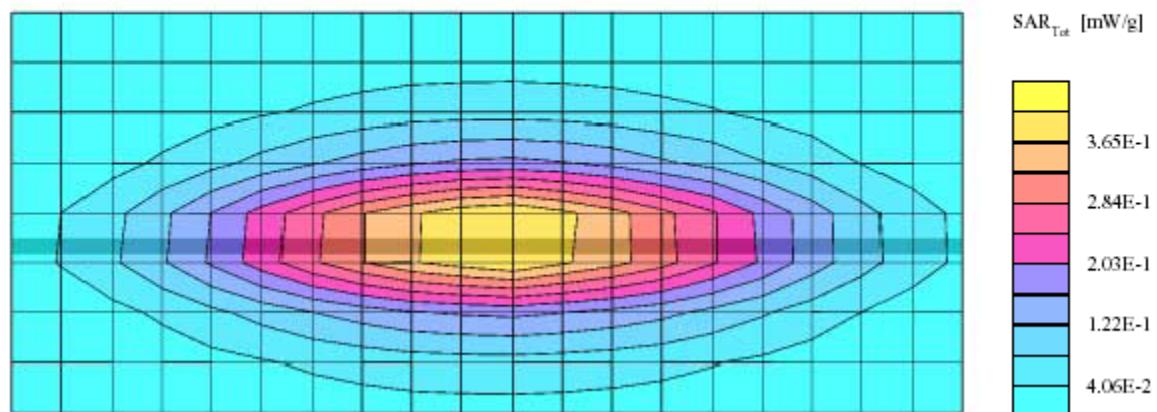
ϵ = relative permittivity, σ = conductivity and $\rho=1000\text{kg/m}^3$

Note: Forward power for Body = 20.61 dBm = 115.08 mW

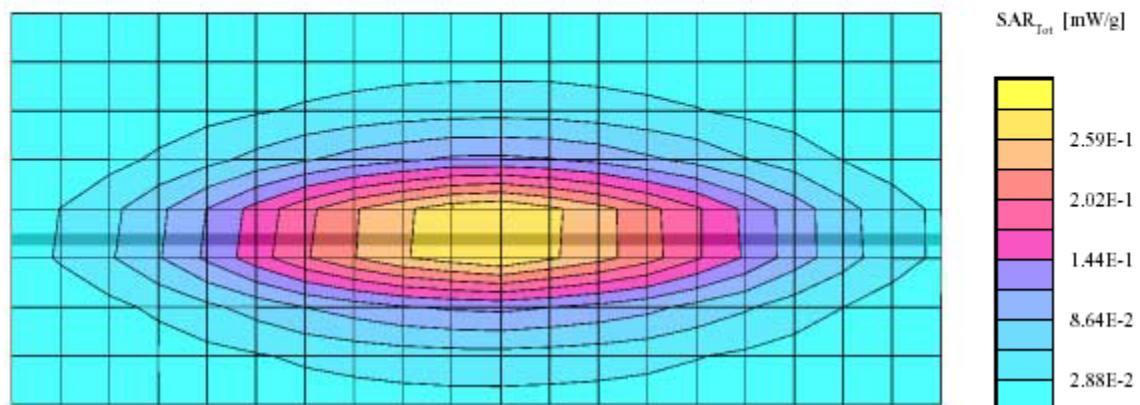
Forward power for Head = 20.21 dBm = 104.95 mW

300 MHz Body Liquid System Validation (Ambient Temp = 21 Deg C, Liquid Temp = 22 Deg C, Forward Power = 20.61 dBm, 2/27/2004)

Flat Phantom v4.4 Phantom; Flat Section; Position: (90°,90°); Frequency: 300 MHz
Probe: ES3DV2 - SN3019; ConvF(7.54,7.54,7.54); Crest factor: 1.0; Body liquid 300 MHz: $\sigma = 0.90 \text{ mho/m}$ $\epsilon_r = 57.4$ $\rho = 1.00 \text{ g/cm}^3$
Cube 5x5x7; SAR (1g): 0.443 mW/g, SAR (10g): 0.299 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: 0.00 dB



300 MHz Head Liquid System Validation (Ambient Temp = 21 Deg C, Liquid Temp = 22 Deg C, Forward Power = 20.21dBm, 2/27/2004)
Flat Phantom v4.4 Phantom; Flat Section; Position: (90°,90°); Frequency: 300 MHz
Probe: ES3DV2 - SN3019; ConvF(7.81,7.81,7.81); Crest factor: 1.0; Head liquid 300 MHz: $\sigma = 0.84 \text{ mho/m}$ $\epsilon_r = 45.9$ $\rho = 1.00 \text{ g/cm}^3$
Cube 5x5x7: SAR (1g): 0.315 mW/g, SAR (10g): 0.213 mW/g, (Worst-case extrapolation)
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Powerdrift: -0.00 dB



7.4 SAR Evaluation Procedure

- a. The evaluation was performed in the applicable area of the phantom depending on the type of device being tested. For device held to the dear during normal operation, both the left and right ear positions were evaluated in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01) using the SAM phantom. For body-worn and face-held devices a planar phantom was used. The EUT in the test setup for body-worn and face-held devices was placed in three different positions (relative to the phantom): with belt clip, without belt clip and 2.5cm facing left head side and 2.5cm facing right head side.
- b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm.
- c. A 5x5x7 matrix was performed around the greatest special SAR distribution found during the area scan of the applicable exposed region. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.
- d. The depth of the simulating tissue in the planar used for the SAR evaluation and system validation was no less than 15.0cm.
- e. For this particular evaluation, a stack of low-density, low-loss dielectric foamed polystyrene was used in place of the device holder.
- f. Re-measurement of the SAR value at the same location as in a. If the value changed by more than 5%, the evaluation was repeated.

7.5 Exposure Limits

Table 1: Limits for Occupational/Controlled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.4	8.0	20.0

Table 2: Limits for General Population/Uncontrolled Exposure (W/kg)

Whole-Body	Partial-Body	Hands. Wrists. Feet and Ankles
0.08	1.6	4.0

Note: Whole-body SAR is averaged over the entire body, partial-body SAR is averaged over any 1 gram of tissue defined as a tissue volume in the shape of a cube SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual 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 people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

Occupational/Controlled environments Partial-body limit 8mW/kg applied to the EUT.

8 - TEST RESULTS

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device could be found in the following pages.

According to the data in section 8.1, the EUT complied with the FCC 2.1093 RF Exposure standards, with worst case of **0.0525 mW/g**.

8.1 SAR Test Data

Ambient Temperature (°C): 23.0
Relative Humidity (%): 49.3

Worst case SAR reading

EUT position	Frequency (MHz)	Conducted Power (W)	Test Type	Antenna Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)		Limit (mW/g)	Plot #
								100%	50% duty cycle		
2.5 cm head separation to phantom	163	4.875	Face-held	Built-in	head	flat	none	0.105	0.0525	8	1
back in touch with phantom	163	4.875	Body worn	Built-in	body	flat	Belt Clip and Headset	0.100	0.0500	8	2

8.2 Plots of Test Result

The plots of test result were attached as reference.

Genex, Model number: GX-80 (Face-held 2.5 cm separation to flat phantom, Mid Channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 2/27/2004)

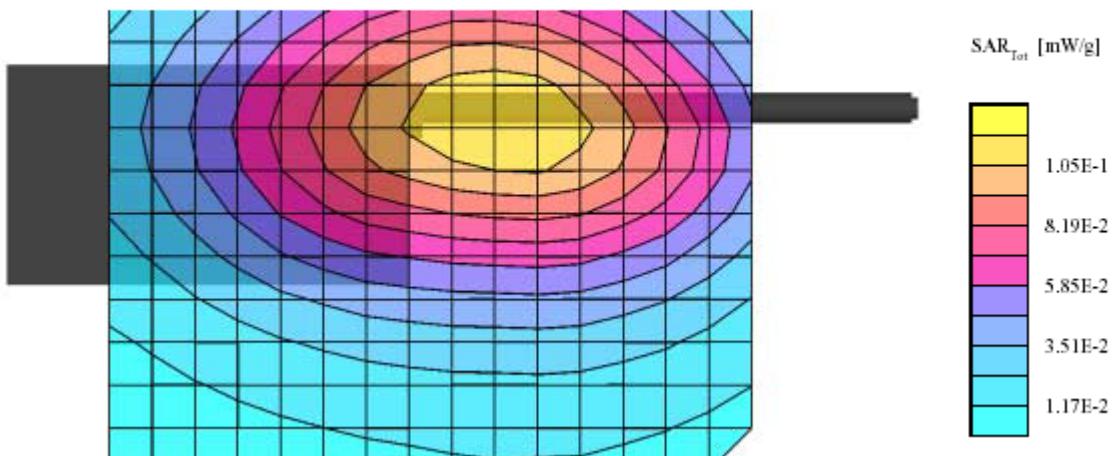
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 163 MHz

Probe: ES3DV2 - SN3019; ConvF(8.70,8.70,8.70); Crest factor: 1.0; 150 MHz Head liquid: $\sigma = 0.74 \text{ mho/m}$ $\epsilon_r = 52.8$ $\rho = 1.00 \text{ g/cm}^3$

Cube 5x5x7: SAR (1g): 0.105 mW/g, SAR (10g): 0.0777 mW/g, (Worst-case extrapolation)

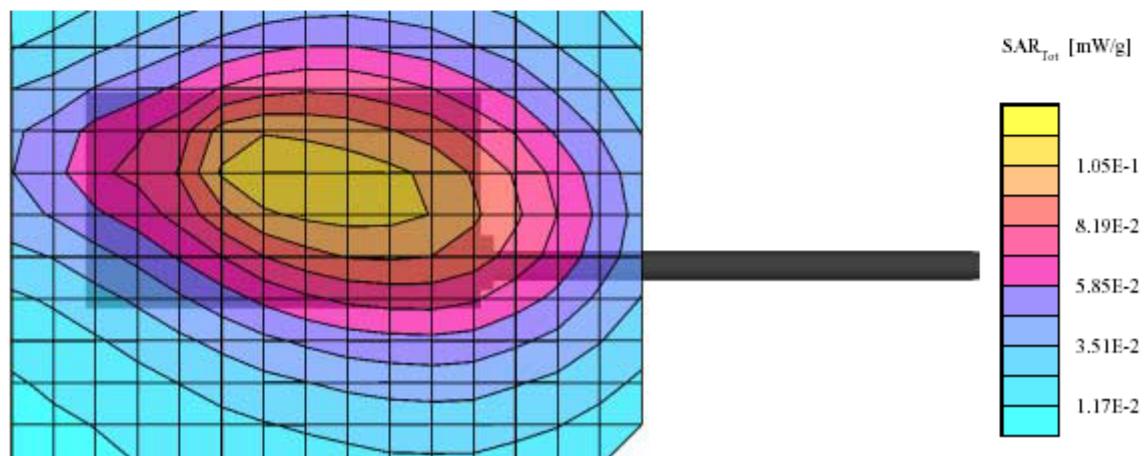
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0

Powerdrift: -0.00 dB



Plot #1

Genex, Model number: GX-80 (Back touching flat phantom with belt clip and headset, Mid Channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 2/27/2004)
SAM Phantom; Flat Section; Position: (270°,270°); Frequency: 163 MHz
Probe: ES3DV2 - SN3019; ConvF(8.30,8.30,8.30); Crest factor: 1.0; 150 MHz Body liquid: $\sigma = 0.74 \text{ mho/m s}$, $\epsilon_r = 52.8$, $\rho = 1.00 \text{ g/cm}^3$
Cube 5x5x7: SAR (1g): 0.100 mW/g, SAR (10g): 0.0732 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.01 dB



Plot #2

EXHIBIT A - SAR SETUP PHOTOGRAPHS

2.5cm Head Separation to Flat Phantom



Back Touching with Flat Phantom with Belt Clip and Headset



EXHIBIT B - EUT PHOTOGRAPHS

Chassis - Front View



Chassis – Back View I



Chassis – Back View II



Chassis – Back Frame



Chassis – Top View



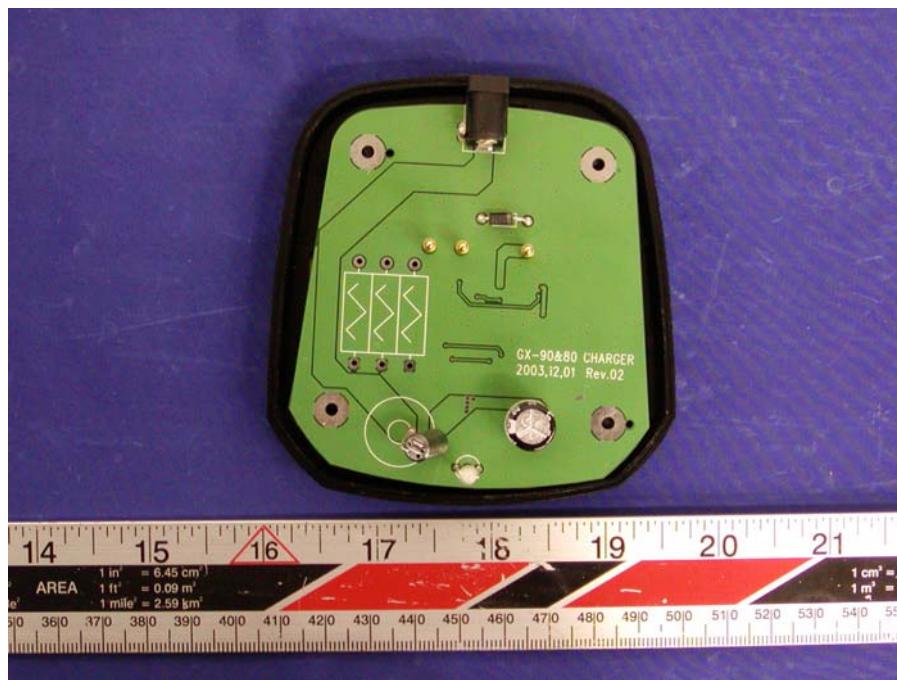
Chassis – Left Side View

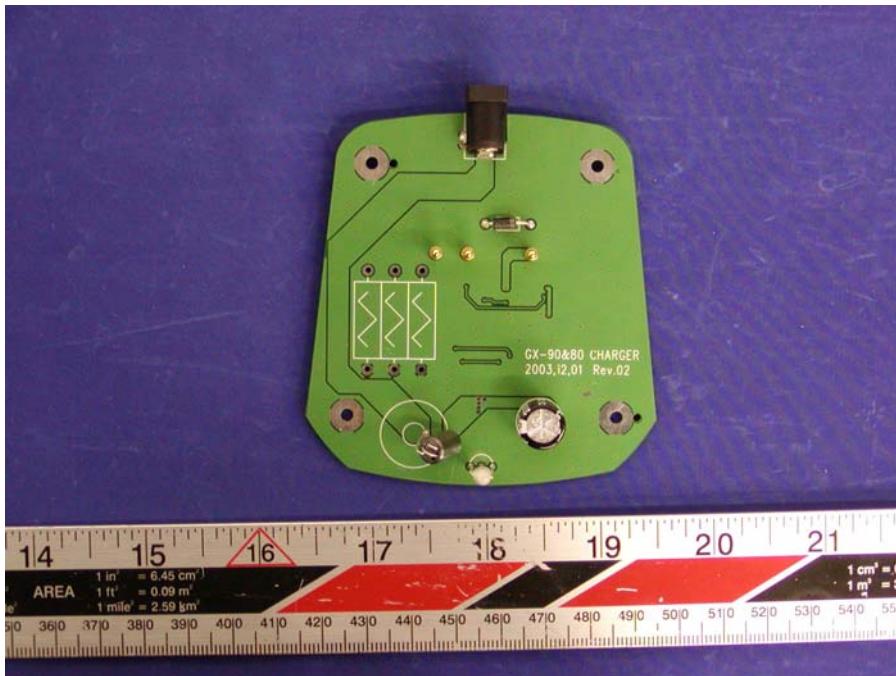
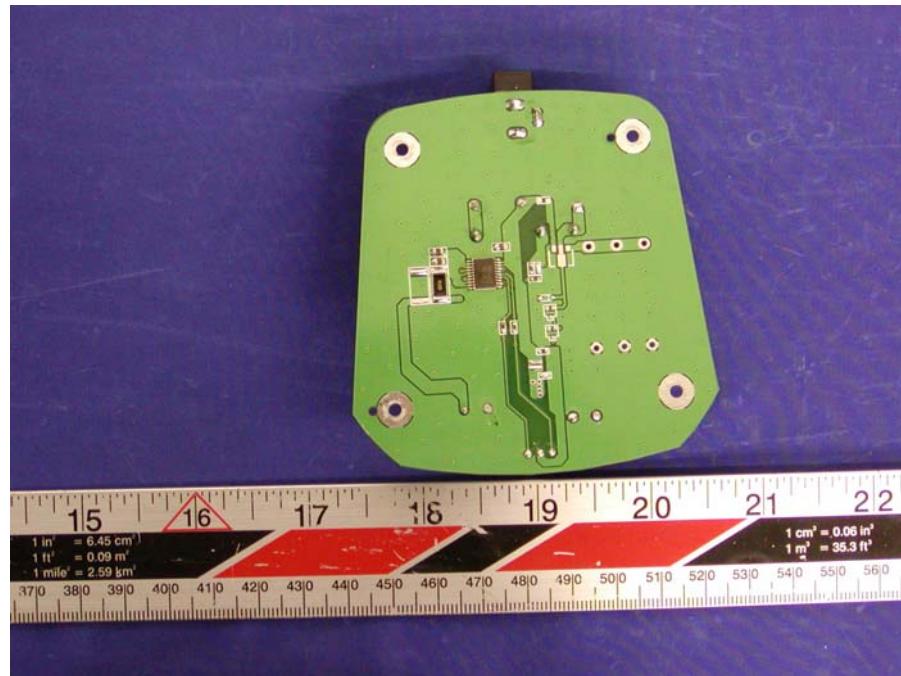


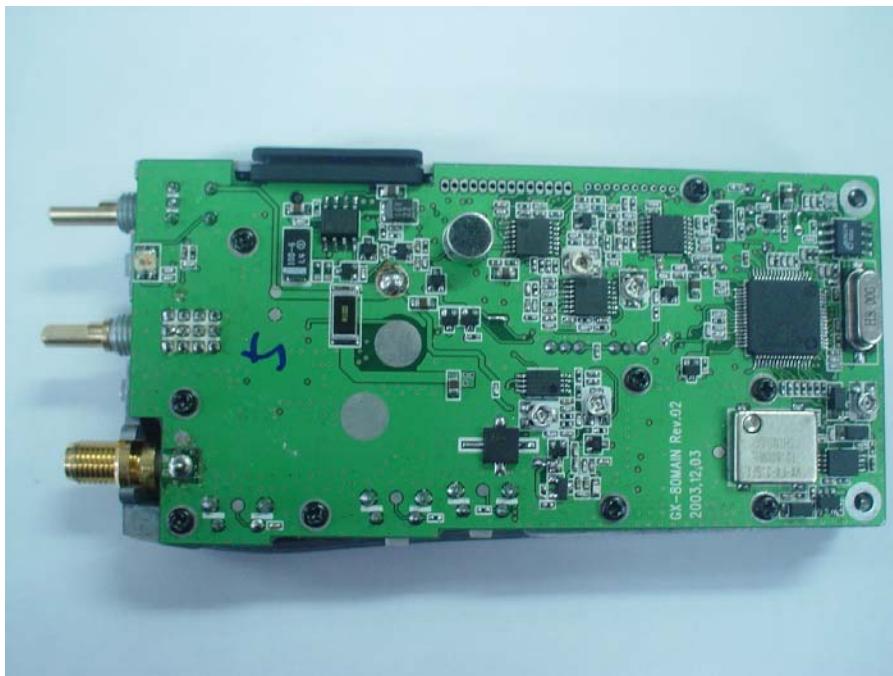
Chassis – Right Side View



Adapter View**Battery Charger – Front View**

Battery Charger – Rear View**Battery Charger – Cover off View**

Battery Charger – Component View**Battery Charger – Solder View**

PCB – Top View I**PCB – Top View II**

PCB – Bottom View

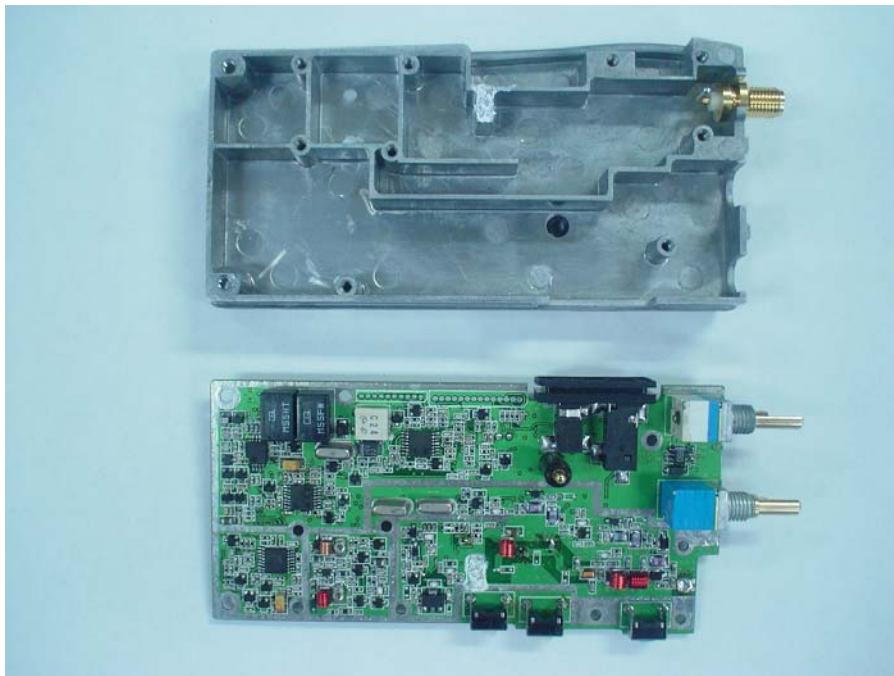


EXHIBIT C – Z-Axis

Genex, Model number: GX-80 (Face-held 2.5 cm separation to flat phantom, Mid Channel, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 2/27/2004)

SAM Phantom; Section; Position: ; Frequency: 163 MHz

Probe: ES3DV2 - SN3019; ConvF(8.70,8.70,8.70); Crest factor: 1.0; 150 MHz Head liquid: $\sigma = 0.74 \text{ mho/m}$ $\epsilon_r = 52.8$ $\rho = 1.00 \text{ g/cm}^3$

Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 2.0

