SAR EVALUATION REPORT

For

MIDLAND RADIO CORPORATION

1120 Clay Street
North Kansas City, MO 64116

FCC ID: MMASP200U2

2003-11-04

This Report Concerns: ☒ Original Report	**Equipment Type:** Portable Radio
Test Engineer:	Eric Hong
Report No.:	R0309223S
Test Date:	2003-10-15
Reviewed By:	Ling Zhang
Prepared By:	Bay Area Compliance Laboratory Corporation 230 Commercial Street Sunnyvale, CA 94085 Tel: (408) 732-9162 Fax: (408) 732 9164

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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 C95.1-1992 [6] for an uncontrolled environment (Paragraph 65). According to the Supplement C of OET Bulletin 65 “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 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 (ºC): 23.0
Relative Humidity (%): 51.1

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 #
2.5 cm head separation to phantom	455	5.212	Face-held	Built-in	head	flat	none	3.97	8	1
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-616	0.747	8	2
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-714	0.782	8	3
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-715	0.741	8	4
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-727	0.793	8	5
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-616	2.96	8	6
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-714	2.47	8	7
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-715	2.54	8	8
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-727	2.35	8	9
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-616	3.67	8	10
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-714	3.38	8	11
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-715	2.27	8	12
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-727	1.88	8	13

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.

[8] Katja Pokovic, Thomas Schmid, and Niels Kuster, \E-_eld probe with improved isotropy in brain simulating liquids", in Proceedings of the ELMAR, Zadar, Croatia, 23{25 June, 1996, pp. 172-175.

[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.

[10] Klaus Meier, Ralf Kastle, Volker Hombach, Roger Tay, and Niels Kuster, \The dependence of EM energy absorption upon human head modeling at 1800 MHz", IEEE Transactions on Microwave Theory and Techniques, Oct. 1997, in press.

[11] W. Gander, Computermathematik, Birkhaeuser, Basel, 1992.

[12] W. H. Press, S. A. Teukolsky,W. T. Vetterling, and B. P. Flannery, Numerical Recepies 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 uncertainity 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

Type / Model	Cal. Date	S/N:
DASY3 Professional Dosimetric System	N/A	N/A
Robot RX60L	N/A	F00/5H31A1/A/01
Robot Controller	N/A	F01/5J72A1/A/01
Dell Computer Optiplex GX110	N/A	N/A
Pentium III, Windows NT	N/A	N/A
SPEAG EDC3	N/A	N/A
SPEAG DAE3	6/02	456
SPEAG E-Field Probe ET3DV6	9/7/02	1604
SPEAG Dummy Probe	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
Apprel Validation Dipole D-1800-S-2	11/6/01	BCL-049
SPEAG Validation Dipole D900V2	9/3/02	122
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Brain Equivalent Matter (2450MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (2450MHz)	Daily	N/A
Robot Table	N/A	N/A
Phone Holder	N/A	N/A
Phantom Cover	N/A	N/A
HP Spectrum Analyzer HP8593GM	6/20/02	3009A00791
Microwave Amp. 8349B	N/A	2644A02662
Power Meter HP436A	4/2/02	2709A29209
Power Sensor HP8482A	4/2/02	2349A08568
Signal Generator RS SMIQ O3	2/10/02	1084800403
Network Analyzer HP-8753ES	7/30/02	820079
Dielectric Probe Kit HP85070A	N/A	N/A
Apprel Validation Dipole D-2450-S-1	10/1/02	BCL-141
Dipole Antenna AD-100 (450MHz)	5/7/02	02220

2.2 Equipment Calibration Certificate

Please see the attached file.

Calibration Laboratory of
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	GB41293874	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-99 (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

	Name	Function	Signature
Calibrated by:	[redacted]		
Approved by:	[redacted]		

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.

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

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!)

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DASY - Parameters of Probe: ES3DV2 SN:3019

Sensitivity in Free Space

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

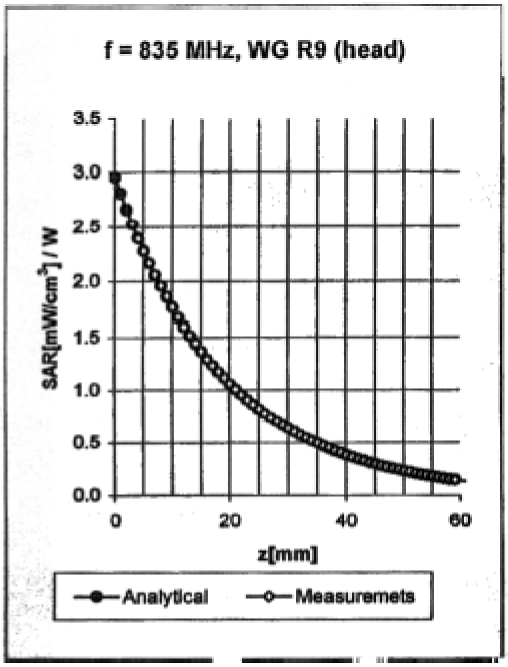
Diode Compression

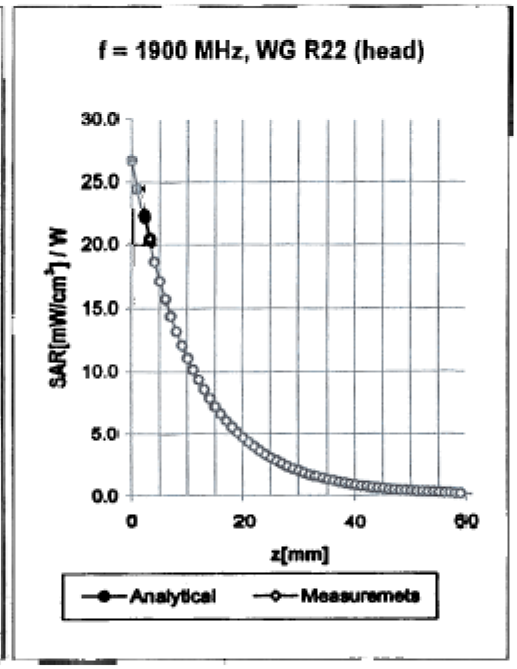
DCP X	**99**
DCP Y	**99**
DCP Z	**99**

Sensor Offset

Probe Tip to Sensor Center	**2.1**	mm

Conversion Factor Assessment





Head **835 MHz** ε_r **= 41.5 ± 5%** **σ = 0.90 ± 5% mho/m**

Valid for f=793-877 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**6.5** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.5** ± 9.5% (k=2)	Alpha	**0.35**
ConvF Z	**6.5** ± 9.5% (k=2)	Depth	**1.46**

Head **1900 MHz** ε_r **= 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

Valid for f=1805-1995 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**4.7** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)	Alpha	**0.22**
ConvF Z	**4.7** ± 9.5% (k=2)	Depth	**3.48**

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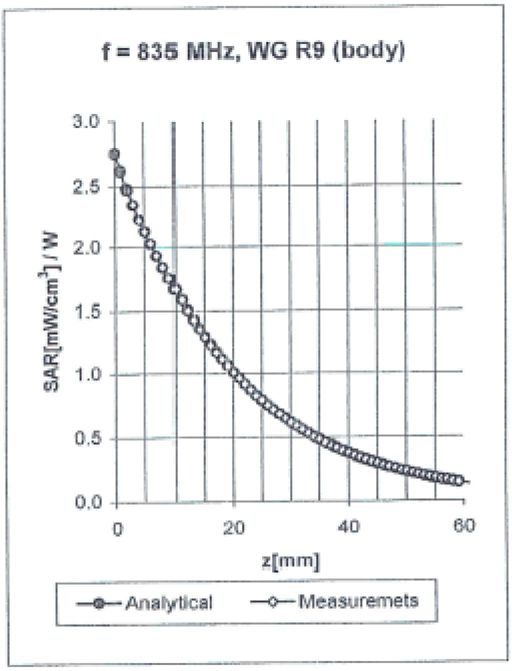
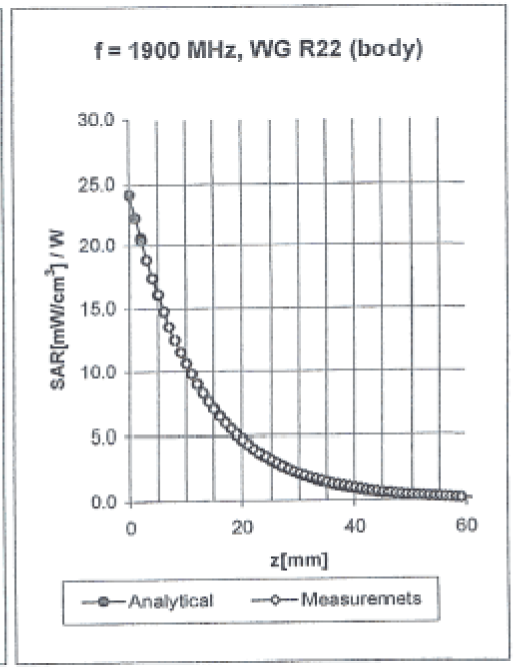
Conversion Factor Assessment





Body **835 MHz** **ε_r = 55.2 ± 5%** **σ = 0.97 ± 5% mho/m**

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

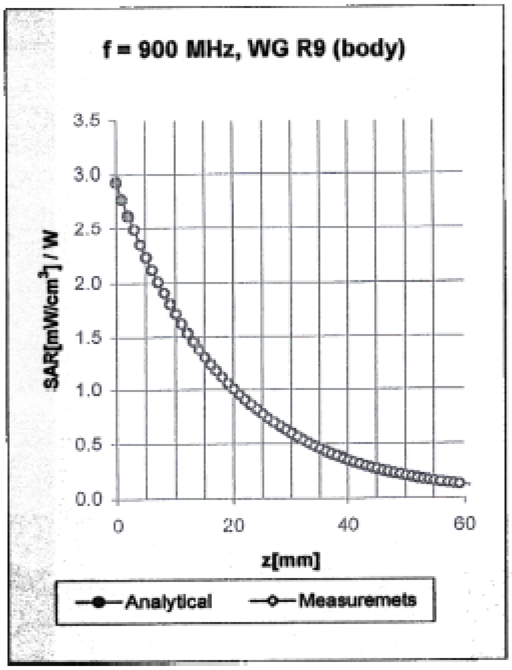
ConvF X	**6.1**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.1**	± 9.5% (k=2)	Alpha	**0.24**
ConvF Z	**6.1**	± 9.5% (k=2)	Depth	**2.00**

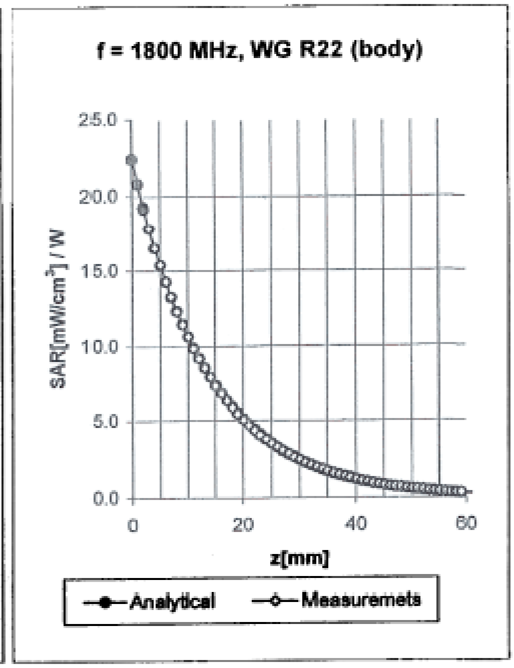
Body **1900 MHz** **ε_r = 53.3 ± 5%** **σ = 1.52 ± 5% mho/m**

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

ConvF X	**4.6**	± 9.5% (k=2)	Boundary effect:	
ConvF Y	**4.6**	± 9.5% (k=2)	Alpha	**0.24**
ConvF Z	**4.6**	± 9.5% (k=2)	Depth	**2.64**

Conversion Factor Assessment





Body 900 MHz $\varepsilon_r = 55.0 \pm 5\%$ $\sigma = 1.05 \pm 5\%$ mho/m

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

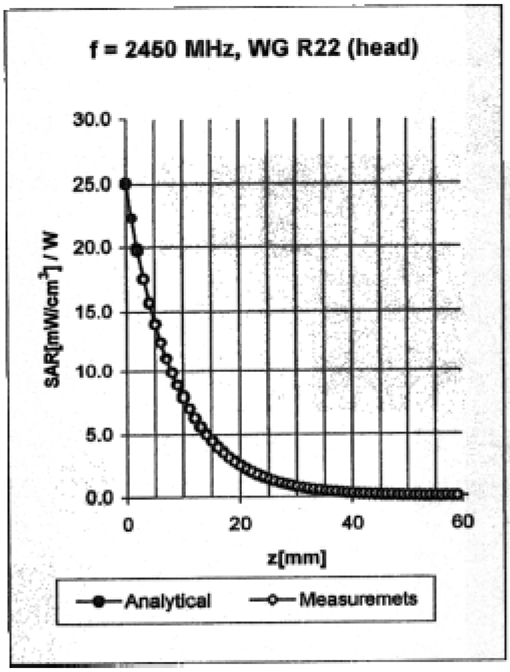
ConvF X	**6.1** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**6.1** ± 9.5% (k=2)		Alpha	**0.27**
ConvF Z	**6.1** ± 9.5% (k=2)		Depth	**1.82**

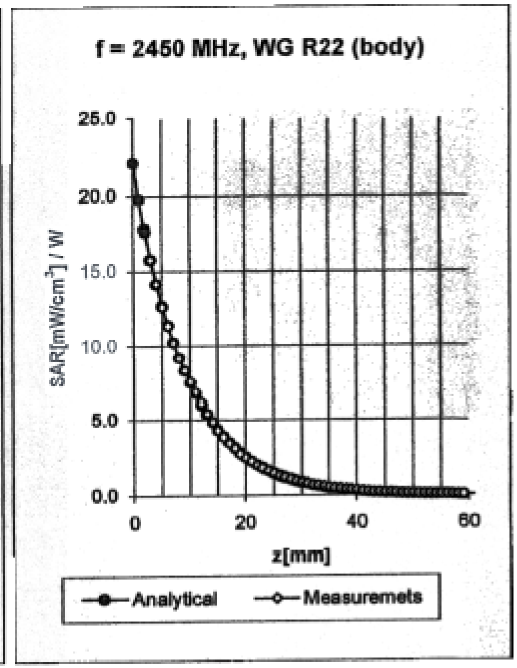
Body 1800 MHz $\varepsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\%$ mho/m

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

ConvF X	**4.7** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**4.7** ± 9.5% (k=2)		Alpha	**0.23**
ConvF Z	**4.7** ± 9.5% (k=2)		Depth	**2.99**

Conversion Factor Assessment





Head **2450 MHz** ε_r = **39.2 ± 5%** σ = **1.80 ± 5% mho/m**

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**4.5** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**4.5** ± 9.5% (k=2)		Alpha	**0.40**
ConvF Z	**4.5** ± 9.5% (k=2)		Depth	**1.62**

Body **2450 MHz** ε_r = **52.7 ± 5%** σ = **1.95 ± 5% mho/m**

Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**4.2** ± 9.5% (k=2)		Boundary effect:	
ConvF Y	**4.2** ± 9.5% (k=2)		Alpha	**0.32**
ConvF Z	**4.2** ± 9.5% (k=2)		Depth	**1.98**

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Additional Conversion Factors

for Dosimetric E-Field Probe

'ype:	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

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Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor (± standard deviation)

150 MHz	ConvF	8.7 ± 8%	ε_r = 52.3 ± 5% σ = 0.76 ± 5% mho/m (head tissue)
150 MHz	ConvF	8.3 ± 8%	ε_r = 61.9 ± 5% σ = 0.80 ± 5% mho/m (body tissue)
450 MHz	ConvF	7.4 ± 8%	ε_r = 43.5 ± 5% σ = 0.87 ± 5% mho/m (head tissue)
450 MHz	ConvF	7.3 ± 8%	ε_r = 56.7 ± 5% σ = 0.94 ± 5% mho/m (body tissue)

ES3DV2-SN:3019 October 13, 2003

Body 450MHz Liquid Validation, 10/15/03

frequency	e'	e''
425000000.0000	56.1781	37.0928
426000000.0000	56.1067	37.1375
427000000.0000	56.0184	37.1722
428000000.0000	55.9591	37.0966
429000000.0000	55.8088	37.0608
430000000.0000	55.6998	37.0142
431000000.0000	55.5435	36.9517
432000000.0000	55.4686	37.0268
433000000.0000	55.3141	36.9139
434000000.0000	55.2578	37.0273
435000000.0000	55.1569	36.8431
436000000.0000	55.0381	36.9087
437000000.0000	55.0873	36.7995
438000000.0000	54.9216	36.7423
439000000.0000	54.8881	36.7492
440000000.0000	54.6584	36.7670
441000000.0000	54.6264	36.7240
442000000.0000	54.5459	36.6589
443000000.0000	54.4586	36.6457
444000000.0000	54.3479	36.6744
445000000.0000	54.3057	36.7197
446000000.0000	54.3423	36.6658
447000000.0000	54.2768	36.7526
448000000.0000	54.1560	36.6367
449000000.0000	54.0651	36.6534
450000000.0000	54.2112	36.7167
451000000.0000	54.0437	36.6567
452000000.0000	54.0123	36.7338
453000000.0000	53.9403	36.6131
454000000.0000	53.9538	36.6499
455000000.0000	53.9413	36.6175
456000000.0000	53.8793	36.6058
457000000.0000	53.8700	36.6833
458000000.0000	53.8778	36.6729
459000000.0000	53.8144	36.7032
460000000.0000	53.7794	36.5880
461000000.0000	53.8926	36.6100
462000000.0000	53.8090	36.6392
463000000.0000	53.7560	36.5572
464000000.0000	53.8885	36.6963
465000000.0000	53.8545	36.6091
466000000.0000	53.9106	36.5511
467000000.0000	53.9098	36.6520
468000000.0000	53.9683	36.6747
469000000.0000	54.0070	36.6282
470000000.0000	54.1118	36.6237
471000000.0000	54.0335	36.6177
472000000.0000	54.1832	36.5594
473000000.0000	54.2079	36.6989
474000000.0000	54.2107	36.6693
475000000.0000	54.3588	36.6310

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon''=0.92$
where $f = 450$
$\varepsilon_o = 8.854 \times 10^{-12}$
$\varepsilon'' = 36.7167$

Head 450MHz Liquid Validation, 10/15/03

frequency	e'	e''
425000000.0000	43.2790	36.2488
426000000.0000	43.2919	36.1681
427000000.0000	43.1852	36.1072
428000000.0000	43.1449	36.1174
429000000.0000	43.2063	36.0840
430000000.0000	43.2120	36.2088
431000000.0000	43.2295	36.0741
432000000.0000	43.2763	35.9959
433000000.0000	43.1897	35.9264
434000000.0000	43.2243	35.8575
435000000.0000	43.1826	35.8551
436000000.0000	43.1345	35.8939
437000000.0000	43.1279	35.8589
438000000.0000	43.0048	35.8035
439000000.0000	42.9534	35.6568
440000000.0000	42.9923	35.6549
441000000.0000	43.0720	35.6991
442000000.0000	42.8901	35.6018
443000000.0000	42.9504	35.6886
444000000.0000	43.0179	35.5437
445000000.0000	42.9055	35.6591
446000000.0000	42.9867	35.5975
447000000.0000	43.0071	35.5267
448000000.0000	43.0055	35.5578
449000000.0000	42.9595	35.5571
450000000.0000	42.9378	35.5069
451000000.0000	42.8860	35.5463
452000000.0000	42.9956	35.4675
453000000.0000	42.9094	35.4934
454000000.0000	42.8779	35.5357
455000000.0000	42.8830	35.5266
456000000.0000	42.8043	35.4034
457000000.0000	42.8500	35.4068
458000000.0000	42.8468	35.3866
459000000.0000	42.7910	35.3946
460000000.0000	42.8613	35.3937
461000000.0000	42.7395	35.3496
462000000.0000	42.6763	35.3845
463000000.0000	42.7171	35.4330
464000000.0000	42.7581	35.3737
465000000.0000	42.7409	35.3437
466000000.0000	42.7740	35.3491
467000000.0000	42.6667	35.3789
468000000.0000	42.6596	35.2971
469000000.0000	42.6465	35.3608
470000000.0000	42.6527	35.2832
471000000.0000	42.5484	35.2878
472000000.0000	42.4616	35.2831
473000000.0000	42.5873	35.2474
474000000.0000	42.4983	35.2992
475000000.0000	42.4478	35.2511

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\,\pi f\, \varepsilon_o\, \varepsilon''=0.89$

where $f = 450$

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

$\varepsilon'' = 35.5069$

3 - EUT DESCRIPTION

FCC ID:	MMASP200U2
Applicant:	MIDLAND RADIO CORPORATION
Product Description:	Portable Radio (prototype)
FCC ID:	MMASP200U2
Serial Number:	B002
Transmitter Frequency:	440.000 – 470.000 MHz
Maximum Output Power:	5.012W
Dimension:	7.5"L x 2.5"W x 1.9"H approximately
RF Exposure environment:	Occupational Population
Applicable Standard	FCC CFR 47, Part 80 & 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. C95.1-1992 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 in a typical fashion (as normally used by a typical user).

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 Special Accessories

All interface cables used for compliance testing are shielded as normally supplied by INMAC, Monster Cable and their respective support equipment manufacturer. The EUT is featured shielded metal connectors.

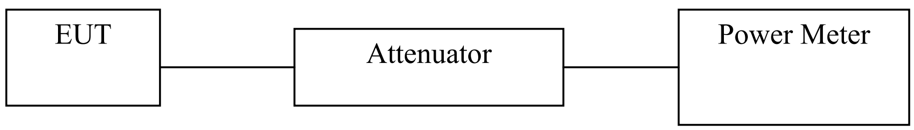
4.4 Equipment Modifications

No modification(s) were made to ensure that the EUT complies with the applicable limits.

5 - CONDUCTED OUTPUT POWER MEASUREMENT

5.1 Measurement Procedure

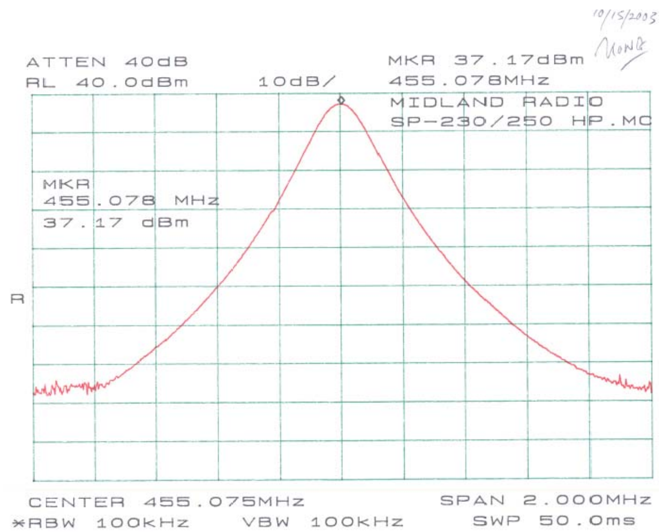
1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to a spectrum analyzer.
3. Add a correction factor to the display.

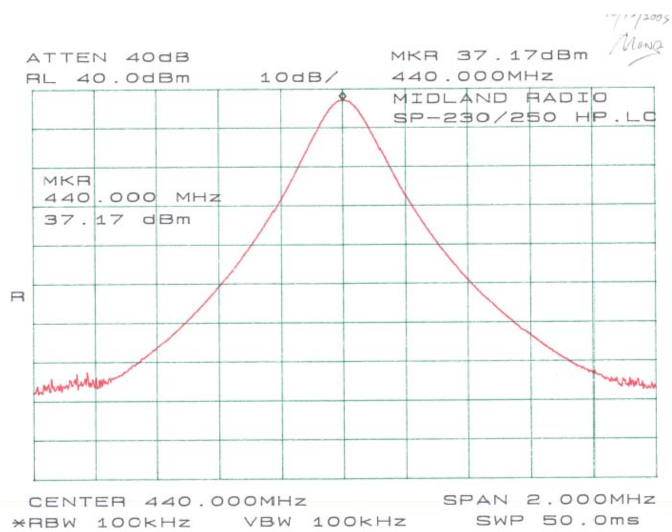


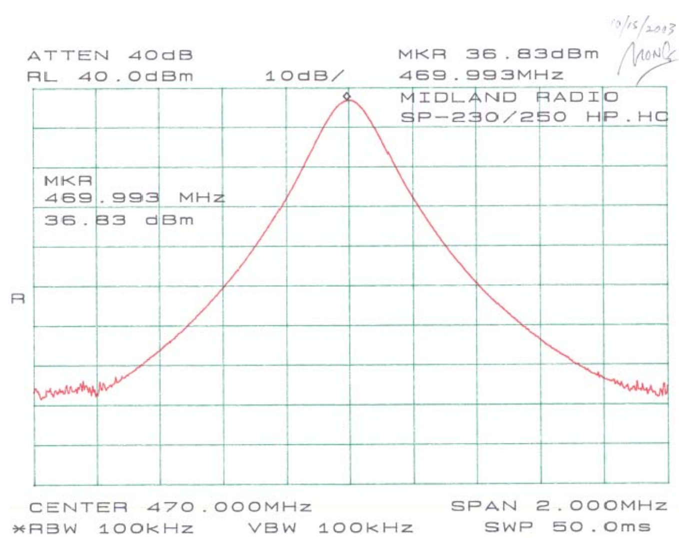
5.2 Test Results

Channel	Output Power in dBm	Output Power in W
440.000	37.17	5.212
455.075	37.17	5.212
470.000	36.83	4.819

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


10/15/2003
ATTEN 40dB
RL 40.0dBm
10dB/
MKR 37.17dBm
455.078MHz
MIDLAND RADIO
SP-230/250 HP.MC
MKR
455.078 MHz
37.17 dBm
A
CENTER 455.075MHz
SPAN 2.000MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


ATTEN 40dB
RL 40.0dBm
10dB/
MKR 37.17dBm
440.000MHz
MIDLAND RADIO
SP-230/250 HP.LC
MKR
440.000 MHz
37.17 dBm
A
CENTER 440.000MHz
SPAN 2.000MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms


10/15/2003
ATTEN 40dB
RL 40.0dBm
10dB/
MKR 36.83dBm
469.993MHz
MIDLAND RADIO
SP-230/250 HP.HC
MKR
469.993 MHz
36.83 dBm
A
CENTER 470.000MHz
SPAN 2.000MHz
*RBW 100kHz
VBW 100kHz
SWP 50.0ms

6 - DOSIMETRIC ASSESSMENT SETUP

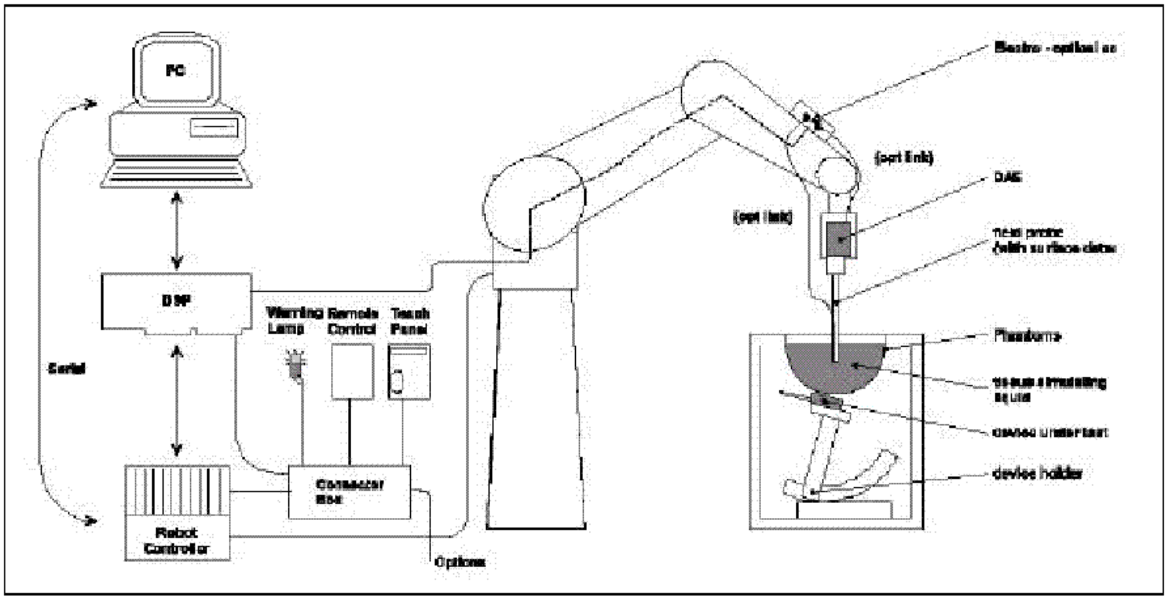
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special 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 ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25dB.

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 according 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

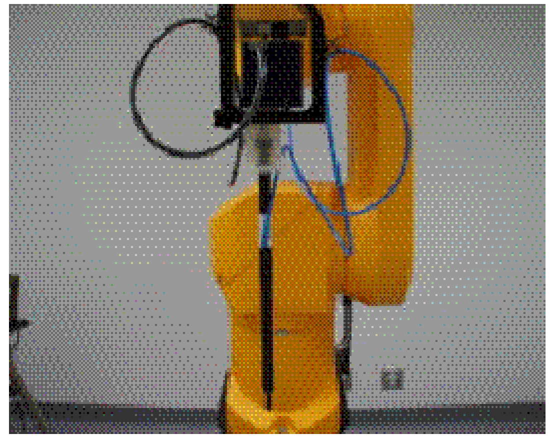


The DASY3 system for performing compliance tests consist of the following items:

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.

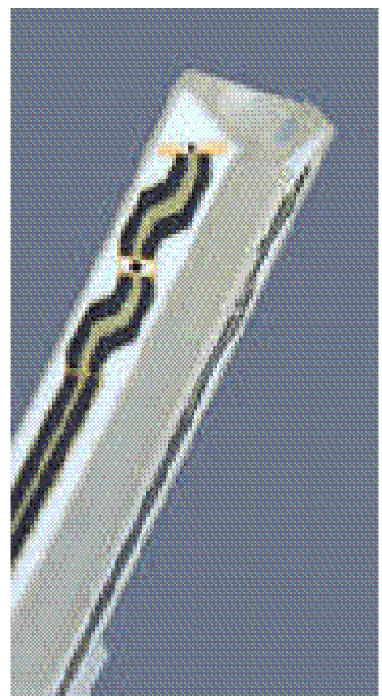
6.2 System Components

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 ± 8%)
Frequency 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity ± 0.2 dB in brain tissue (rotation around
probe axis)
± 0.4 dB in brain tissue (rotation normal probe axis)
Dynamic 5 mW/g to > 100 mW/g;
Range Linearity: ± 0.2 dB
Surface ± 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:

$$Vi = Ui + (Ui)^2 \, cf / dcp_i$$

With Vi = compensated signal of channel i (i =x, y, z)
Ui = 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:

E-field probes: $$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

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

With Vi = compensated signal of channel i (i =x, y, z)
$Norm_i$ = sensor sensitivity of channel i (i =x, y, z)
μV/ $(V/m)^2$ for E-field probes
ConF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strenggy 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):

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

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

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

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/cm^3

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.

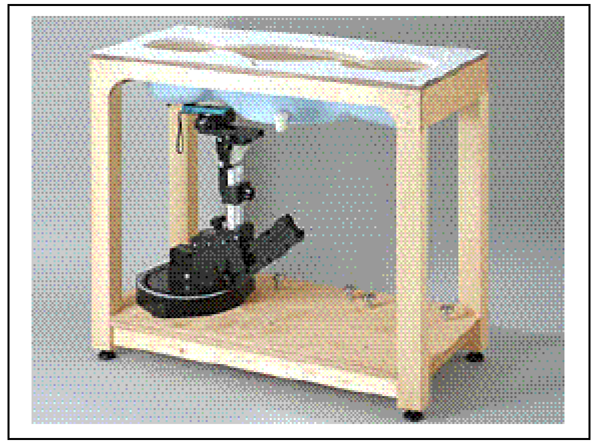
The power flow density is calculated assuming the excitation field as a free space field.

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

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

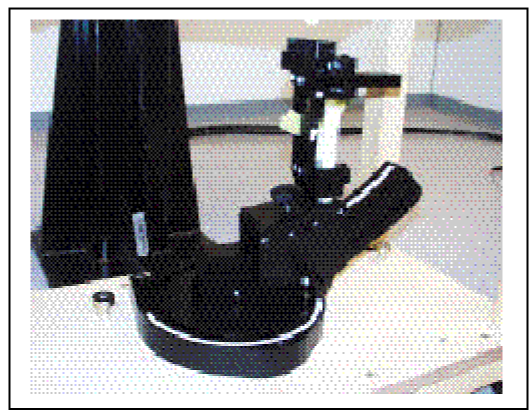


Generic Twin Phantom

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 algorithmsfor 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 polynomal 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 ±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 (450 MHz)

Validation Measurement	SAR @ 9.225mW Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 9.225mW Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	0.0451	0.89	0.0315	3.4
Test 2	0.0447	4.85	0.0312	3.38
Test 3	0.0448	4.86	0.0313	3.39
Test 4	0.0450	4.88	0.0313	3.39
Test 5	0.0451	4.89	0.0313	3.39
Test 6	0.0450	4.88	0.0315	3.4
Test 7	0.0451	4.89	0.0314	3.4
Test 8	0.0449	4.87	0.0312	3.38
Test 9	0.0449	4.87	0.0312	3.38
Test 10	0.0448	4.86	0.0311	3.37
Average	0.0449	4.874	0.0313	3.388

System validation result

10/15/03

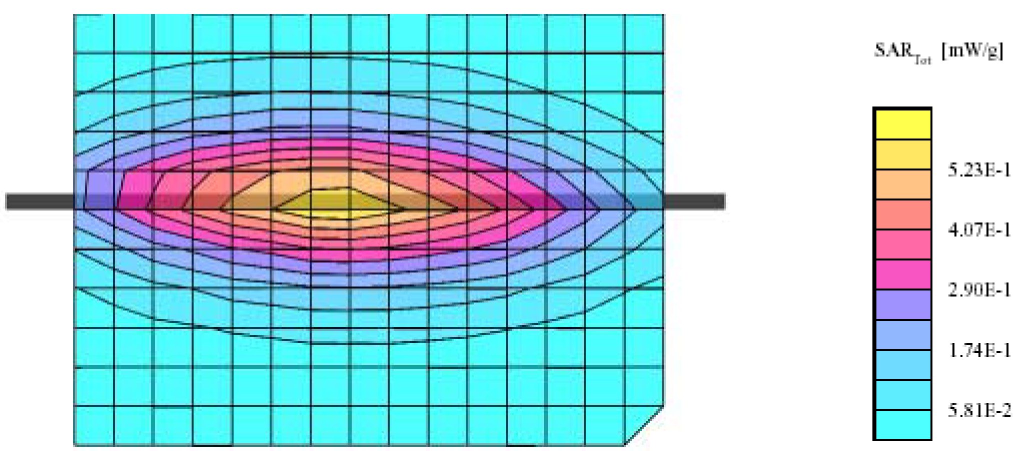
Ambient Temperature (ºC): 23.0
Relative Humidity (%): 49.3

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation [%]	Limits [%]
Body	450	ε	21	56.7	54.2	-4.4	±5
		σ	21	0.94	0.92	-2.1	±5
		1g SAR	21	4.874	4.50	-7.67	±10
Head	450	ε	21	43.5	42.9	-1.38	±5
		σ	21	0.87	0.89	2.3	±5
		1g SAR	21	4.9	4.54	-7.35	±10

ε = relative permittivity, σ = conductivity and ρ=1000kg/m^3
Note: Forward power = 117mW

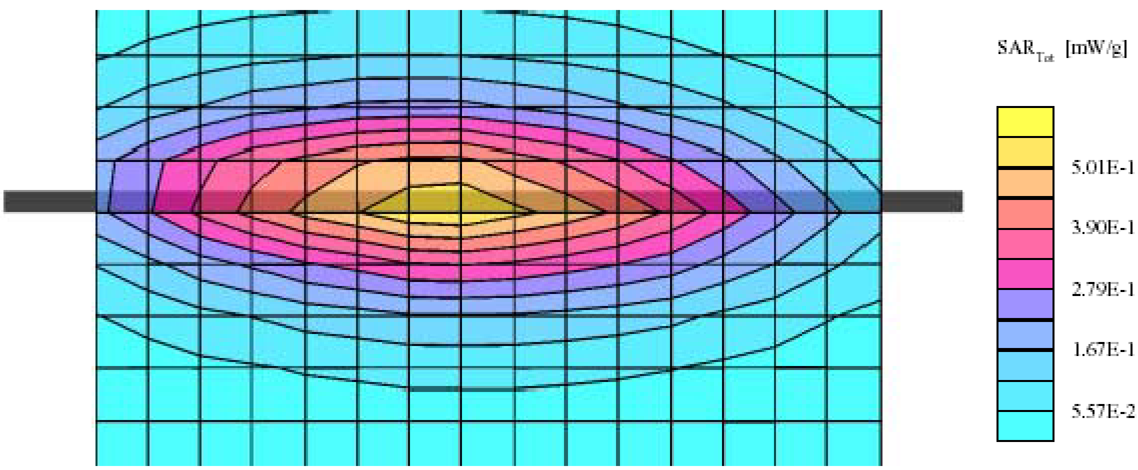
450 MHz Body Liquid System Validation (Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, Forward Power = 20.4 dBm, 10/15/2003)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 450 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; (Body liquid) 450 MHz: σ = 0.92 mho/m ε_r = 54.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.527 mW/g, SAR (10g): 0.343 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.00 dB



450 MHz Head Liquid System Validation (Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, Forward Power = 20.38 dBm, 10/15/2003)

SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 450 MHz
Probe: ES3DV2 - SN3019; ConvF(7.40,7.40,7.40); Crest factor: 1.0; (Head liquid) 450 MHz: σ = 0.89 mho/m ε_r = 42.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.531 mW/g, SAR (10g): 0.346 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.01 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, writs, 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 **3.97mW/g**.

8.1 SAR Test Data

Ambient Temperature (ºC): 23.0
Relative Humidity (%): 51.1

Worst case SAR reading

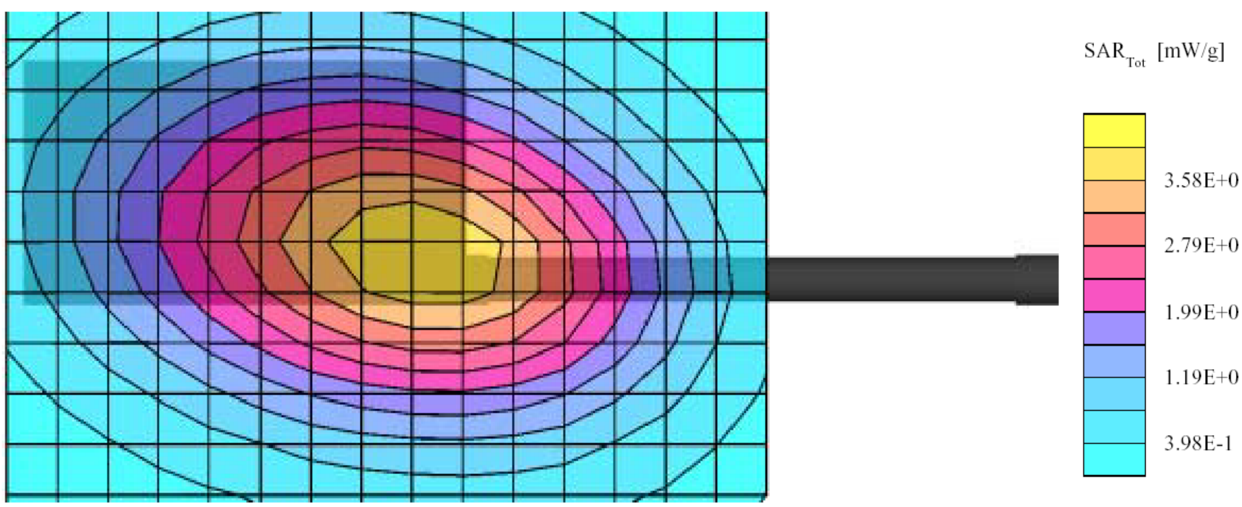
EUT position	Frequency (MHz)	Conducted Power (W)	Test Type	Antenna Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)	Limit (mW/g)	Plot #
2.5 cm head separation to phantom	455	5.212	Face-held	Built-in	head	flat	none	3.97	8	1
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-616	0.747	8	2
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-714	0.782	8	3
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-715	0.741	8	4
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Leather Case: ACC-300 Headset: ACC-727	0.793	8	5
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-616	2.96	8	6
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-714	2.47	8	7
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-715	2.54	8	8
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Nylon Case: ACC-301 Headset: ACC-727	2.35	8	9
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-616	3.67	8	10
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-714	3.38	8	11
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-715	2.27	8	12
back in touch with phantom	455	5.212	Body worn	Built-in	body	flat	Swievel Belt: 070-0018 Headset: ACC-727	1.88	8	13

8.2 Plots of Test Result

The plots of test result were attached as reference.

Midland, Model: SP-230 / 250 (Face 2.5 cm separation to the flat phantom, Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 10/15/2003)

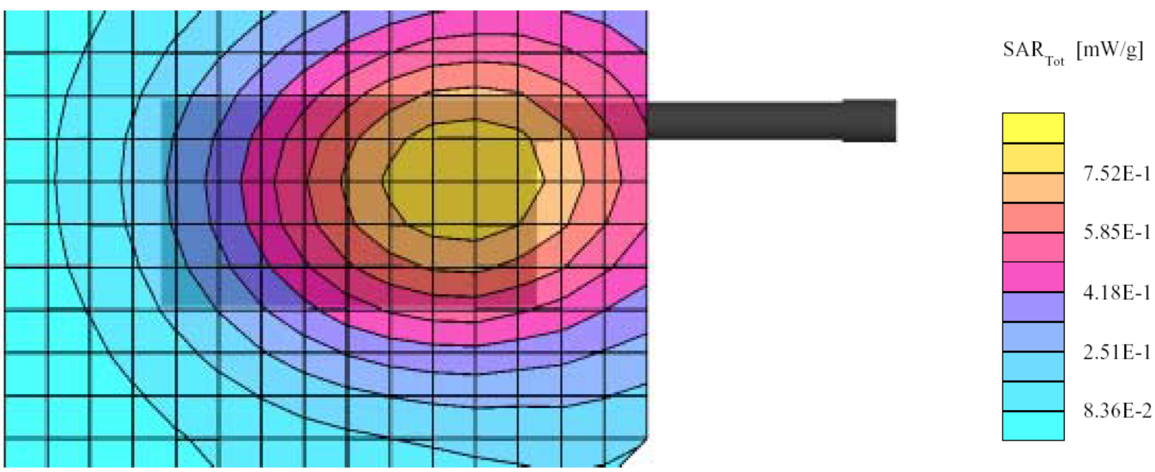
SAM Phantom; Flat Section; Position: (90°,90°); Frequency: 455 MHz
Probe: ES3DV2 - SN3019; ConvF(7.40,7.40,7.40); Crest factor: 1.0; 450 MHz head liquid: σ = 0.89 mho/m ε_r = 42.9 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 3.97 mW/g, SAR (10g): 2.01 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.01 dB



Plot #1

Midland, Model: SP-230 / 250 (Back side in touch with flat phantom with accessories - leather case p/n: ACC-300 and headset p/n: ACC-616, Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 10/15/2003)

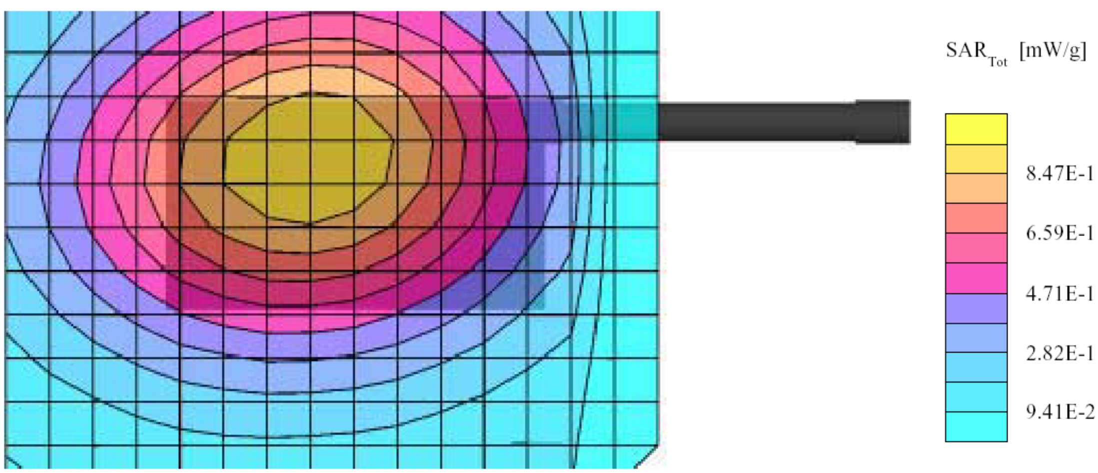
SAM Phantom; Flat Section; Position: (270°,270°); Frequency: 455 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Body liquid: $\sigma = 0.92$ mho/m $\varepsilon_r = 54.2$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 0.747 mW/g, SAR (10g): 0.581 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.00 dB



Plot #2

Midland, Model: SP-230 / 250 (Back side in touch with flat phantom with accessories - leather case p/n: ACC-300 and speaker microphone with PTT p/n: ACC-714, Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 10/15/2003)

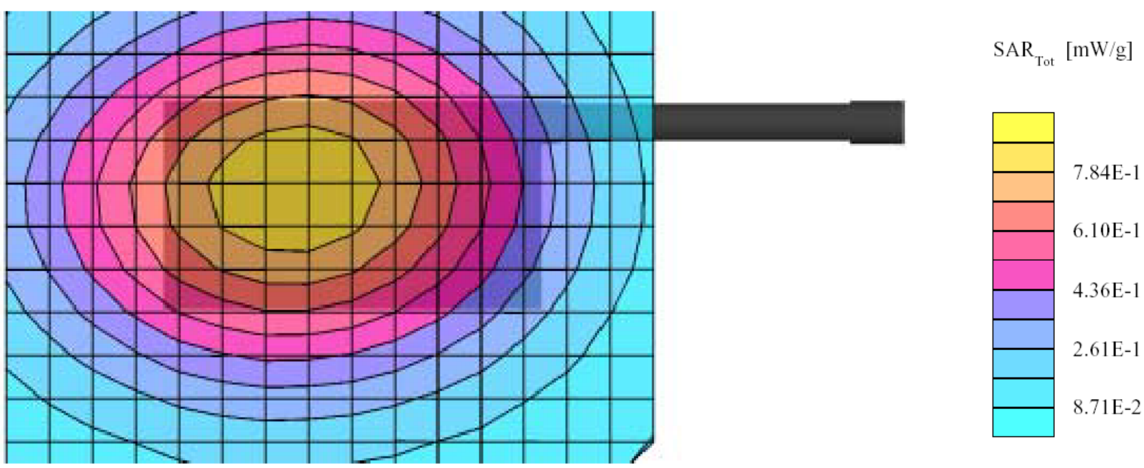
SAM Phantom; Flat Section; Position: (270°,270°); Frequency: 455 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Body liquid: $\sigma = 0.92$ mho/m $\varepsilon_r = 54.2$ $\rho = 1.00$ g/cm³
Cube 5x5x7: SAR (1g): 0.782 mW/g, SAR (10g): 0.607 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.01 dB



Plot #3

Midland, Model: SP-230 / 250 (Back side in touch with flat phantom with accessories - leather case p/n: ACC-300 and ear-hook earphone microphone with VOX PTT p/n: ACC-715, Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 10/15/2003)

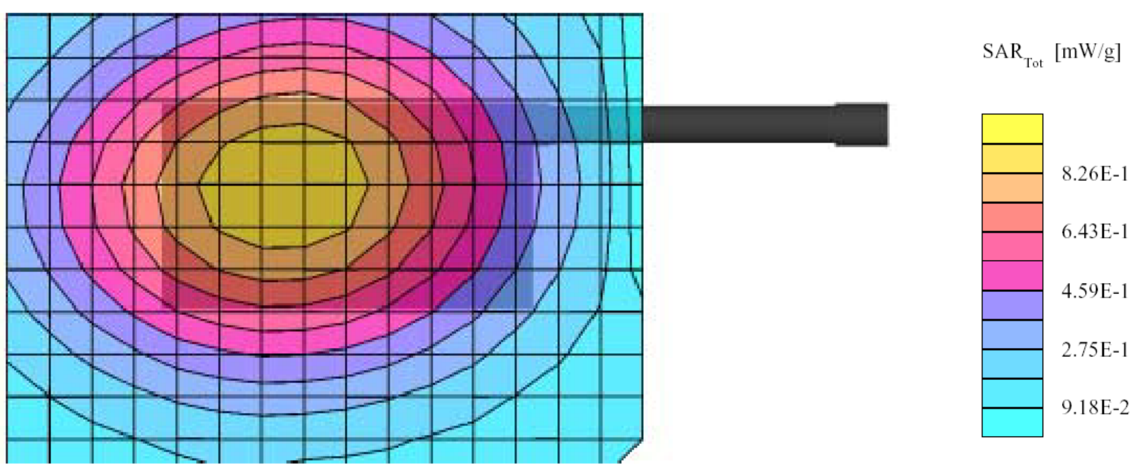
SAM Phantom; Flat Section; Position: (270°,270°); Frequency: 455 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Body liquid: σ = 0.92 mho/m ε_r = 54.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.741 mW/g, SAR (10g): 0.580 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: -0.04 dB



Plot #4

Midland, Model: SP-230 / 250 (Back side in touch with flat phantom with accessories - leather case p/n: ACC-300 and speaker with microphone p/n: ACC-727, Mid channel, Ambient Temp = 23 Deg C, Liquid Temp = 21 Deg C, 10/15/2003)

SAM Phantom; Flat Section; Position: (270°,270°); Frequency: 455 MHz
Probe: ES3DV2 - SN3019; ConvF(7.30,7.30,7.30); Crest factor: 1.0; 450 MHz Body liquid: σ = 0.92 mho/m ε_r = 54.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.793 mW/g, SAR (10g): 0.617 mW/g, (Worst-case extrapolation)
Coarse: Dx = 12.0, Dy = 12.0, Dz = 10.0
Powerdrift: 0.04 dB



Plot #5