

SAR EVALUATION REPORT

For

VeriFone Inc.

3755 Atherton Road
Rocklin, CA 95765

FCC ID: B32ONMI3600D

2003-11-03

This Report Concerns: ☒ Original Report	Equipment Type: Wireless Point of Sale Terminal
Test Engineer: Eric Hong / 	
Report No.: R0309221S	
Test Date: 2003-09-24 / 2003-09-29 / 2003-10-27 / 2003-10-30	
Reviewed By: Ling Zhang / 	
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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.

There was no SAR of any concern measured on the device for any of the investigated configurations.

Summary of the Worst Case SAR values for head and body:

Ambient Temperature (°C): 23.0

Relative Humidity (%): 42.0

Position	Frequency (MHz)	Output Power (dBm)	Test Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)	Limit (mW/g)	Plot #
Back Touching	836	23.83	Body worn	Body	Flat	None	0.309	1.6	4
Back Touching	1880	23.83	Body worn	Body	Flat	None	0.232	1.6	8

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, Office 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 Kastle, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with known precision", IEEE 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-field 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 Kuhn, and Niels Kuster, "The dependence 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 Recipes 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 Equipments 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	2004-08-26	456
SPEAG E-Field Probe ET3DV6	2004-08-26	1604
SPEAG Dummy Probe	N/A	N/A
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
SPEAG Validation Dipole D-1800-S-2	2003-11-06	BCL-049
SPEAG Validation Dipole D900V2	2004-09-02	122
Brain Equivalent Matter (800MHz)	Daily	N/A
Brain Equivalent Matter (1900MHz)	Daily	N/A
Muscle Equivalent Matter (800MHz)	Daily	N/A
Muscle Equivalent Matter (1900MHz)	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	2004-06-20	3009A00791
Microwave Amp. 8349B	N/A	2644A02662
Power Meter HP436A	2004-04-02	2709A29209
Power Sensor HP8482A	2004-04-02	2349A08568
Signal Generator RS SMIQ O3	2004-02-10	1084800403
Network Analyzer HP-8753ES	2004-07-30	820079
Dielectric Probe Kit HP85070A	N/A	N/A
Hewlett Packard HP8566B Spectrum Analyzer	2004-07-23	None
Hewlett Packard HP 7470A Plotter	2004-07-23	None
A.H. System SAS0200 Horn Antenna	2004-07-23	None
Com-Power AB-100 Dipole Antenna	2004-07-23	None
Agilent E4419b	2004-04-08	GB40202891
Agilent E4412a	2004-04-08	US38486529

2.2 Equipment Calibration Certificate

Please see the attached file for detailed information.

Schmid & Partner Engineering AG

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

Calibration Certificate

Dosimetric E-Field Probe

Type:

ET3DV6

Serial Number:

1604

Place of Calibration:

Zurich

Date of Calibration:

August 26, 2002

Calibration Interval

12 months

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

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

Calibrated by

N. Vetter

Approved by:

Heidi Kaya

**Schmid & Partner
Engineering AG**

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

Probe ET3DV6

SN:1604

Manufactured:	July 30, 2001
Last calibration:	September 7, 2001
Recalibrated:	August 26, 2002

Calibrated for System DASY3

ET3DV6 SN:1604

August 26, 2002

DASY3 - Parameters of Probe: ET3DV6 SN:1604**Sensitivity in Free Space****Diode Compression**

NormX	1.73 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP X	93	mV
NormY	1.68 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Y	93	mV
NormZ	1.72 $\mu\text{V}/(\text{V}/\text{m})^2$	DCP Z	93	mV

Sensitivity in Tissue Simulating Liquid

Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
	ConvF X	$6.5 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$6.5 \pm 9.5\%$ (k=2)	Alpha 0.36
	ConvF Z	$6.5 \pm 9.5\%$ (k=2)	Depth 2.82
Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
	ConvF X	$5.5 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$5.5 \pm 9.5\%$ (k=2)	Alpha 0.50
	ConvF Z	$5.5 \pm 9.5\%$ (k=2)	Depth 2.46

Boundary Effect

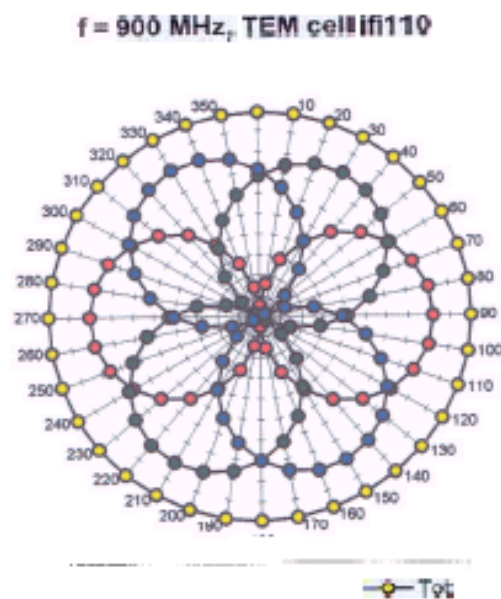
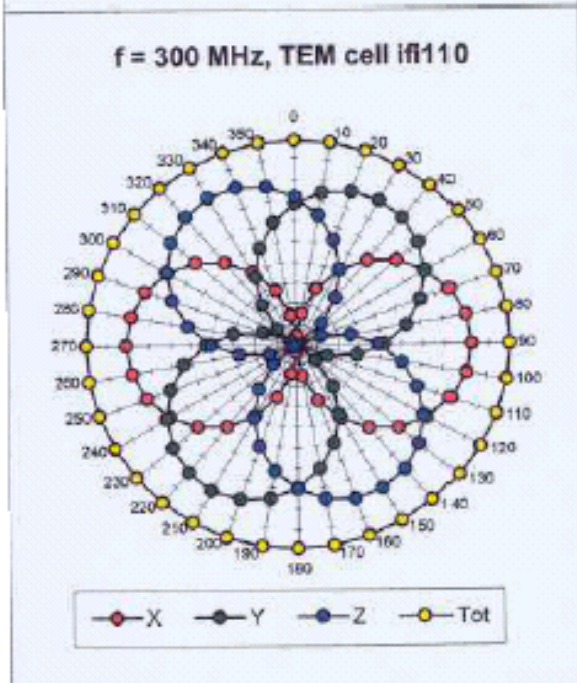
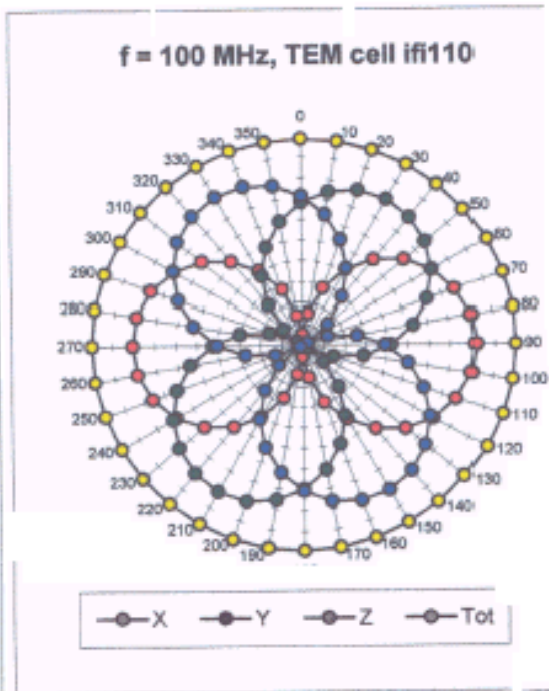
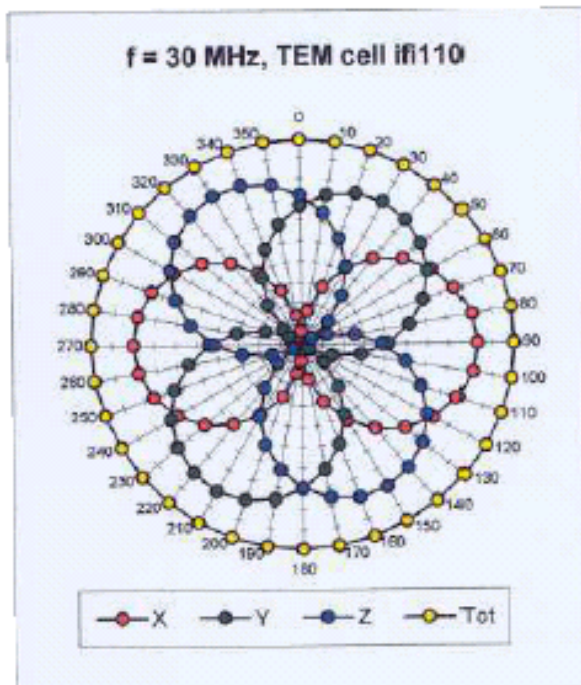
Head	900 MHz	Typical SAR gradient: 5 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%] Without Correction Algorithm		11.1	6.6	
SAR _{be} [%] With Correction Algorithm		0.4	0.6	
Head	1800 MHz	Typical SAR gradient: 10 % per mm		
Probe Tip to Boundary		1 mm	2 mm	
SAR _{be} [%] Without Correction Algorithm		12.3	8.1	
SAR _{be} [%] With Correction Algorithm		0.1	0.1	

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 $\pm$ 0.2	mm

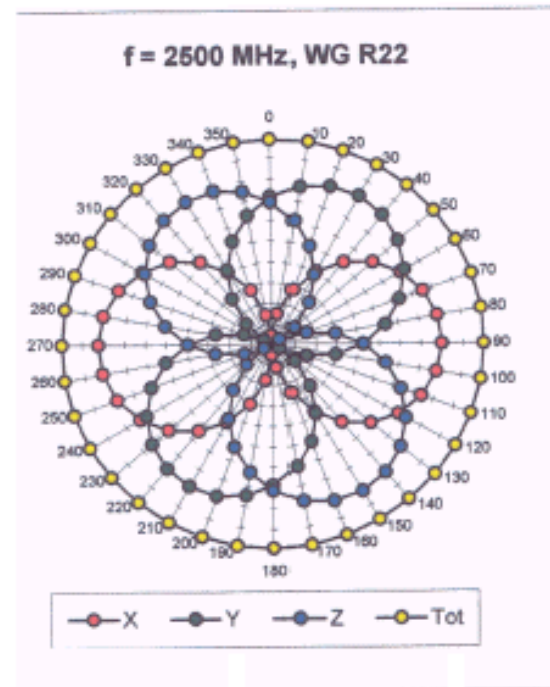
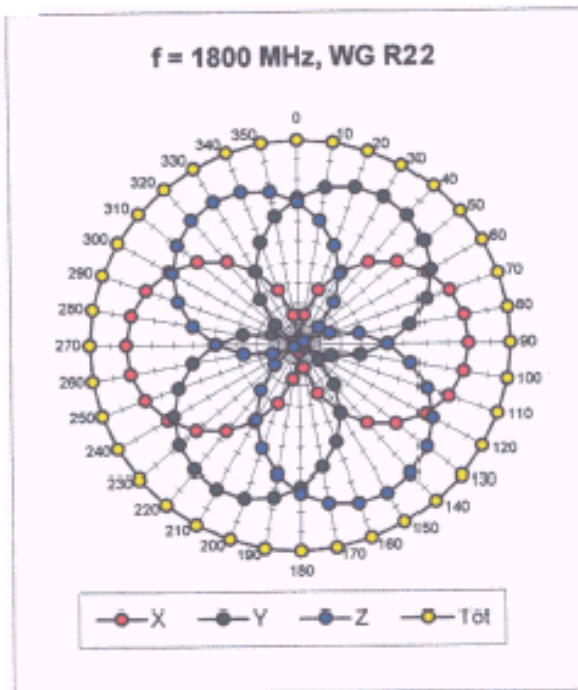
ET3DV6 SN:1604

August 26, 2002

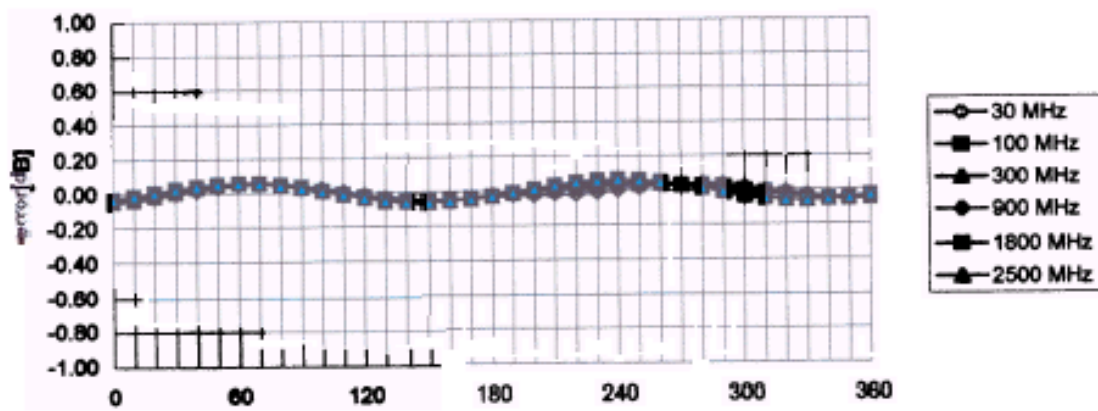
Receiving Pattern (ϕ), $\theta = 0^\circ$ 

ET3DV6 SN:1604

August 26, 2002



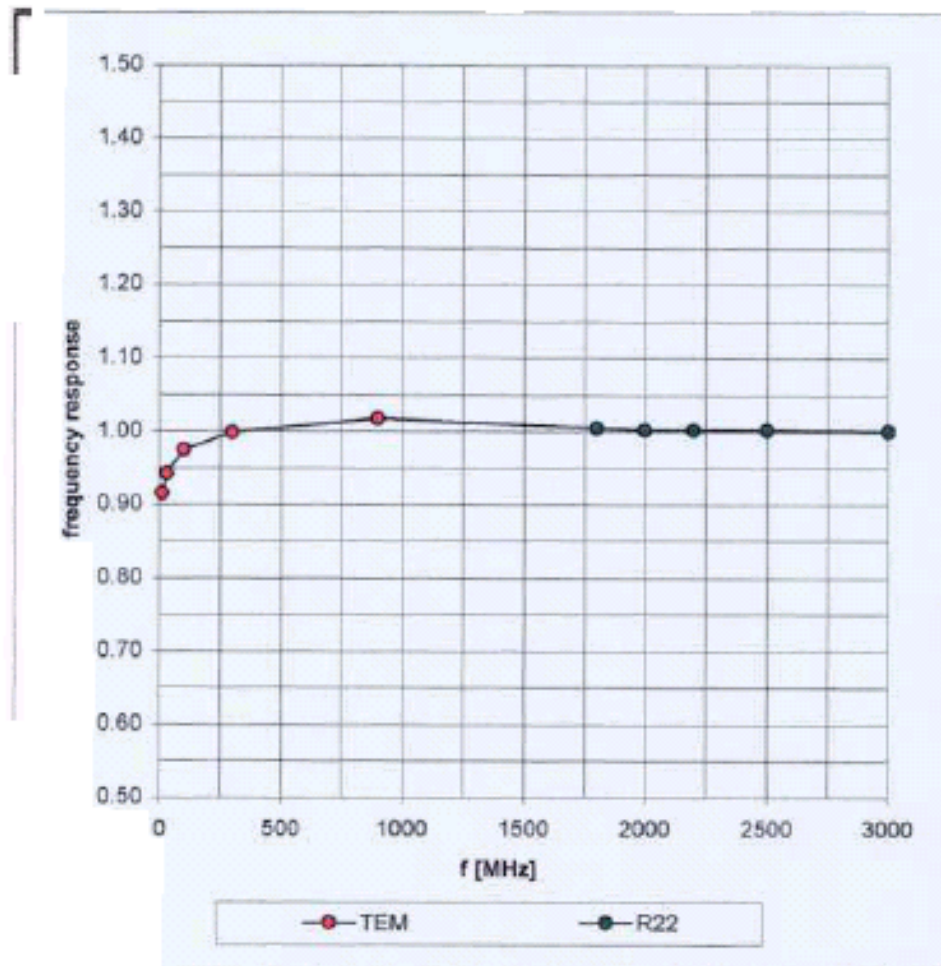
Isotropy Error (ϕ), $\theta = 0^\circ$



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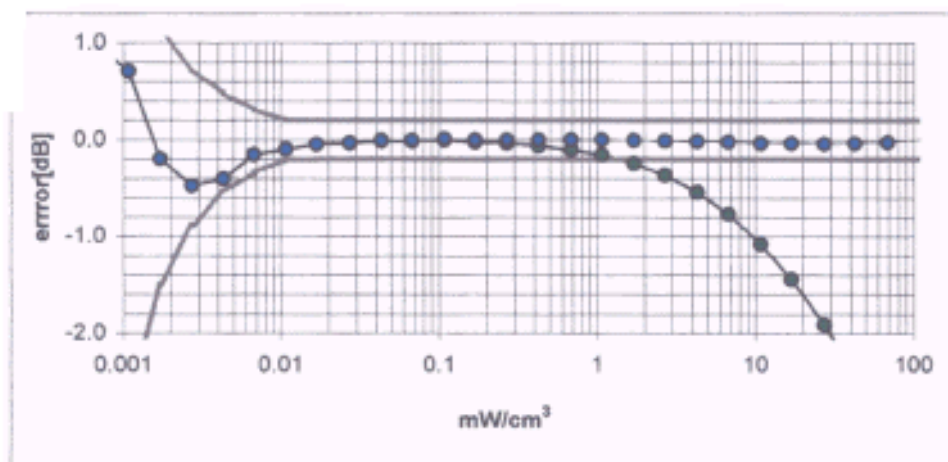
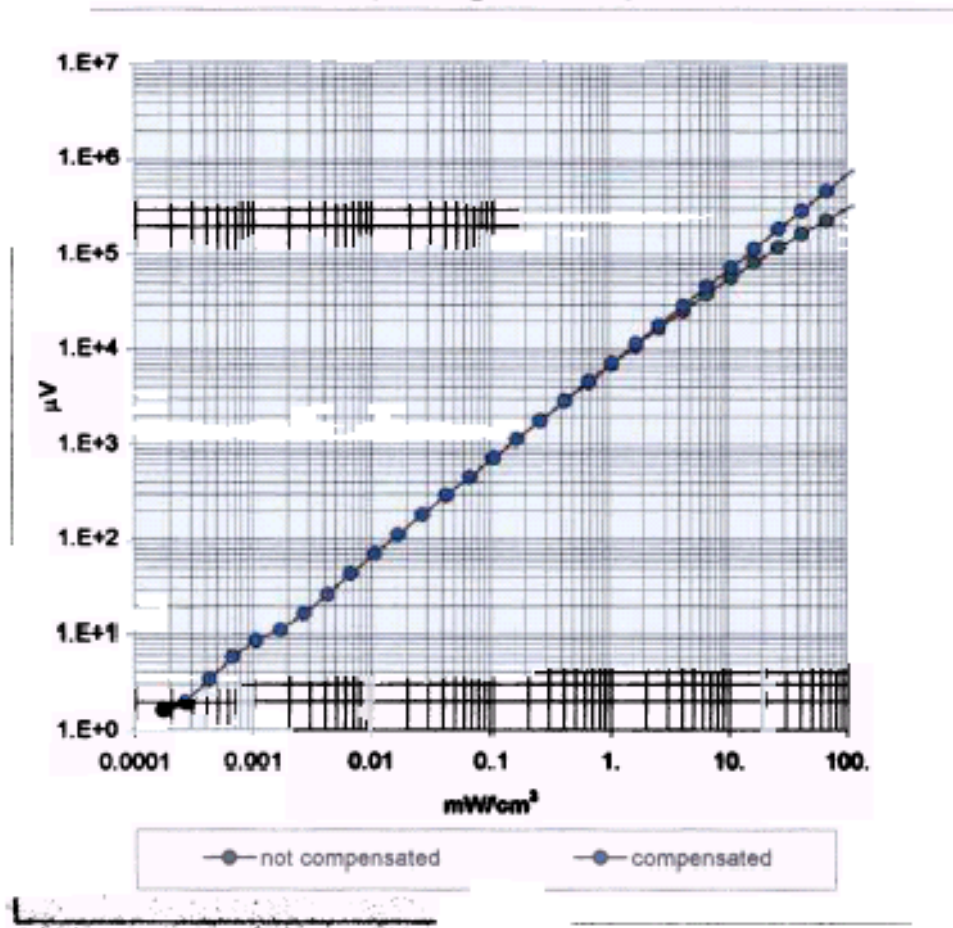
Frequency Response of E-Field (TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1604

August 26, 2002

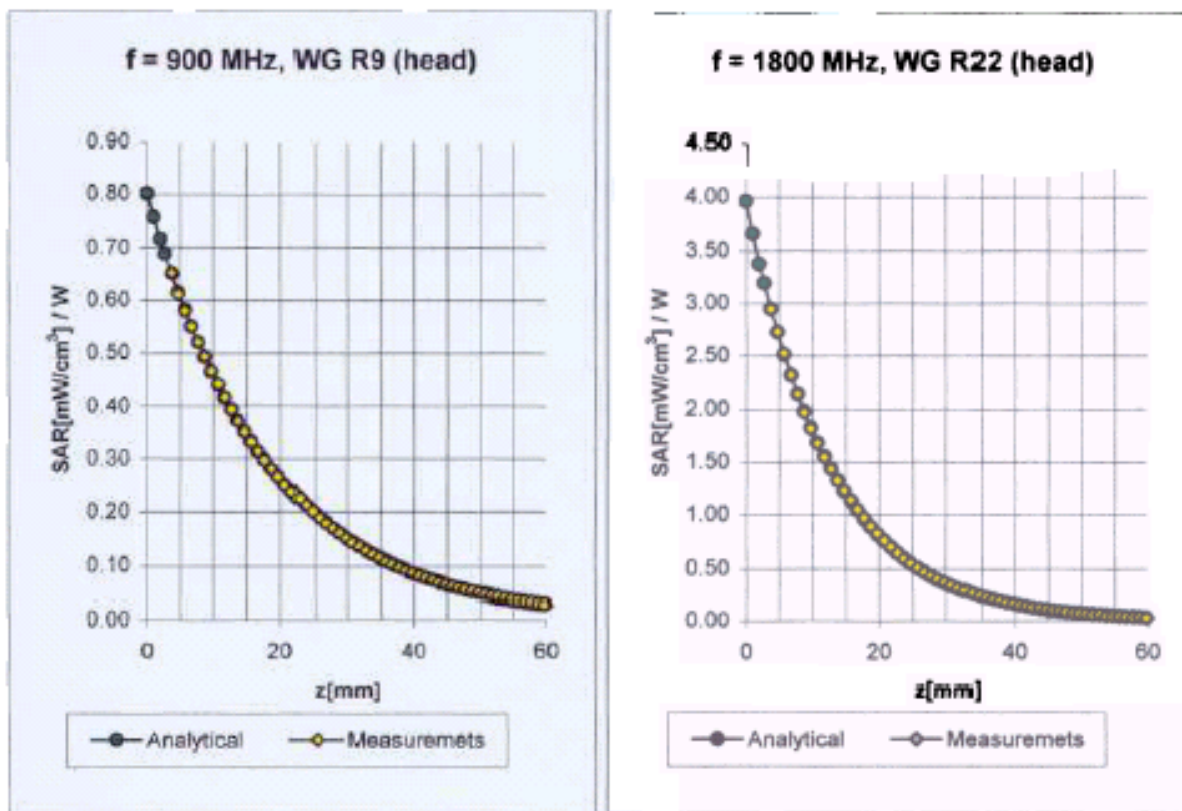
Dynamic Range $f(\text{SAR}_{\text{brain}})$ (Waveguide R22)



ET3DV6 SN:1604

August 26, 2002

Conversion Factor Assessment



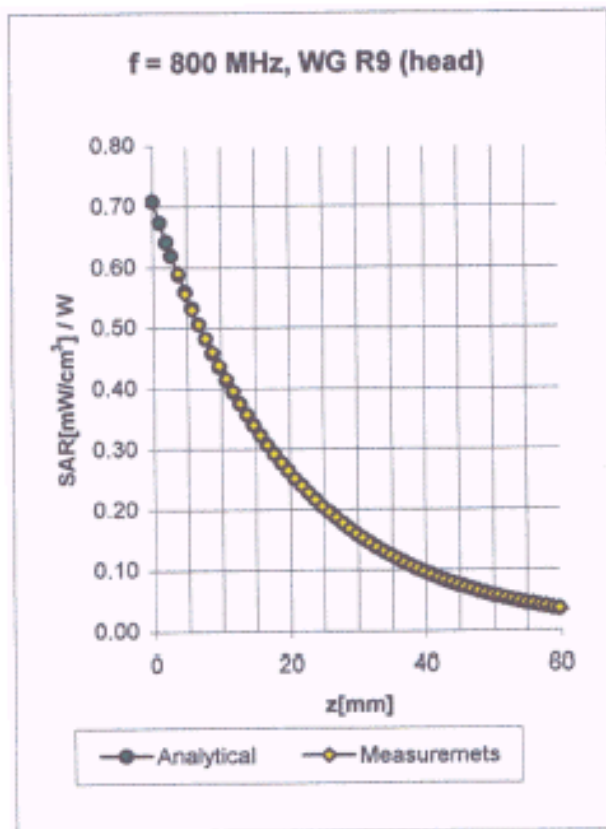
Head	900 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.97 \pm 5\%$ mho/m
Head	835 MHz	$\epsilon_r = 41.5 \pm 5\%$	$\sigma = 0.90 \pm 5\%$ mho/m
	ConvF X	$6.5 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$6.5 \pm 9.5\%$ (k=2)	Alpha
	ConvF Z	$6.5 \pm 9.5\%$ (k=2)	Depth

Head	1800 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
Head	1900 MHz	$\epsilon_r = 40.0 \pm 5\%$	$\sigma = 1.40 \pm 5\%$ mho/m
	ConvF X	$5.5 \pm 9.5\%$ (k=2)	Boundary effect:
	ConvF Y	$5.5 \pm 9.5\%$ (k=2)	Alpha
	ConvF Z	$5.5 \pm 9.5\%$ (k=2)	Depth

ET3DV6 SN:1604

August 26, 2002

Conversion Factor Assessment



Head

800 MHz

 $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.88 \pm 5\% \text{ mho/m}$ ConvF X **6.7** $\pm 8.9\%$ (k=2)ConvF Y **6.7** $\pm 8.9\%$ (k=2)ConvF Z **6.7** $\pm 8.9\%$ (k=2)

Boundary effect:

Alpha

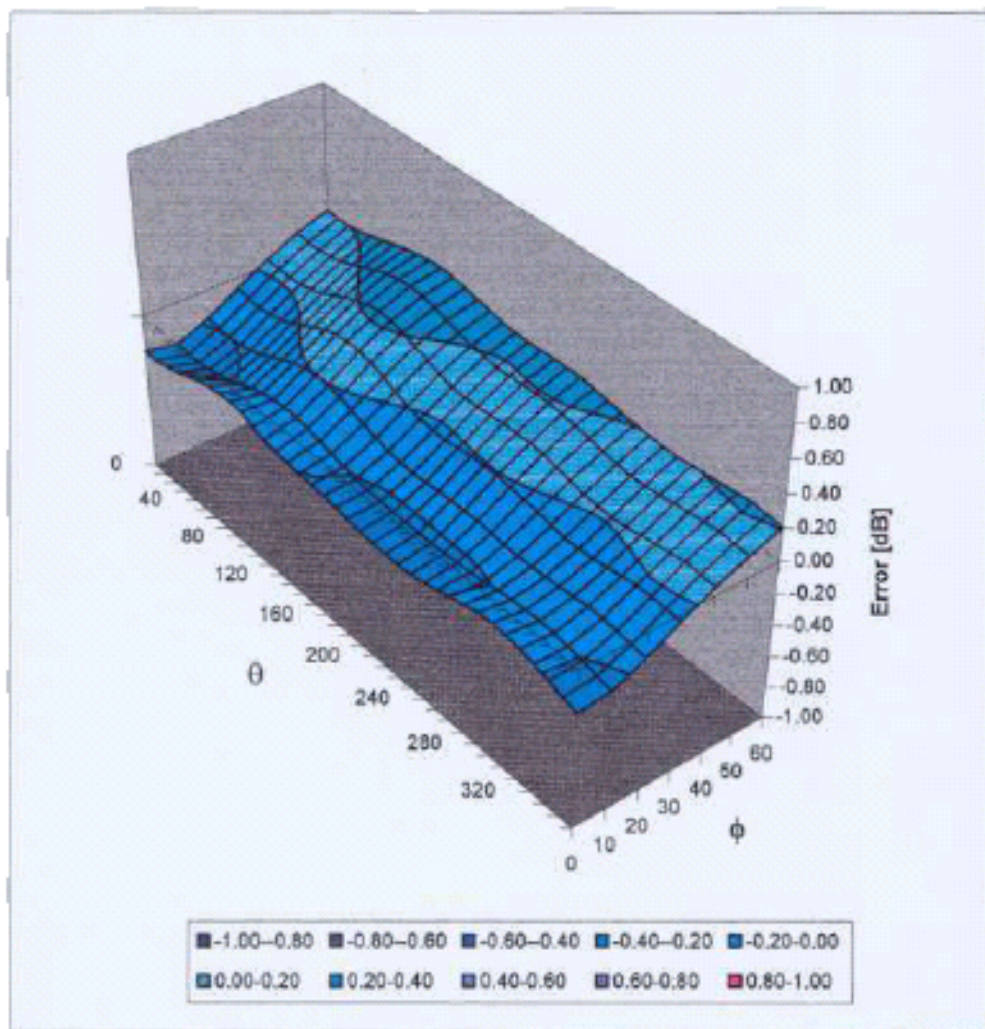
Depth

ET3DV6 SN:1604

August 26, 2002

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



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Additional Conversion Factors

for Dosimetric E-Field Probe

Type**ET3DV6****Serial Number:****1604****Place of Assessment****Zurich****Date of Assessment:****October 4, 2002****Probe Calibration Date:****August 26, 2002**

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

Conversion factor ($\pm$ standard deviation)**835 MHz** **ConvF** **$6.4 \pm 8\%$** $\epsilon_r = 55.2 \pm 5\%$
 $\sigma = 0.97 \pm 5\%$ mho/m
(body tissue)**1900 MHz** **ConvF** **$4.9 \pm 8\%$** $\epsilon_r = 53.3 \pm 5\%$
 $\sigma = 1.52 \pm 5\%$ mho/m
(body tissue)

835MHz Body Liquid Validation

9/24/2003
HONOR

835 MHz Body Liquid Validation			
frequency	ϵ'	ϵ''	
815000000.0000	54.1933		21.1375
815800000.0000	54.1992		21.1469
816600000.0000	54.1467		21.1077
817400000.0000	54.2055		21.1058
818200000.0000	54.1290		21.0914
819000000.0000	54.1123		21.0712
819800000.0000	54.1089		21.0984
820600000.0000	54.1532		21.0942
821400000.0000	54.1257		21.0793
822200000.0000	54.1817		21.0339
823000000.0000	54.1085		21.0540
823800000.0000	54.0770		21.0588
824600000.0000	54.1058		21.0218
825400000.0000	54.0886		21.0377
826200000.0000	54.1103		20.9110
827000000.0000	54.1090		20.9416
827800000.0000	54.0007		20.9520
828600000.0000	54.0990		20.9220
829400000.0000	54.0164		20.9955
830200000.0000	53.9872		20.9111
831000000.0000	54.0389		20.8855
831800000.0000	54.0412		20.9231
832600000.0000	54.0176		20.9157
833400000.0000	54.0119		20.9085
834200000.0000	54.0332		20.9767
835000000.0000	54.0388		20.9377
835800000.0000	54.0300		20.9056
836600000.0000	54.0421		20.8988
837400000.0000	54.0393		20.9342
838200000.0000	54.0306		20.9022
839000000.0000	54.0216		20.8879
839800000.0000	53.9841		20.8873
840600000.0000	53.9826		20.8519
841400000.0000	54.0090		20.8382
842200000.0000	54.0277		20.8633
843000000.0000	53.9701		20.8024
843800000.0000	53.9701		20.7883
844600000.0000	53.9797		20.8396
845400000.0000	54.0127		20.8576
846200000.0000	53.9638		20.8147
847000000.0000	53.9402		20.8601
847800000.0000	53.9334		20.8318
848600000.0000	53.9373		20.7897
849400000.0000	53.9320		20.7913
850200000.0000	53.9036		20.8173
851000000.0000	53.8936		20.7645
851800000.0000	53.8954		20.7628
852600000.0000	53.8785		20.7136
853400000.0000	53.8020		20.6848
854200000.0000	53.8097		20.6238
855000000.0000	53.7941		20.6306

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.973$$

where $f = 835 \times 10^6$
 $\epsilon_0 = 8.854 \times 10^{-12}$
 $\epsilon'' = 20.9377$

835MHz Head Liquid Validation

9/29/2008
HONG

835 MHz Head Liquid validation			
Frequency	ϵ'	ϵ''	
815000000.0000	41.4129		18.8719
815800000.0000	41.4475		18.8985
816600000.0000	41.6532		18.9825
817400000.0000	41.7308		18.9921
818200000.0000	41.6969		18.9913
819000000.0000	41.6411		18.9661
819800000.0000	41.5506		18.9257
820600000.0000	41.5034		18.8479
821400000.0000	41.5629		18.8643
822200000.0000	41.5661		18.8946
823000000.0000	41.4285		18.8483
823800000.0000	41.3696		18.8453
824600000.0000	41.3110		18.8218
825400000.0000	41.1978		18.8155
826200000.0000	41.2821		18.8222
827000000.0000	41.3041		18.8370
827800000.0000	41.1766		18.8038
828600000.0000	41.1863		18.7661
829400000.0000	41.3165		18.8486
830200000.0000	41.2942		18.8234
831000000.0000	41.1867		18.8195
831800000.0000	41.1238		18.7941
832600000.0000	41.1295		18.7256
833400000.0000	41.0731		18.7060
834200000.0000	41.0833		18.8145
835000000.0000	41.0732		18.8092
835800000.0000	41.0355		18.7336
836600000.0000	41.0632		18.7622
837400000.0000	40.9998		18.7860
838200000.0000	40.9273		18.7244
839000000.0000	40.9577		18.7599
839800000.0000	40.9629		18.8133
840600000.0000	40.8990		18.7324
841400000.0000	40.8710		18.7424
842200000.0000	40.8892		18.7261
843000000.0000	40.9635		18.7602
843800000.0000	41.0268		18.7260
844600000.0000	41.0661		18.8141
845400000.0000	41.0488		18.7594
846200000.0000	40.9031		18.7156
847000000.0000	40.9231		18.7547
847800000.0000	40.8817		18.7300
848600000.0000	40.9681		18.7949
849400000.0000	40.9212		18.7563
850200000.0000	40.9593		18.7801
851000000.0000	41.0457		18.8447
851800000.0000	41.1107		18.8255
852600000.0000	40.9506		18.7443
853400000.0000	40.9045		18.7775
854200000.0000	41.0212		18.8176
855000000.0000	41.0309		18.8006

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.874$$

where $f = 835 \times 10^6$
 $\epsilon_0 = 8.854 \times 10^{-12}$
 $\epsilon'' = 18.8092$

1900MHz Body Liquid Validation

9/29/2003
HONG

1900 MHz Body Liquid Validation		
frequency	ϵ'	ϵ''
1850000000.0000	52.7110	14.5904
1852000000.0000	52.7552	14.5974
1854000000.0000	52.7487	14.6128
1856000000.0000	52.7570	14.6628
1858000000.0000	52.7649	14.7096
1860000000.0000	52.8018	14.8075
1862000000.0000	52.8382	14.8402
1864000000.0000	52.8101	14.8299
1866000000.0000	52.8258	14.8435
1868000000.0000	52.8336	14.8364
1870000000.0000	52.8264	14.8180
1872000000.0000	52.8202	14.8295
1874000000.0000	52.8234	14.8013
1876000000.0000	52.8216	14.8189
1878000000.0000	52.8366	14.8373
1880000000.0000	52.8399	14.8089
1882000000.0000	52.8621	14.8178
1884000000.0000	52.8883	14.8094
1886000000.0000	52.8541	14.8199
1888000000.0000	52.8540	14.8352
1890000000.0000	52.8622	14.8276
1892000000.0000	52.8807	14.8218
1894000000.0000	52.8265	14.7970
1896000000.0000	52.8674	14.7842
1898000000.0000	52.8696	14.7692
1900000000.0000	52.8824	14.7790
1902000000.0000	52.8785	14.7565
1904000000.0000	52.8855	14.7704
1906000000.0000	52.8907	14.7946
1908000000.0000	52.8350	14.7802
1910000000.0000	52.8520	14.7724
1912000000.0000	52.8919	14.8043
1914000000.0000	52.9011	14.8510
1916000000.0000	52.9347	14.8637
1918000000.0000	52.8972	14.8564
1920000000.0000	52.9329	14.8901
1922000000.0000	52.9584	14.8824
1924000000.0000	52.8979	14.8755
1926000000.0000	52.9026	14.8411
1928000000.0000	52.8342	14.8058
1930000000.0000	52.8751	14.8483
1932000000.0000	52.8653	14.8662
1934000000.0000	52.8180	14.8175
1936000000.0000	52.8225	14.8394
1938000000.0000	52.8254	14.8717
1940000000.0000	52.7677	14.8778
1942000000.0000	52.7121	14.8569
1944000000.0000	52.7048	14.8081
1946000000.0000	52.7188	14.8251
1948000000.0000	52.6769	14.8253
1950000000.0000	52.6586	14.8082

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.562$$

where $f = 1900 \times 10^6$
 $\epsilon_0 = 8.854 \times 10^{-12}$
 $\epsilon'' = 14.7790$

1900MHz Head Liquid Validation

9/29/2001
HONG

1900 MHz Head Liquid Validation		
Frequency	ϵ'	ϵ''
1850000000.0000	39.2326	13.4313
1852000000.0000	39.2019	13.4718
1854000000.0000	39.2128	13.4909
1856000000.0000	39.1353	13.4744
1858000000.0000	38.9515	13.3838
1860000000.0000	38.8655	13.3149
1862000000.0000	38.8144	13.3081
1864000000.0000	38.7847	13.3370
1866000000.0000	38.7878	13.3414
1868000000.0000	38.8594	13.3573
1870000000.0000	38.9015	13.3949
1872000000.0000	38.9045	13.4021
1874000000.0000	38.9790	13.4594
1876000000.0000	38.9933	13.5116
1878000000.0000	39.0130	13.5004
1880000000.0000	39.0047	13.5069
1882000000.0000	38.9634	13.5165
1884000000.0000	38.9740	13.5192
1886000000.0000	38.9987	13.5311
1888000000.0000	38.9958	13.5133
1890000000.0000	39.0227	13.5481
1892000000.0000	39.0162	13.5946
1894000000.0000	39.0097	13.5522
1896000000.0000	38.9905	13.5553
1898000000.0000	39.0075	13.5909
1900000000.0000	39.0049	13.5644
1902000000.0000	38.9966	13.5906
1904000000.0000	39.0104	13.5903
1906000000.0000	38.9996	13.6050
1908000000.0000	38.9992	13.6070
1910000000.0000	38.9856	13.6215
1912000000.0000	39.0184	13.6144
1914000000.0000	38.9920	13.6300
1916000000.0000	39.0117	13.6325
1918000000.0000	38.9987	13.6327
1920000000.0000	38.9902	13.6259
1922000000.0000	38.9956	13.6336
1924000000.0000	38.9692	13.6633
1926000000.0000	38.9427	13.6347
1928000000.0000	38.9548	13.6666
1930000000.0000	38.9587	13.6870
1932000000.0000	38.9568	13.7088
1934000000.0000	38.9606	13.6693
1936000000.0000	38.9388	13.7032
1938000000.0000	38.9255	13.7344
1940000000.0000	38.9232	13.7191
1942000000.0000	38.9204	13.7292
1944000000.0000	38.9063	13.7447
1946000000.0000	38.8979	13.7547
1948000000.0000	38.8949	13.7874
1950000000.0000	38.9138	13.7822

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.434$$

where $f = 1900 \times 10^6$
 $\epsilon_0 = 8.854 \times 10^{-12}$
 $\epsilon'' = 13.5644$

3 - EUT DESCRIPTION

Applicant:	VeriFone Inc.
Product Description:	Wireless Point of Sale Terminal
Product Model Number:	OMNI 3600D
FCC ID:	B32ONMI3600D
Serial Number:	None
Maximum RF Output Power:	23.83 dBm for CDMA 800 23.83 dBm for CDMA 1900
RF Exposure environment:	General Population/Uncontrolled
Applicable Standard	FCC CFR 47, Part 22, & 24
Application Type:	Certification

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.

4.3 Equipment Modifications

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

5 – CONDUCTED OUTPUT POWER MEASUREMENTS

5.1 Provision Applicable

According to §15.247(b) (3), for systems using digital modulation, the maximum peak output power of the intentional radiator shall not exceed 1 Watt.

According to FCC §22.913 (a), the ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts. According to FCC § 24.232(b), EIRP peak power for mobile/portable stations are limited to 2 watts.

5.2 Test Procedure

The RF output of the transmitter was connected to the input of the spectrum analyzer through sufficient attenuation.

5.3 Test equipment

Hewlett Packard HP8564E Spectrum Analyzer, Calibration Due Date: 2004-08-01.

Hewlett Packard HP 7470A Plotter, Calibration not required.

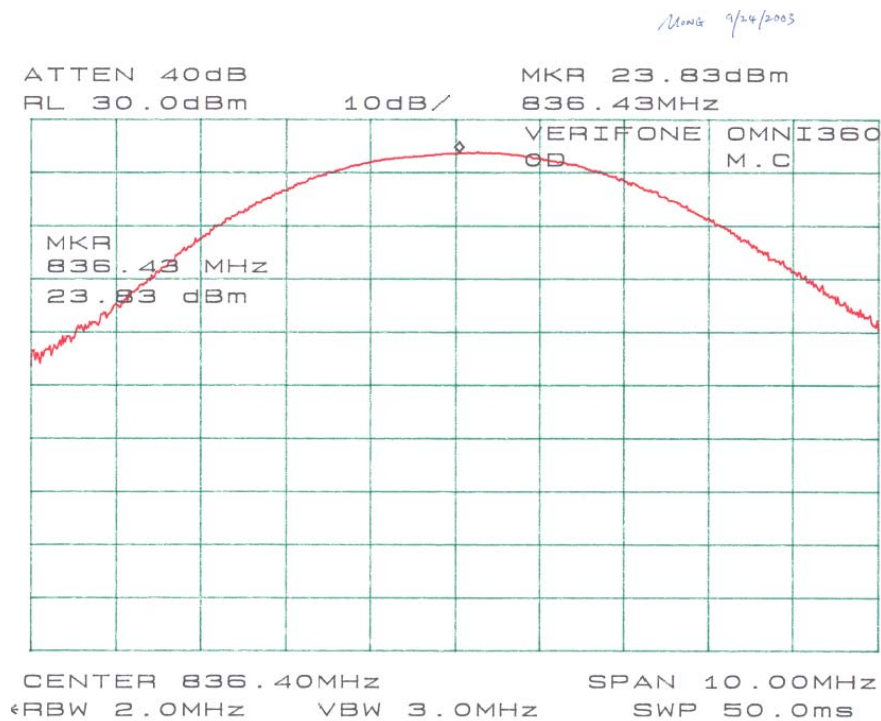
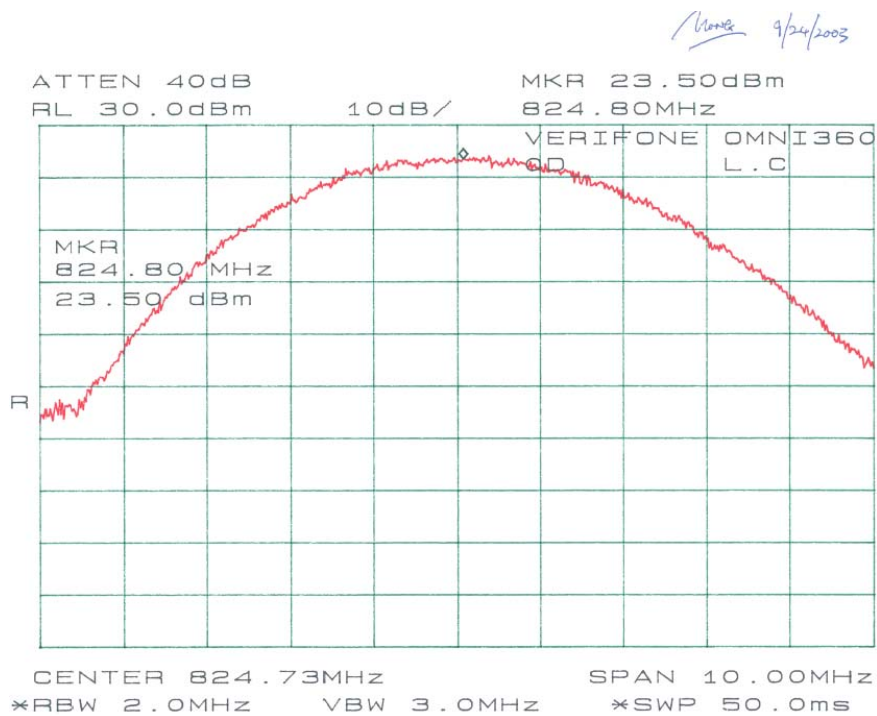
A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2004-05-31

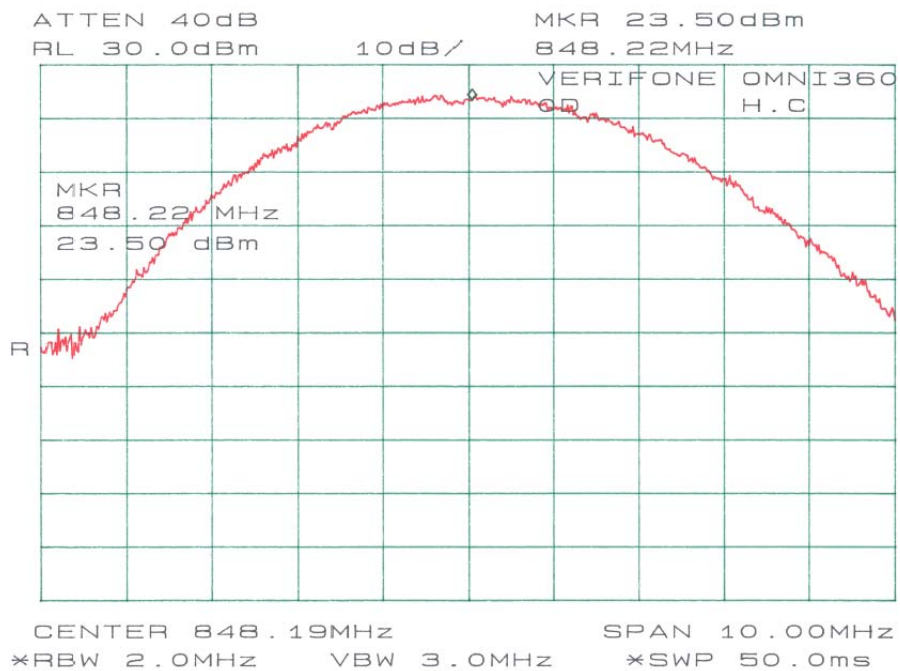
Com-Power AB-100 Dipole Antenna, Calibration Due Date: 2004-09-05

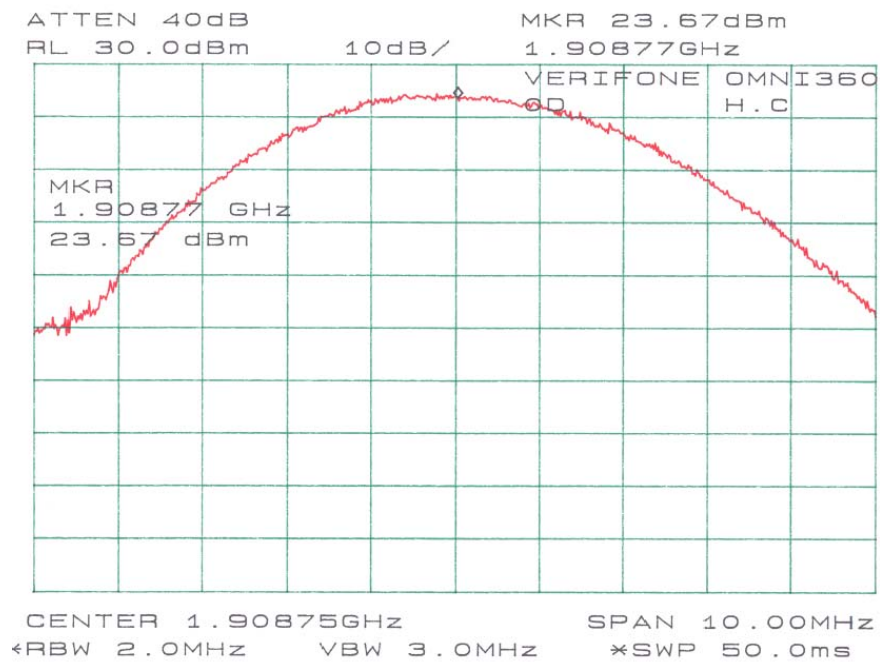
5.4 Test Results

Modulation Type	Channel	Frequency (MHz)	Output Power (dBm)	Output Power (W)	Limit (W)
CDMA 800	Low	824.73	23.50	0.224	7
	Middle	836.40	23.83	0.242	7
	High	848.19	23.50	0.224	7
CDMA 1900	Low	1851.25	23.67	0.233	2
	Middle	1880.00	23.83	0.242	2
	High	1908.75	23.67	0.233	2

Please refer to the following plots.



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6 - DOSIMETRIC ASSESSMENT SETUP

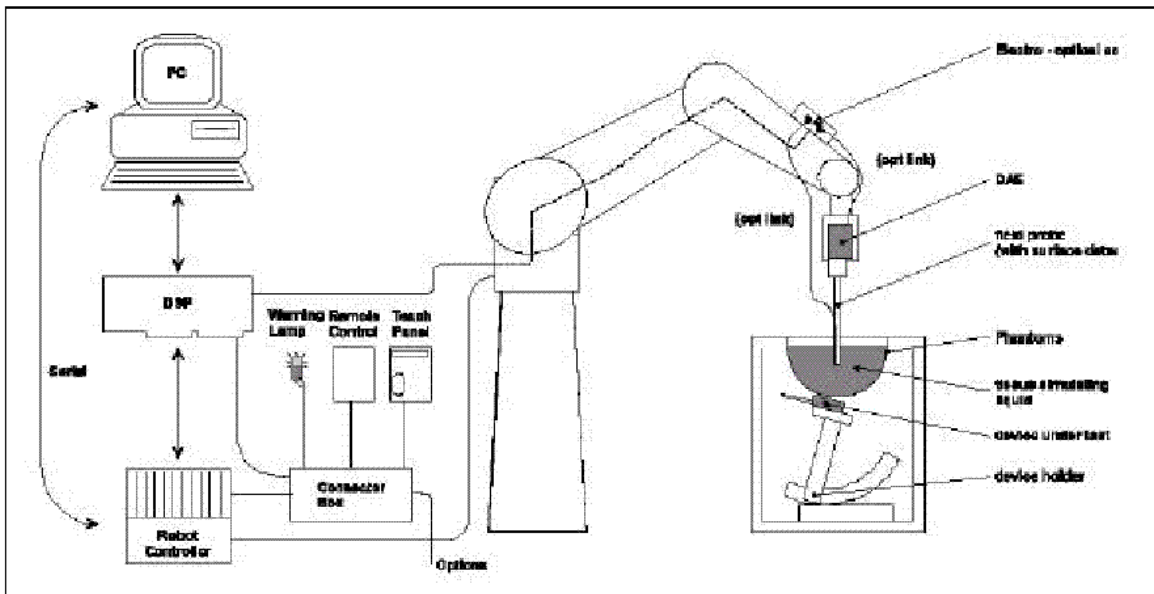
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than $\pm 0.02\text{mm}$. 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 ET3DV6 SN: 1577 (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 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	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (s/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

6.1 Measurement System Diagram



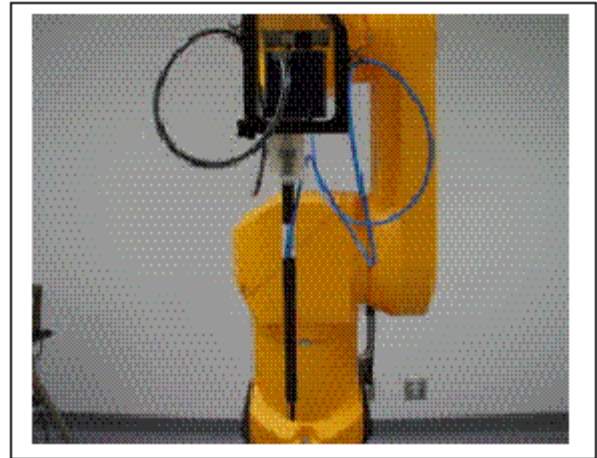
The DAS3 system for performing compliance tests consist of the following items:

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. DAS3 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.

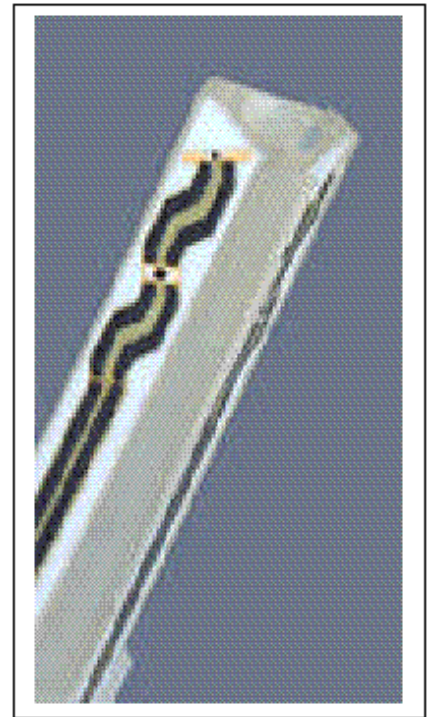
6.2. System Components

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: ± 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



Inside view of
ET3DV6 E-field 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 2nd order fitting. The approach is stopped when reaching the maximum.

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 below 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:

$$V_i = U_i + (U_i)^2 \text{ cf} / \text{dcp}_i$$

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:

$$\begin{aligned} \text{E-field probes:} \quad E_i &= \sqrt{\frac{V_i}{\text{Norm}_i \cdot \text{ConvF}}} \\ \text{H-field probes:} \quad H_i &= \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f} \end{aligned}$$

With V_i = compensated signal of channel i (i=x, y, z)
 Norm_i = sensor sensitivity of channel i (i=x, y, z)
 $\mu\text{V}/(\text{V/m})^2$ for E-field probes
 ConvF = 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/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.

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

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

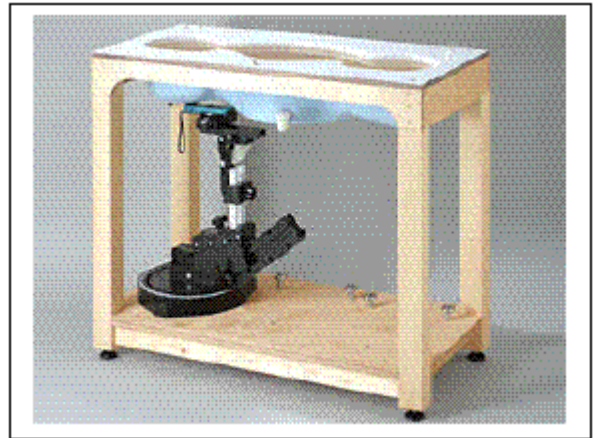
Generic Twin Phantom

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)

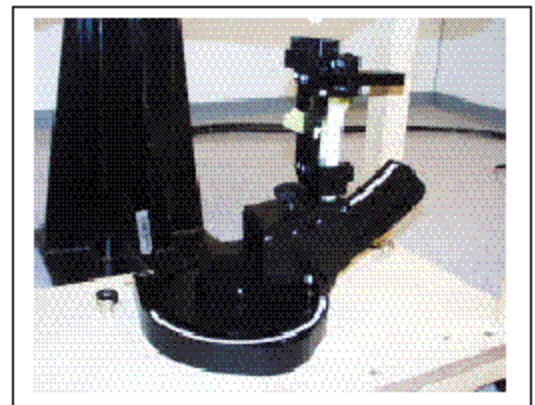


Generic Twin Phantom

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.