SAR EVALUATION REPORT

For

VeriFone Inc.

3755 Atherton Road
Rocklin, CA 95765

FCC ID: B32ONMI3600D

2003-11-03

This Report Concerns:	**Equipment Type:**
☒ Original Report	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 (ºC): 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, O_ce of Engineering & Technology, Washington, DC, 1997.

[3] Thomas Schmid, Oliver Egger, and Niels Kuster, \Automated E-_eld 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-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 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 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: [signature]

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

NormX	1.73 $\mu V/(V/m)^2$
NormY	1.68 $\mu V/(V/m)^2$
NormZ	1.72 $\mu V/(V/m)^2$

Diode Compression

DCP X	93	mV
DCP Y	93	mV
DCP Z	93	mV

Sensitivity in Tissue Simulating Liquid

Head 900 MHz ε_r = 41.5 ± 5% σ = 0.97 ± 5% mho/m
Head 835 MHz ε_r = 41.5 ± 5% σ = 0.90 ± 5% mho/m

ConvF X	6.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5 ± 9.5% (k=2)	Alpha	0.36
ConvF Z	6.5 ± 9.5% (k=2)	Depth	2.82

Head 1800 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m
Head 1900 MHz ε_r = 40.0 ± 5% σ = 1.40 ± 5% mho/m

ConvF X	5.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.5 ± 9.5% (k=2)	Alpha	0.50
ConvF Z	5.5 ± 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

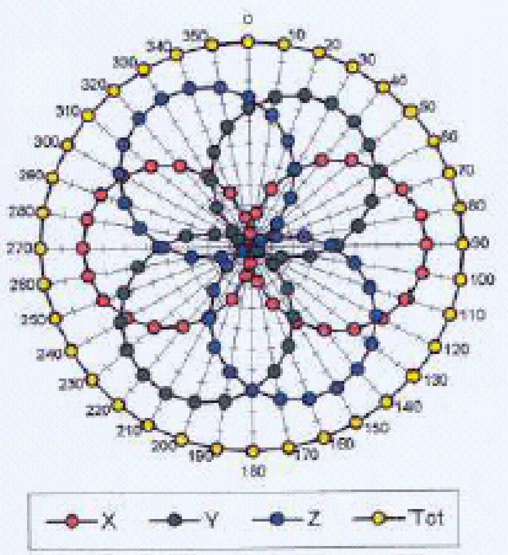
Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.3 ± 0.2	mm

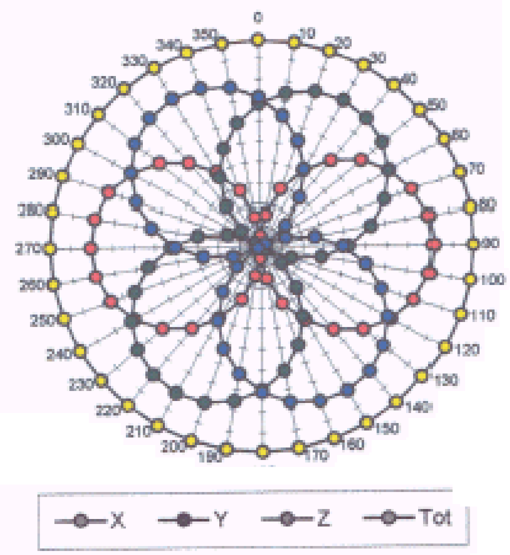
ET3DV6 SN:1604 August 26, 2002

Receiving Pattern (ϕ), θ = 0°

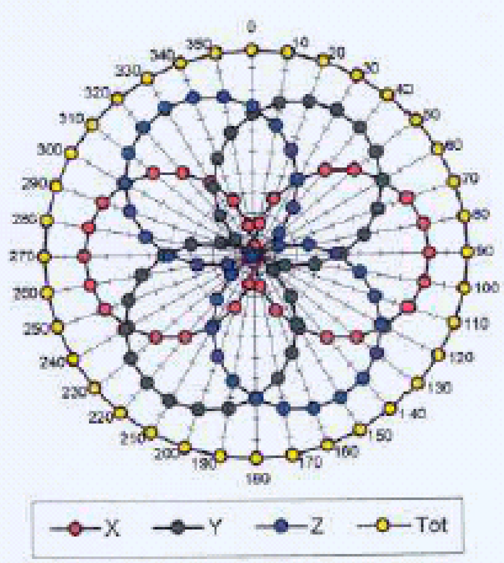
f = 30 MHz, TEM cell ifi110



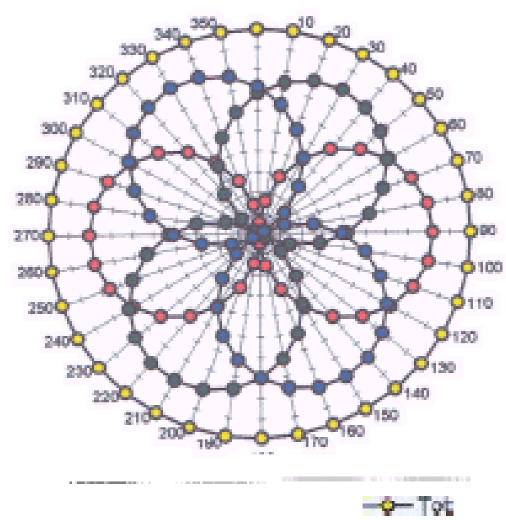
f = 100 MHz, TEM cell ifi110



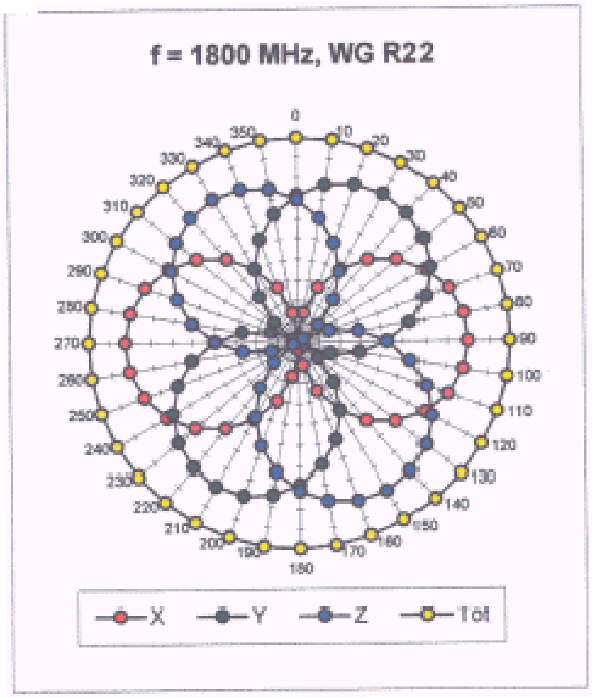
f = 300 MHz, TEM cell ifi110

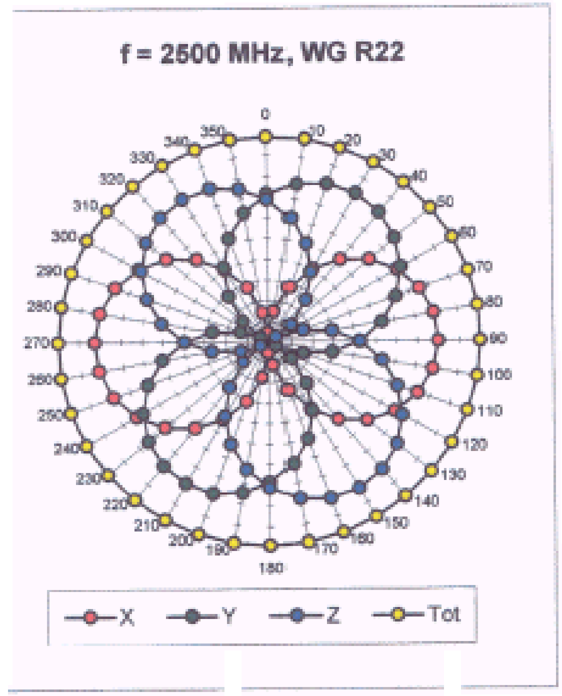


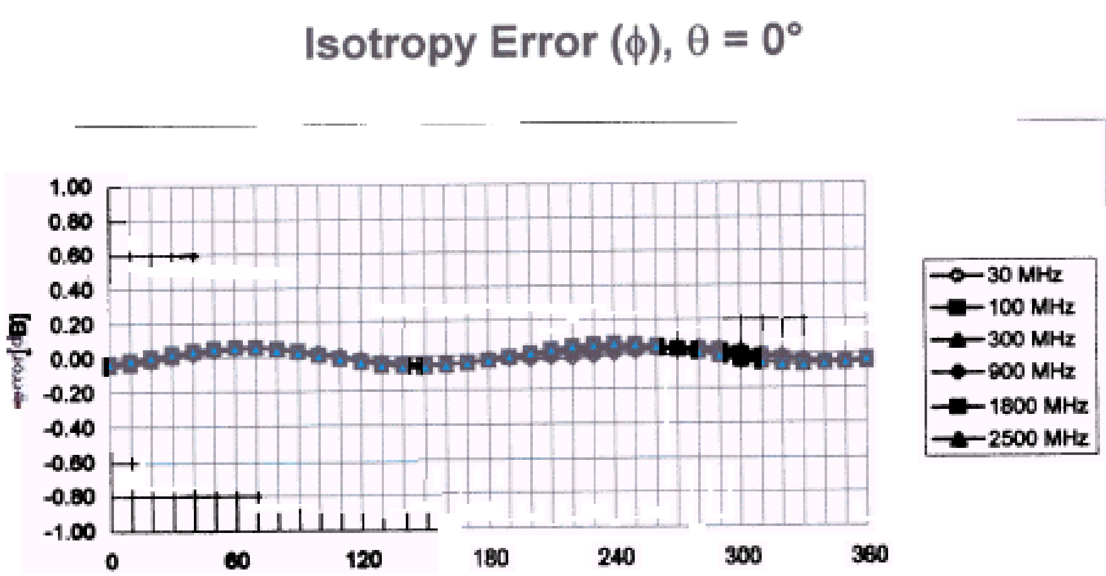
f = 900 MHz, TEM cell ifi110



ET3DV6 SN:1604 August 26, 2002



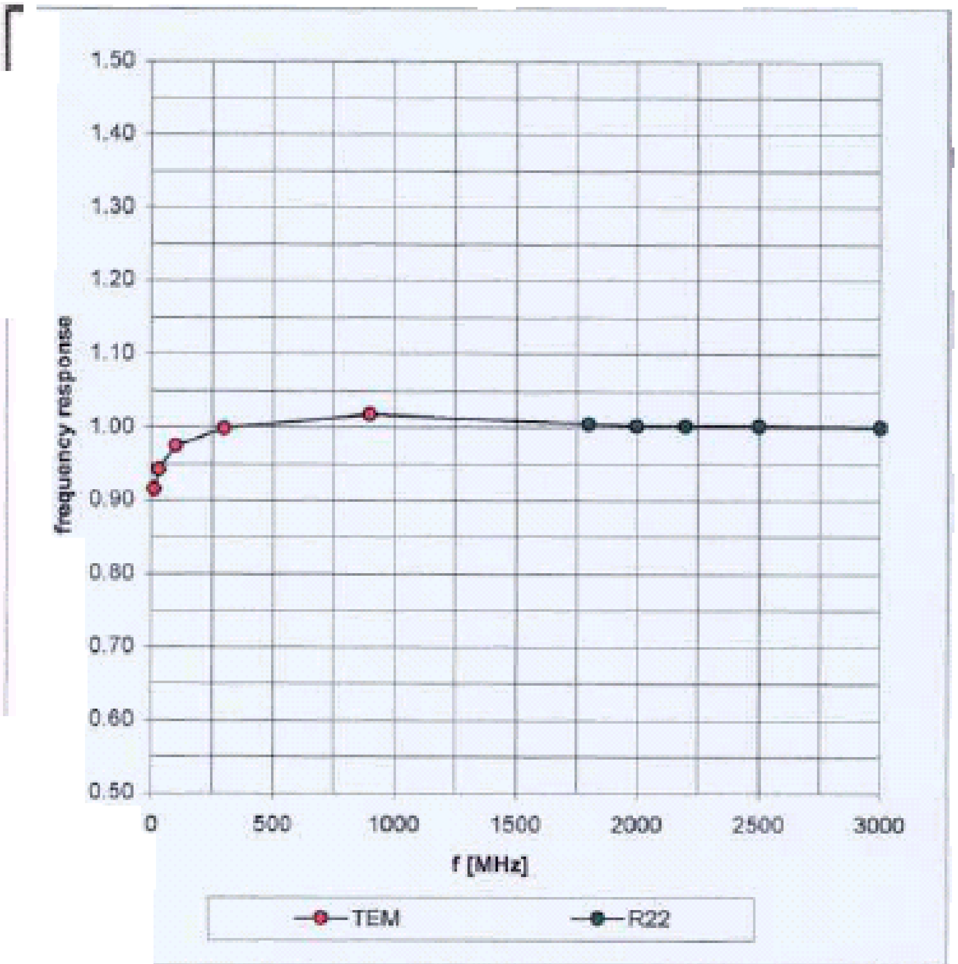




ET3DV6 SN:1604 **August 26, 2002**

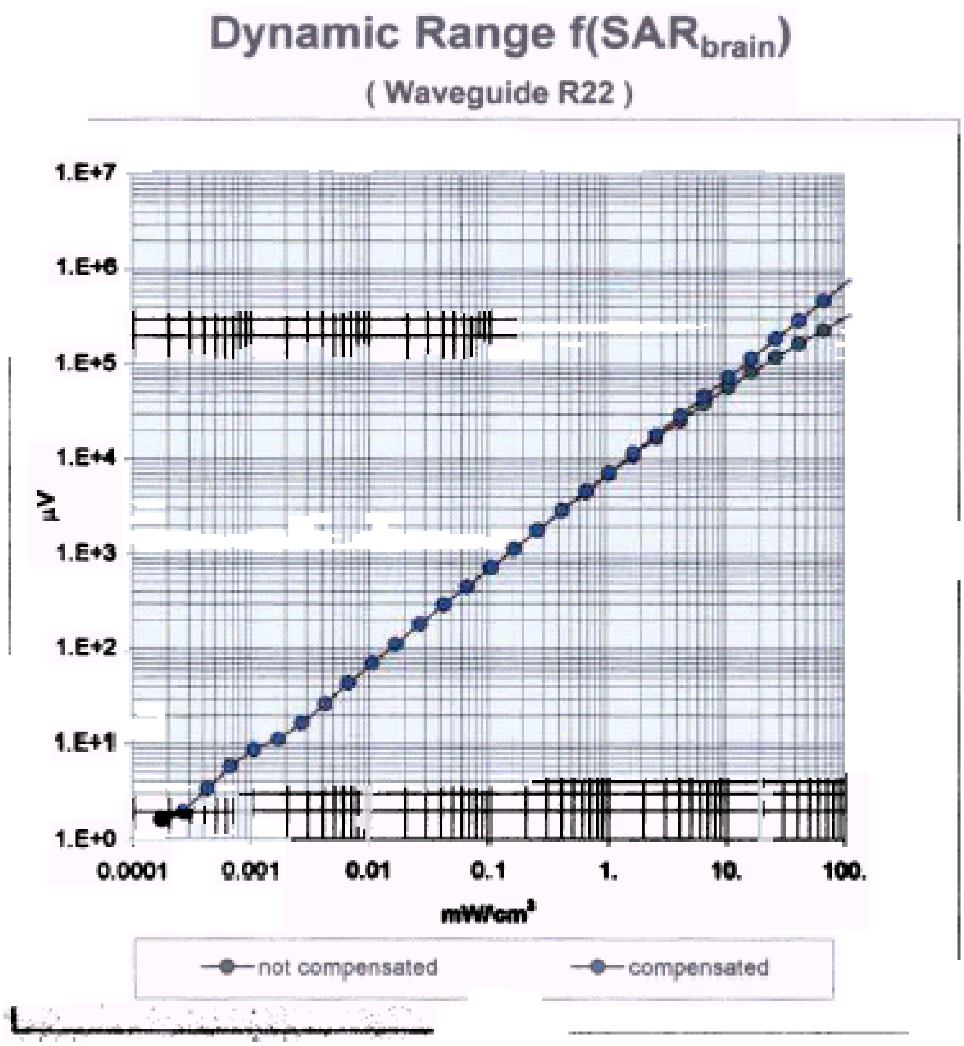
Frequency Response of E-Field

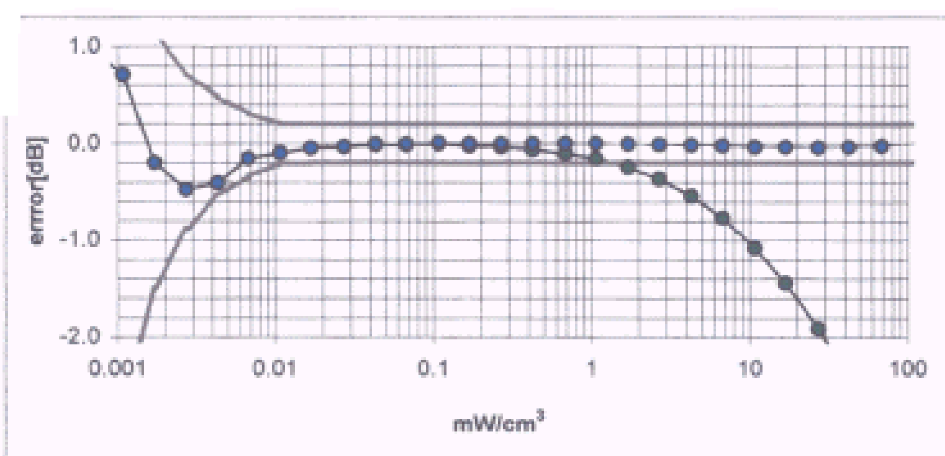
(TEM-Cell:ifi110, Waveguide R22)



ET3DV6 SN:1604

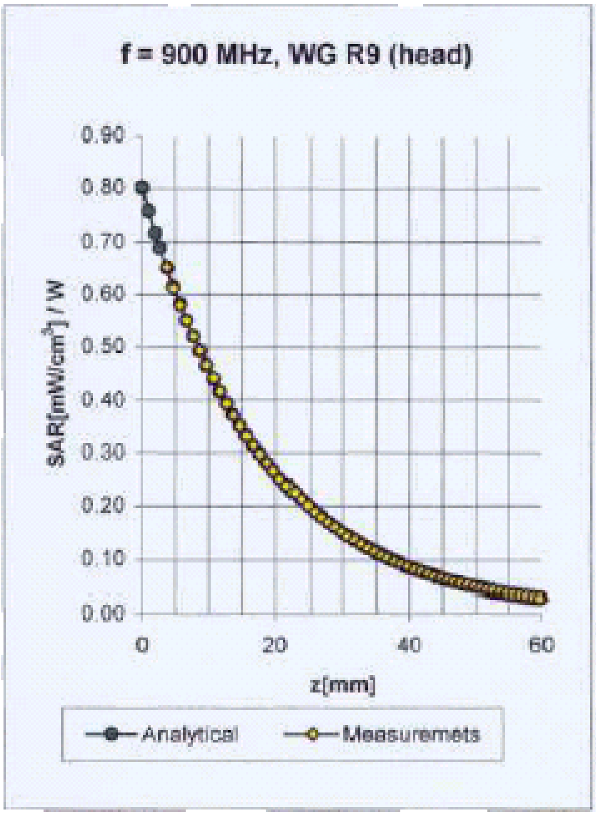
August 26, 2002

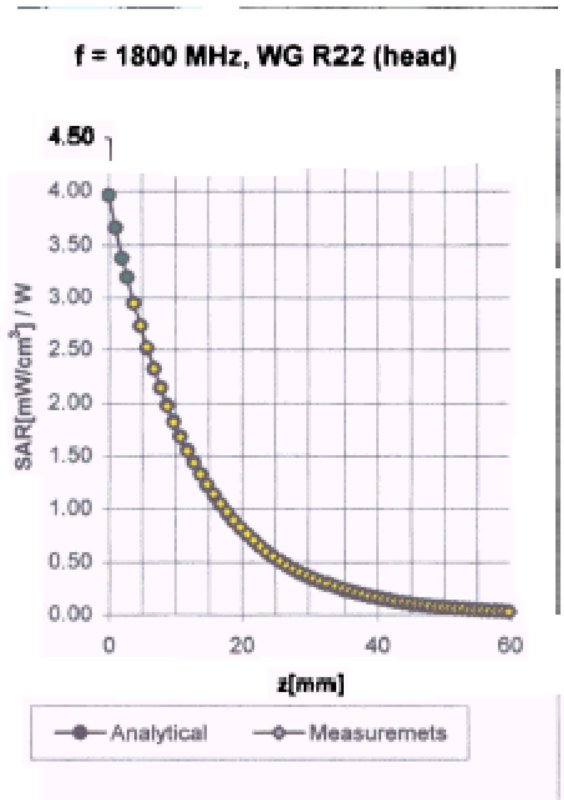




ET3DV6 SN:1604 **August 26, 2002**

Conversion Factor Assessment





Head	900 MHz	ε_r = 41.5 ± 5%	σ = 0.97 ± 5% mho/m
Head	835 MHz	ε_r = 41.5 ± 5%	σ = 0.90 ± 5% mho/m

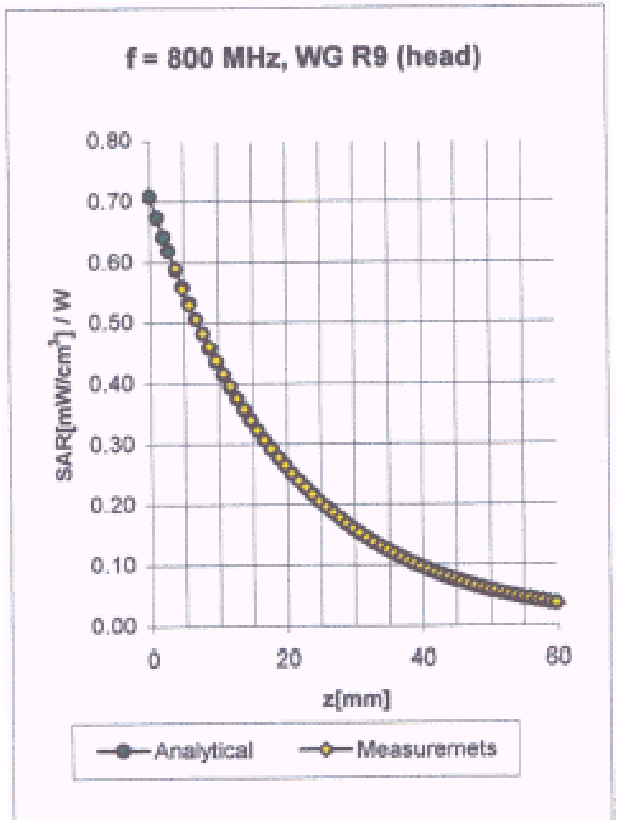
ConvF X	6.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5 ± 9.5% (k=2)	Alpha	
ConvF Z	6.5 ± 9.5% (k=2)	Depth	

Head	1800 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m
Head	1900 MHz	ε_r = 40.0 ± 5%	σ = 1.40 ± 5% mho/m

ConvF X	5.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.5 ± 9.5% (k=2)	Alpha	0.50
ConvF Z	5.5 ± 9.5% (k=2)	Depth	2.46

ET3DV6 SN:1604 **August 26, 2002**

Conversion Factor Assessment



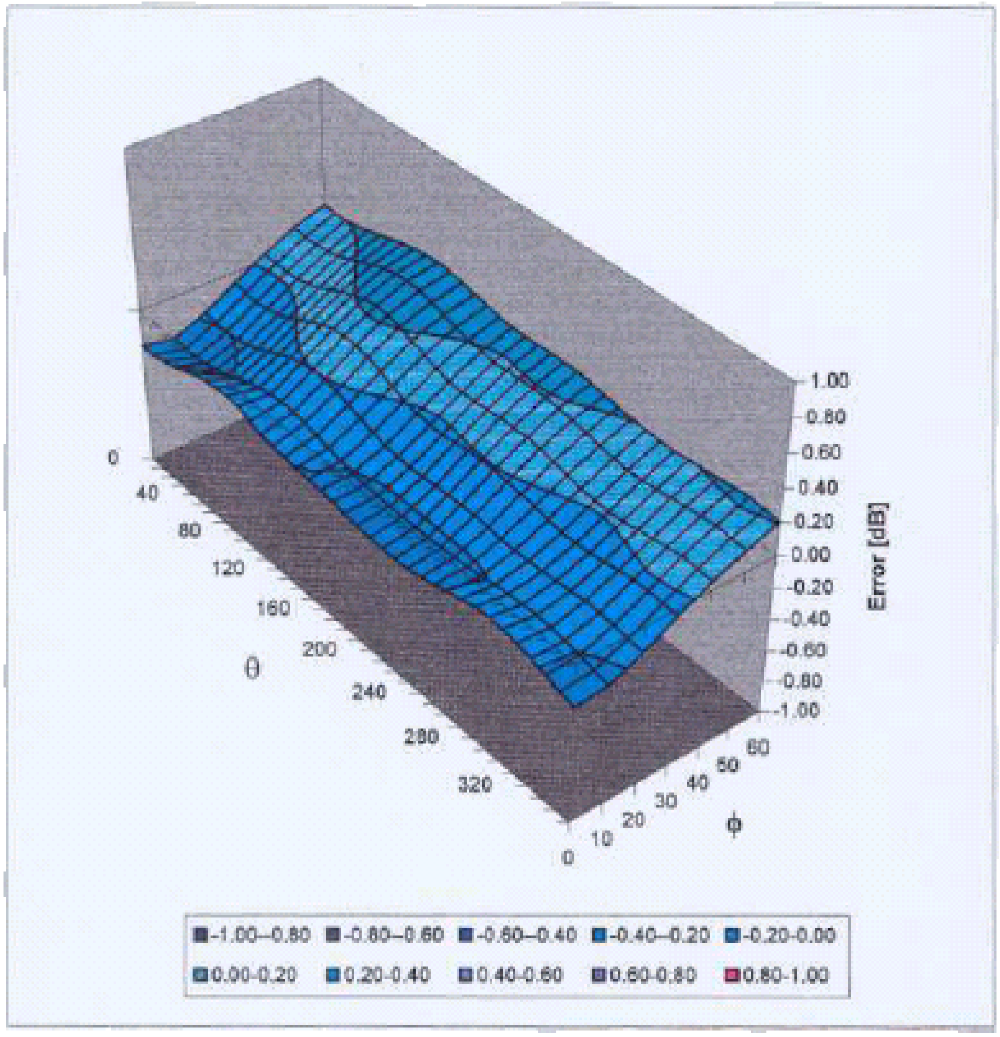
Head	800 MHz	ε_r = 41.5 ± 5%	σ = 0.88 ± 5% mho/m

ConvF X	**6.7** ± 8.9% (k=2)	Boundary effect:
ConvF Y	**6.7** ± 8.9% (k=2)	Alpha
ConvF Z	**6.7** ± 8.9% (k=2)	Depth

ET3DV6 SN:1604 **August 26, 2002**

Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz



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

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

Page of 2 October 4, 2002

Conversion factor (± standard deviation)

835 MHz	**ConvF**	**6.4 ± 8%**	ε_r = 55.2 ± 5% σ = 0.97 ± 5% mho/m (body tissue)
1900 MHz	**ConvF**	**4.9 ± 8%**	ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m (body tissue)

835MHz Body Liquid Validation

9/24/2003
Hong

835 MHz Body Liquid Validation

frequency	e'	e''
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

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 0.973$

where $f = 835 \times 10^6$

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

$\varepsilon'' = 20.9377$

835MHz Head Liquid Validation

9/29/2008
Hong

835 MHz Head Liquid Validation

frequency	e'	e''
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

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon'' = 0.874$

where $f = 835 \times 10^6$

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

$\varepsilon'' = 18.8092$

1900MHz Body Liquid Validation

9/29/2003
Hong

1900 MHz Body Liquid Validation

frequency	e'	e''
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	14.8296
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

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon''=1.562$

where $f = 1900 \times 10^6$

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

$\varepsilon'' = 14.7790$

1900MHz Head Liquid Validation

9/29/2003
Hong

1900 MHz Head Liquid Validation

frequency	e'	e''
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	38.9668	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

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon'' = 1.434$

where $f = 1900 \times 10^6$

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

$\varepsilon'' = 13.5644$

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.

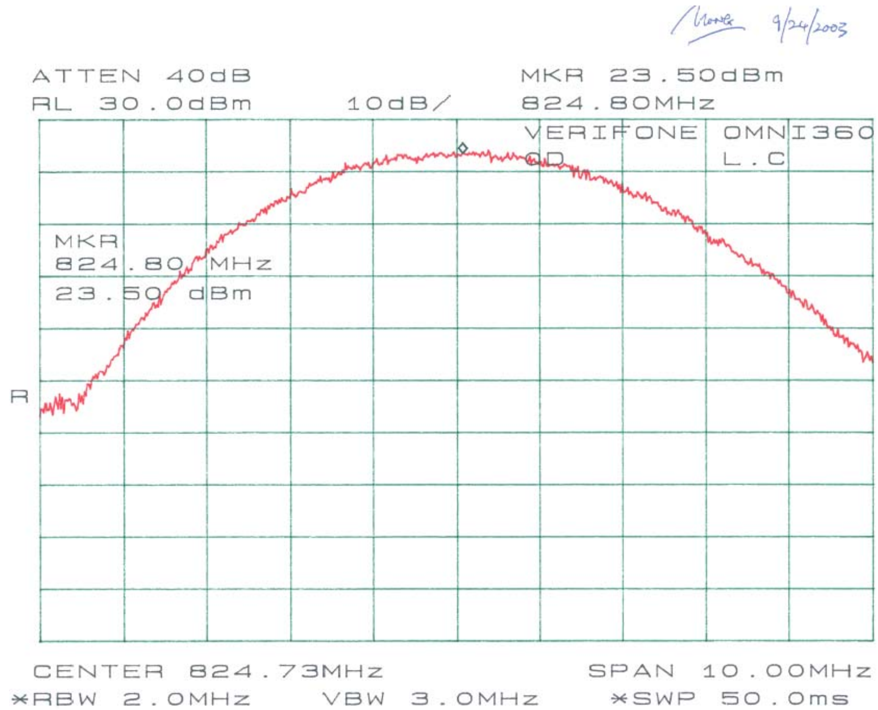
5.3 Test equipment

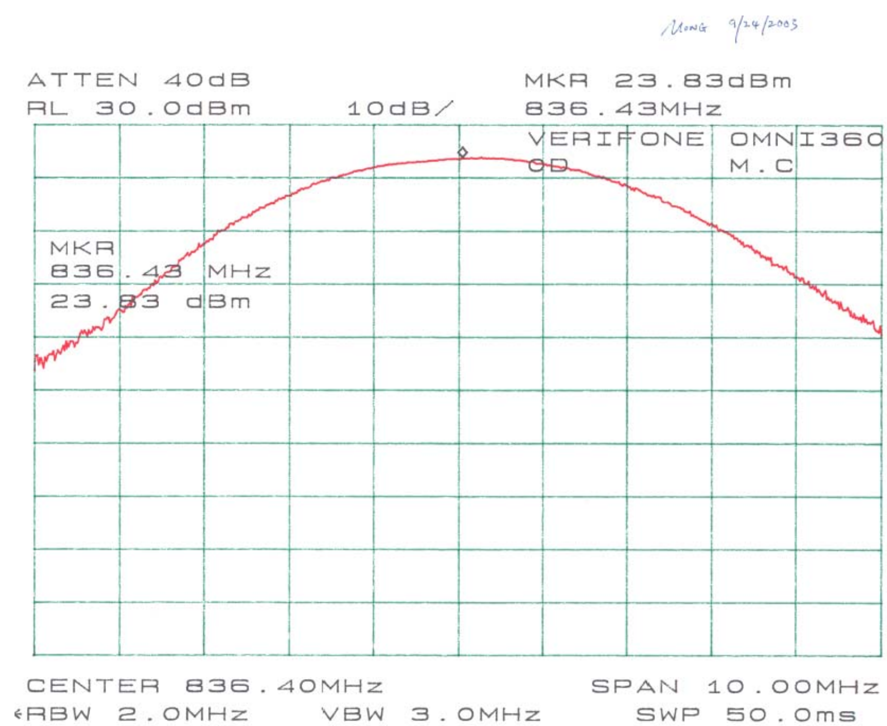
Hewlett Packard HP8564E Spectrum Analyzer, Calibration Due Date: 2004-08-01.
Hewlett Packard HP 7470A Plotter, Calibration not required.
A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2004-05-31
Com-Power AB-100 Dipole Antenna, Calibration Due Date: 2004-09-05

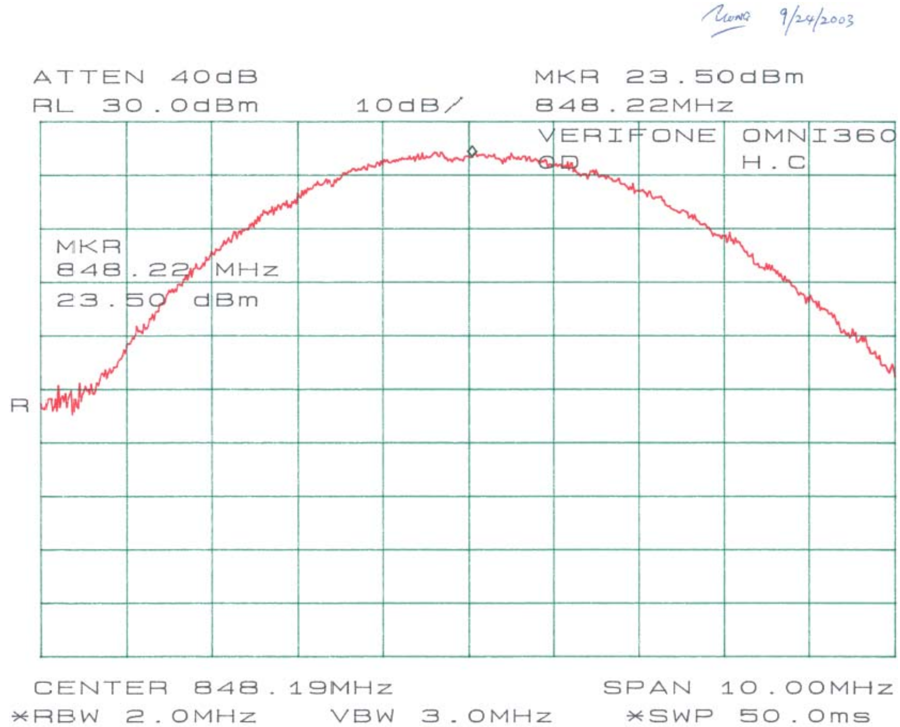
5.4 Test Results

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

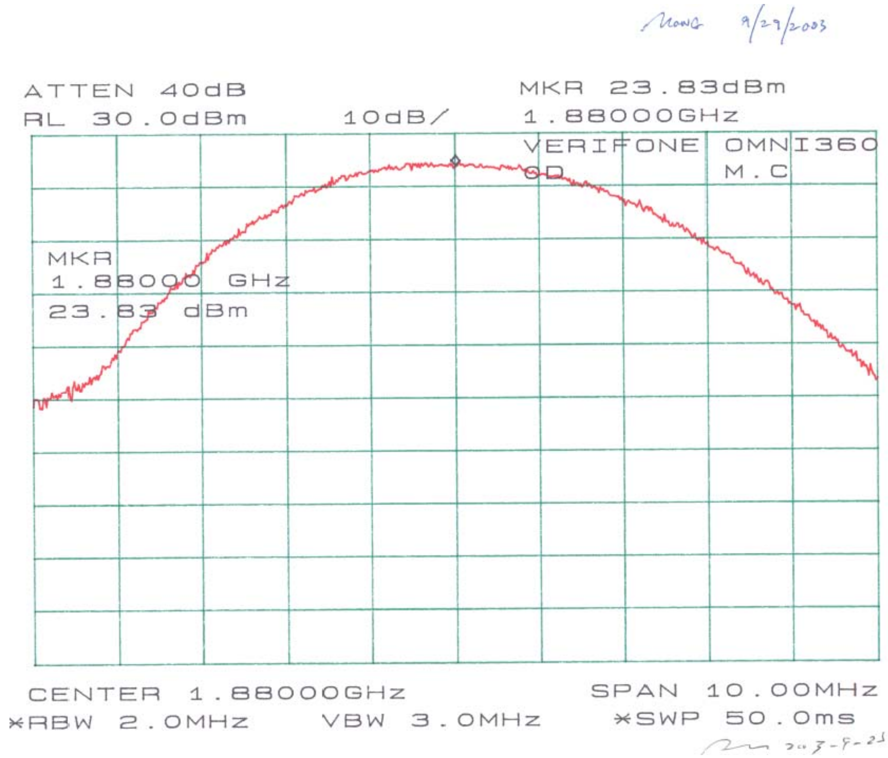
Please refer to the following plots.

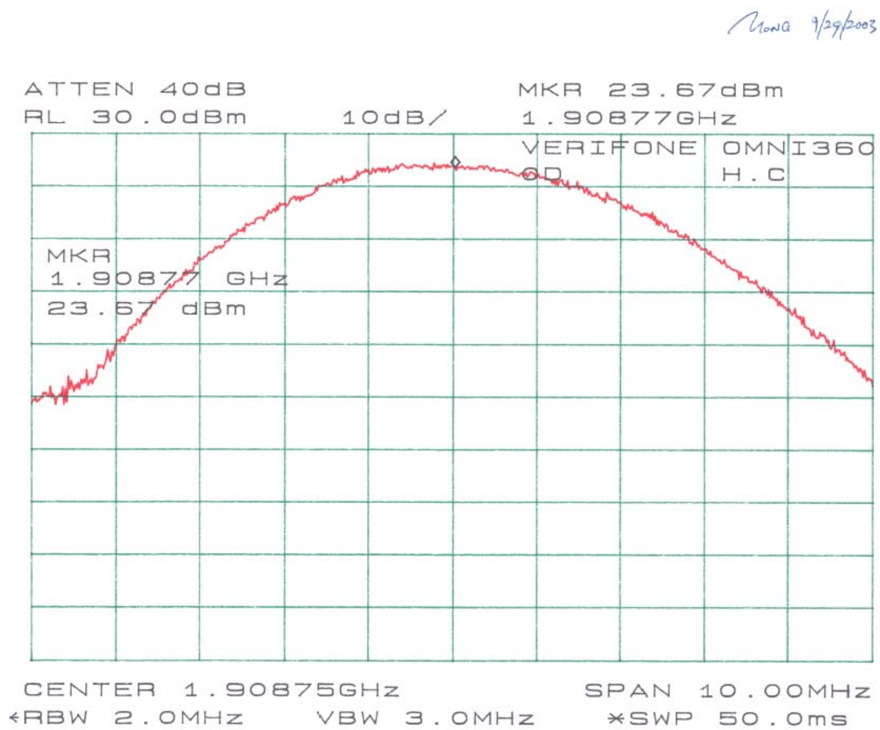

ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.50dBm
824.80MHz
VERIFONE OMNI360
0D
L.C
MKR
824.80 MHz
23.50 dBm
CENTER 824.73MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.83dBm
836.43MHz
VERIFONE OMNI360
0D
M.C
MKR
836.43 MHz
23.83 dBm
CENTER 836.40MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.50dBm
848.22MHz
VERIFONE OMNI3600D
H.C
MKR
848.22 MHz
23.50 dBm
R
CENTER 848.19MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.67dBm
1.85130GHz
VERIFONE OMNI3600D
L.C
MKR
1.85130 GHz
23.67 dBm
CENTER 1.85125GHz
SPAN 10.00MHz
RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.83dBm
1.88000GHz
VERIFONE OMNI360
0D
M.C
MKR
1.88000 GHz
23.83 dBm
CENTER 1.88000GHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 50.0ms


ATTEN 40dB
RL 30.0dBm
10dB/
MKR 23.67dBm
1.90877GHz
VERIFONE OMNI360
0D
H.C
MKR
1.90877 GHz
23.67 dBm
CENTER 1.90875GHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
*SWP 50.0ms

6 - DOSIMETRIC ASSESSMENT SETUP

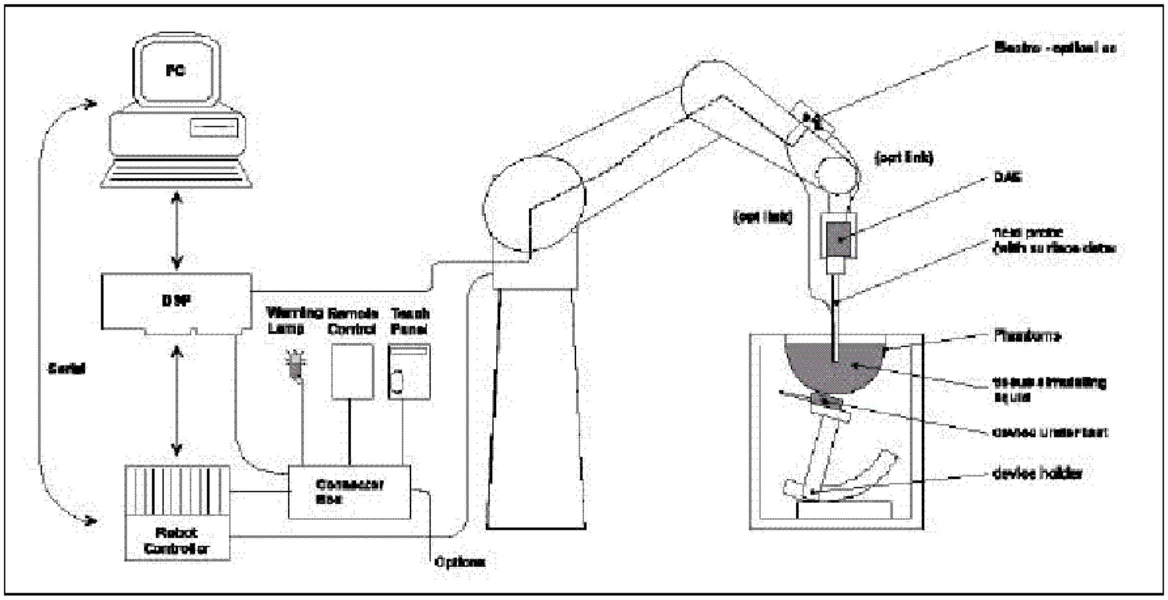
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special 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 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 ±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	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



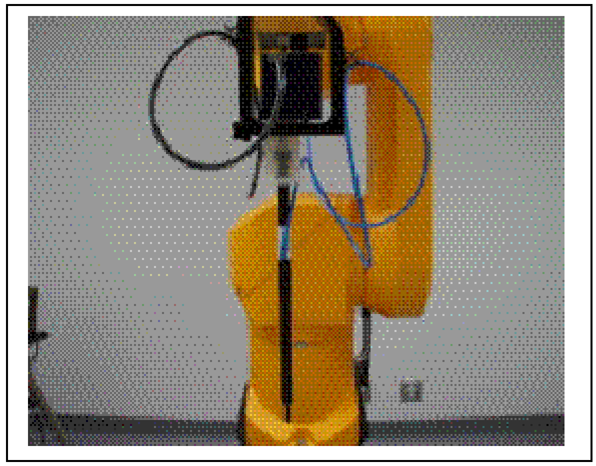
The DASY3 system for performing compliance tests consist of the following items:

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

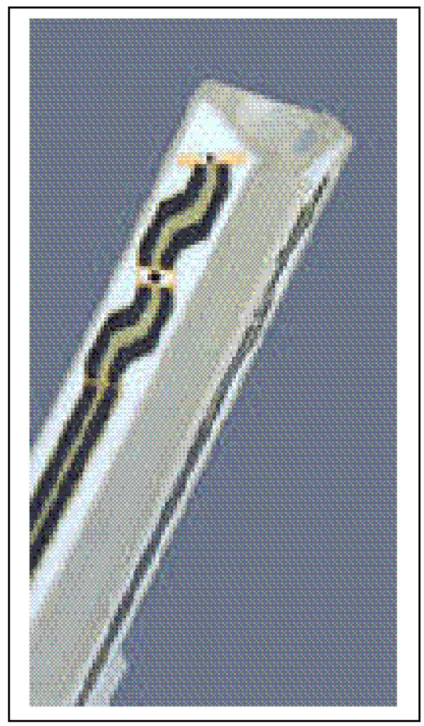
ET3DV6 Probe Specification

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.

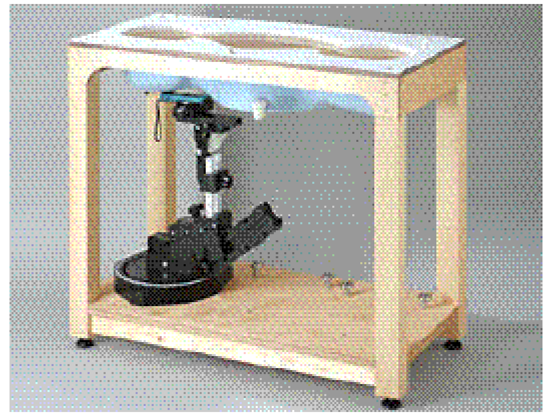
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

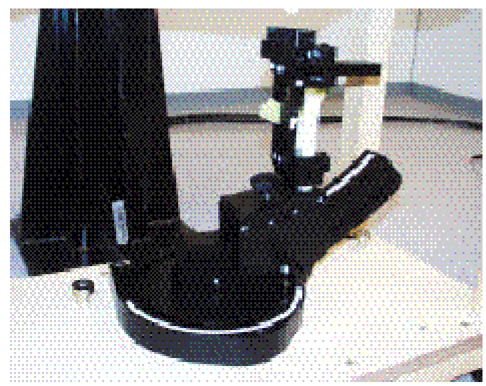


Generic Twin Phantom

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.