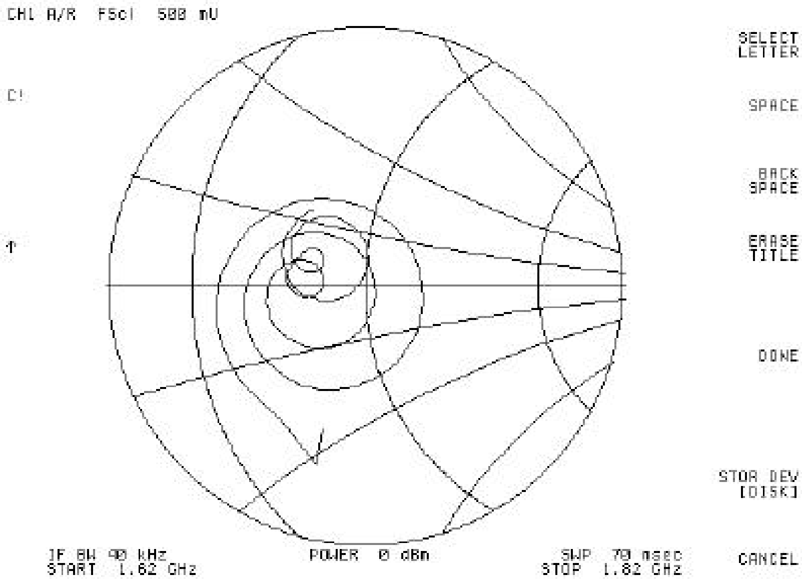
Smith Chart


CH1 A/R FScl 500 mU
SELECT LETTER
SPACE
BACK SPACE
ERASE TITLE
DONE
STOR DEV [DISK]
CANCEL
IF BW 90 kHz
START 1.62 GHz
POWER 0 dBm
SWP 70 msec
STOP 1.82 GHz

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

Client Bay Area Comp. Lab (BACL)

CALIBRATION CERTIFICATE

Object(s)	D900V2 - SN:122
Calibration procedure(s)	QA CAL-05.v2 Calibration procedure for dipole validation kits
Calibration date:	October 3, 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 sensor HP 8481A	MY41092317	18-Oct-02 (Agilent, No. 20021018)	Oct-04
Power sensor HP 8481A	US37292783	30-Oct-02 (METAS, No. 252-0236)	Oct-03
Power meter EPM E442	GB37480704	30-Oct-02 (METAS, No. 252-0236)	Oct-03
RF generator R&S SML-03	100698	27-Mar-2002 (R&S, No. 20-92389)	In house check: Mar-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03

	Name	Function	Signature
Calibrated by:	Judith Mueller	Technician	
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: October 9, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Schmid & Partner Engineering AG

s p e a g

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

DASY

Dipole Validation Kit

Type: D900V2

Serial: 122

Manufactured: July 4, 2001
Calibrated: October 3, 2003

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating solution** of the following electrical parameters at 900 MHz:

Relative Dielectricity	**42.3**	± 5%
Conductivity	**0.96 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.6 at 900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

2. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**10.2 mW/g** ± 16.8 % (k=2)[1]
averaged over 10 cm^3 (10 g) of tissue:	**6.60 mW/g** ± 16.2 % (k=2)[1]

3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

Electrical delay:	**1.409 ns**	(one direction)
Transmission factor:	**0.983**	(voltage transmission, one direction)

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 900 MHz:	Re{Z} = **50.8 Ω**
	Im {Z} = **-5.7 Ω**
Return Loss at 900 MHz	**-24.8 dB**

4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating solution** of the following electrical parameters at 900 MHz:

Relative Dielectricity	**54.4**	± 5%
Conductivity	**1.04 mho/m**	± 5%

The DASY4 System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 6.3 at 900 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from dipole center to the solution surface. The included distance spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.
The dipole input power (forward power) was 250mW ± 3 %. The results are normalized to 1W input power.

5. SAR Measurement with DASY4 System

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ET3DV6 SN:1507 and applying the advanced extrapolation are:

averaged over 1 cm^3 (1 g) of tissue:	**10.7 mW/g** ± 16.8 % (k=2)[2]
averaged over 10 cm^3 (10 g) of tissue:	**6.92 mW/g** ± 16.2 % (k=2)[2]

6. Dipole Impedance and Return Loss

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 900 MHz:	Re{Z} = **47.1 Ω**
	Im {Z} = **-6.7 Ω**
Return Loss at 900 MHz	**-22.6 dB**

7. Handling

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

8. Design

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

9. Power Test

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN122

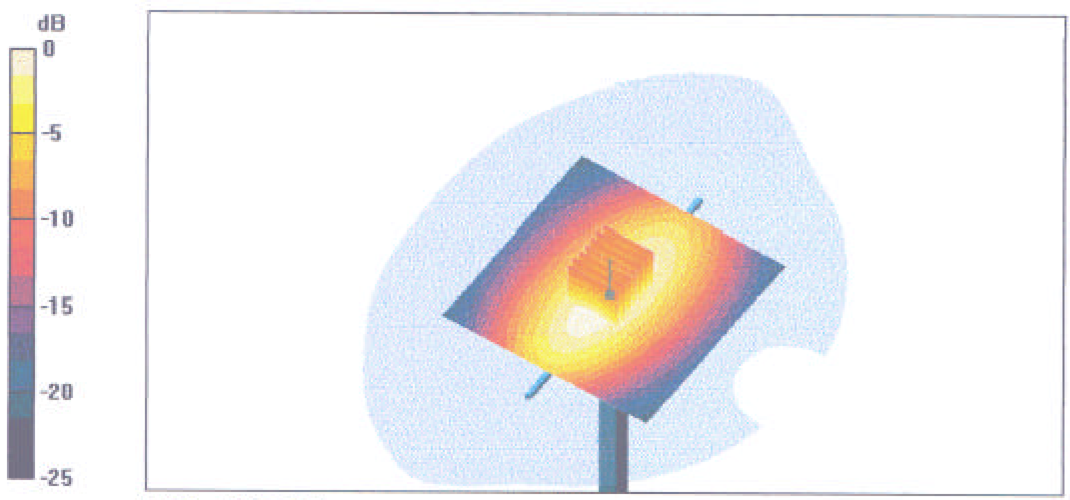
Communication System: CW-900; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: HSL 900 MHz (σ = 0.96 mho/m, ε_r = 42.26, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

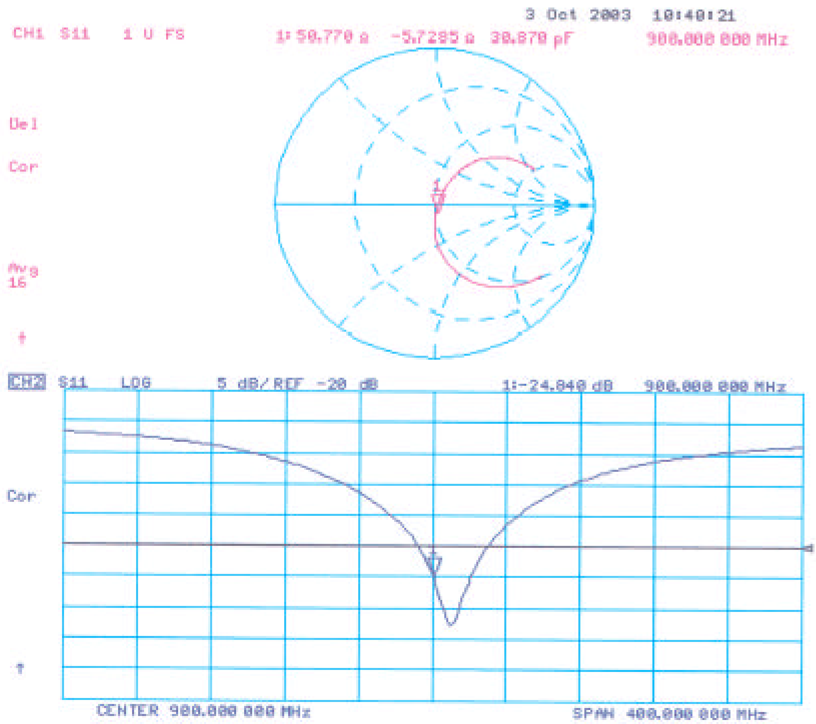
- Probe: ET3DV6 - SN1507; ConvF(6.6, 6.6, 6.6); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- *Electronics: DAE3 - SN411; Calibrated: 1/16/2003*
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 55.6 V/m
Power Drift = 0.003 dB
Maximum value of SAR = 2.75 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.81 W/kg
SAR(1 g) = 2.55 mW/g; SAR(10 g) = 1.65 mW/g
Reference Value = 55.6 V/m
Power Drift = 0.003 dB
Maximum value of SAR = 2.76 mW/g



0 dB = 2.76mW/g


3 Oct 2003 10:40:21
CH1 S11 1 U FS
1: 50.770 Ω -5.7295 Ω 30.870 pF 900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/ REF -20 dB 1:-24.040 dB 900.000 000 MHz
Cor
CENTER 900.000 000 MHz
SPAN 400.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 900 MHz; Type: D900V2; Serial: D900V2 - SN122

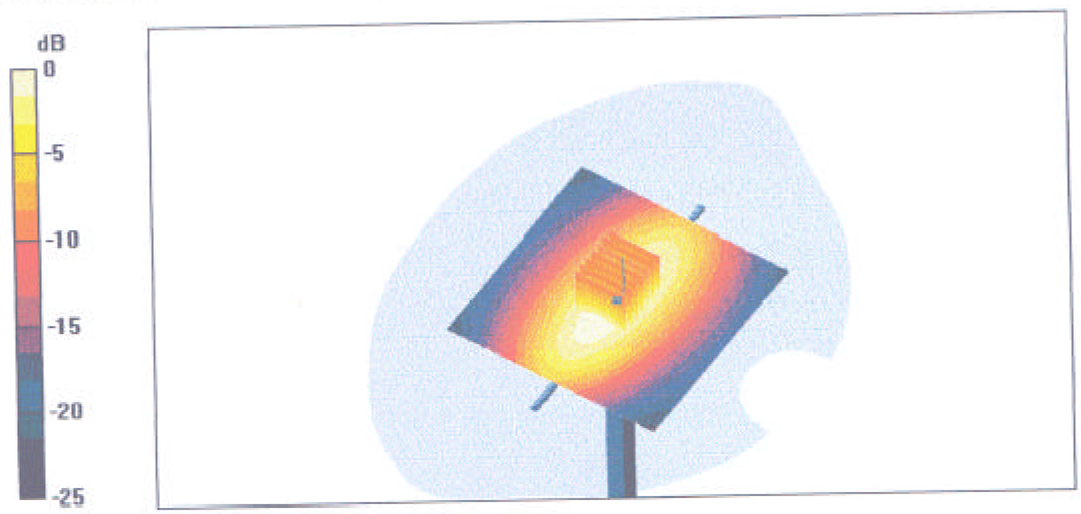
Communication System: CW-900; Frequency: 900 MHz;Duty Cycle: 1:1
Medium: Muscle 900 MHz (σ = 1.04 mho/m, ε_r = 54.38, ρ = 1000 kg/m^3)
Phantom section: Flat Section
Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ET3DV6 - SN1507; ConvF(6.3, 6.3, 6.3); Calibrated: 1/18/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: *DAE3 - SN411; Calibrated: 1/16/2003*
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.8 Build 60

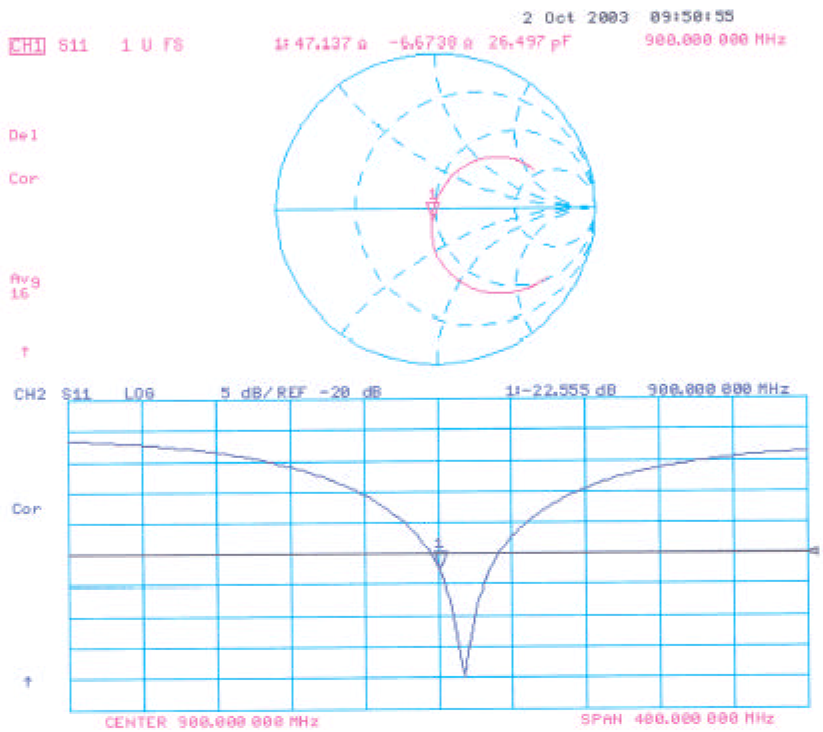
Pin = 250 mW; d = 15 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Reference Value = 55 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 2.87 mW/g

Pin = 250 mW; d = 15 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Peak SAR (extrapolated) = 3.92 W/kg
SAR(1 g) = 2.67 mW/g; SAR(10 g) = 1.73 mW/g
Reference Value = 55 V/m
Power Drift = 0.0 dB
Maximum value of SAR = 2.88 mW/g



0 dB = 2.88mW/g

Body


2 Oct 2003 09:50:55
CH1 S11 1 U FS
1: 47.137 Ω -6.6730 Ω 26.497 pF
900.000 000 MHz
Del
Cor
Avg
16
CH2 S11 LOG
5 dB/ REF -20 dB
1:-22.555 dB
900.000 000 MHz
Cor
CENTER 900.000 000 MHz
SPAN 400.000 000 MHz

835 MHZ Body Liquid Validation
Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C , 2004/8/2

frequency	e'	e''
815000000.0000	52.8436	21.6487
815800000.0000	52.8270	21.6106
816600000.0000	52.8738	21.5509
817400000.0000	52.8161	21.5609
818200000.0000	52.8532	21.5382
819000000.0000	52.7440	21.5274
819800000.0000	52.8197	21.5457
820600000.0000	52.8072	21.4599
821400000.0000	52.8993	21.5114
822200000.0000	52.8421	21.4938
823000000.0000	52.7553	21.5184
823800000.0000	52.7870	21.4661
824600000.0000	52.7889	21.4838
825400000.0000	52.8093	21.4647
826200000.0000	52.8058	21.4345
827000000.0000	52.7859	21.3896
827800000.0000	52.7181	21.4052
828600000.0000	52.7808	21.3880
829400000.0000	52.7517	21.3708
830200000.0000	52.6678	21.3259
831000000.0000	52.7450	21.3289
831800000.0000	52.7306	21.3319
832600000.0000	52.7200	21.3329
833400000.0000	52.7240	21.3084
834200000.0000	52.7134	21.3277
835000000.0000	52.7185	21.3141
835800000.0000	52.7134	21.3115
836600000.0000	52.7073	21.2544
837400000.0000	52.7222	21.2154
838200000.0000	52.6973	21.2237
839000000.0000	52.6904	21.1958
839800000.0000	52.6365	21.1643
840600000.0000	52.6514	21.1254
841400000.0000	52.6410	21.0904
842200000.0000	52.6779	21.1311
843000000.0000	52.6875	21.1267
843800000.0000	52.6411	21.1099
844600000.0000	52.6923	21.1161
845400000.0000	52.6151	21.0743
846200000.0000	52.5523	20.9801
847000000.0000	52.5457	20.9524
847800000.0000	52.6113	20.9783
848600000.0000	52.5992	20.9400
849400000.0000	52.5644	20.9898
850200000.0000	52.4880	20.9842
851000000.0000	52.5332	20.9168
851800000.0000	52.5664	20.9320
852600000.0000	52.5566	20.9331
853400000.0000	52.5162	20.9184
854200000.0000	52.5080	20.9052
855000000.0000	52.5031	20.8456

$s = w e_o e'' = 2\,p\,f e_o e'' = 0.99$

where $f = 835 \times 10^6$

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

$e'' = 21.3141$

835 MHZ Head Liquid Validation
Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C , 2004/8/2

frequency	e'	e''
815000000.0000	41.1038	19.7028
815800000.0000	41.0235	19.6892
816600000.0000	40.9890	19.6357
817400000.0000	40.9580	19.6122
818200000.0000	40.9566	19.5972
819000000.0000	40.9327	19.6091
819800000.0000	40.9022	19.5988
820600000.0000	40.9135	19.5539
821400000.0000	40.8799	19.5346
822200000.0000	40.8961	19.5108
823000000.0000	40.8354	19.4983
823800000.0000	40.8167	19.4590
824600000.0000	40.8033	19.4067
825400000.0000	40.7895	19.3510
826200000.0000	40.7780	19.3266
827000000.0000	40.7961	19.2988
827800000.0000	40.7873	19.3159
828600000.0000	40.7600	19.2960
829400000.0000	40.7811	19.2381
830200000.0000	40.7650	19.2037
831000000.0000	40.7265	19.1698
831800000.0000	40.7112	19.1258
832600000.0000	40.6200	19.1021
833400000.0000	40.6031	19.0987
834200000.0000	40.6216	19.0326
835000000.0000	40.5638	19.0283
835800000.0000	40.5536	19.0239
836600000.0000	40.5403	19.0026
837400000.0000	40.5367	18.9826
838200000.0000	40.5490	18.9768
839000000.0000	40.5388	18.9753
839800000.0000	40.5128	18.8937
840600000.0000	40.5200	18.7982
841400000.0000	40.5009	18.7358
842200000.0000	40.4837	18.7467
843000000.0000	40.4908	18.7322
843800000.0000	40.4761	18.7231
844600000.0000	40.4633	18.7026
845400000.0000	40.4550	18.6982
846200000.0000	40.4430	18.6791
847000000.0000	40.4267	18.6649
847800000.0000	40.4191	18.6024
848600000.0000	40.3826	18.5873
849400000.0000	40.3710	18.5634
850200000.0000	40.3566	18.5027
851000000.0000	40.3328	18.4768
851800000.0000	40.3207	18.4651
852600000.0000	40.3001	18.4325
853400000.0000	40.2988	18.3895
854200000.0000	40.2891	18.3756
855000000.0000	40.2905	18.3655

$s = w e_o e'' = 2 p f e_o e'' = 0.8839$

where $f = 835x\ 10^{6}$

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

$e'' = 19.0283$

1900 MHZ Body Liquid Validation
Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 2004/8/4

frequency	e'	e''
1850000000.0000	52.4329	13.9304
1852000000.0000	52.4374	13.9426
1854000000.0000	52.4346	13.9272
1856000000.0000	52.4014	13.9306
1858000000.0000	52.3063	13.9237
1860000000.0000	52.2688	13.9402
1862000000.0000	52.2881	13.9549
1864000000.0000	52.2694	13.9800
1866000000.0000	52.3075	13.9808
1868000000.0000	52.3138	14.0021
1870000000.0000	52.3081	14.0172
1872000000.0000	52.2924	14.0496
1874000000.0000	52.3188	14.0662
1876000000.0000	52.3427	14.1498
1878000000.0000	52.3473	14.1998
1880000000.0000	52.3349	14.2205
1882000000.0000	52.3379	14.2578
1884000000.0000	52.2618	14.2453
1886000000.0000	52.1670	14.2322
1888000000.0000	52.1318	14.2355
1890000000.0000	52.1376	14.2581
1892000000.0000	52.1572	14.3293
1894000000.0000	52.1185	14.3302
1896000000.0000	52.1063	14.2952
1898000000.0000	52.0097	14.3081
1900000000.0000	52.0068	14.3128
1902000000.0000	52.0185	14.3502
1904000000.0000	51.9497	14.3368
1906000000.0000	51.8781	14.3347
1908000000.0000	51.8781	14.3358
1910000000.0000	51.8926	14.3585
1912000000.0000	51.9353	14.3799
1914000000.0000	51.9952	14.4301
1916000000.0000	52.0259	14.4043
1918000000.0000	52.0210	14.4125
1920000000.0000	51.9668	14.3985
1922000000.0000	51.9627	14.4206
1924000000.0000	51.9986	14.4363
1926000000.0000	52.1264	14.5207
1928000000.0000	52.1940	14.5454
1930000000.0000	52.2197	14.5451
1932000000.0000	52.1936	14.4995
1934000000.0000	52.1848	14.5095
1936000000.0000	52.2190	14.5122
1938000000.0000	52.2206	14.5458
1940000000.0000	52.2359	14.5485
1942000000.0000	52.2838	14.5740
1944000000.0000	52.2643	14.6032
1946000000.0000	52.2475	14.5748
1948000000.0000	52.2419	14.5730
1950000000.0000	52.2356	14.5950

$s = w e_o e'' = 2\, p\, f e_o e'' = 1.512$

where $f = 1900 \times 10^6$

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

$e'' = 14.3128$

1900 MHZ Head Liquid Validation
Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 2004/8/4

frequency	e'	e''
1850000000.0000	39.7747	13.6335
1852000000.0000	39.7971	13.6536
1854000000.0000	39.7837	13.6500
1856000000.0000	39.8059	13.6730
1858000000.0000	39.7006	13.6683
1860000000.0000	39.7055	13.6735
1862000000.0000	39.7574	13.7253
1864000000.0000	39.7957	13.7510
1866000000.0000	39.8616	13.7615
1868000000.0000	39.9044	13.8371
1870000000.0000	39.9254	13.8610
1872000000.0000	39.9666	13.8894
1874000000.0000	40.0159	13.9082
1876000000.0000	40.0578	13.9467
1878000000.0000	40.0889	13.9755
1880000000.0000	40.0788	13.9526
1882000000.0000	40.0742	13.9521
1884000000.0000	39.9934	13.8654
1886000000.0000	39.8618	13.8010
1888000000.0000	39.8091	13.7690
1890000000.0000	39.8330	13.7419
1892000000.0000	39.8870	13.7751
1894000000.0000	39.8955	13.7396
1896000000.0000	39.8818	13.6908
1898000000.0000	39.7089	13.6500
1900000000.0000	39.7252	13.6266
1902000000.0000	39.7440	13.6094
1904000000.0000	39.5899	13.5214
1906000000.0000	39.4460	13.4571
1908000000.0000	39.4539	13.4520
1910000000.0000	39.4694	13.4406
1912000000.0000	39.4446	13.4318
1914000000.0000	39.4619	13.4533
1916000000.0000	39.4904	13.4199
1918000000.0000	39.5361	13.4249
1920000000.0000	39.3987	13.3992
1922000000.0000	39.3992	13.3978
1924000000.0000	39.3741	13.3975
1926000000.0000	39.4501	13.4160
1928000000.0000	39.5210	13.4654
1930000000.0000	39.5446	13.4601
1932000000.0000	39.5082	13.4589
1934000000.0000	39.4495	13.4746
1936000000.0000	39.4634	13.5068
1938000000.0000	39.4173	13.4851
1940000000.0000	39.3854	13.4855
1942000000.0000	39.3782	13.4779
1944000000.0000	39.3440	13.5122
1946000000.0000	39.3270	13.5237
1948000000.0000	39.3108	13.5451
1950000000.0000	39.2730	13.5933

$s = w e_o e" = 2\ p\ f e_o e" = 1.44$

where $f = 1900 \times 10^{6}$

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

$e" = 13.6266$

3 - EUT DESCRIPTION

Applicant:	VeriFone Inc.
Product Description:	Wireless POS Terminal
Product Model Number:	OMNI56XXC
FCC ID:	B32OMNI56XXC
Serial Number:	60137F09-01
Maximum RF Output Power:	23.50dBm for CDMA800
	23.30dBm for CDMA1900
RF Exposure environment:	General Population/Uncontrolled
Applicable Standard	FCC CFR 47, Part 22, Part 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 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: 2004-08-25.
Hewlett Packard HP 7470A Plotter, Calibration not required.
A.H. Systems SAS200 Horn Antenna, Calibration Due Date: 2004-08-01
Com-Power AD-100 Dipole Antenna, Calibration Due Date: 2004-09-26

5.4 Test Results

800 MHz

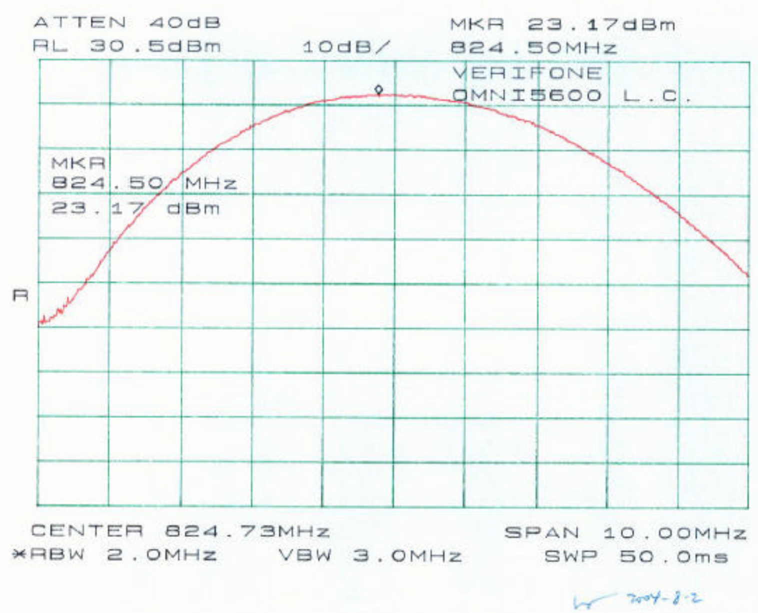
Modulation Type	Channel	Frequency (MHz)	Output Power in dBm	Output Power in W	Limit (W)
CDMA	Low	824.50	23.17	0.207	7
	Middle	836.15	23.50	0.224	7
	High	848.19	23.33	0.215	7

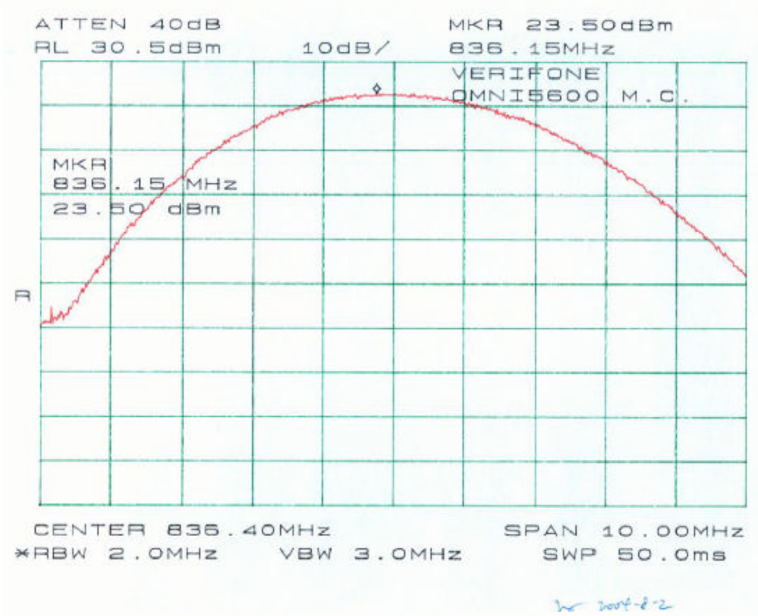
1900 MHz

Modulation Type	Channel	Frequency (MHz)	Output Power in dBm	Output Power in W	Limit (W)
CDMA	Low	1851.25	22.80	0.191	7
	Middle	1879.75	23.30	0.214	7
	High	1908.80	22.97	0.198	7

Please refer to the following plots.

800MHz


ATTEN 40dB
RL 30.5dBm
10dB/
MKR 23.17dBm
824.50MHz
VERIFONE
OMNI5600 L.C.
MKR
824.50 MHz
23.17 dBm
CENTER 824.73MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms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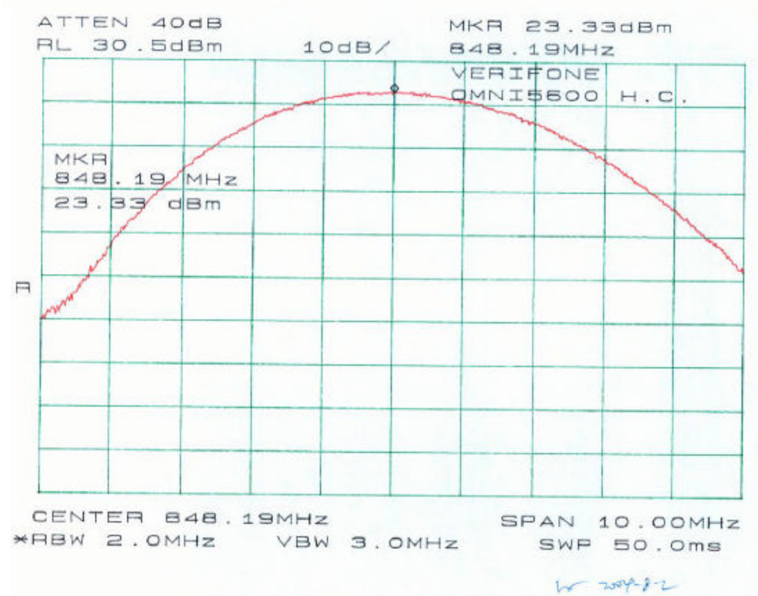
RL 30.5dBm
10dB/
MKR 23.50dBm
836.15MHz
VERIFONE
OMNI5600 M.C.
MKR
836.15 MHz
23.50 dBm
CENTER 836.40MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms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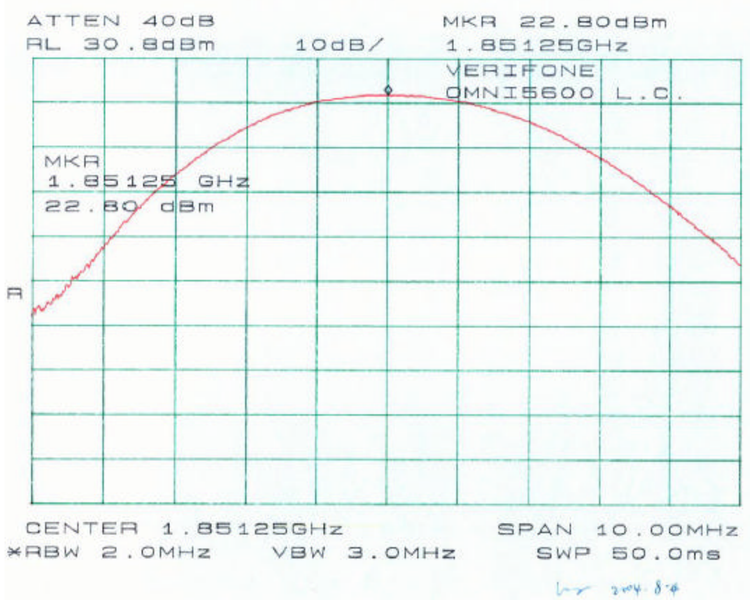
RL 30.5dBm
10dB/
MKR 23.33dBm
848.19MHz
VERIFONE
OMNI5600 H.C.
MKR
848.19 MHz
23.33 dBm
CENTER 848.19MHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms

1900MHz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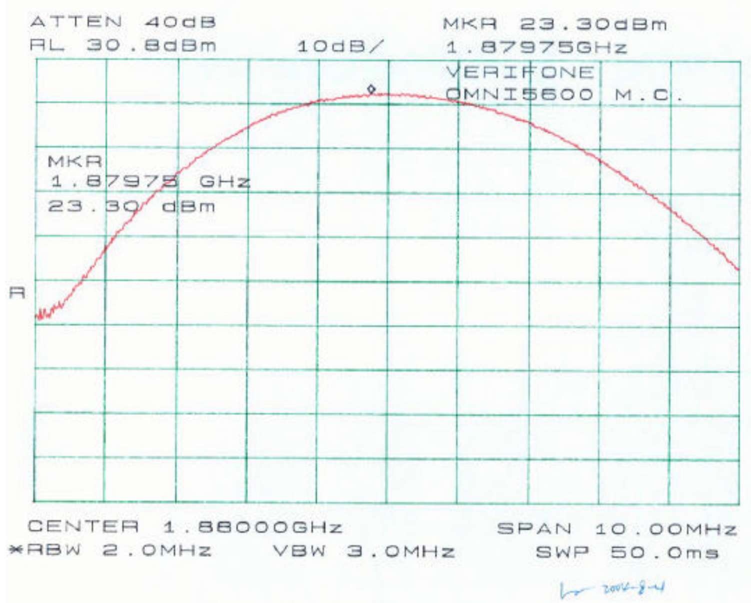
10dB/
MKR 22.80dBm
1.85125GHz
VERIFONE
OMNI5600 L.C.
MKR
1.85125 GHz
22.80 dBm
CENTER 1.85125GHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms


ATTEN 40dB
RL 30.8dBm
10dB/
MKR 23.30dBm
1.87975GHz
VERIFONE
OMNI5600 M.C.
MKR
1.87975 GHz
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CENTER 1.88000GHz
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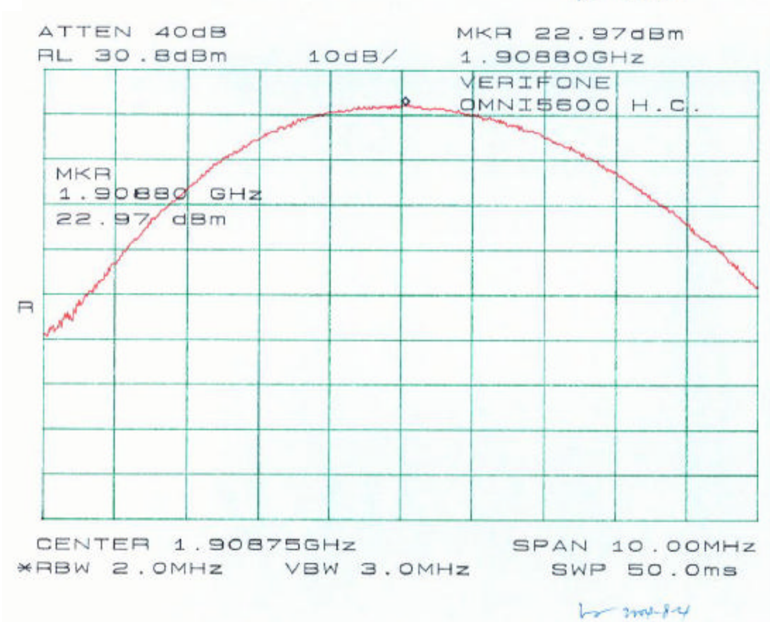
VBW 3.0MHz
SWP 50.0ms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RL 30.8dBm
10dB/
MKR 22.97dBm
1.90880GHz
VERIFONE
OMNI5600 H.C.
MKR
1.90880 GHz
22.97 dBm
CENTER 1.90875GHz
SPAN 10.00MHz
*RBW 2.0MHz
VBW 3.0MHz
SWP 50.0ms

6 - DOSIMETRIC ASSESSMENT SETUP

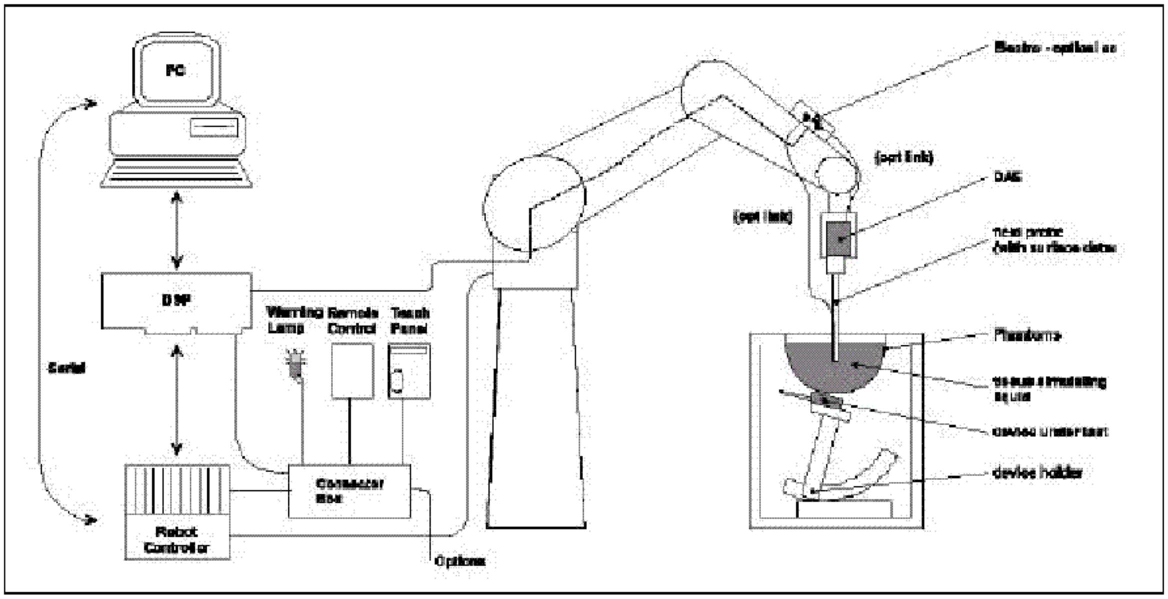
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m) which positions the probes with a positional repeatability of better than ±0.02mm. Special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

ES3DV2 Probe Specification

Photograph of the probe

Construction	Symmetrical design with triangular core Interleafed sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., glycol)
Calibration	In air from 10 MHz to 3 GHz In brain and muscle simulating tissue at frequencies of 450 MHz, 900 MHz and 1.8 GHz (accuracy ± 8%) Calibratin for other liquids and frequencies upon request
Frequency	10 MHz to > 6GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in brain tissue (rotation around probe axis) ± 0.3 dB in brain tissue (rotation normal to probe axis)
Dynamic Range	5μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm Tip length: 20 mm Body diameter: 12 mm Tip diameter: 3.9 mm Distance from probe tip to dipole centers: 2.7 mm
Application:	General dosimetry up to 5 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

The SAR measurements were conducted with the dosimetric probe ET3DV2 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 ES3DV2 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	s
	-Density	?

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.

$$SAR = (E_{tot})^2 ?s /(? ?1000)$$

With SAR = local specific absorption rate in mW/g
E_{tot} = total field strength in V/m
s = conductivity in [mho/m] or [Siemens/m]
? = 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.

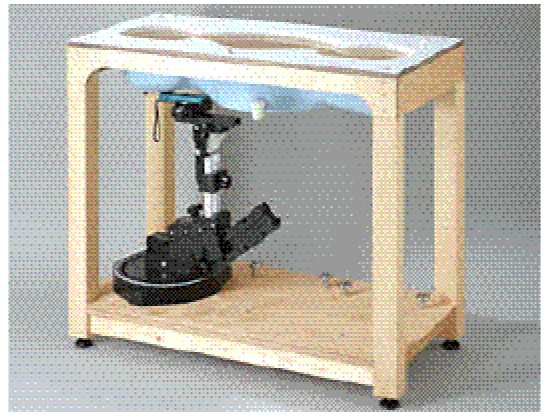
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

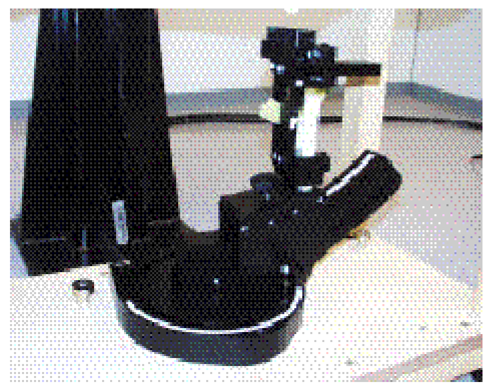


Generic Twin Phantom

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 permitiv ity, 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 - EVALUATION PROCEDURE

7.1 Body SAR Evaluation Procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location within an anthropomorphic torso simulation shell was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the torso was measured at the required distance from the inner surface of the shell. The area covered the entire dimension of the EUT and the horizontal grid spacing was 20 mm x 20 mm. Based on these data, the area of the maximum absorption was determined by spline interpolation.

Step 3: Around this point, a volume of 32 mm x 32 mm x 34 mm was assessed by measuring 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated under the following procedure:

1. The data at the surface were extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm [11]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

2. The maximum interpolated value was searched with a straightforward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed by the 3D-Spline interpolation algorithm. The 3D-Spline is composed of three one dimensional splines with the “Not a knot"-condition (in x, y and z-directions) [11], [12]. The volume was integrated with the trapezoidal-algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

3. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

Step 4: Re-measurement of the SAR value at the same location as in Step 1. If the value changed by more than 5%, the evaluation was repeated.

7.2 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).

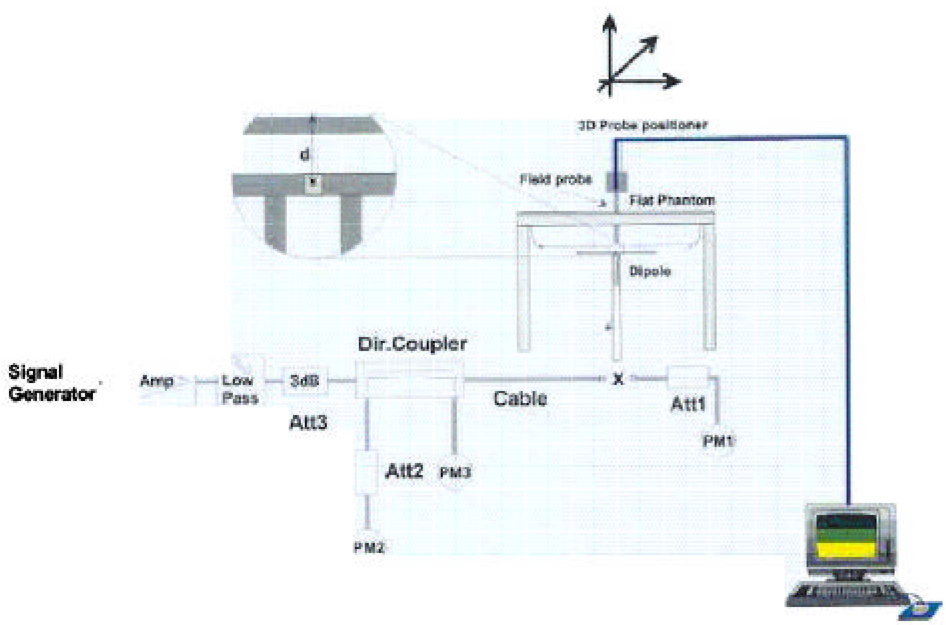
Population/uncontrolled environments Partial-body limit 1.6W/kg applied to the EUT.

7.3 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:

7.4 SAR Measurement

The SAR measurement was performed with the E-field probe in mechanical detection mode only. The setup and determination of the forward power into the dipole was performed using the following procedures.



First, the power meter PM1 (including attenuator Att1) is connected to the cable to measure the forward power at the location of the dipole connector (X). The signal generator is adjusted for the desired forward power at he dipole connector (taking into account the attenuation of Att1) as read by power meter PM2. after connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2. If the signal generator does not allow adjustment in 0.01dB steps, the remaining difference at PM 2 must be taken into consideration. PM3 records the reflected power from the dipole to ensure that the value is not changed form the previous value. The reflected power should be 20dB below the forward power.

The SAR measurements were performed in order to achieve repeatability and to establish an average target value.

7.5 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 for head

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 (835 MHz)

Validation Measurement	SAR @ 0.025W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.025W Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	0.222	8.88	0.112	4.48
Test 2	0.221	8.84	0.111	4.44
Test 3	0.222	8.88	0.112	4.48
Test 4	0.220	8.80	0.111	4.44
Test 5	0.223	8.92	0.113	4.52
Test 6	0.222	8.88	0.115	4.60
Test 7	0.221	8.84	0.114	4.56
Test 8	0.222	8.88	0.114	4.56
Test 9	0.223	8.92	0.113	4.52
Test 10	0.222	8.88	0.112	4.48
Average	0.2218	8.872	0.1127	4.51

Validation Dipole SAR Reference Test Result for Body (1900 MHz)

Validation Measurement	SAR @ 0.126W Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 0.126W Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	3.1	24.61	1.42	11.27
Test 2	3.1	24.61	1.41	11.20
Test 3	3.2	25.41	1.43	11.35
Test 4	3.2	25.41	1.42	11.27
Test 5	3.1	24.61	1.42	11.27
Test 6	3.2	25.61	1.41	11.20
Test 7	3.2	25.61	1.43	11.35
Test 8	3.1	24.61	1.42	11.27
Test 9	3.1	24.61	1.42	11.27
Test 10	3.1	24.61	1.43	11.35
Average	3.14	24.97	1.421	11.28

7.6 Liquid Measurement Result

2004-08-02

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation	Limits [%]
Body	835	ε_r	22.0	55.2	52.7	-4.53	±5
		σ	22.0	0.97	0.99	2.06	±5
		1g SAR	22.0	8.872	8.90	0.32	±10
Head	835	ε_r	22.0	41.5	40.6	-2.17	±5
		σ	22.0	0.90	0.88	-2.22	±5
		1g SAR	22.0	9.5	9.58	0.84	±10

ε_r = relative permittivity, σ = conductivity and ρ=1000kg/m^3

Liquid Forward Power for body = 20.4 dBm = 109.65 mW
Liquid Forward Power for head = 20.4 dBm = 109.65 mW

2004-08-04

Simulant	Freq [MHz]	Parameters	Liquid Temp [ºC]	Target Value	Measured Value	Deviation	Limits [%]
Body	1900	ε_r	22.0	53.3	52.0	-2.44	±5
		σ	22.0	1.52	1.51	-0.66	±5
		1g SAR	22.0	24.97	26.38	5.65	±10
Head	1900	ε_r	22.0	40.0	39.7	-0.75	±5
		σ	22.0	1.40	1.44	2.86	±5
		1g SAR	22.0	39.7	40.59	2.24	±10

ε_r = relative permittivity, σ = conductivity and ρ=1000kg/m^3

Liquid Forward Power for body = 20.5 dBm = 112.20 mW
Liquid Forward Power for head = 20.6 dBm = 114.82 mW