

# SAR EVALUATION REPORT

For

## High Tech Computer, Corp.

23, Hsin-Hua Rd.,  
Taoyuan, 330, Taiwan

**FCC ID: NM8HARRIER**

<b>This Report Concerns:</b> <input checked="" type="checkbox"/> Original Report	<b>Equipment Type:</b> CDMA 800/1900 + Bluetooth PDA Phone
<b>Test Engineer:</b> Eric Hong / <i>HONG</i> Daniel Deng / <i>[Signature]</i>	
<b>Report No.:</b> R0407195S	
<b>Report Date:</b> 2004-08-05	
<b>Reviewed By:</b> Ling Zhang / <i>[Signature]</i>	
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## SUMMARY

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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:

Model: PH20A2

Mode	Position	Frequency (MHz)	Output Power (dBm)	Test Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)	Limit (mW/g)	Plot #
CDMA800	Body Back Touching	836	24.83	Body worn	Body	Flat	Headset & Pouch	0.0184	1.6	1
	Face Touching	836	24.83	Body worn	Body	Flat	Headset & Pouch	0.0174	1.6	2
	Left Head Cheek	836	24.83	Face-held	Head	Head	/	0.0268	1.6	3
	Left Head Tilted	836	24.83	Face-held	Head	Head	/	0.0302	1.6	4
	Right Head Cheek	836	24.83	Face-held	Head	Head	/	0.0231	1.6	5
	Right Head Tilted	836	24.83	Face-held	Head	Head	/	0.0926	1.6	6
CDMA1900	Body Back Touching	1851	24.67	Body worn	Body	Flat	Headset & Pouch	1.01	1.6	7
		1880	24.83	Body worn	Body	Flat	Headset & Pouch	1.30	1.6	8
		1908	24.67	Body worn	Body	Flat	Headset & Pouch	1.16	1.6	9
		1880	24.83	Body worn	Body	Flat	Memory Card, Headset & Pouch	1.17	1.6	10
	Left Head Cheek	1880	24.83	Face-held	Head	Head	/	0.122	1.6	11
	Left Head Tilted	1880	24.83	Face-held	Head	Head	/	0.105	1.6	12
	Right Head Cheek	1880	24.83	Face-held	Head	Head	/	0.115	1.6	13
	Right Head Tilted	1880	24.83	Face-held	Head	Head	/	0.110	1.6	14
CDMA2000 Cellular Band	Body Back Touching	836	24.67	Body worn	Body	Flat	/	0.748	1.6	15
CDMA2000 PCS Band	Body Back Touching	1851	24.33	Body worn	Body	Flat	/	1.28	1.6	16
	Body Back Touching	1880	24.33	Body worn	Body	Flat	/	1.41	1.6	17
	Body Back Touching	1908	23.50	Body worn	Body	Flat	/	1.24	1.6	18

Model: PH20A3

Mode	Position	Frequency (MHz)	Output Power (dBm)	Test Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)	Limit (mW/g)	Note	Plot #
CDMA800	Body Back Touching	836	24.50	Body worn	Body	Flat	Headset & Pouch & Memory Card	0.110	1.6	Bluetooth Off	19
	Face Touching	836	24.50	Body worn	Body	Flat	Headset & Pouch & Memory Card	0.198	1.6	Bluetooth On	20
	Left Head Cheek	836	24.50	Face-held	Head	Head	/	0.0174	1.6	/	21
	Left Head Tilted	836	24.50	Face-held	Head	Head	/	0.0111	1.6	/	22
	Right Head Cheek	836	24.50	Face-held	Head	Head	/	0.0157	1.6	/	23
	Right Head Tilted	836	24.50	Face-held	Head	Head	/	0.0134	1.6	/	24
CDMA1900	Body Back Touching	1851	24.50	Body worn	Body	Flat	Headset & Pouch & Memory Card	1.14	1.6	Bluetooth Off	25
		1880	24.50	Body worn	Body	Flat	Headset & Pouch & Memory Card	1.38	1.6	Bluetooth On	26
		1908	24.50	Body worn	Body	Flat	Headset & Pouch	1.22	1.6	Bluetooth On	27
		1880	24.50	Body worn	Body	Flat	Memory Card, Headset & Pouch	0.985	1.6	Bluetooth On	28
	Left Head Cheek	1880	24.50	Face-held	Head	Head	/	0.0925	1.6	/	29
	Left Head Tilted	1880	24.50	Face-held	Head	Head	/	0.0647	1.6	/	30
	Right Head Cheek	1880	24.50	Face-held	Head	Head	/	0.0801	1.6	/	31
	Right Head Tilted	1880	24.50	Face-held	Head	Head	/	0.0565	1.6	/	32
CDMA2000 Cellular Band	Body Back Touching	836	24.67	Body worn	Body	Flat	Cable & Memory Card	0.722	1.6	Bluetooth Off	33
								0.781		Bluetooth On	34
CDMA2000 PCS Band	Body Back Touching	1851	24.33	Body worn	Body	Flat	Cable & Memory Card	1.29	1.6	Bluetooth On	35
	Body Back Touching	1880	24.50	Body worn	Body	Flat	Cable & Memory Card	1.31	1.6	Bluetooth Off	36
								1.47		Bluetooth On	37
Body Back Touching	1908	23.50	Body worn	Body	Flat	Cable & Memory Card	1.16	1.6	Bluetooth On	38	

## 1 - REFERENCE

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## 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	2003-08-26	456
SPEAG E-Field Probe ET3DV6	2003-08-26	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	2003-09-02	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

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## 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:

Doris Klatka

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

**Client** Bay Area Comp. Lab (BACL)

CALIBRATION CERTIFICATE																																			
Object(s)	E33DV2 - SN:3019																																		
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes																																		
Calibration date:	October 9, 2003																																		
Condition of the calibrated item	In Tolerance (according to the specific calibration document)																																		
<p>This calibration statement documents traceability of M&amp;TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.</p> <p>All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity &lt; 75%.</p> <p>Calibration Equipment used (M&amp;TE critical for calibration)</p> <table border="1"> <thead> <tr> <th>Model Type</th> <th>ID #</th> <th>Cal Date (Calibrated by, Certificate No.)</th> <th>Scheduled Calibration</th> </tr> </thead> <tbody> <tr> <td>Power meter EPM E4419B</td> <td>GB41293874</td> <td>2-Apr-03 (METAS, No 252-0250)</td> <td>Apr-04</td> </tr> <tr> <td>Power sensor E4412A</td> <td>MY41495277</td> <td>2-Apr-03 (METAS, No 252-0250)</td> <td>Apr-04</td> </tr> <tr> <td>Reference 20 dB Attenuator</td> <td>SN: 5086 (20b)</td> <td>3-Apr-03 (METAS No. 251-0340)</td> <td>Apr-04</td> </tr> <tr> <td>Fluke Process Calibrator Type 702</td> <td>SN: 6295803</td> <td>8-Sep-03 (Sintrel SCS No. E-030020)</td> <td>Sep-04</td> </tr> <tr> <td>Power sensor HP 8481A</td> <td>MY41092180</td> <td>18-Sep-02 (Agilent, No. 20020918)</td> <td>In house check: Oct 03</td> </tr> <tr> <td>RF generator HP 8684C</td> <td>US3642U01700</td> <td>4-Aug-99 (SPEAG, In house check Aug-02)</td> <td>In house check: Aug-05</td> </tr> <tr> <td>Network Analyzer HP 8753E</td> <td>US37390585</td> <td>18-Oct-01 (Agilent, No. 24BR1033101)</td> <td>In house check: Oct 03</td> </tr> </tbody> </table>				Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration	Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04	Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04	Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04	Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04	Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	In house check: Oct 03	RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, In house check Aug-02)	In house check: Aug-05	Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
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Calibrated by:	Name Nico Velters	Function Technician	Signature 																																
Approved by:	Name Kerja Rokowo	Function Laboratory Director	Signature 																																
Date issued: October 9, 2003																																			
<p>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 &amp; Partner Engineering AG is completed.</p>																																			

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# Probe ES3DV2

## SN:3019

### Additional Conversion Factors

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

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

## DASY - Parameters of Probe: ES3DV2 SN:3019

### Sensitivity in Free Space

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

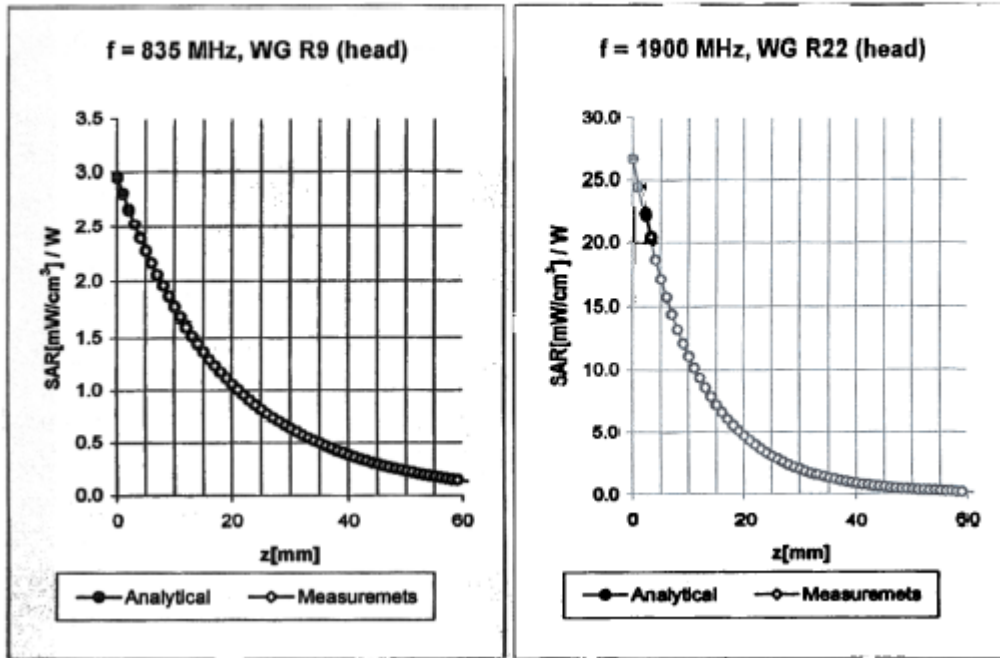
### Diode Compression

DCP X	99
DCP Y	99
DCP Z	99

### Sensor Offset

Probe Tip to Sensor Center	2.1	mm
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### Conversion Factor Assessment



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

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

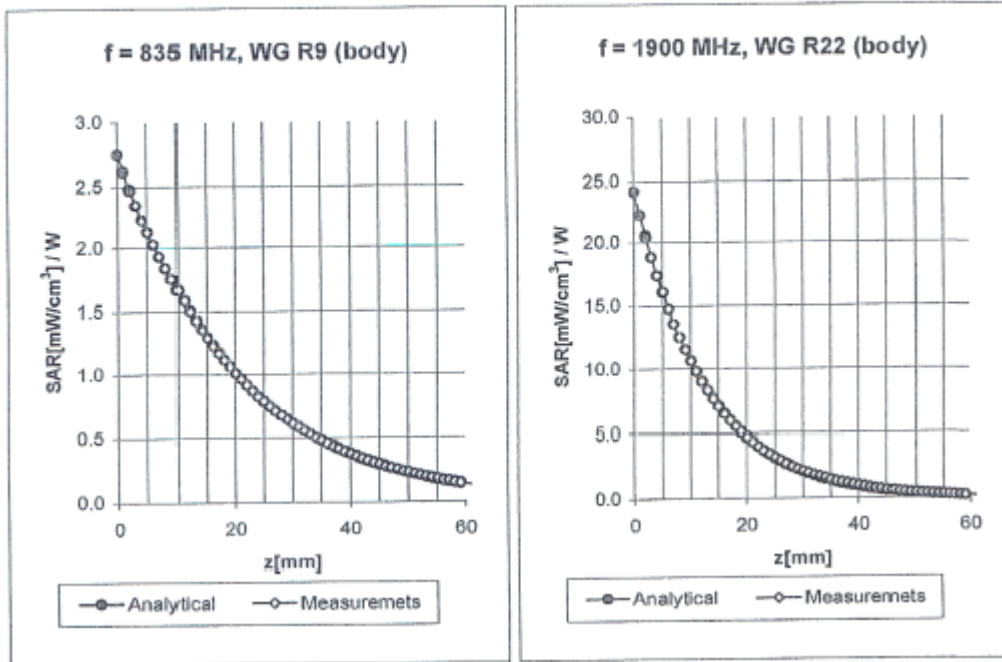
ConvF X	6.5 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.5 ± 9.5% (k=2)	Alpha	0.35
ConvF Z	6.5 ± 9.5% (k=2)	Depth	1.46

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

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

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

### Conversion Factor Assessment



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

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

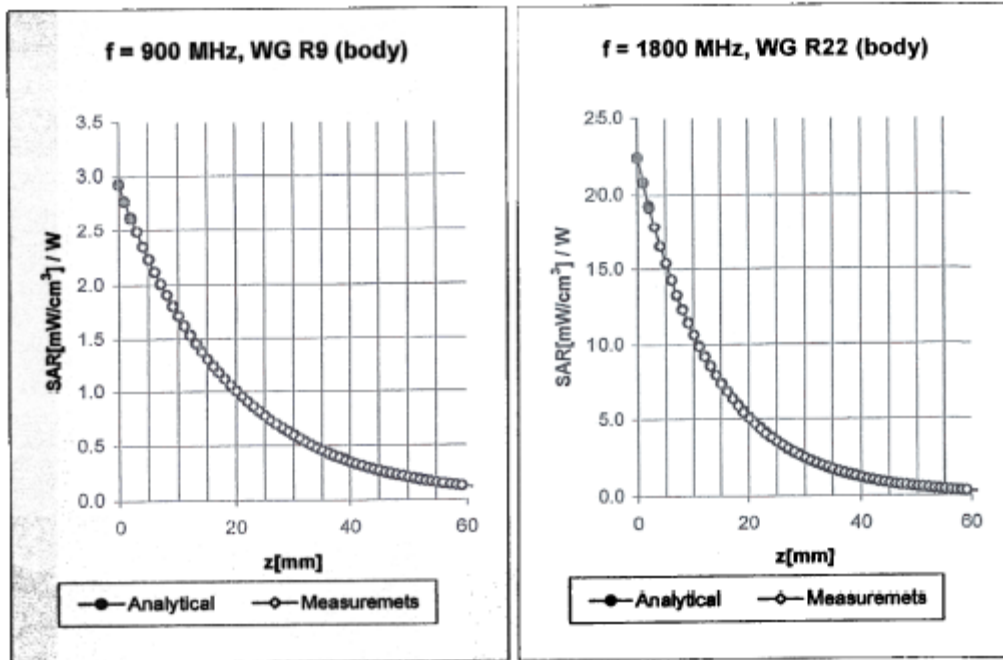
ConvF X	<b>6.1</b> $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	<b>6.1</b> $\pm 9.5\%$ (k=2)	Alpha <b>0.24</b>
ConvF Z	<b>6.1</b> $\pm 9.5\%$ (k=2)	Depth <b>2.00</b>

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

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

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

### Conversion Factor Assessment



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

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

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

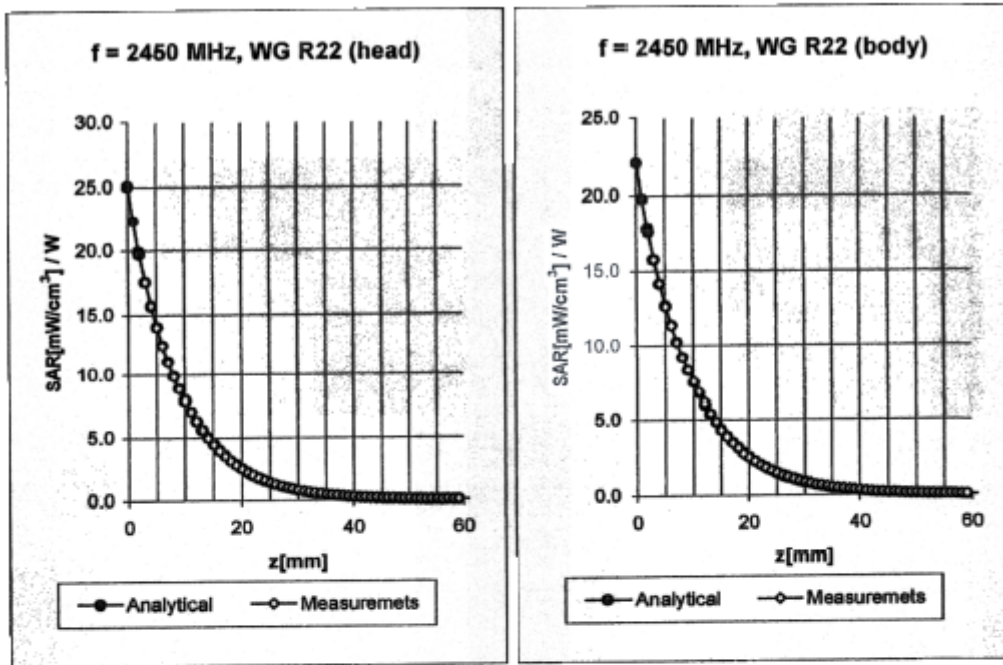
Body                    1800 MHz                     $\epsilon_r = 53.3 \pm 5\%$                      $\sigma = 1.52 \pm 5\%$  mho/m

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

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



### Conversion Factor Assessment



**Head**                      **2450 MHz**                       $\epsilon_r = 39.2 \pm 5\%$                        $\sigma = 1.80 \pm 5\% \text{ mho/m}$

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 60381, P1528-200X

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

**Body**                      **2450 MHz**                       $\epsilon_r = 52.7 \pm 5\%$                        $\sigma = 1.95 \pm 5\% \text{ mho/m}$

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

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



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info@speag.com, http://www.speag.com

## Additional Conversion Factors for Dosimetric E-Field Probe

Type:

ES3DV2

Serial Number:

3019

Place of Assessment:

Zurich

Date of Assessment:

October 13, 2003

Probe Calibration Date:

October 9, 2003

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

Assessed by:



ES3DV2-SN:3019

October 13, 2003

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

### Dosimetric E-Field Probe ES3DV2 SN:3019

Conversion factor ( $\pm$  standard deviation)

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

**ES3DV2-SN:3019**

**October 13, 2003**

## PH20A2, CDMA800 835MHz Body Liquid Validation. 2004-01-27

835 MHz Body Liquid Validation

frequency	$\epsilon'$	$\epsilon''$
815000000.0000	54.7440	20.9545
815800000.0000	54.7087	20.9886
816600000.0000	54.7332	20.9834
817400000.0000	54.6901	20.9354
818200000.0000	54.6776	20.9078
819000000.0000	54.6550	20.8885
819800000.0000	54.5618	20.8685
820600000.0000	54.6139	20.8481
821400000.0000	54.6142	20.8693
822200000.0000	54.5379	20.8230
823000000.0000	54.5029	20.8111
823800000.0000	54.4848	20.8295
824600000.0000	54.4681	20.8946
825400000.0000	54.4382	20.9065
826200000.0000	54.4681	20.8536
827000000.0000	54.4066	20.8623
827800000.0000	54.4824	20.8364
828600000.0000	54.4711	20.8642
829400000.0000	54.4624	20.8731
830200000.0000	54.4947	20.8460
831000000.0000	54.5070	20.7968
831800000.0000	54.5146	20.8137
832600000.0000	54.5070	20.8224
833400000.0000	54.5057	20.8241
834200000.0000	54.5112	20.8116
835000000.0000	54.5175	20.8001
835800000.0000	54.5554	20.8465
836600000.0000	54.5775	20.8380
837400000.0000	54.5823	20.7739
838200000.0000	54.5205	20.7235
839000000.0000	54.4717	20.7472
839800000.0000	54.4909	20.7918
840600000.0000	54.4582	20.8167
841400000.0000	54.4655	20.8253
842200000.0000	54.4612	20.8577
843000000.0000	54.4099	20.8747
843800000.0000	54.4418	20.8121
844600000.0000	54.4079	20.7952
845400000.0000	53.5639	20.7380
846200000.0000	53.5860	20.7336
847000000.0000	53.5995	20.7216
847800000.0000	53.6840	20.7392
848600000.0000	53.6596	20.7198
849400000.0000	53.6181	20.6571
850200000.0000	53.6371	20.6248
851000000.0000	53.6890	20.7071
851800000.0000	53.6907	20.7321
852600000.0000	53.6864	20.7585
853400000.0000	53.6882	20.6955
854200000.0000	53.6432	20.7470
855000000.0000	53.6225	20.7806

1/27/2004

Mondr

0.9662

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.9662$$

where  $f = 835 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 20.8001$

## CDMA800 835MHz Head Liquid Validation. 2004-01-27

835 MHz Head Liquid Validation

frequency	$\epsilon'$	$\epsilon''$
81500000.0000	41.7226	19.4151
81580000.0000	41.7490	19.4195
81660000.0000	41.7060	19.3846
81740000.0000	41.6984	19.3235
81820000.0000	41.6534	19.3682
81900000.0000	41.6629	19.3295
81980000.0000	41.6476	19.3544
82060000.0000	41.6830	19.2974
82140000.0000	41.6663	19.3187
82220000.0000	41.6904	19.3281
82300000.0000	41.6131	19.3524
82380000.0000	41.6069	19.3159
82460000.0000	41.6026	19.3158
82540000.0000	41.5295	19.2974
82620000.0000	41.5262	19.2682
82700000.0000	41.5449	19.2427
82780000.0000	41.5555	19.2697
82860000.0000	41.5593	19.2377
82940000.0000	41.5473	19.2490
83020000.0000	41.5096	19.1843
83100000.0000	41.5238	19.2098
83180000.0000	41.4737	19.2279
83260000.0000	41.5317	19.2401
83340000.0000	41.4784	19.1982
83420000.0000	41.4877	19.2418
83500000.0000	41.4309	19.2218
83580000.0000	41.4657	19.2472
83660000.0000	41.5103	19.2359
83740000.0000	41.5085	19.2513
83820000.0000	41.4870	19.2581
83900000.0000	41.4179	19.1862
83980000.0000	41.4202	19.3138
84060000.0000	41.4368	19.2323
84140000.0000	41.4477	19.2588
84220000.0000	41.4111	19.2474
84300000.0000	41.4731	19.2493
84380000.0000	41.4330	19.2191
84460000.0000	41.4334	19.2496
84540000.0000	41.4227	19.2725
84620000.0000	41.4218	19.2185
84700000.0000	41.4908	19.3186
84780000.0000	41.4626	19.2878
84860000.0000	41.4041	19.3217
84940000.0000	41.4130	19.3123
85020000.0000	41.4121	19.2787
85100000.0000	41.3737	19.2319
85180000.0000	41.4273	19.2933
85260000.0000	41.4516	19.3221
85340000.0000	41.4391	19.3294
85420000.0000	41.4246	19.3617
85500000.0000	41.4266	19.3349

1/27/2004  
Mong

0.8929

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.8929$$

$$\text{where } f = 835 \times 10^6$$

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

$$\epsilon'' = 19.2218$$

## CDMA2000 835MHz Body Liquid Validation. 2004-03-24

8350MHz Body Liquid validation  
 Ambient Temp=23 DegC ,Liquid Temp=22 DegC 3/24/2004

Frequency	$\epsilon'$	$\epsilon''$
815000000.0000	53.2565	21.4858
815800000.0000	53.2224	21.4201
816600000.0000	53.2008	21.4192
817400000.0000	53.2638	21.4013
818200000.0000	53.2472	21.3898
819000000.0000	53.2206	21.3509
819800000.0000	53.2651	21.3421
820600000.0000	53.2031	21.3342
821400000.0000	53.2569	21.3262
822200000.0000	53.2297	21.3126
823000000.0000	53.1929	21.3050
823800000.0000	53.2089	21.3010
824600000.0000	53.1688	21.2968
825400000.0000	53.2007	21.2836
826200000.0000	53.1317	21.2780
827000000.0000	53.1724	21.2616
827800000.0000	53.1547	21.2583
828600000.0000	53.1444	21.2514
829400000.0000	53.1139	21.2381
830200000.0000	53.0801	21.2127
831000000.0000	53.0866	20.9850
831800000.0000	53.0999	20.9766
832600000.0000	53.0462	20.7568
833400000.0000	53.0726	20.5038
834200000.0000	53.0510	20.4107
835000000.0000	53.0629	20.2467
835800000.0000	53.0710	20.0301
836600000.0000	53.0212	19.9797
837400000.0000	53.0293	19.9712
838200000.0000	53.0265	19.9690
839000000.0000	52.9767	19.9631
839800000.0000	52.0030	19.9504
840600000.0000	52.9823	19.8921
841400000.0000	52.9904	19.8836
842200000.0000	52.9084	19.8830
843000000.0000	52.9562	19.8787
843800000.0000	52.8925	19.8652
844600000.0000	52.9097	19.8547
845400000.0000	52.9287	19.8338
846200000.0000	52.8795	19.7933
847000000.0000	52.8465	19.7809
847800000.0000	52.9121	19.7758
848600000.0000	52.9329	19.7745
849400000.0000	52.8786	19.7659
850200000.0000	52.8850	19.7540
851000000.0000	52.8702	19.7495
851800000.0000	52.8997	19.6976
852600000.0000	52.8670	19.6807
853400000.0000	52.8648	19.6731
854200000.0000	52.8339	19.6687
855000000.0000	52.8313	19.6465

$$\begin{aligned} \sigma &= 2\pi f \epsilon_0 \epsilon'' \\ &= 2\pi \times 835 \times 10^6 \times 8.854 \times 10^{-12} \times 20.2467 \\ &= 0.9405 \end{aligned}$$

$$\begin{aligned} \sigma &= \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.9405 \\ \text{where } f &= 835 \times 10^6 \\ \epsilon_0 &= 8.854 \times 10^{-12} \\ \epsilon'' &= 20.2467 \end{aligned}$$



**CDMA2000 835MHz Head Liquid Validation. 2004-03-24**

835 MHZ Head Liquid Validation

Ambient Temp=23 DegC , Liquid Temp=22 DegC , 3/24/2004

frequency	e'	e''
815000000.0000	40.5310	19.3508
815800000.0000	40.5616	19.3415
816600000.0000	40.5384	19.3411
817400000.0000	40.5010	19.3403
818200000.0000	40.4908	19.3269
819000000.0000	40.4811	19.3271
819800000.0000	40.4675	19.3255
830600000.0000	40.4674	19.3210
821400000.0000	40.4669	19.3177
822200000.0000	40.4667	19.3176
823000000.0000	40.4622	19.3167
823800000.0000	40.4596	19.3079
824600000.0000	40.4571	19.3048
825400000.0000	40.4554	19.2976
826200000.0000	40.4546	19.2917
827000000.0000	40.4464	19.2883
827800000.0000	40.4445	19.2865
828600000.0000	40.4346	19.2844
829400000.0000	40.4337	19.2795
830200000.0000	40.4286	19.2791
831000000.0000	40.4253	19.2666
831800000.0000	40.4251	19.2611
832600000.0000	40.4146	19.2558
833400000.0000	40.4128	19.2515
834200000.0000	40.4096	19.2477
835000000.0000	40.4054	19.2411
835800000.0000	40.4045	19.2393
836600000.0000	40.4034	19.2341
837400000.0000	40.4030	19.2281
838200000.0000	40.3998	19.2188
839000000.0000	40.3986	19.2150
839800000.0000	40.3954	19.2141
840600000.0000	40.3937	19.2133
841400000.0000	40.3930	19.2115
842200000.0000	40.3967	19.2095
843000000.0000	40.3978	19.2080
843800000.0000	40.3953	19.2071
844600000.0000	40.3974	19.2001
845400000.0000	40.3961	19.1988
846200000.0000	40.3971	18.1974
847000000.0000	40.3885	18.1810
847800000.0000	40.3863	18.1792
848600000.0000	40.3882	18.1712
849400000.0000	40.3865	18.1698
850200000.0000	40.3861	18.1637
851000000.0000	40.3831	18.1600
851800000.0000	40.3826	18.1596
852600000.0000	40.3873	18.1502
853400000.0000	40.3850	18.1464
854200000.0000	40.3715	18.1389
855000000.0000	40.3645	18.1308

*Handwritten notes:*  
 $\sigma = 0.8938$   
 $\sigma = 2\pi f \epsilon_0 \epsilon''$   
 $= 2\pi \times 835 \times 10^6 \times 8.854 \times 10^{-12} \times 19.2411$   
 $= 0.8938$

$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.8938$   
 where  $f = 835 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 19.2411$

**CDMA1900 1900 MHz Body Liquid Validation, 2004-01-24**

frequency	$\epsilon'$	$\epsilon''$	1900 body Liquid validation
1850000000.0000	53.2512		14.3762
1852000000.0000	53.2308		14.3531
1854000000.0000	53.2291		14.3314
1856000000.0000	53.2333		14.3657
1858000000.0000	53.2174		14.3733
1860000000.0000	53.1914		14.3465
1862000000.0000	53.2252		14.3344
1864000000.0000	53.1865		14.3675
1866000000.0000	53.2179		14.3753
1868000000.0000	53.1984		14.3872
1870000000.0000	53.2157		14.3631
1872000000.0000	53.1338		14.3712
1874000000.0000	53.1921		14.4164
1876000000.0000	53.2152		14.4377
1878000000.0000	53.2181		14.3752
1880000000.0000	53.2137		14.3687
1882000000.0000	53.2463		14.3518
1884000000.0000	53.2510		14.3324
1886000000.0000	53.1983		14.3253
1888000000.0000	53.2278		14.3532
1890000000.0000	53.2142		14.3441
1892000000.0000	53.2431		14.4820
1894000000.0000	53.2253		14.3989
1896000000.0000	53.2269		14.3837
1898000000.0000	53.1734		14.3365
1900000000.0000	53.1810		14.3321
1902000000.0000	53.0991		14.3532
1904000000.0000	53.0836		14.3373
1906000000.0000	53.0724		14.3186
1908000000.0000	53.0648		14.3198
1910000000.0000	53.0562		14.2855
1912000000.0000	53.0514		14.2914
1914000000.0000	53.0538		14.2821
1916000000.0000	53.0473		14.2736
1918000000.0000	53.0436		14.2684
1920000000.0000	53.0354		14.2682
1922000000.0000	53.0291		14.2573
1924000000.0000	53.0238		14.2527
1926000000.0000	53.0152		14.2434
1928000000.0000	52.9765		14.2479
1930000000.0000	52.9731		14.2453
1932000000.0000	52.9749		14.2324
1934000000.0000	52.9582		14.2318
1936000000.0000	52.9575		14.2293
1938000000.0000	52.8942		14.1128
1940000000.0000	52.8434		14.1163
1942000000.0000	52.8021		14.0915
1944000000.0000	52.7901		14.0823
1946000000.0000	52.7412		14.0801
1948000000.0000	52.7526		14.1149
1950000000.0000	52.7389		14.1227

1/24/2004

*[Handwritten signature]*

1.5149

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.5149$$
 where  $f = 1900 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 14.3321$

**CDMA1900 1900 MHz Head Liquid Validation, 2004-01-24**

1900 head liquid validation

frequency	$\epsilon'$	$\epsilon''$
1850000000.0000	39.2049	13.6089
1852000000.0000	39.2696	13.6770
1854000000.0000	39.2535	13.6820
1856000000.0000	39.3700	13.6755
1858000000.0000	39.3955	13.6026
1860000000.0000	39.2045	13.6088
1862000000.0000	39.3687	13.6126
1864000000.0000	39.3215	13.6387
1866000000.0000	39.3105	13.6069
1868000000.0000	39.3137	13.6239
1870000000.0000	39.3625	13.6726
1872000000.0000	39.2540	13.6797
1874000000.0000	39.4114	13.6078
1876000000.0000	39.4793	13.6995
1878000000.0000	39.5188	13.6384
1880000000.0000	39.5216	13.6270
1882000000.0000	39.4455	13.6617
1884000000.0000	39.5152	13.6152
1886000000.0000	39.4876	13.6014
1888000000.0000	39.3196	13.6920
1890000000.0000	39.2421	13.6479
1892000000.0000	39.1749	13.6317
1894000000.0000	39.1938	13.6201
1896000000.0000	39.2345	13.6196
1898000000.0000	39.2564	13.6040
1900000000.0000	39.2687	13.6019
1902000000.0000	39.1259	13.6293
1904000000.0000	39.1177	13.6357
1906000000.0000	39.1520	13.6345
1908000000.0000	39.0601	13.6210
1910000000.0000	39.1650	13.6146
1912000000.0000	39.0437	13.6258
1914000000.0000	39.0171	13.6236
1916000000.0000	39.1496	13.6145
1918000000.0000	39.2223	13.6153
1920000000.0000	39.3629	13.6159
1922000000.0000	39.4641	13.6260
1924000000.0000	39.5983	13.6390
1926000000.0000	39.5584	13.6386
1928000000.0000	39.6435	13.6324
1930000000.0000	39.7128	13.6433
1932000000.0000	39.7201	13.6549
1934000000.0000	39.6063	13.6501
1936000000.0000	39.5563	13.6628
1938000000.0000	39.5641	13.6568
1940000000.0000	39.5419	13.6510
1942000000.0000	39.4962	13.6608
1944000000.0000	39.3709	13.6552
1946000000.0000	39.4082	13.6483
1948000000.0000	39.4536	13.6441
1950000000.0000	39.5183	13.6309

*MontG*  
*1/24/2004*

*1.4377*

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.4377$$
 where  $f = 1900 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 13.6019$



## CDMA2000 1900 MHz Body Liquid Validation, 2004-03-22

1900 Body liquid validation 3/22/04

frequency	e'	e''
185000000.0000	52.8448	13.7993
185200000.0000	52.8627	13.7892
185400000.0000	52.8130	13.8094
185600000.0000	52.7874	13.8186
185800000.0000	52.7629	13.8422
186000000.0000	52.7364	13.8369
186200000.0000	52.6773	13.8475
186400000.0000	52.6666	13.8912
186600000.0000	52.6738	13.9089
186800000.0000	52.6151	13.9032
187000000.0000	52.5828	13.8990
187200000.0000	52.5769	13.9401
187400000.0000	52.5391	13.9841
187600000.0000	52.5123	13.9999
187800000.0000	52.5077	14.0035
188000000.0000	52.4878	14.0375
188200000.0000	52.4682	14.0553
188400000.0000	52.4360	14.0916
188600000.0000	52.4466	14.0970
188800000.0000	52.4204	14.1128
189000000.0000	52.4249	14.1194
189200000.0000	52.4036	14.1601
189400000.0000	52.3833	14.1633
189600000.0000	52.4199	14.1750
189800000.0000	52.3698	14.1825
190000000.0000	52.4144	14.2183
190200000.0000	52.3858	14.1860
190400000.0000	52.3970	14.2153
190600000.0000	52.3896	14.2160
190800000.0000	52.4433	14.2143
191000000.0000	52.4179	14.2218
191200000.0000	52.4362	14.2285
191400000.0000	52.4439	14.2309
191600000.0000	52.4567	14.2015
191800000.0000	52.5080	14.2030
192000000.0000	52.5140	14.1960
192200000.0000	52.5524	14.2048
192400000.0000	52.5437	14.2281
192600000.0000	52.5365	14.1961
192800000.0000	52.5641	14.1600
193000000.0000	52.5978	14.1760
193200000.0000	52.5641	14.1641
193400000.0000	52.5859	14.1613
193600000.0000	52.5988	14.1476
193800000.0000	52.6168	14.1424
194000000.0000	52.6571	14.1355
194200000.0000	52.6173	14.1460
194400000.0000	52.6254	14.1394
194600000.0000	52.6152	14.1369
194800000.0000	52.6293	14.1129
195000000.0000	52.6229	14.1128

$$\begin{aligned} \sigma &= 2\pi f \epsilon_0 \epsilon'' \\ &= 2\pi \times 1900 \times 10^6 \times 8.854 \times 10^{-12} \times 14.2183 \\ &= 1.5029 \end{aligned}$$

$$\begin{aligned} \sigma &= \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.5029 \\ \text{where } f &= 1900 \times 10^6 \\ \epsilon_0 &= 8.854 \times 10^{-12} \\ \epsilon'' &= 14.2183 \end{aligned}$$

## CDMA2000 1900 MHz Head Liquid Validation, 2004-03-22

1900 Head liquid validation 3/22/04

frequency	$\epsilon'$	$\epsilon''$
185000000.0000	39.0307	14.0872
185200000.0000	38.9674	14.0934
185400000.0000	38.9674	14.0687
185600000.0000	38.9253	14.0428
185800000.0000	38.8970	14.0512
186000000.0000	38.8597	14.0430
186200000.0000	38.8223	14.0160
186400000.0000	38.7975	13.9971
186600000.0000	38.7591	13.9875
186800000.0000	38.7374	13.9877
187000000.0000	38.7162	13.9822
187200000.0000	38.6403	13.9892
187400000.0000	38.6150	13.8902
187600000.0000	38.5864	13.8798
187800000.0000	38.5433	13.7745
188000000.0000	38.5564	13.7769
188200000.0000	38.5112	13.6713
188400000.0000	38.5151	13.6262
188600000.0000	38.4988	13.6411
188800000.0000	38.4617	13.5445
189000000.0000	38.4671	13.5593
189200000.0000	38.4432	13.5837
189400000.0000	38.4488	13.5955
189600000.0000	38.4327	13.5132
189800000.0000	38.4286	13.5444
190000000.0000	38.4209	13.5654
190200000.0000	38.4469	13.5755
190400000.0000	38.4578	13.5234
190600000.0000	38.4560	13.4662
190800000.0000	38.4723	13.4497
191000000.0000	38.4822	13.4431
191200000.0000	38.4958	13.4223
191400000.0000	38.5182	13.4490
191600000.0000	38.5113	13.4341
191800000.0000	38.5379	13.3952
192000000.0000	38.5717	13.4009
192200000.0000	38.5552	13.4954
192400000.0000	38.6026	13.3832
192600000.0000	38.6046	13.3957
192800000.0000	38.6150	13.3813
193000000.0000	38.6457	13.3751
193200000.0000	38.6572	13.3736
193400000.0000	38.6455	13.3666
193600000.0000	38.6613	13.3537
193800000.0000	38.6611	13.3472
194000000.0000	38.6982	14.3396
194200000.0000	38.6720	14.3304
194400000.0000	38.6749	14.2910
194600000.0000	38.6575	14.2793
194800000.0000	38.6823	14.2682
195000000.0000	38.6708	14.2467

$$\sigma = 2\pi f \epsilon_0 \epsilon'' = 2\pi \times 1900 \times 10^6 \times 8.854 \times 10^{-12} \times 13.5654 = 1.4339$$

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.4339$$

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

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

$$\epsilon'' = 13.5654$$

## PH20A3, 835MHz Body Liquid Validation. 2004-07-20

## 835 MHZ Body Liquid Validation

Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C , 2004/7/21

frequency	$\epsilon'$	$\epsilon''$
815000000.0000	56.0140	21.0259
815800000.0000	56.0953	21.0025
816600000.0000	56.0919	21.0385
817400000.0000	56.0039	20.9700
818200000.0000	56.0945	21.0340
819000000.0000	56.0759	20.9603
819800000.0000	56.0657	20.9814
820600000.0000	56.0680	20.9428
821400000.0000	56.0400	20.9543
822200000.0000	56.0651	20.9455
823000000.0000	56.0439	20.9046
823800000.0000	56.1020	20.9563
824600000.0000	56.1249	20.8858
825400000.0000	55.9312	20.9529
826200000.0000	55.7756	20.8815
827000000.0000	55.8117	20.9434
827800000.0000	55.9154	20.9022
828600000.0000	55.8566	20.8661
829400000.0000	55.8362	20.8076
830200000.0000	55.8722	20.8781
831000000.0000	55.8688	20.8650
831800000.0000	55.8560	20.8697
832600000.0000	55.8426	20.9012
833400000.0000	55.8946	20.9018
834200000.0000	55.8536	20.8843
835000000.0000	55.8136	20.8309
835800000.0000	55.8817	20.9124
836600000.0000	55.8411	20.8859
837400000.0000	55.8812	20.8522
838200000.0000	55.8419	20.8562
839000000.0000	55.8474	20.8522
839800000.0000	55.9121	20.9171
840600000.0000	55.8897	20.8911
841400000.0000	55.8647	20.8044
842200000.0000	55.9115	20.8865
843000000.0000	55.8312	20.9059
843800000.0000	55.7916	20.8440
844600000.0000	55.8250	20.8795
845400000.0000	55.8270	20.8859
846200000.0000	55.8292	20.8746
847000000.0000	55.8280	20.8562
847800000.0000	55.7841	20.8584
848600000.0000	55.7436	20.8676
849400000.0000	55.7679	20.8107
850200000.0000	55.7139	20.8445
851000000.0000	55.7183	20.8404
851800000.0000	55.7181	20.7867
852600000.0000	55.7913	20.7764
853400000.0000	55.7306	20.7633
854200000.0000	55.7603	20.8063
855000000.0000	55.7521	20.7914

$$\sigma = 2\pi f \epsilon_0 \epsilon'' = 0.9676$$

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.9676$$

where  $f = 835 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 20.8309$

## PH20A3, 835MHz Head Liquid Validation. 2004-07-20

## 835 MHZ Head Liquid Validation

Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C , 2004/7/20

frequency	$\epsilon'$	$\epsilon''$
815000000.0000	40.8652	19.1403
815800000.0000	40.8522	19.0551
816600000.0000	40.8803	19.0614
817400000.0000	40.9031	19.0532
818200000.0000	40.9056	19.0116
819000000.0000	40.8466	19.0250
819800000.0000	40.8537	18.9736
820600000.0000	40.8073	18.9988
821400000.0000	40.8275	18.9834
822200000.0000	40.8229	19.0340
823000000.0000	40.8750	19.0394
823800000.0000	40.8470	19.0254
824600000.0000	40.8954	18.9875
825400000.0000	40.9378	19.0329
826200000.0000	40.9492	19.0491
827000000.0000	40.7798	18.9694
827800000.0000	40.8474	18.9731
828600000.0000	40.7804	18.9735
829400000.0000	40.7189	18.9558
830200000.0000	40.7194	18.9639
831000000.0000	40.7690	18.9297
831800000.0000	40.6137	18.8862
832600000.0000	40.6644	18.9322
833400000.0000	40.6082	18.9169
834200000.0000	40.5957	18.9218
835000000.0000	40.6223	18.9161
835800000.0000	40.5165	18.9012
836600000.0000	40.4537	18.9025
837400000.0000	40.5443	18.8936
838200000.0000	40.5625	18.8512
839000000.0000	40.4694	18.8538
839800000.0000	40.4648	18.8798
840600000.0000	40.4773	18.8436
841400000.0000	40.3864	18.8296
842200000.0000	40.4015	18.8005
843000000.0000	40.3281	18.8121
843800000.0000	40.3503	18.7805
844600000.0000	40.3124	18.7154
845400000.0000	40.2985	18.7369
846200000.0000	40.3049	18.7272
847000000.0000	40.3267	18.7592
847800000.0000	40.2112	18.7628
848600000.0000	40.2239	18.7270
849400000.0000	40.2986	18.7948
850200000.0000	40.2331	18.7405
851000000.0000	40.1927	18.7322
851800000.0000	40.1370	18.6824
852600000.0000	40.2039	18.7291
853400000.0000	40.2451	18.6434
854200000.0000	40.1676	18.7043
855000000.0000	40.1300	18.7031

$$\sigma = 2\pi f \epsilon_0 \epsilon'' = 0.8787$$

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 0.8787$$

where  $f = 835 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 18.9161$



**PH20A3, 1900MHz Body Liquid Validation. 2004-07-21**

1900 MHz Body Liquid Validation  
 Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C ,

frequency	$\epsilon'$	$\epsilon''$
1850000000.0000	53.0943	13.6019
1852000000.0000	53.0864	13.6066
1854000000.0000	53.0818	13.6107
1856000000.0000	53.0462	13.6151
1858000000.0000	52.9602	13.6196
1860000000.0000	52.9043	13.6370
1862000000.0000	52.9239	13.6190
1864000000.0000	52.9010	13.6572
1866000000.0000	52.9167	13.6448
1868000000.0000	52.9407	13.6994
1870000000.0000	52.9321	13.7058
1872000000.0000	52.9342	13.7363
1874000000.0000	52.9300	13.7483
1876000000.0000	52.9521	13.7900
1878000000.0000	52.9721	13.8467
1880000000.0000	52.9230	13.8436
1882000000.0000	52.9152	13.8886
1884000000.0000	52.0052	13.8626
1886000000.0000	52.8043	13.8893
1888000000.0000	52.7760	13.8808
1890000000.0000	52.8123	13.9067
1892000000.0000	52.8147	13.9615
1894000000.0000	52.8214	13.9665
1896000000.0000	52.8245	13.9688
1898000000.0000	52.7220	13.9800
1900000000.0000	52.7315	13.9810
1902000000.0000	52.7440	13.9980
1904000000.0000	52.6874	13.9833
1906000000.0000	52.6139	13.9812
1908000000.0000	52.6098	13.9588
1910000000.0000	52.6536	13.9862
1912000000.0000	52.6639	13.9986
1914000000.0000	52.7382	14.0415
1916000000.0000	52.7477	14.0312
1918000000.0000	52.8044	14.0559
1920000000.0000	52.7305	14.0155
1922000000.0000	52.7374	14.0329
1924000000.0000	52.7926	14.0316
1926000000.0000	52.8513	14.0654
1928000000.0000	52.8974	14.1015
1930000000.0000	52.9617	14.0867
1932000000.0000	52.9698	14.0584
1934000000.0000	52.9270	14.0689
1936000000.0000	52.9467	14.0835
1938000000.0000	52.9471	14.0743
1940000000.0000	52.9452	14.0688
1942000000.0000	52.9601	14.0745
1944000000.0000	52.9438	14.0701
1946000000.0000	52.9426	14.0676
1948000000.0000	52.9153	14.0638
1950000000.0000	52.8823	14.0480

$\sigma = 2\pi f \epsilon_0 \epsilon''$   
 $= 1.4778$

$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.4778$   
 where  $f = 1900 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 13.9810$

**PH20A3, 1900MHz Head Liquid Validation. 2004-07-21****1900 MHZ Head Liquid Validation**

Ambient Temp = 23 Deg C , Liquid Temp = 22 Deg C ,

frequency e'	e''	
1850000000.0000	39.8524	13.4841
1852000000.0000	39.8159	13.4627
1854000000.0000	39.7739	13.4186
1856000000.0000	39.6912	13.4011
1858000000.0000	39.5562	13.3704
1860000000.0000	39.4969	13.3443
1862000000.0000	39.4781	13.3882
1864000000.0000	39.4612	13.3701
1866000000.0000	39.5047	13.3774
1868000000.0000	39.4892	13.4187
1870000000.0000	39.4914	13.4228
1872000000.0000	39.4827	13.4555
1874000000.0000	39.4619	13.4519
1876000000.0000	39.4784	13.5042
1878000000.0000	39.4709	13.5415
1880000000.0000	39.4369	13.5382
1882000000.0000	39.3679	13.5514
1884000000.0000	39.2732	13.4961
1886000000.0000	39.1256	13.4264
1888000000.0000	39.0823	13.4178
1890000000.0000	39.1112	13.4268
1892000000.0000	39.1457	13.4583
1894000000.0000	39.1043	13.4649
1896000000.0000	39.0737	13.4457
1898000000.0000	38.9218	13.4435
1900000000.0000	38.9072	13.4299
1902000000.0000	38.9648	13.4660
1904000000.0000	38.8295	13.4067
1906000000.0000	38.7033	13.4048
1908000000.0000	38.7111	13.3698
1910000000.0000	38.7525	13.3900
1912000000.0000	38.7911	13.4640
1914000000.0000	38.8705	13.5220
1916000000.0000	38.9148	13.5043
1918000000.0000	38.9366	13.5358
1920000000.0000	38.8729	13.5187
1922000000.0000	38.8533	13.4801
1924000000.0000	38.8861	13.5209
1926000000.0000	38.9873	13.5841
1928000000.0000	39.0992	13.6216
1930000000.0000	39.1985	13.6973
1932000000.0000	39.2631	13.7487
1934000000.0000	39.2733	13.7628
1936000000.0000	39.3055	13.7986
1938000000.0000	39.2623	13.7582
1940000000.0000	39.2622	13.7291
1942000000.0000	39.2622	13.7220
1944000000.0000	39.2388	13.7164
1946000000.0000	39.2027	13.7303
1948000000.0000	39.1804	13.7320
1950000000.0000	39.1716	13.7519

$\sigma = 2\pi f \epsilon_0 \epsilon''$   
 $= 1.4195$

$$\sigma = \omega \epsilon_0 \epsilon'' = 2 \pi f \epsilon_0 \epsilon'' = 1.4195$$

where  $f = 1900 \times 10^6$   
 $\epsilon_0 = 8.854 \times 10^{-12}$   
 $\epsilon'' = 13.4299$