SAR EVALUATION REPORT

For

High Tech Computer, Corp.

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

FCC ID: NM8MAGICIAN

This Report Concerns:	**Equipment Type:**
☒ Original Report	GSM 850/1900 + Bluetooth PDA Phone

Test Engineer: Eric Hong

Report No.: R0411298S

Test Date: 2004-12-08 / 2004-12-18

Reviewed By: Daniel Deng

Prepared By: Bay Area Compliance Laboratory Corporation (BACL)
230 Commercial Street
Sunnyvale, CA 94085
Tel: (408) 732-9162
Fax: (408) 732 9164

DECLARATION OF COMPLIANCE SAR EVALUATION

Rule Part(s):	**FCC §2.1093**
Test Procedure(s):	**FCC OET Bulletin 65 Supplement C**
Device Classification:	**Licensed Portable Transmitter Held to Ear (PCE)**
Device Type:	**GSM 850/1900 + Bluetooth PDA Phone**
FCC ID:	**NM8MAGICIAN**
Model Number:	**PM10C**
Modulation:	**GMSK**
TX Frequency Range:	**824 – 849MHz/1850 – 1910MHz**
Max. Conducted Power Tested:	**GSM835: 33 dBm** **GSM1900: 29.50dBm**
Antenna Type(s):	**Integral Antenna**
Battery Type(s):	**Rechargeable**
Body-Worn Accessories:	**Headset, Pouch and Memory Card**
Face-Head Accessories:	**None**

Max. SAR Level(s) Measured: 0.532 W/kg (Face-Held) / 0.740 W/kg (Body-Worn)

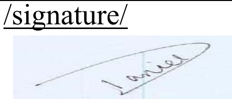
BACL Corp. declares under its sole responsibility that this device was found to be in compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in the relevant regulatory rules, e.g. FCC §2.1093 and Health Canada's Safety Code 6.

The device was tested in accordance with the measurement standards and procedures specified in the appropriate directives, e.g. FCC OET Bulletin 65, Supplement C, Edition 01-01 and Industry Canada RSS-102 Issue 1 (Occupational Environment/Controlled Exposure).

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

The results and statements contained in this report pertain only to the device(s) evaluated.

/signature/



Daniel Deng
Bay Area Compliance Laboratory Corp.

TABLE OF CONTENTS

INTRODUCTION AND OVERVIEW

The US Federal Communications Commission has released report and order; "Guidelines for Evaluating the Environmental Effects of RF Radiation", ET Docket No. 93-62 in August 1996 [1]. Furthermore, in accordance with Part 2 rules on RF exposure, testing for compliance is required for certain products.

The test configurations were laid out on a specially designed test fixture to ensure reproducibility of measurements. Each configuration was scanned and measurements recorded for SAR. Analysis of each scan was carried out to characterize the device under test.

SAR readings for this device tested in the described configurations, were found to be in compliance with applicable rules

REFERENCE, STANDARDS, AND GUILDELINES

The Report and 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.

SAR Limits

EXPOSURE LIMITS	SAR (W/kg)	
	(General Population / Uncontrolled Exposure Environment)	**(Occupational / Controlled Exposure Environment)**
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

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 Spatial Peak limit 1.6 w/kg applied to the EUT.

EUT DESCRIPTION

The *High Tech Computer, Corp.'s* product, model no.: PM10C or the "EUT" as referred to this report is a GSM 850/1900 + Bluetooth PDA Phone which measures approximately 60mmL x 18mmW x 110mmH.

** The test data gathered are from typical production sample, serial number: 400J442300086, provided by the manufacturer.*

DESCRIPTION OF TEST SYSTEM

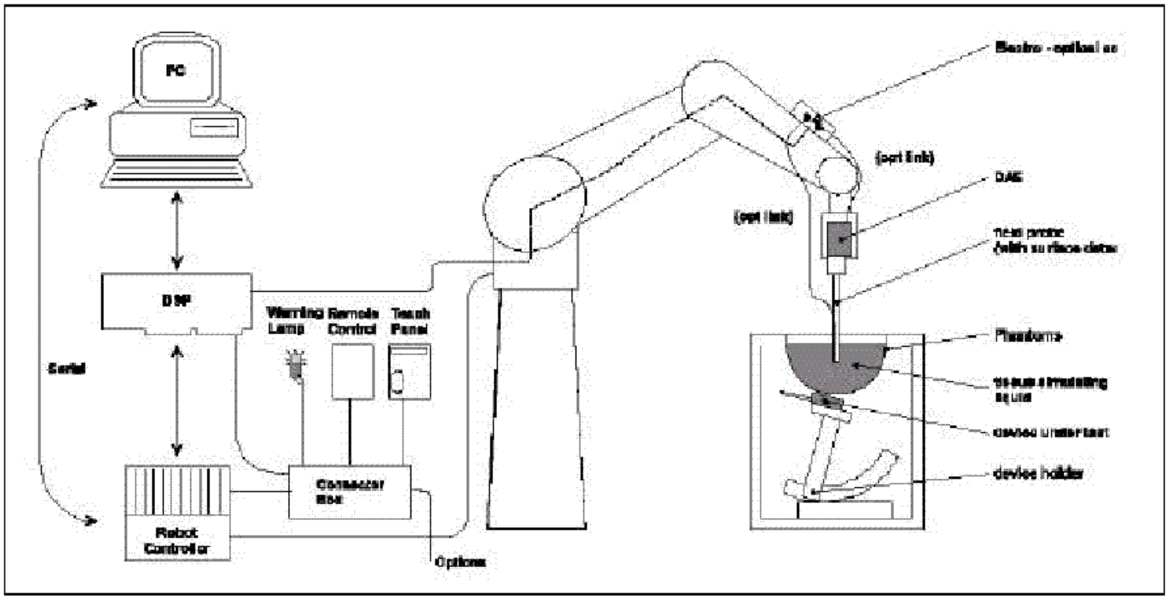
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ±0.02mm. Special 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: 1604 (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

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.

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	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.

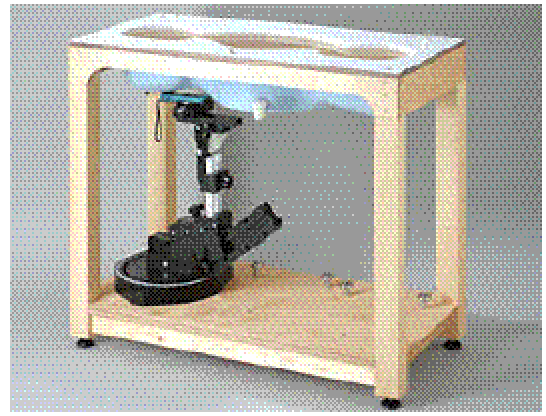
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

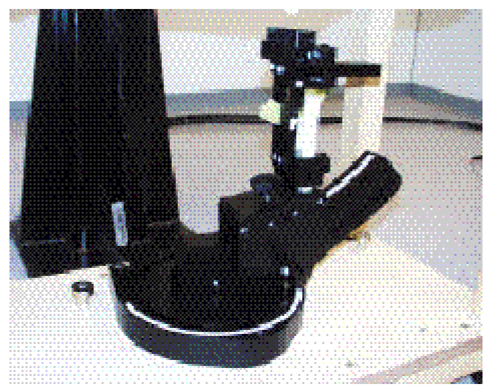


Generic Twin Phantom

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

TESTING EQUIPMENT

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	2004-06-01	456
SPEAG E-Field Probe ES3DV2	2003-10-09	3019
SPEAG E-Field Probe ET3DV6	2004-06-10	1604
Antenna, Dipole, D900V2	2003-10-03	122
SPEAG Generic Twin Phantom	N/A	N/A
SPEAG Light Alignment Sensor	N/A	278
Aprel Validation Dipole D-1800-S-2	2004-04-09	BCL-049
Brain Equivalent Matter (1900MHz)	Each Use	N/A
Muscle Equivalent Matter (1900MHz)	Each Use	N/A
Robot Table	Each Use	N/A
Phone Holder	Each Use	N/A
Phantom Cover	Each Use	N/A
HP Spectrum Analyzer HP8566A	N/A	2240A01930
Microwave Amp. 8349A	N/A	2644A02662
Power Meter Agilent E4919B	2004-04-29	MY4121511
Power Sensor Agilent E4412A	2004-05-07	US38488542
Network Analyzer HP-8752C	2002-08-11	820079
Dielectric Probe Kit HP85070A	Each Use	US99360201
Signal Generator HP-83650B	2004-02-29	3614A002716
Amplifier, ST181-20	N/R	E012-0101
Antenna, Horn DRG-118A	2004-02-06	A052704
Analyzer, Communication, Agilent E5515C	2004-04-05	GB44051221

SAR MEASUREMENT SYSTEM VERIFICATION

Liquid Validation

835 MHz Body Liquid Validation
Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 12/18/2004

Frequency	e'	e''	
815000000.0000	55.4674	20.0683	
815800000.0000	55.4558	20.0817	
816600000.0000	55.5542	20.0745	
817400000.0000	55.5830	20.0604	
818200000.0000	55.5163	20.0521	
819000000.0000	55.5358	20.0343	
819800000.0000	55.5435	20.0417	
820600000.0000	55.5242	20.0259	
821400000.0000	55.5460	20.0305	
822200000.0000	55.5624	20.0441	
823000000.0000	55.5516	20.0843	
823800000.0000	55.5404	20.0724	
824600000.0000	55.5312	20.0852	
825400000.0000	55.5199	20.0735	
826200000.0000	55.5075	20.0607	
827000000.0000	55.5421	20.0581	
827800000.0000	55.5583	20.0690	
828600000.0000	55.5664	20.0355	
829400000.0000	55.5255	20.0478	
830200000.0000	55.5379	20.0649	
831000000.0000	55.5892	20.0836	
831800000.0000	55.5031	20.0754	
832600000.0000	55.5224	19.9620	
833400000.0000	55.4895	20.0412	
834200000.0000	55.4524	20.0506	
835000000.0000	55.4439	20.0874	0.9331
835800000.0000	55.4348	20.0457	
836600000.0000	55.4952	19.9492	
837400000.0000	55.5006	19.9528	
838200000.0000	55.4942	19.8704	
839000000.0000	55.4386	19.8332	
839800000.0000	55.5258	19.9120	
840600000.0000	55.4672	19.8256	
841400000.0000	55.4561	20.0981	
842200000.0000	55.4430	20.0238	
843000000.0000	55.4348	19.9506	
843800000.0000	55.4252	19.8485	
844600000.0000	55.4635	19.9307	
845400000.0000	55.4012	20.0454	
846200000.0000	55.4345	20.0492	
847000000.0000	55.4423	20.0564	
847800000.0000	55.4568	19.9626	
848600000.0000	55.4481	19.9478	
849400000.0000	55.4360	20.0241	
850200000.0000	55.4238	19.9854	
851000000.0000	55.4170	19.9362	
851800000.0000	55.4012	20.0146	
852600000.0000	55.3985	20.0695	
853400000.0000	55.3822	20.0548	
854200000.0000	55.3791	19.9125	
855000000.0000	55.3684	19.8746	

Page 1

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon'' = 0.9331$

where $f = 835 \times 10^6$

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

$\varepsilon'' = 20.0874$

835 MHz Head Liquid Validation
Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 12/18/2004

Frequency	e'	e''
815000000.0000	41.7692	18.8594
815800000.0000	41.7453	18.8960
816600000.0000	41.7445	18.8826
817400000.0000	41.7867	18.8560
818200000.0000	41.7134	18.8400
819000000.0000	41.7390	18.8304
819800000.0000	41.7421	18.8436
820600000.0000	41.7175	18.8145
821400000.0000	41.7464	18.8469
822200000.0000	41.7552	18.8415
823000000.0000	41.7413	18.8956
823800000.0000	41.7348	18.8888
824600000.0000	41.7283	18.8957
825400000.0000	41.6976	18.8684
826200000.0000	41.7013	18.8593
827000000.0000	41.7225	18.8451
827800000.0000	41.7741	18.8844
828600000.0000	41.7285	18.8320
829400000.0000	41.7068	18.8435
830200000.0000	41.7190	18.8697
831000000.0000	41.7382	18.8923
831800000.0000	41.7646	18.8842
832600000.0000	41.7287	18.9014
833400000.0000	41.7007	18.8370
834200000.0000	41.6921	18.8303
835000000.0000	41.6856	18.8685
835800000.0000	41.6587	18.8821
836600000.0000	41.7192	18.9211
837400000.0000	41.7285	18.9534
838200000.0000	41.7373	18.8979
839000000.0000	41.7280	18.8928
839800000.0000	41.7158	18.9194
840600000.0000	41.6962	18.9222
841400000.0000	41.6803	18.8981
842200000.0000	41.6748	18.8716
843000000.0000	41.7045	18.8784
843800000.0000	41.6960	18.8673
844600000.0000	41.6816	18.9190
845400000.0000	41.6789	18.8947
846200000.0000	41.6623	18.8359
847000000.0000	41.6545	18.8988
847800000.0000	41.6484	18.8824
848600000.0000	41.6331	18.8931
849400000.0000	41.6224	18.8355
850200000.0000	41.6437	18.9083
851000000.0000	41.6574	18.9170
851800000.0000	41.6612	18.9016
852600000.0000	41.6746	18.8745
853400000.0000	41.6570	18.9596
854200000.0000	41.6498	18.8254
855000000.0000	41.6384	18.8832

0.8765

Page 1

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon''=0.8765$

where $f = 835 \times 10^6$

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

$\varepsilon'' = 18.8685$

1900 MHZ Body Liquid Validation
Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 12/8/2004

Frequency	e'	e"
1850000000.0000	53.7474	14.0212
1852000000.0000	53.7142	14.0345
1854000000.0000	53.6921	14.0513
1856000000.0000	53.6865	14.0821
1858000000.0000	53.6781	14.0054
1860000000.0000	53.6577	14.0903
1862000000.0000	53.6364	14.0858
1864000000.0000	53.6256	14.0441
1866000000.0000	53.6143	14.0376
1868000000.0000	53.6037	14.0414
1870000000.0000	53.5924	14.0520
1872000000.0000	53.5415	14.0628
1874000000.0000	53.5322	14.0759
1876000000.0000	53.4993	14.0963
1878000000.0000	53.4804	14.1021
1880000000.0000	53.4733	14.1974
1882000000.0000	53.4682	14.2026
1884000000.0000	53.4590	14.2434
1886000000.0000	53.4461	14.2516
1888000000.0000	53.4428	14.2560
1890000000.0000	53.4301	14.2687
1892000000.0000	53.4212	14.2810
1894000000.0000	53.4163	14.2751
1896000000.0000	53.4221	14.2643
1898000000.0000	53.4329	14.1858
1900000000.0000	53.4203	14.1542 — 1.4961
1902000000.0000	53.4256	14.1916
1904000000.0000	53.4292	14.2542
1906000000.0000	53.4305	14.2659
1908000000.0000	53.4297	14.2687
1910000000.0000	53.4233	14.2581
1912000000.0000	53.4195	14.2636
1914000000.0000	53.3990	14.2551
1916000000.0000	53.3867	14.3573
1918000000.0000	53.3734	14.3790
1920000000.0000	53.3613	14.3847
1922000000.0000	53.3521	14.3745
1924000000.0000	53.3460	14.3602
1926000000.0000	53.3332	14.4501
1928000000.0000	53.3201	14.4324
1930000000.0000	53.3167	14.4278
1932000000.0000	53.3085	14.4316
1934000000.0000	53.3037	14.4103
1936000000.0000	53.2911	14.4205
1938000000.0000	53.2806	14.4169
1940000000.0000	53.2959	14.4211
1942000000.0000	53.3040	14.4358
1944000000.0000	53.3108	14.4145
1946000000.0000	53.3261	14.4231
1948000000.0000	53.3353	14.4336
1950000000.0000	53.3301	14.4375

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon'' = 1.4961$

where $f = 1900 \times 10^6$

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

$\varepsilon'' = 14.1542$

1900 MHZ Head Liquid Validation

Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 12/8/2004

Frequency	e'	e"
1850000000.0000	39.5526	13.1584
1852000000.0000	39.5438	13.1652
1854000000.0000	39.5304	13.1481
1856000000.0000	39.5419	13.1562
1858000000.0000	39.5589	13.1947
1860000000.0000	39.5517	13.1838
1862000000.0000	39.5575	13.2084
1864000000.0000	39.5432	13.1921
1866000000.0000	39.5648	13.2030
1868000000.0000	39.5365	13.2168
1870000000.0000	39.5046	13.2042
1872000000.0000	39.5223	13.2135
1874000000.0000	39.4906	13.2347
1876000000.0000	39.4878	13.2262
1878000000.0000	39.4729	13.2154
1880000000.0000	39.4661	13.2271
1882000000.0000	39.4029	13.2339
1884000000.0000	39.3952	13.2487
1886000000.0000	39.3824	13.2568
1888000000.0000	39.3707	13.2780
1890000000.0000	39.3663	13.2841
1892000000.0000	39.3535	13.2922
1894000000.0000	39.2983	13.2769
1896000000.0000	39.2706	13.2921
1898000000.0000	39.2428	13.3608
1900000000.0000	39.2305	13.3364
1902000000.0000	39.2093	13.3397
1904000000.0000	39.1574	13.3052
1906000000.0000	39.1435	13.2916
1908000000.0000	39.1312	13.2843
1910000000.0000	39.0927	13.2925
1912000000.0000	39.0165	13.2950
1914000000.0000	39.0963	13.3023
1916000000.0000	39.0965	13.3060
1918000000.0000	39.1224	13.3281
1920000000.0000	39.1103	13.3469
1922000000.0000	39.1322	13.3734
1924000000.0000	39.1661	13.3672
1926000000.0000	39.1533	13.3781
1928000000.0000	39.1360	13.3847
1930000000.0000	39.1258	13.3885
1932000000.0000	39.2026	13.3936
1934000000.0000	39.2238	13.4052
1936000000.0000	39.2504	13.4228
1939000000.0000	39.2823	13.4470
1940000000.0000	39.3081	13.4512
1942000000.0000	39.3445	13.5141
1944000000.0000	39.4274	13.5020
1946000000.0000	39.4463	13.5258
1948000000.0000	39.4958	13.5627
1950000000.0000	39.4750	13.5871

1.4097

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 1.4097$

where $f = 1900 \times 10^6$

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

$\varepsilon'' = 13.3364$

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 (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

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

EUT TEST STRATEGY AND METHODOLOGY

SAR Evaluation Procedure

The evaluation was performed with the following procedure:

Step 1: Measurement of the SAR value at a fixed location above the ear point or central position was used as a reference value for assessing the power drop.

Step 2: The SAR distribution at the exposed side of the head was measured at a distance of 3.9 mm from the inner surface of the shell. The area covered the entire dimension of the head or 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 onedimensional 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.

CONCLUSION

This page summarizes the results of the performed dosimetric evaluation. The plots with the corresponding SAR distributions, which reveal information about the location of the maximum SAR with respect to the device could be found in Appendix E.

SAR Body and Head Worst-Case Test Data

Environmental Conditions

Ambient Temperature:	21° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

Mobile Phone	Position	Frequency (MHz)	Output Power (dBm)	Test Type	Liquid	Phantom	Accessory	Measured (mW/g)	Limit (mW/g)	Plot #
GPRS 835	Bottom touching flat phantom, Middle Channel	837	33.00	Body Worn	Body	Flat	Headset, Pouch, and Memory Card	0.613	1.6	1
GSM 835	Bottom touching to flat phantom, Middle Channel	837	33.00	Body Worn	Body	Flat	Headset and Pouch	0.717		2
	Bottom touching to flat phantom, Middle Channel	837	33.00	Body Worn	Body	Flat	Headset, Pouch, and Memory Card	0.740	1.6	3
	Left Head, Cheek, Middle Channel	837	33.00	Head	Head	Left	None	0.337		4
	Left Head, Tilted, Middle Channel	837	33.00	Head	Head	Left	None	0.284		5
	Right Head, Cheek, Middle Channel	837	33.00	Head	Head	Right	None	0.307		6
	Right Head, Tilted, Middle Channel	837	33.00	Head	Head	Right	None	0.283		7
GSM 1900	Bottom touching flat phantom, Middle Channel	1880	29.50	Body Worn	Body	Flat	Headset and Pouch	0.279	1.6	8
	Bottom touching flat phantom, Middle Channel	1880	29.50	Body Worn	Body	Flat	Headset, Pouch and Memory Card	0.296		9
GPRS 1900	Bottom touching flat phantom, Middle Channel	1880	29.50	Body Worn	Body	Flat	Headset, Pouch	0.270		10
	Left Head, Cheek, Middle Channel	1880	29.50	Head	Head	Left	None	0.399		11
	Left Head, Tilted, Middle Channel	1880	29.50	Head	Head	Left	None	0.532		12
	Right Head, Cheek, Middle Channel	1880	29.50	Head	Head	Right	None	0.308	1.6	13
	Right Head, Tilted, Middle Channel	1880	29.50	Head	Head	Right	None	0.403		14

APPENDIX A – 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.

Uncertainty Description	Error	Distribution	Weight	Std. Dev.	Offset
Probe Uncertainty					
Axial isotropy	± 0.2 dB	U-shape	0.5	±2.4 %	/
Spherical isotropy	±0.4 dB	U-shape	0.5	±4.8 %	/
Isotropy from gradient	±0.5 dB	U-shape	0	/	/
Spatial resolution	±0.5 %	Normal	1	±0.5 %	/
Linearity error	±0.2 dB	Rectangle	1	±2.7 %	/
Calibration error	±3.3 %	Normal	1	± 3.3 %	/
SAR Evaluation Uncertainty					
Data acquisition error	±1%	Rectangle	1	±0.6 %	/
ELF and RF disturbances	±0.25 %	Normal	1	±0.25 %	/
Conductivity assessment	±10 %	Rectangle	1	± 5.8 %	/
Spatial Peak SAR Evaluation Uncertainty					
Extrapol boundary effect	±3%	Normal	1	±3%	± 5%
Probe positioning error	±0.1 mm	Normal	1	± 1%	/
Integrat. and cube orient	±3%	Normal	1	±3%	/
Cube shape inaccuracies	±2%	Rectangle	1	±1.2 %	/
Device positioning	±6%	Normal	1	± 6%	/
Combined Uncertainties	/	/	1	±11.7 %	± 5%
Extended uncertainty (K = 2)	/	/	/	± 23.5 %.	/

APPENDIX B – PROBE CALIBRATION CERTIFICATES

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

Client Bay Area (BACL)

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1604
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	June 10, 2004
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	5-May-04 (METAS, No 251-00388)	May-05
Power sensor E4412A	MY41495277	5-May-04 (METAS, No 251-00388)	May-05
Reference 20 dB Attenuator	SN: 5086 (20b)	3-May-04 (METAS, No 251-00389)	May-05
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 (SPEAG, in house check Oct-03)	In house check: Oct 05
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 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	D. Vetterli
Approved by:	Katja Pokovic	Laboratory Director	

Date issued: June 10, 2004

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.

880-KP0301061-A Page 1 of 8

Probe ET3DV6

SN:1604

Manufactured:	July 30, 2001
Last calibrated:	August 26, 2002
Repaired:	June 3, 2004
Recalibrated:	June 10, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1604 June 10, 2004

DASY - Parameters of Probe: ET3DV6 SN:1604

Sensitivity in Free Space

NormX	**1.90** $\mu V/(V/m)^2$
NormY	**1.82** $\mu V/(V/m)^2$
NormZ	**1.92** $\mu V/(V/m)^2$

Diode Compression[A]

DCP X	**94**	mV
DCP Y	**94**	mV
DCP Z	**94**	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Plese see Page 7.

Boundary Effect

Head **900 MHz** **Typical SAR gradient: 5 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	8.9	4.6
SAR_{be} [%]	With Correction Algorithm	0.1	0.2

Head **1800 MHz** **Typical SAR gradient: 10 % per mm**

Sensor Center to Phantom Surface Distance		**3.7 mm**	**4.7 mm**
SAR_{be} [%]	Without Correction Algorithm	13.0	8.7
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

Probe Tip to Sensor Center	**2.7** mm
Optical Surface Detection	**in tolerance**

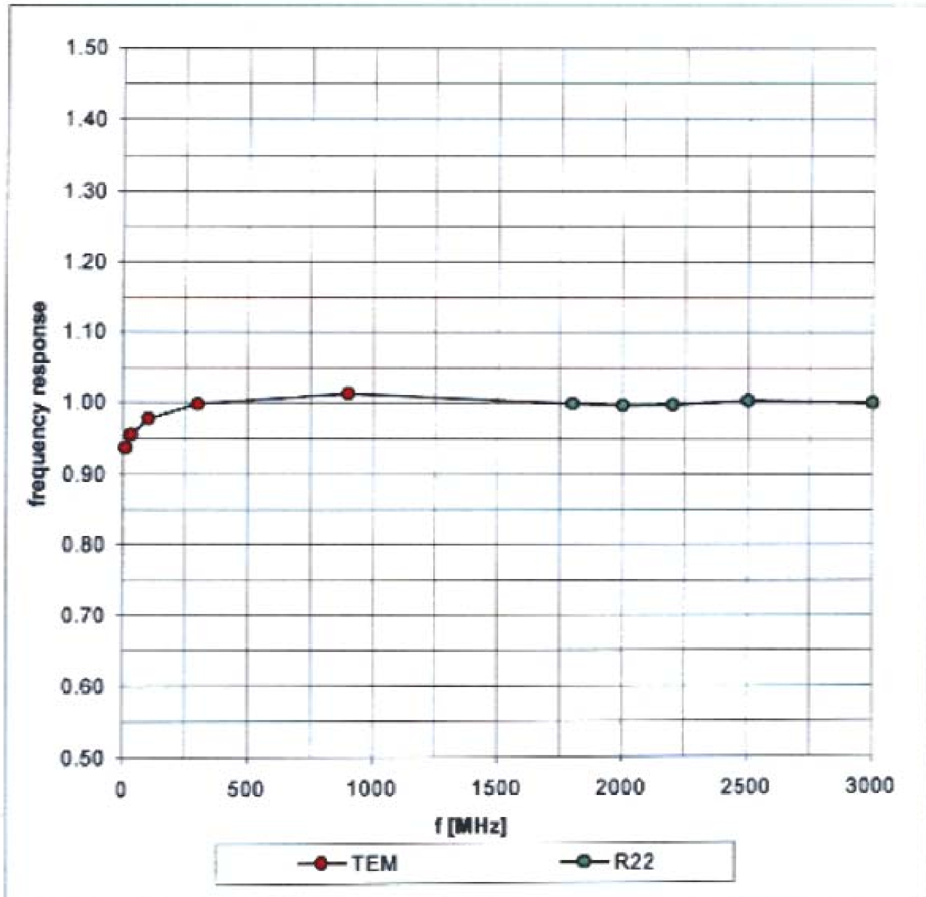
The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] numerical linearization parameter: uncertainty not required

ET3DV6 SN:1604 June 10, 2004

Frequency Response of E-Field

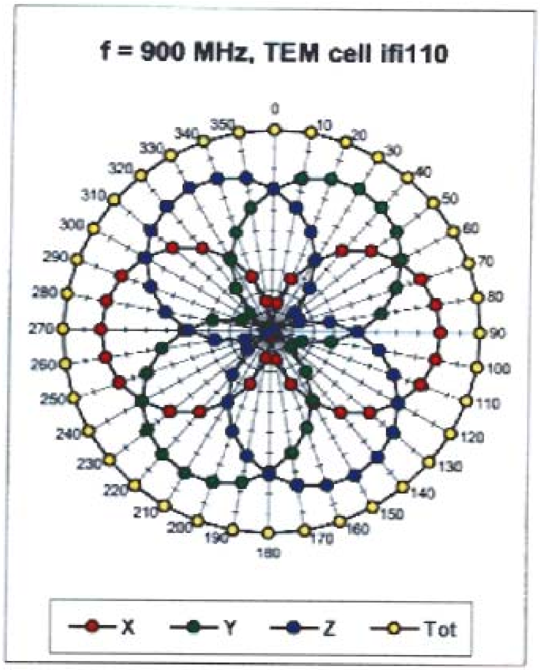
(TEM-Cell:ifi110, Waveguide R22)

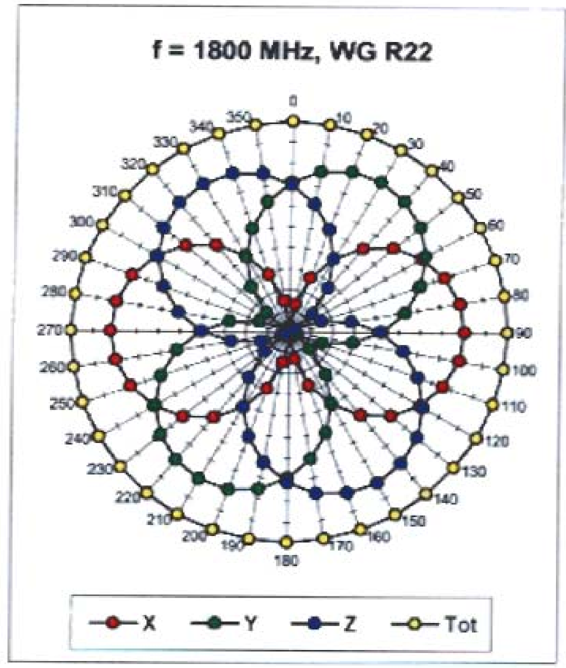


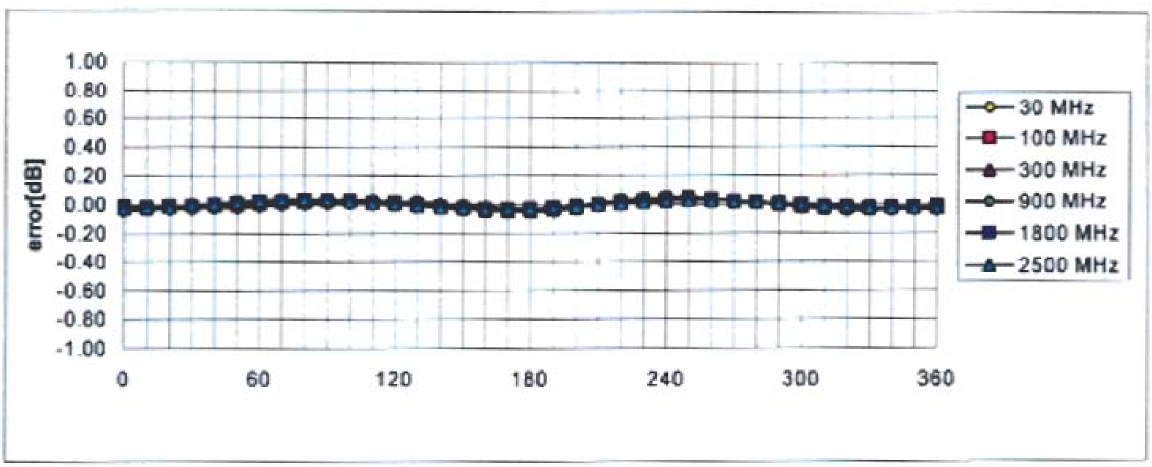
ET3DV6 SN:1604

June 10, 2004

Receiving Pattern (ϕ), θ = 0°







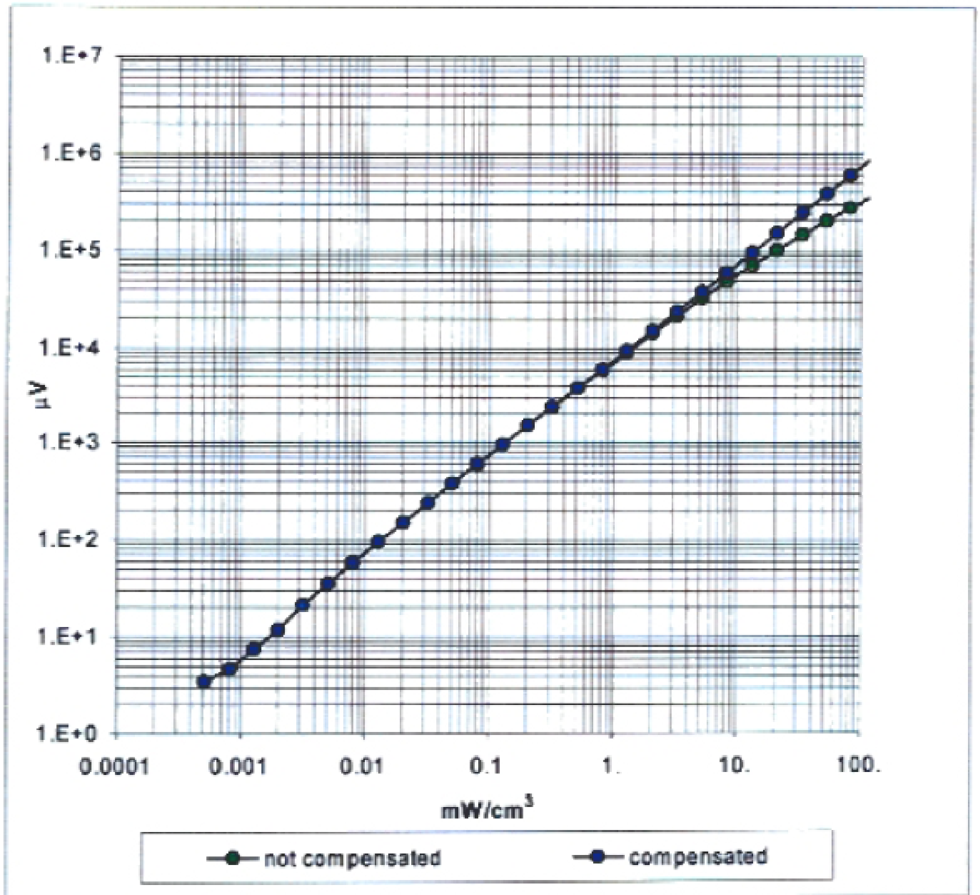
Axial Isotropy Error < ± 0.2 dB

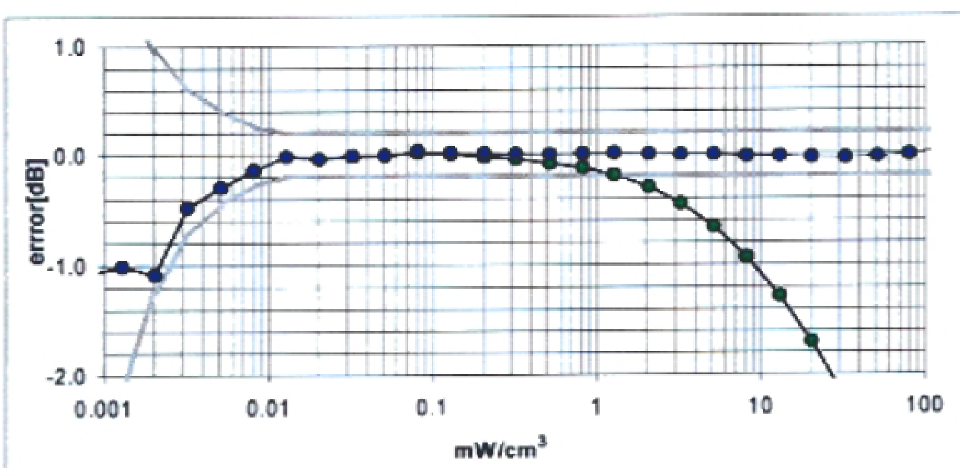
ET3DV6 SN:1604

June 10, 2004

Dynamic Range f(SAR_{head})

(Waveguide R22)



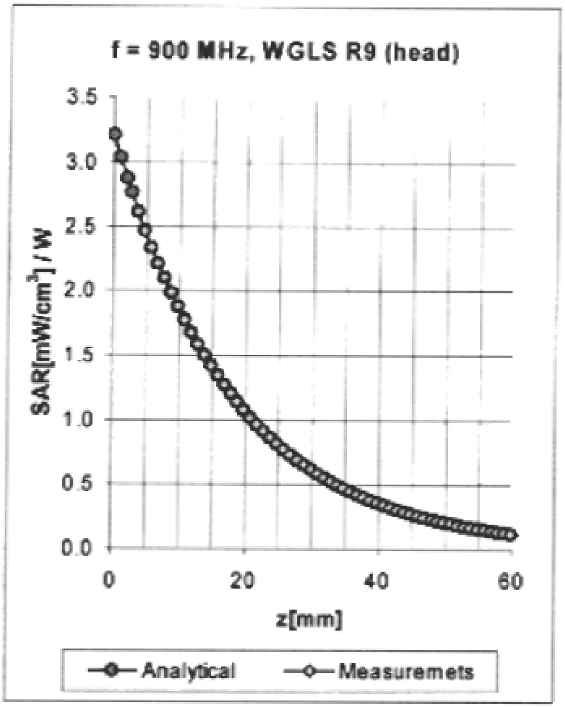


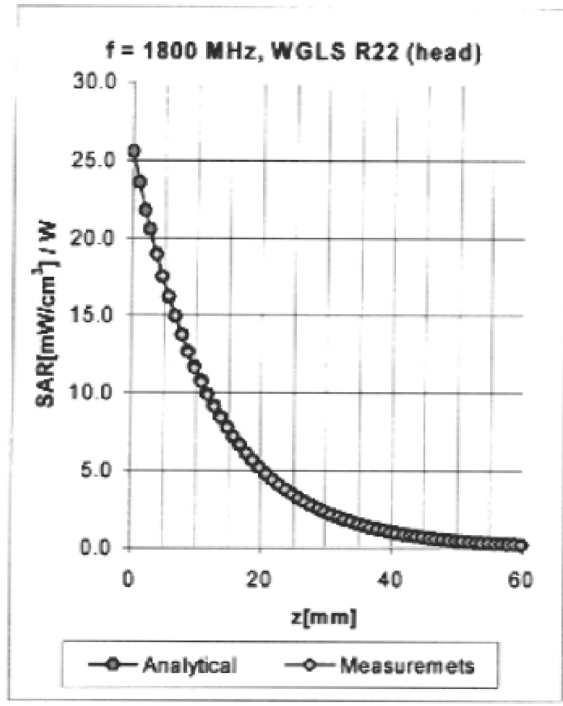
Probe Linearity Error < ± 0.2 dB

ET3DV6 SN:1604

June 10, 2004

Conversion Factor Assessment



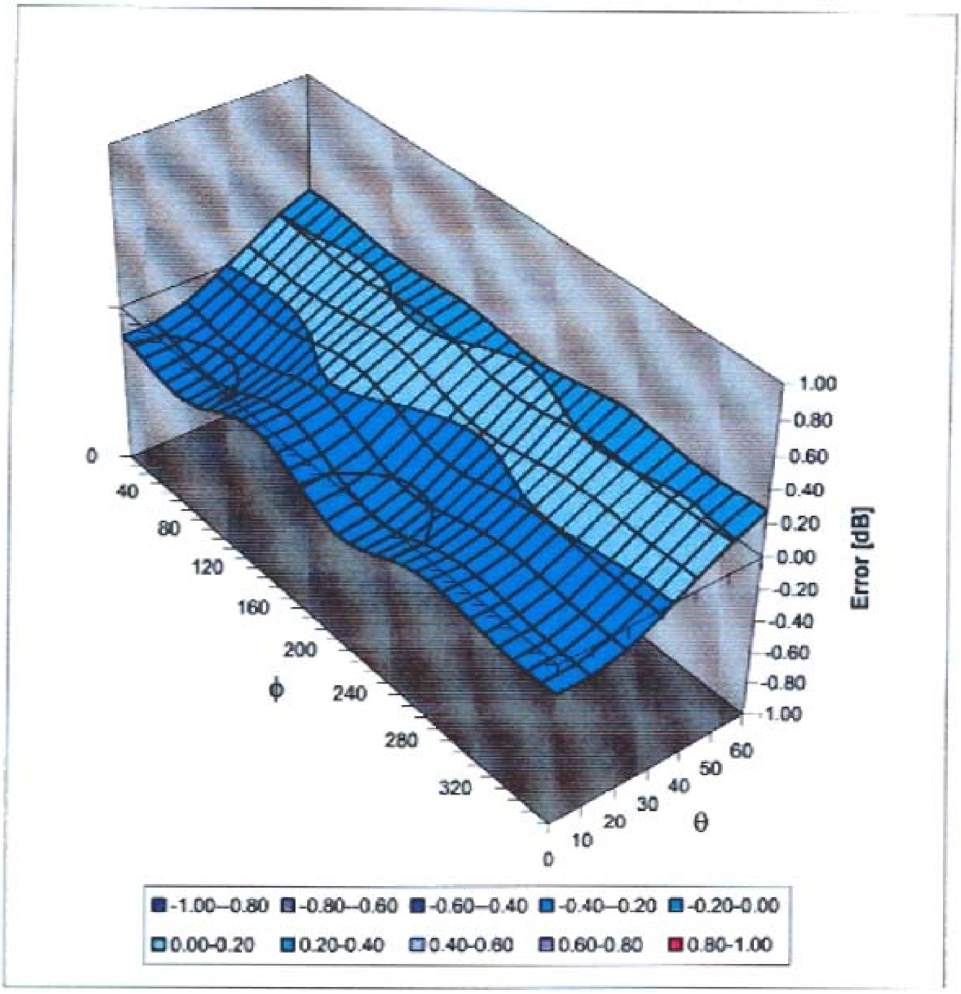


f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.67	1.75	6.45	± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.47	2.64	5.23	± 11.7% (k=2)

ET3DV6 SN:1604 June 10, 2004

Deviation from Isotropy in HSL

Error (θ, φ), f = 900 MHz



Spherical Isotropy Error < ± 0.4 dB

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

Probe ES3DV2

SN: 3019

Manufactured: December 5, 2002
Last calibration: July 12, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ES3DV2 SN: 3019 July 12, 2003

DASY - Parameters of Probe: ES3DV2 SN: 3019

Sensitivity in Free Space

NormX	**1.03** $\mu V/(V/m)^2$
NormY	**1.12** $\mu V/(V/m)^2$
NormZ	**0.98** $\mu V/(V/m)^2$

Diode Compression

DCP X	99
DCP Y	99
DCP Z	99

Sensitivity in Tissue Simulating Liquid

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

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**6.4** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**6.4** ± 9.5% (k=2)	Alpha	**0.68**
ConvF Z	**6.4** ± 9.5% (k=2)	Depth	**1.11**

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

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	**5.0** ± 9.5% (k=2)	Boundary effect:	
ConvF Y	**5.0** ± 9.5% (k=2)	Alpha	**0.21**
ConvF Z	**5.0** ± 9.5% (k=2)	Depth	**2.78**

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	4.3	1.8
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Head 1800 MHz Typical SAR gradient: 10 % per mm

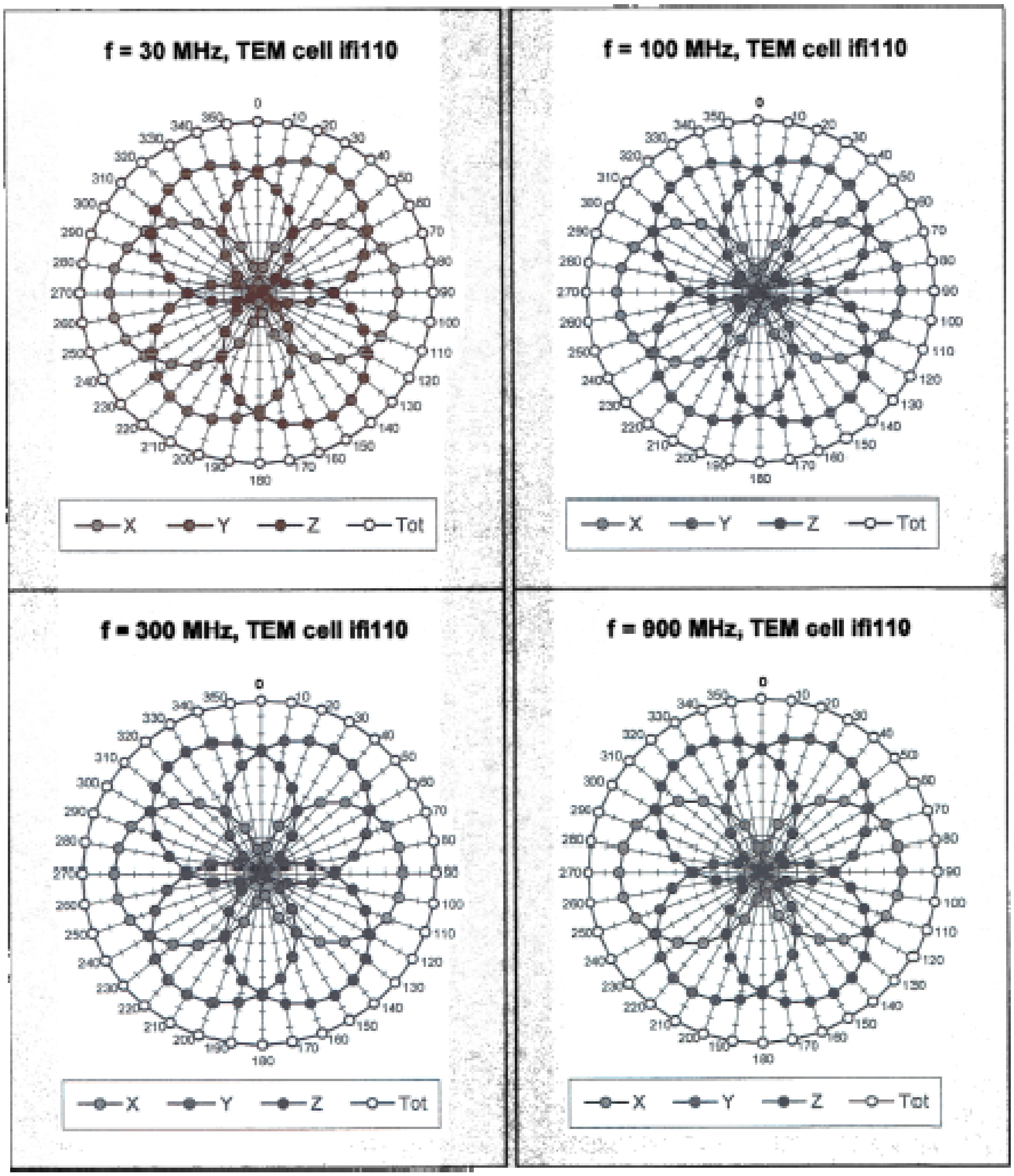
Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	7.4	5.0
SAR_{be} [%]	With Correction Algorithm	0.0	0.1

Sensor Offset

Probe Tip to Sensor Center **2.1** mm

ES3DV2 SN: 3019 July 12, 2003

Receiving Pattern (ϕ, θ = 0°



Page 3 of 10