SAR EVALUATION REPORT

For

SHENZHEN HYT SCIENCE&TECHNOLOGY CO.,LTD

R2-High-Tech Industrial Park
ShenZhen, China

FCC ID: R74TC3600V

This Report Concerns:	Equipment Type:
☒ Original Report	Two-way Radio

Test Engineer: Eric Hong

Report No.: R0412132S

Test Date: 2005-01-03

Reviewed By: Daniel Deng

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DECLARATION OF COMPLIANCE SAR EVALUATION	
Rule Part(s):	**FCC §2.1093**
Test Procedure(s):	**FCC OET Bulletin 65 Supplement C**
Device Classification:	**Two Way Radio, TNF**
Device Type:	**PTT**
FCC ID:	**R74TC3600V**
Model Number:	**TC-3600KV**
Modulation:	**FM**
TX Frequency Range:	**136 – 162 MHz & 145-175 MHz**
Max. Conducted Power Tested:	**37.17dBm**
Antenna Type(s):	**External Antenna**
Battery Type(s):	**Rechargeable**
Body-Worn Accessories:	**Belt Clip & Headset**
Face-Head Accessories:	**None**
Max. SAR Level(s) Measured: 0.01305 W/kg (Face-Held) / 0.02385 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/

Eugene Peyzner
Bay Area Compliance Laboratory Corp.

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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 *Shenzhen HYT Science&Technology Co.,Ltd's* Model: *TC-3600KV* or the "EUT" as referred to in this report is a Two-way Radio, which measures approximately 65mmL x 454mmW x 193mmH.

The EUT operates at 136 – 162 MHz & 145-175 MHz with maximum power of 37.17dBm (5.21W), frequency tolerance 2.5ppm, emission designator 11K0F3E, 16K0F3E.

**The test data gathered are from production sample serial number 04D01F0003 provided by the manufacturer.*

DESCRIPTION OF TEST SYSTEM

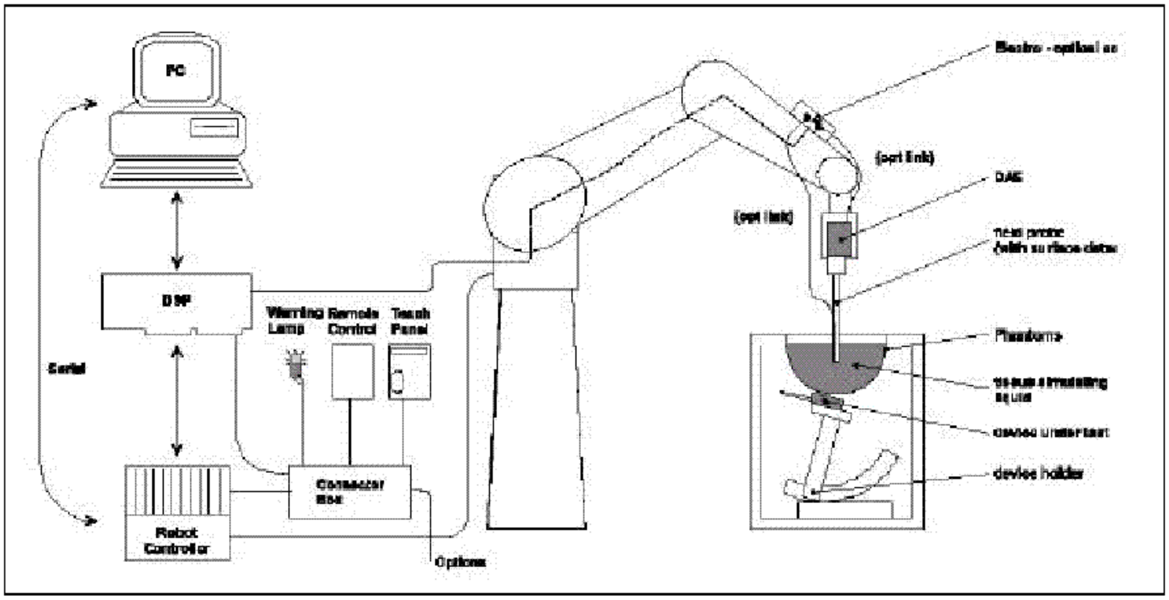
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ±0.02mm. Special 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: 1577 (manufactured by SPEAG), designed in the classical triangular configuration [3] and optimized for dosimetric evaluation. The probe has been calibrated according to the procedure described in [7] with accuracy of better than ±10%. The spherical isotropy was evaluated with the procedure described in [8] and found to be better than ±0.25dB.

The phantom used was the \Generic Twin Phantom" described in [4]. The ear was simulated as a spacer of 4 mm thickness between the earpiece of the phone and the tissue simulating liquid. The Tissue simulation liquid used for each test is in according with the FCC OET65 supplement C as listed below.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (s/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

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.

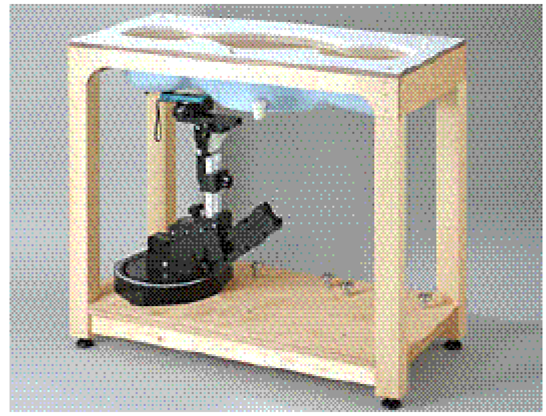
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

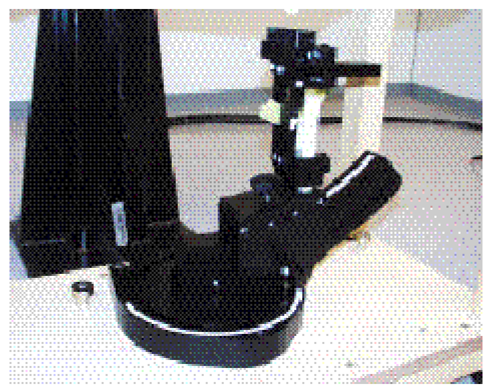


Generic Twin Phantom

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	2004-10-09	3019
SPEAG Generic Twin Phantom	N/R	N/A
SPEAG Light Alignment Sensor	N/A	278
D300V2-SN: 1004	2003-08-25	1004
300 MHz Head Liquid	Each Use	N/A
300 MHz Body Liquid	Each Use	N/A
150 MHz Head Liquid	Each Use	N/A
150 MHz Body Liquid	Each Use	N/A
Robot Table	Each Use	N/A
Phone Holder	Each Use	N/A
HP Spectrum Analyzer HP8566A	N/A	2240A01930
Microwave Amp. 8349A	N/A	2644A02662
Power Meter Agilent E4919B	2004-04-29	18485-66
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	2005-05-04	GB44051221

SAR MEASUREMENT SYSTEM VERIFICATION

Liquid Validation

Body 300MHz Liquid Validation, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C, 01/03/2005

Frequency	e'	e''
250000000.0000	58.9754	58.0867
252000000.0000	58.9646	58.3430
254000000.0000	58.9725	58.2351
256000000.0000	58.9510	58.1036
258000000.0000	58.9685	58.2114
260000000.0000	58.8326	58.0320
262000000.0000	59.7433	57.8115
264000000.0000	59.6447	57.7436
266000000.0000	59.5559	57.6420
268000000.0000	59.4641	57.7318
270000000.0000	59.3715	57.3434
272000000.0000	59.2568	57.5625
274000000.0000	59.1497	56.6063
276000000.0000	59.0783	56.2112
278000000.0000	58.9271	55.8567
280000000.0000	58.8568	55.7235
282000000.0000	58.6423	55.4364
284000000.0000	58.5235	55.4058
286000000.0000	58.4518	55.3441
288000000.0000	58.3404	55.2356
290000000.0000	58.2959	55.2111
292000000.0000	58.1680	54.1292
294000000.0000	58.0457	54.0140
296000000.0000	58.0748	54.8774
298000000.0000	58.0332	54.7047
300000000.0000	57.9773	54.6884
302000000.0000	57.7108	55.2013
304000000.0000	57.6131	55.0232
306000000.0000	57.5372	55.1328
308000000.0000	57.5059	55.3446
310000000.0000	57.4942	55.2375
312000000.0000	57.3136	55.1470
314000000.0000	57.2627	55.1243
316000000.0000	56.9133	55.0142
318000000.0000	56.8349	54.8327
320000000.0000	56.7086	54.4111
322000000.0000	56.6138	54.3799
324000000.0000	56.5076	54.2048
326000000.0000	56.4917	54.4150
328000000.0000	56.3054	54.5348
330000000.0000	56.2479	54.6191
332000000.0000	56.3253	54.5005
334000000.0000	56.4265	54.3896
336000000.0000	56.3874	54.4254
338000000.0000	56.4236	54.1767
340000000.0000	56.5347	54.2392
342000000.0000	56.6403	54.0725
344000000.0000	56.7565	54.5683
346000000.0000	56.8149	54.4541
348000000.0000	56.9212	54.6396
350000000.0000	56.8467	54.7452

0.9127

Hong

$\sigma = \omega \varepsilon_o \varepsilon'' = 2 \pi f \varepsilon_o \varepsilon'' = 0.9127$

where $f = 300 \times 10^6$

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

$\varepsilon'' = 54.6884$

Head 300MHz Liquid Validation, Ambient Temp - 23 Deg C, Liquid Temp = 22 Deg C, 01/03/2005

Frequency	e'	e''
250000000.0000	45.4235	53.8436
252000000.0000	45.3452	53.7618
254000000.0000	45.2414	53.7342
256000000.0000	45.1528	53.6559
258000000.0000	45.1756	53.6763
260000000.0000	45.1471	53.6845
262000000.0000	45.0359	52.5589
264000000.0000	45.1301	52.5323
266000000.0000	45.0987	52.4348
268000000.0000	45.1125	52.3767
270000000.0000	45.1894	52.4480
272000000.0000	45.1712	52.3392
274000000.0000	45.1429	52.2343
276000000.0000	45.0285	52.2236
278000000.0000	45.2467	52.1432
280000000.0000	45.3245	52.0458
282000000.0000	45.4516	51.9389
284000000.0000	45.4628	51.8332
286000000.0000	45.5355	51.7553
288000000.0000	45.3412	51.6128
290000000.0000	45.4589	51.5153
292000000.0000	45.5374	51.4489
294000000.0000	45.4251	51.3870
296000000.0000	45.3408	51.4343
298000000.0000	45.4280	51.5878
300000000.0000	45.5549	51.6323
302000000.0000	45.4581	51.6149
304000000.0000	45.3354	51.5257
306000000.0000	45.2017	51.4876
308000000.0000	45.1268	51.3392
310000000.0000	45.1480	51.2185
312000000.0000	45.2359	51.3076
314000000.0000	45.2584	51.2247
316000000.0000	45.3653	51.1985
318000000.0000	45.4545	51.2082
320000000.0000	45.3328	51.1246
322000000.0000	45.2970	51.1651
324000000.0000	45.1214	51.1147
326000000.0000	45.0475	51.1092
328000000.0000	45.0241	51.1235
330000000.0000	44.9448	51.0316
332000000.0000	44.8214	50.9087
334000000.0000	44.7421	50.8261
336000000.0000	44.6485	50.7129
338000000.0000	44.5352	50.6471
340000000.0000	44.4471	50.5362
342000000.0000	44.3897	50.4840
344000000.0000	44.2963	50.3332
346000000.0000	44.1358	50.2083
348000000.0000	44.0471	50.3495
350000000.0000	44.0649	50.4170

0.8617

Hong

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 0.8617$

where $f = 300 \times 10^6$

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

$\varepsilon'' = 51.6323$

150 MHz body liquid validation
Body 150MHz Liquid Validation, Ambient Temp=23 Deg C, Liquid Temp=22 Deg C,
01/03/2005

Frequency	e'	e''
100000000.0000	61.2728	132.9509
102000000.0000	62.4285	130.8252
104000000.0000	62.1752	128.7113
106000000.0000	61.6864	125.6682
108000000.0000	61.6872	123.5839
110000000.0000	62.2102	122.4861
112000000.0000	61.5361	121.3189
114000000.0000	62.3017	118.5862
116000000.0000	61.9958	117.8641
118000000.0000	61.7760	115.6172
120000000.0000	61.3646	113.5956
122000000.0000	61.8232	110.1878
124000000.0000	62.1246	109.4566
126000000.0000	62.3496	108.3614
128000000.0000	61.2655	107.2526
130000000.0000	61.1726	106.4808
132000000.0000	60.9448	105.5729
134000000.0000	60.8814	104.3047
136000000.0000	60.7140	103.2125
138000000.0000	60.6682	101.1840
140000000.0000	60.5729	99.8178
142000000.0000	60.4691	98.9624
144000000.0000	60.5966	97.8624
146000000.0000	60.2737	96.7987
148000000.0000	60.6745	95.6958
150000000.0000	61.5838	94.9816
152000000.0000	60.0397	93.3643
154000000.0000	60.5462	92.6448
156000000.0000	59.9149	91.9057
158000000.0000	59.9807	92.2102
160000000.0000	60.0415	93.4984
162000000.0000	59.6673	94.7072
164000000.0000	59.6488	95.6219
166000000.0000	59.6667	94.6596
168000000.0000	59.5966	93.9282
170000000.0000	59.1871	92.2958
172000000.0000	59.4493	91.5316
174000000.0000	59.0934	90.9829
176000000.0000	58.9863	89.3961
178000000.0000	58.6711	88.6272
180000000.0000	58.5987	87.2193
182000000.0000	58.7378	86.5075
184000000.0000	58.6364	85.0126
186000000.0000	58.3287	84.5680
188000000.0000	58.5423	83.8132
190000000.0000	58.6087	82.5260
192000000.0000	58.2142	81.9684
194000000.0000	58.1078	80.5176
196000000.0000	58.0475	79.0610
198000000.0000	57.9513	78.6278
200000000.0000	57.6839	77.1212

0.7926

$\sigma = \omega \varepsilon_o \varepsilon'' = 2\pi f \varepsilon_o \varepsilon'' = 0.7926$

where $f = 150 \times 10^6$

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

$\varepsilon'' = 94.9816$

150 MHz head liquid validation
Head 150MHz Liquid Validation, Ambient Temp = 23 Deg C, Liquid Temp = 22 Deg C.
01/03/2005

Frequency	e'	e''
100000000.0000	53.9814	121.8092
102000000.0000	53.6572	119.9434
104000000.0000	53.5621	116.7921
106000000.0000	53.4035	114.9853
108000000.0000	53.3170	112.7191
110000000.0000	53.2532	110.5270
112000000.0000	53.5402	108.8659
114000000.0000	53.4347	107.0523
116000000.0000	53.3938	105.3791
118000000.0000	53.2121	103.3512
120000000.0000	53.5693	101.8934
122000000.0000	53.6520	101.9639
124000000.0000	53.5450	100.4907
126000000.0000	53.3053	99.7788
128000000.0000	53.3364	98.2364
130000000.0000	53.1783	97.6633
132000000.0000	52.6844	96.3874
134000000.0000	53.1363	95.1675
136000000.0000	53.0954	94.5426
138000000.0000	52.5817	93.8107
140000000.0000	53.1723	92.5085
142000000.0000	52.5539	92.2326
144000000.0000	53.1635	92.0050
146000000.0000	52.4290	91.5739
148000000.0000	52.9737	90.4790
150000000.0000	52.2738	90.1259
152000000.0000	51.7667	89.6324
154000000.0000	51.8412	88.4010
156000000.0000	51.7450	87.4548
158000000.0000	51.5542	86.5189
160000000.0000	51.5268	85.6764
162000000.0000	51.2173	84.1253
164000000.0000	51.0539	83.1097
166000000.0000	51.1367	82.9126
168000000.0000	50.6824	80.4671
170000000.0000	50.4835	79.5964
172000000.0000	50.3204	78.3345
174000000.0000	50.2021	77.6504
176000000.0000	49.7593	77.0671
178000000.0000	49.6402	76.4228
180000000.0000	49.3758	75.6245
182000000.0000	49.4390	75.2519
184000000.0000	49.1683	74.0725
186000000.0000	49.0505	73.3894
188000000.0000	49.9229	72.8546
190000000.0000	49.7358	72.3801
192000000.0000	49.4103	71.4735
194000000.0000	49.6075	70.5582
196000000.0000	49.1869	70.1989
198000000.0000	49.1290	70.2583
200000000.0000	49.0867	69.9186

0.7521

Hong

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\, \pi f\, \varepsilon_o\, \varepsilon'' = 0.7521$

where $f = 150 \times 10^{6}$

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

$\varepsilon'' = 90.1259$

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 (300 MHz)

Validation Measurement	SAR @ 100 mW Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 100 mW Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	0.376	3.76	0.255	2.55
Test 2	0.378	3.78	0.256	2.56
Test 3	0.380	3.80	0.258	2.58
Test 4	0.385	3.85	0.261	2.61
Test 5	0.384	3.84	0.261	2.61
Test 6	0.383	3.83	0.261	2.61
Test 7	0.382	3.82	0.260	2.60
Test 8	0.381	3.81	0.259	2.59
Test 9	0.379	3.79	0.258	2.58
Test 10	0.379	3.79	0.257	2.57
Average	0.381	3.81	0.259	2.59

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:	23° C
Relative Humidity:	37%
ATM Pressure:	1032 mbar

EUT position	Frequency (MHz)	Conducted Power (W)	Test Type	Antenna Type	Liquid	Phantom	Notes / Accessories	Measured (mW/g)		Limit (mW/g)	Plot #
								100%	50% duty cycle		
back in touch with phantom	160.3	5.21	Body worn	Built-in	body	flat	Belt Clip, Headset	0.0477	0.02385	8	1
2.5 cm head separation to phantom	160.3	5.21	Face-held	Built-in	head	flat	none	0.0261	0.01305	8	2

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 traceablity 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	
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.

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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%.

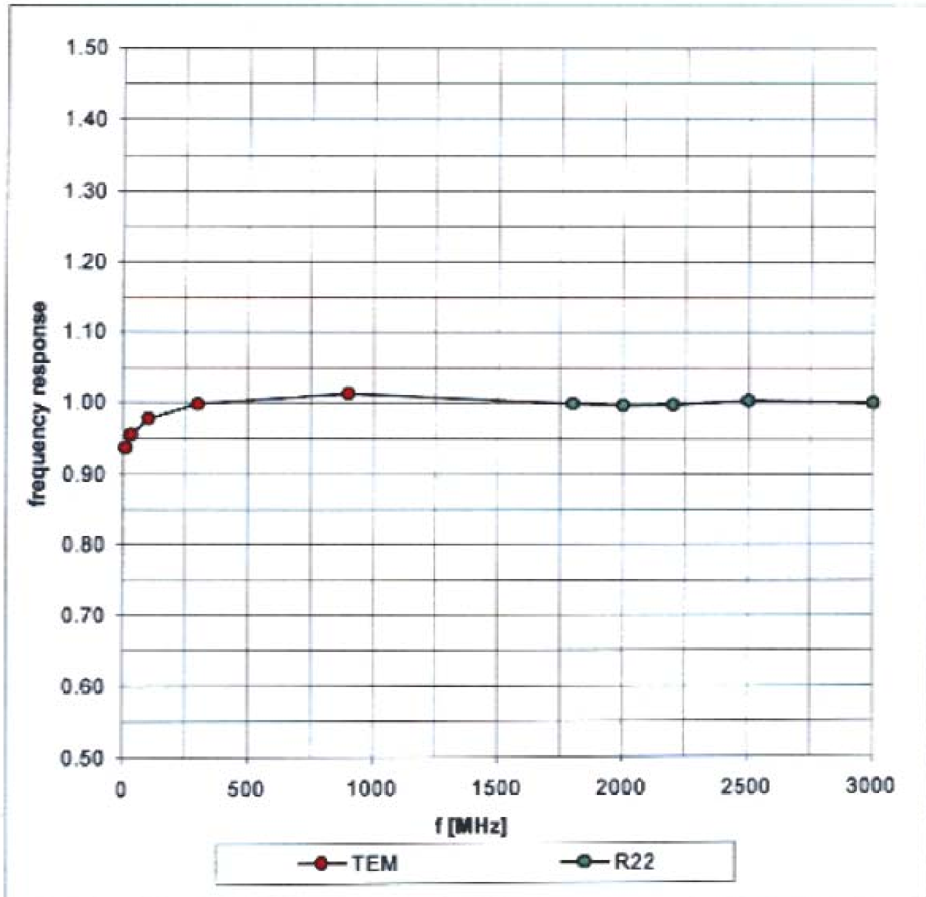
[A] numerical linearization parameter: uncertainty not required

ET3DV6 SN:1604

June 10, 2004

Frequency Response of E-Field

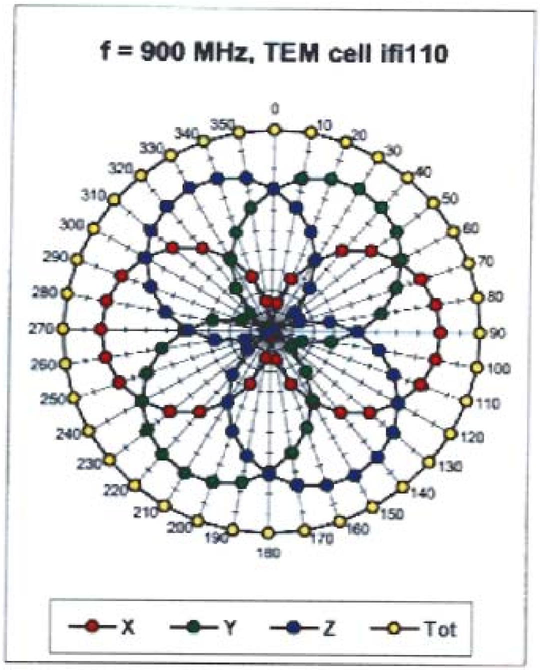
(TEM-Cell:ifi110, Waveguide R22)

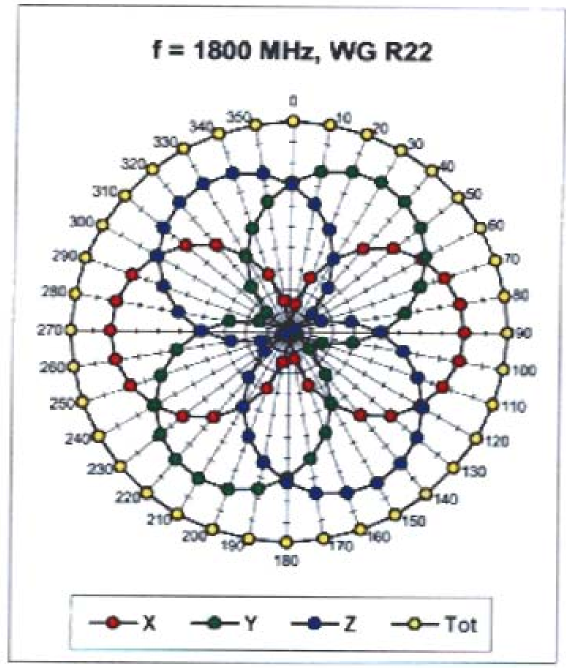


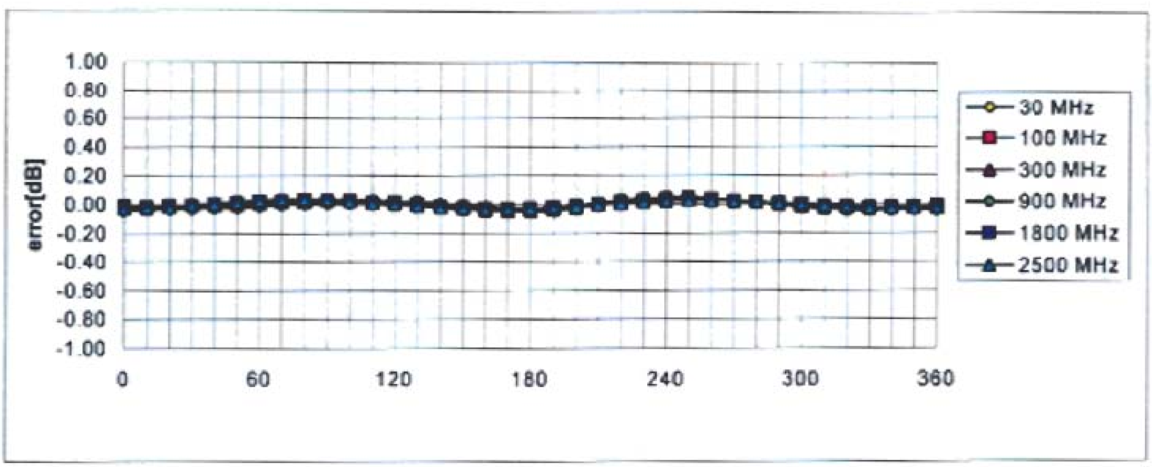
ET3DV6 SN:1604

June 10, 2004

Receiving Pattern (ϕ), θ = 0°





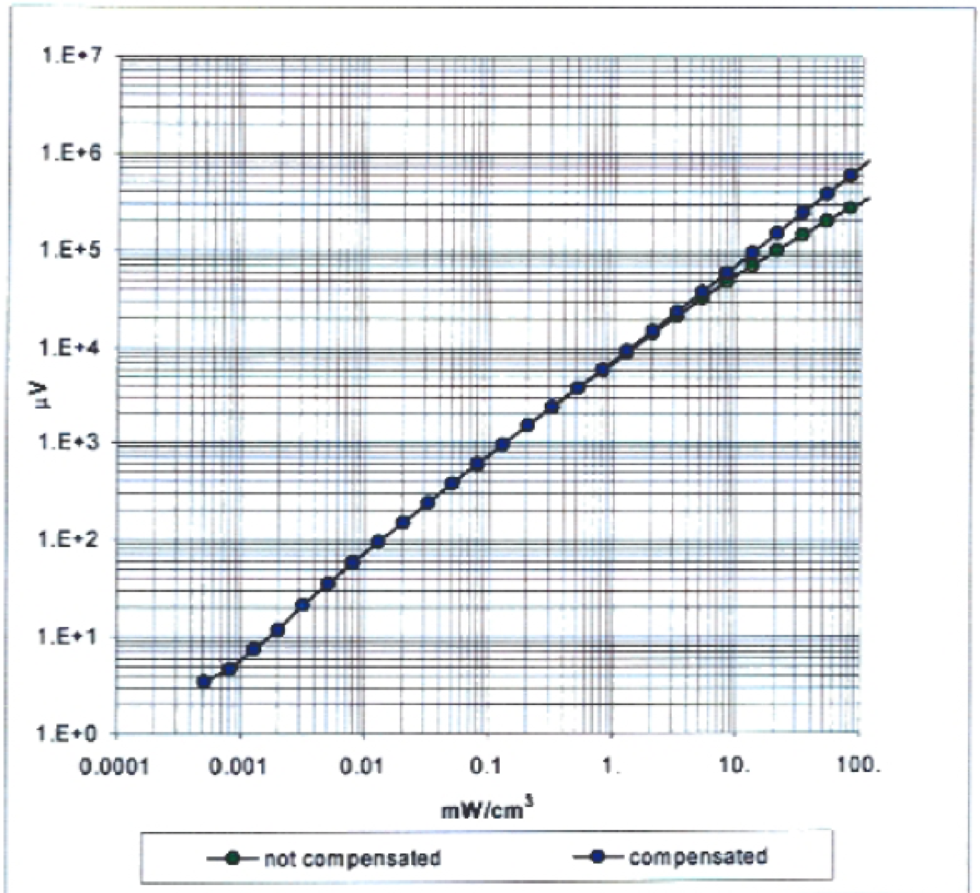


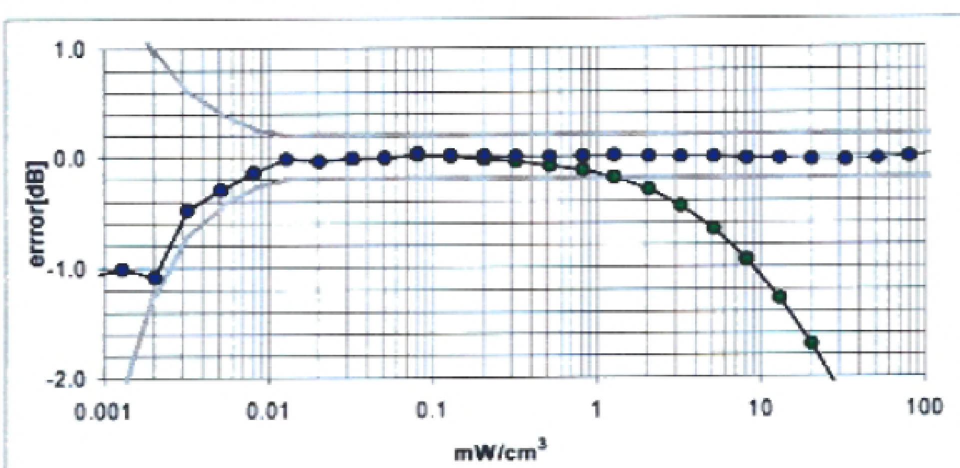
Axial Isotropy Error < ± 0.2 dB

ET3DV6 SN:1604 **June 10, 2004**

Dynamic Range f(SAR_{head})

(Waveguide R22)

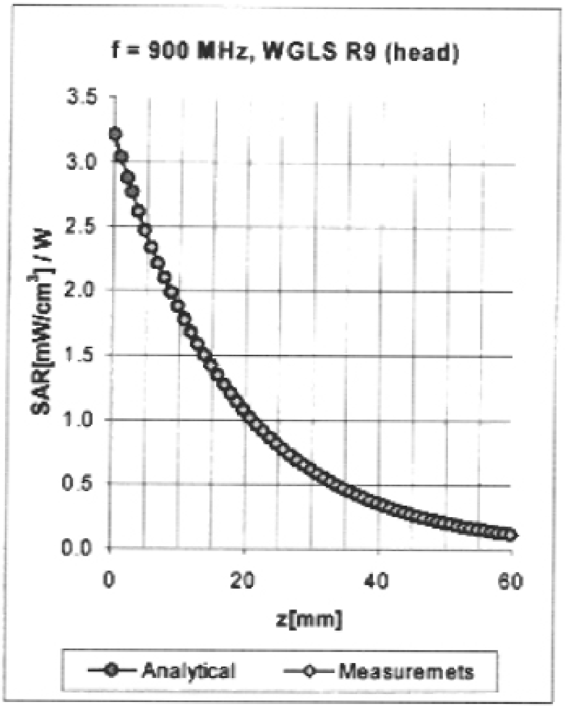


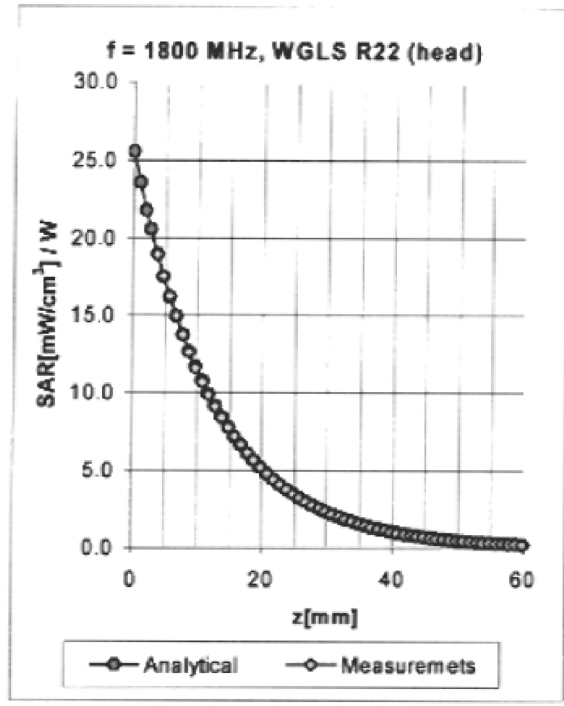


Probe Linearity Error < ± 0.2 dB

ET3DV6 SN:1604 **June 10, 2004**

Conversion Factor Assessment





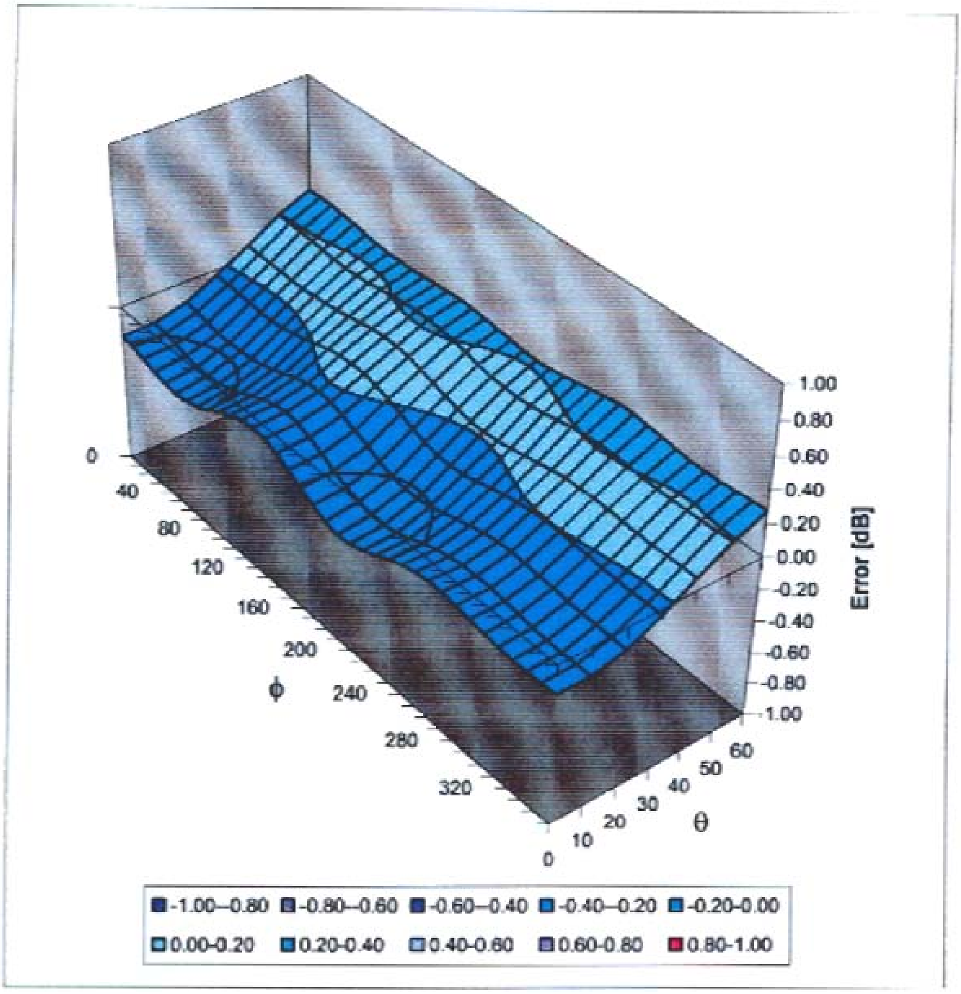
f [MHz]	Validity [MHz][B]	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF	Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	0.67	1.75	6.45	± 11.3% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.47	2.64	5.23	± 11.7% (k=2)

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

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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!)

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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

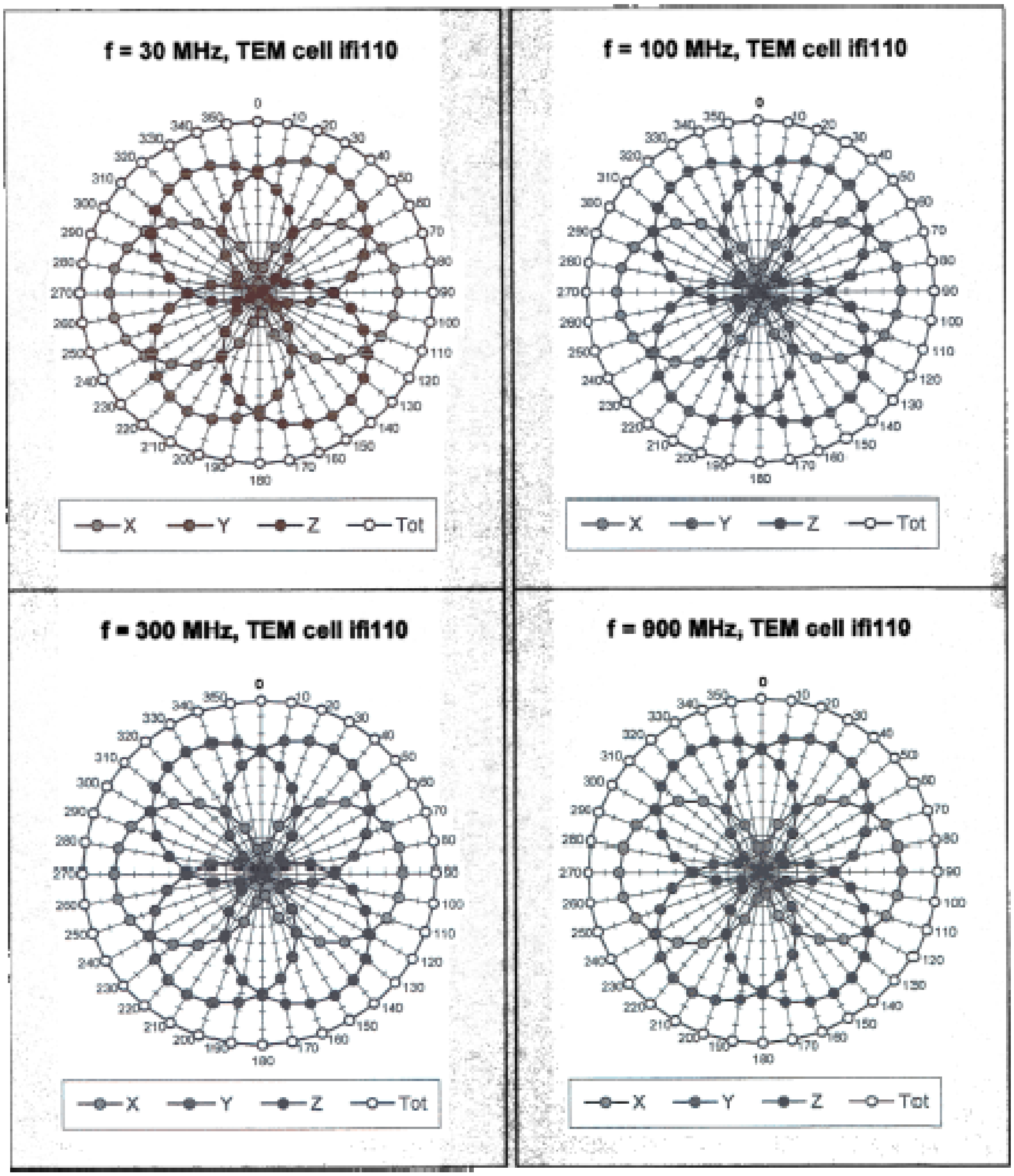
Probe Tip to Boundary	**1 mm**	**2 mm**
SAR_{be} [%] Without Correction Algorithm	7.4	5.0
SAR_{be} [%] With Correction Algorithm	0.0	0.1

Sensor Offset

Probe Tip to Sensor Center **2.1** mm

ES3DV2 SN: 3019 July 12, 2003

Receiving Pattern (φ, θ = 0°



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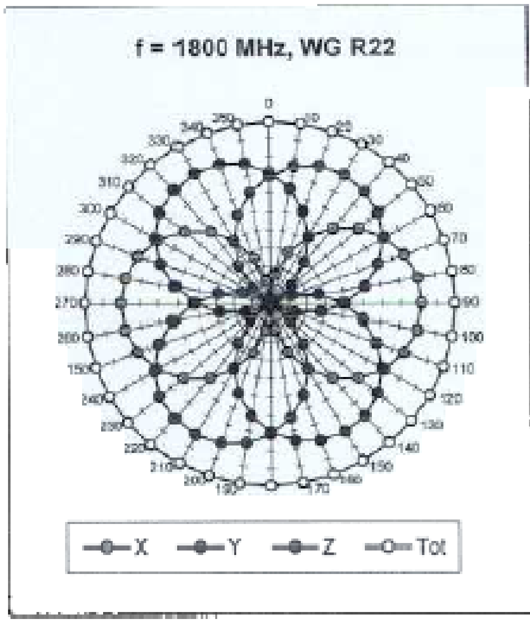
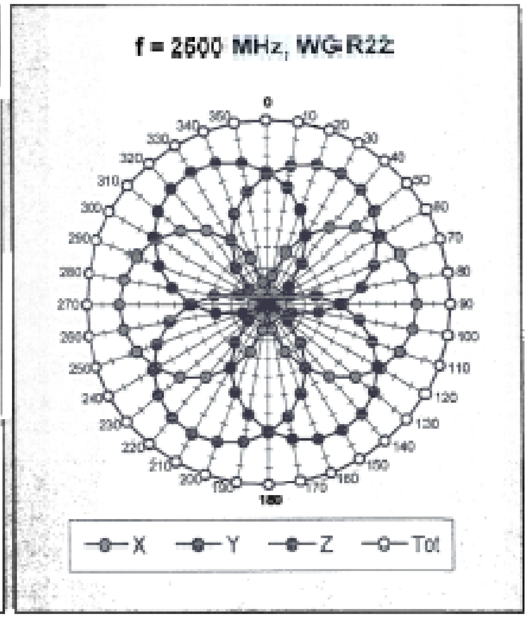
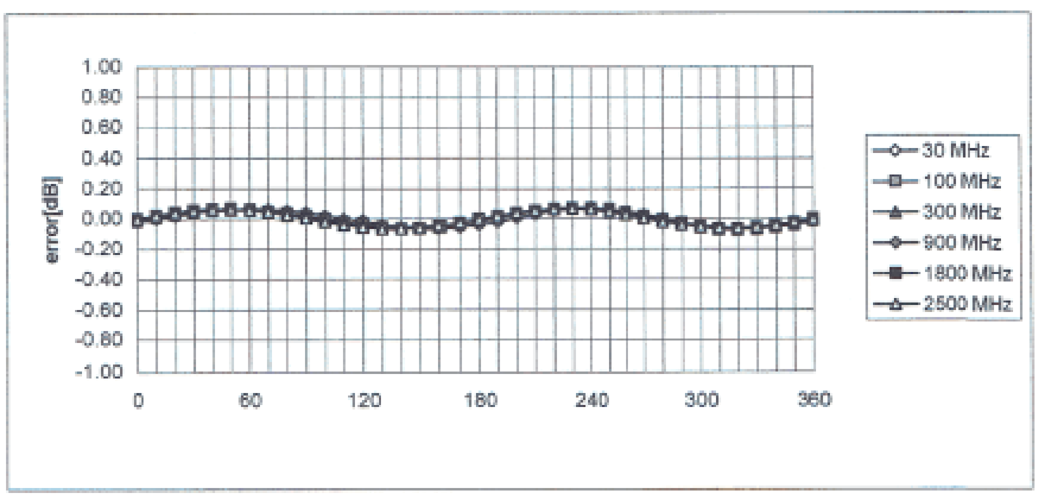
ES3DV2 SN: 3019 July 2003





Isotropy Error (φ), θ 0°

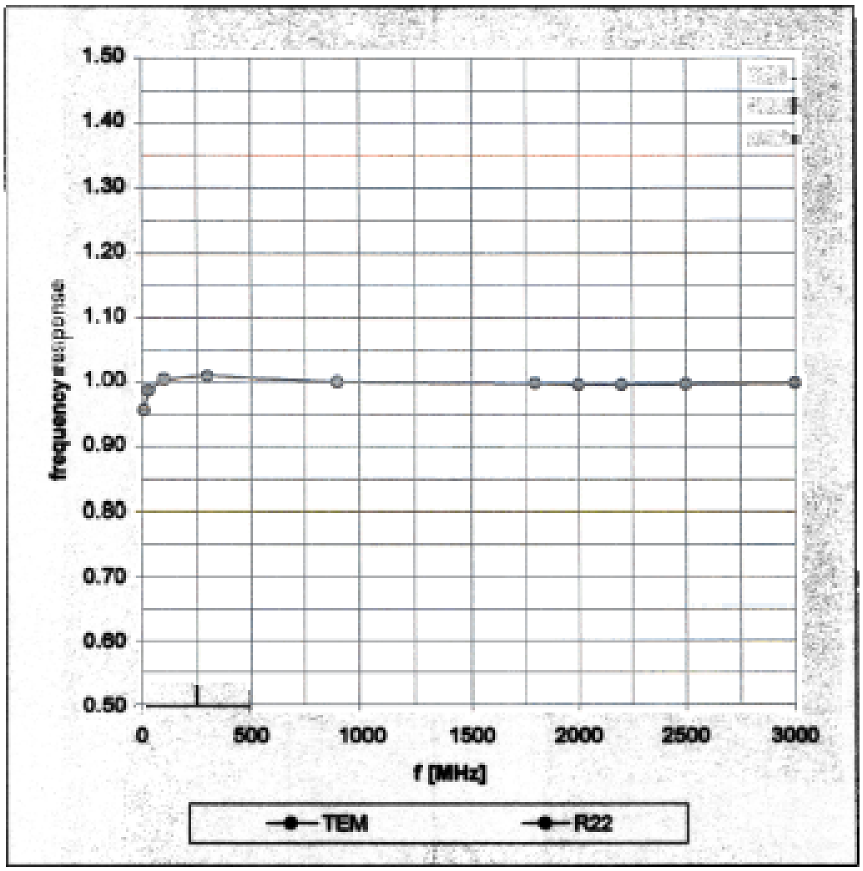


Page

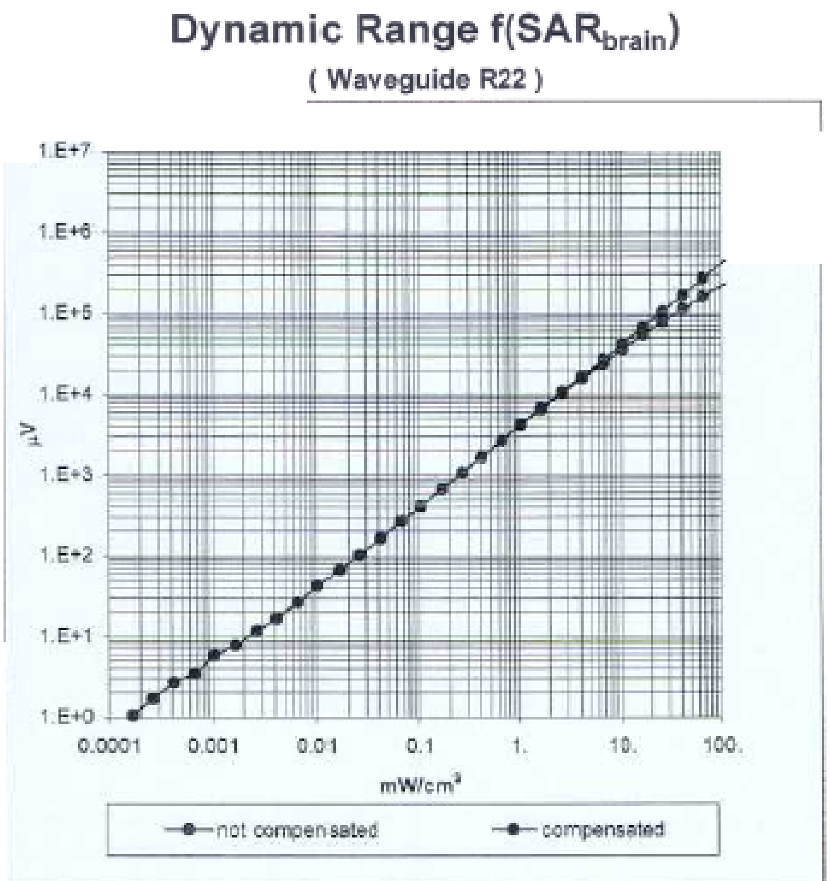
ES3DV2 SN: 3019 **July 12, 2003**

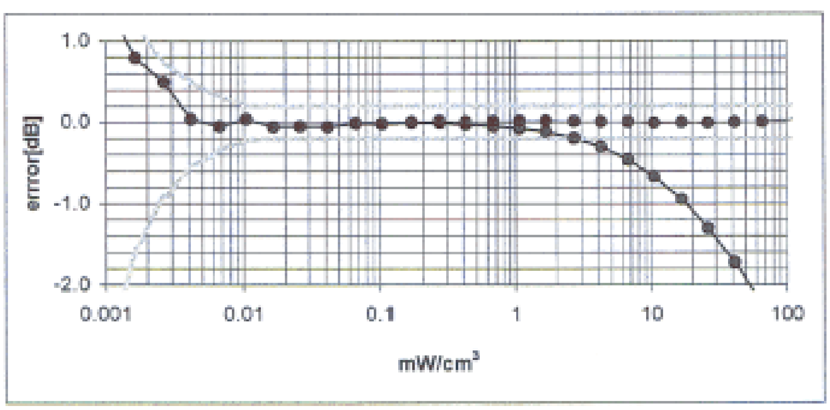
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



ES3DV2 SN: 3019 **July 12, 2003**





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