SAR EVALUATION REPORT

For

SHENZHEN HYT SCIENCE&TECHNOLOGY CO.,LTD

R2-High-Tech Industrial Park
ShenZhen, China

FCC ID: R74TC3600U

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

Test Engineer: Eric Hong

Report No.: R0412133S

Test Date: 2005-01-05

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:	**Two Way Radio, TNF**
Device Type:	**PTT**
FCC ID:	**R74TC3600U**
Model Number:	**TC-3600KU**
Modulation:	**FM**
TX Frequency Range:	**350-390MHz, 400-430MHz & 440-470 MHz**
Max. Conducted Power Tested:	**36.33dBm**
Antenna Type(s):	**External Antenna**
Battery Type(s):	**Rechargeable**
Body-Worn Accessories:	**Belt Clip & Headset**
Face-Head Accessories:	**None**

Max. SAR Level(s) Measured: 0.705 W/kg (Face-Held) / 2.160 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.

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 *Shenzhen HYT Science&Technology Co.,Ltd's* FCC ID: *R74TC3600U* or the "EUT" as referred to in this report is a Two-way Radio, which measures approximately 65mmL x 450mmW x 193mmH.

The EUT operates at 350-390MHz, 400-430MHz & 440-470 MHz with maximum power of 36.33dBm (4.30W), frequency tolerance 2.5ppm, emission designator 11K0F3E, 16K0F3E.

**The test data gathered are from production sample serial number 04N29F0003 provided by the manufacturer.*

DESCRIPTION OF TEST SYSTEM

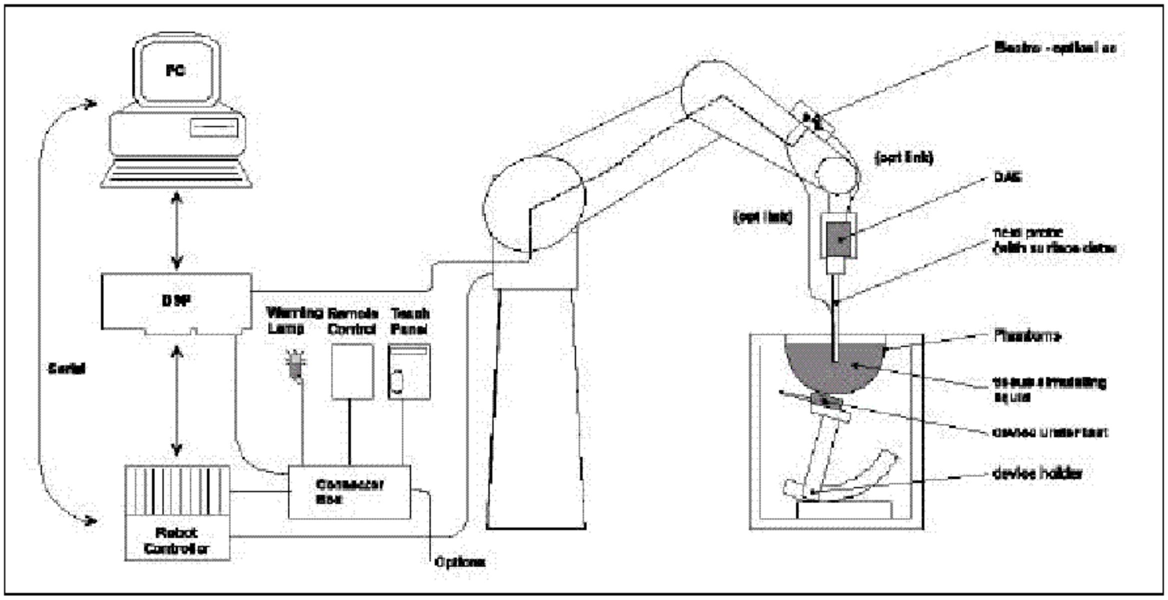
These measurements were performed with the automated near-field scanning system DASY3 from Schmid & Partner Engineering AG (SPEAG). The system is based on a high precision robot (working range greater than 0.9m), which positions the probes with a positional repeatability of better than ±0.02mm. Special 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: $E_i = \sqrt{\dfrac{V_i}{Norm_i \cdot ConvF}}$

H-field probes: $H_i = \sqrt{Vi} \cdot \dfrac{a_{i0} + a_{i1} f + a_{i2} f^2}{f}$

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.

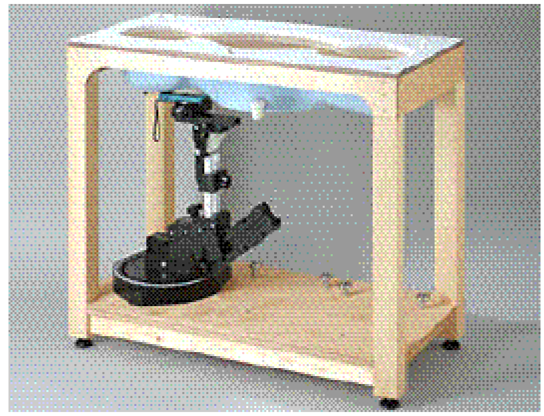
The power flow density is calculated assuming the excitation field as a free space field.

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

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)

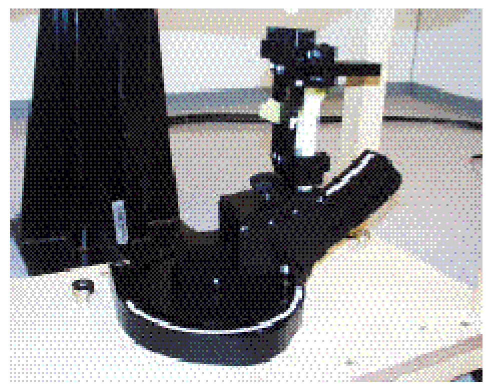


Generic Twin Phantom

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
D450V2	2004-01-04	1010
450 MHz Head Liquid	Each Use	N/A
450 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

Head 450MHz Liquid Validation, Ambient Temp=23°C,Liquid Temp=22°C, 01/05/2005

Frequency	e'	e"
400000000.0000	44.6335	36.1182
402000000.0000	44.5643	35.9838
404000000.0000	44.3127	35.0737
406000000.0000	44.2408	35.9936
408000000.0000	44.1769	35.0085
410000000.0000	44.0291	35.9344
412000000.0000	43.7842	35.9445
414000000.0000	43.6265	35.8457
416000000.0000	43.8230	35.9238
418000000.0000	43.5819	35.9389
420000000.0000	43.6672	35.7844
422000000.0000	43.5591	35.9101
424000000.0000	43.4656	35.8393
426000000.0000	43.3778	35.8626
428000000.0000	43.2549	35.8148
430000000.0000	43.1423	35.8226
432000000.0000	43.0802	35.8033
434000000.0000	42.9695	35.7342
436000000.0000	42.8710	35.7579
438000000.0000	42.7622	35.5660
440000000.0000	42.6301	35.5021
442000000.0000	42.5936	35.4247
444000000.0000	42.4624	35.5065
446000000.0000	42.5238	35.5264
448000000.0000	42.3965	35.4543
450000000.0000	42.2916	34.5422
452000000.0000	42.3984	34.6707
454000000.0000	42.4297	34.5879
456000000.0000	42.5786	34.4016
458000000.0000	42.6831	34.3964
460000000.0000	42.3925	33.2701
462000000.0000	42.2490	33.1764
464000000.0000	42.2967	33.0468
466000000.0000	42.2703	32.9052
468000000.0000	42.2572	32.8041
470000000.0000	42.2198	32.6878
472000000.0000	42.3017	32.6393
474000000.0000	42.3264	32.6485
476000000.0000	42.4230	32.4093
478000000.0000	42.5569	32.3052
480000000.0000	42.6400	32.2271
482000000.0000	42.4282	32.1428
484000000.0000	42.5641	32.0249
486000000.0000	42.3077	31.9865
488000000.0000	42.1849	31.8234
490000000.0000	42.3462	31.6352
492000000.0000	42.3568	31.6761
494000000.0000	42.3150	31.4997
496000000.0000	42.3498	31.4246
498000000.0000	42.3869	31.3630
500000000.0000	42.3726	31.2967

0.8647

Hong

$\sigma = \omega\, \varepsilon_o\, \varepsilon'' = 2\,\pi f\, \varepsilon_o\, \varepsilon''=0.8647$

where $f = 450 \times 10^{6}$

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

$\varepsilon'' = 34.5422$

450MHz Body Liquid Validation, Ambient=23°C, Liquid Temp=22°C, 01/05/2005

Frequency	e'	e''
400000000.0000	56.3476	36.1673
402000000.0000	56.4562	36.2035
404000000.0000	56.5854	36.2614
406000000.0000	56.5132	36.3252
408000000.0000	56.4806	36.3267
410000000.0000	56.2179	36.5198
412000000.0000	56.1682	36.4472
414000000.0000	56.2863	36.7451
416000000.0000	56.2436	36.7023
418000000.0000	56.2518	36.6809
420000000.0000	56.2741	36.7238
422000000.0000	56.0465	36.8831
424000000.0000	55.9413	37.0363
426000000.0000	55.8436	37.1552
428000000.0000	55.7642	37.2075
430000000.0000	55.8521	37.3579
432000000.0000	55.7297	37.3808
434000000.0000	55.5672	37.2952
436000000.0000	55.6268	37.5240
438000000.0000	55.4702	37.6145
440000000.0000	55.4504	37.4363
442000000.0000	55.4524	37.6252
444000000.0000	55.4458	37.5574
446000000.0000	55.4101	37.8030
448000000.0000	55.4717	37.7160
450000000.0000	55.3419	37.7659
452000000.0000	55.3423	37.7724
454000000.0000	55.4989	37.9876
456000000.0000	55.4260	37.8610
458000000.0000	55.5407	37.8093
460000000.0000	55.5834	37.7960
462000000.0000	55.6529	37.7825
464000000.0000	55.7517	37.7406
466000000.0000	55.7781	37.7278
468000000.0000	55.8558	37.6929
470000000.0000	55.8856	37.6502
472000000.0000	55.9335	37.6874
474000000.0000	56.0984	37.6745
476000000.0000	56.2867	37.6262
478000000.0000	56.3423	37.7013
480000000.0000	56.4094	37.5523
482000000.0000	56.5368	37.4977
484000000.0000	56.5735	37.5836
486000000.0000	56.6569	37.4942
488000000.0000	56.7940	37.3461
490000000.0000	56.8136	37.4283
492000000.0000	56.9712	37.5496
494000000.0000	57.0190	37.4175
496000000.0000	57.1943	37.4643
498000000.0000	57.2538	37.4517
500000000.0000	57.3918	37.3958

0.9377

Hong

$\sigma = \omega \varepsilon_o \varepsilon'' = 2\pi f \varepsilon_o \varepsilon'' = 0.9377$

where $f = 450 \times 10^6$

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

$\varepsilon'' = 37.7659$

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 (450 MHz)

Validation Measurement	SAR @ 9.225mW Input averaged over 1g	SAR @ 1W Input averaged over 1g	SAR @ 9.225mW Input averaged over 10g	SAR @ 1W Input averaged over 10g
Test 1	0.0451	0.89	0.0315	3.4
Test 2	0.0447	4.85	0.0312	3.38
Test 3	0.0448	4.86	0.0313	3.39
Test 4	0.0450	4.88	0.0313	3.39
Test 5	0.0451	4.89	0.0313	3.39
Test 6	0.0450	4.88	0.0315	3.4
Test 7	0.0451	4.89	0.0314	3.4
Test 8	0.0449	4.87	0.0312	3.38
Test 9	0.0449	4.87	0.0312	3.38
Test 10	0.0448	4.86	0.0311	3.37
Average	0.0449	4.874	0.0313	3.388

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	455.25	4.30	Body worn	Built-in	body	flat	Belt Clip, Headset	4.32	2.160	8	1
2.5 cm head separation to phantom	455.25	4.30	Face-held	Built-in	head	flat	none	1.41	0.705	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 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	N. 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

Schmid & Partner Engineering AG

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!)

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

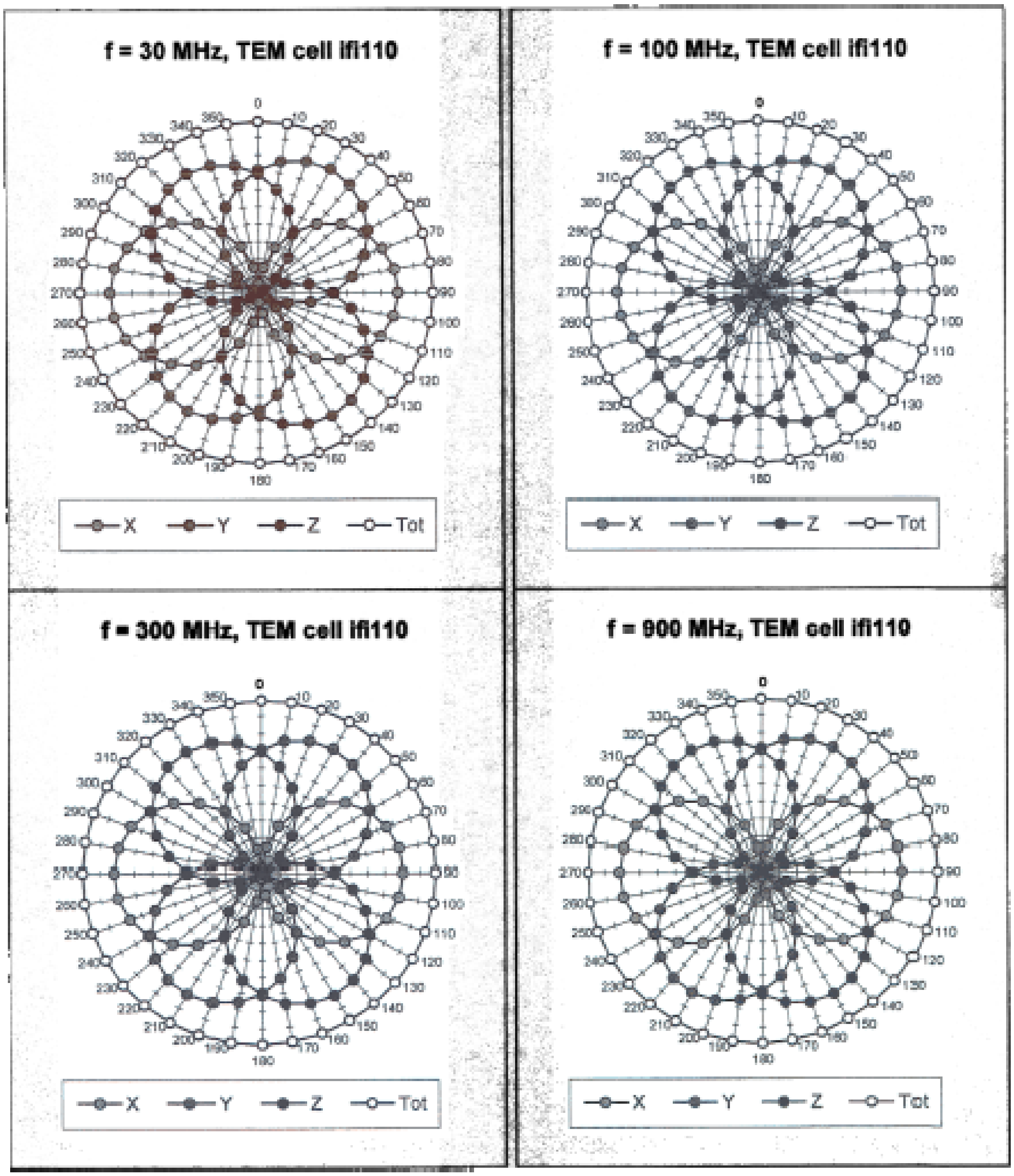
Probe Tip to Boundary	1 mm	2 mm
SAR_{be} [%] Without Correction Algorithm	7.4	5.0
SAR_{be} [%] With Correction Algorithm	0.0	0.1

Sensor Offset

Probe Tip to Sensor Center	**2.1**	mm

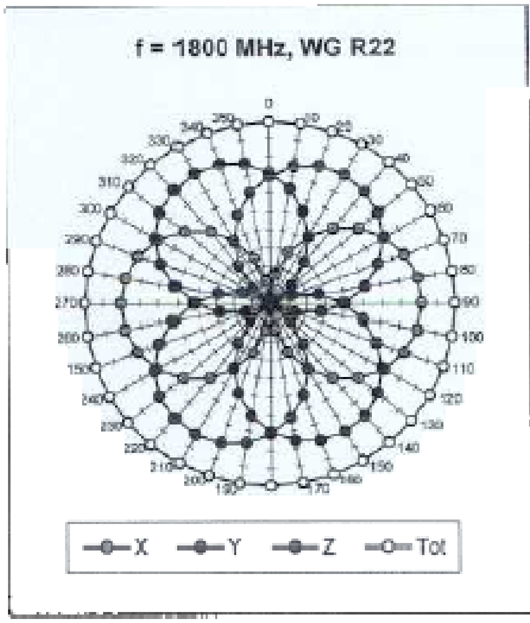
ES3DV2 SN: 3019 **July 12, 2003**

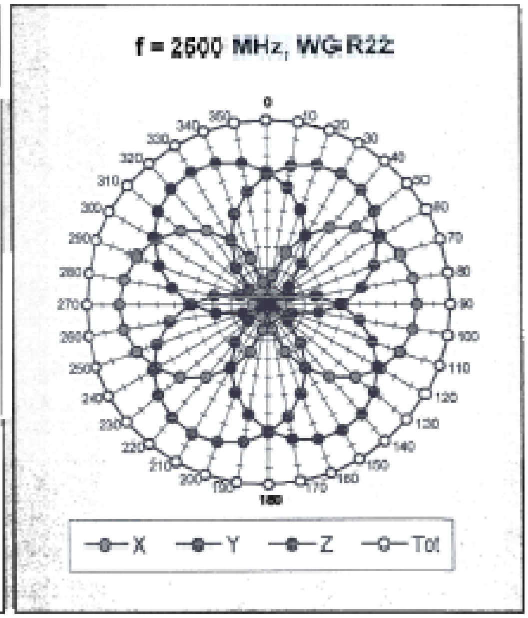
Receiving Pattern (ϕ, $\theta = 0°$)



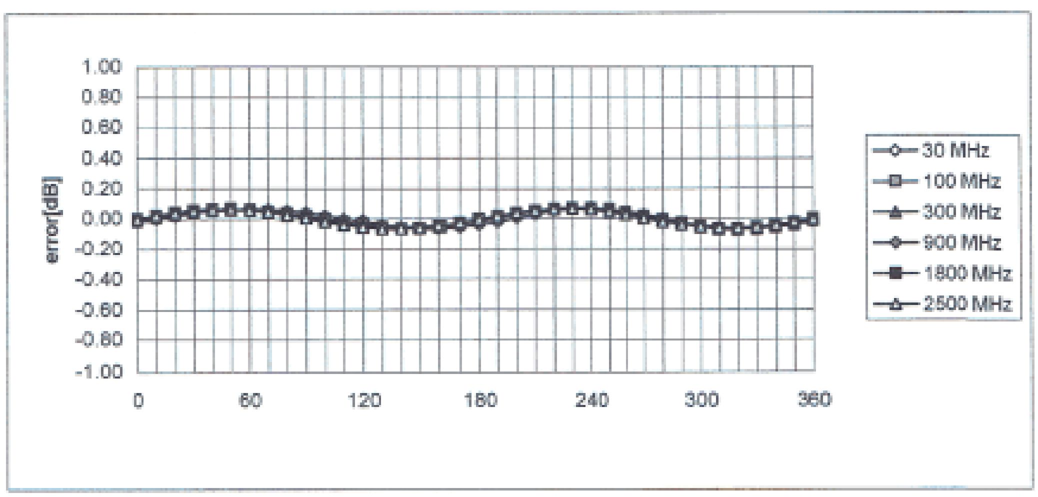
Page 3 of 10

ES3DV2 SN: 3019 July 2003





Isotropy Error (φ), θ 0°

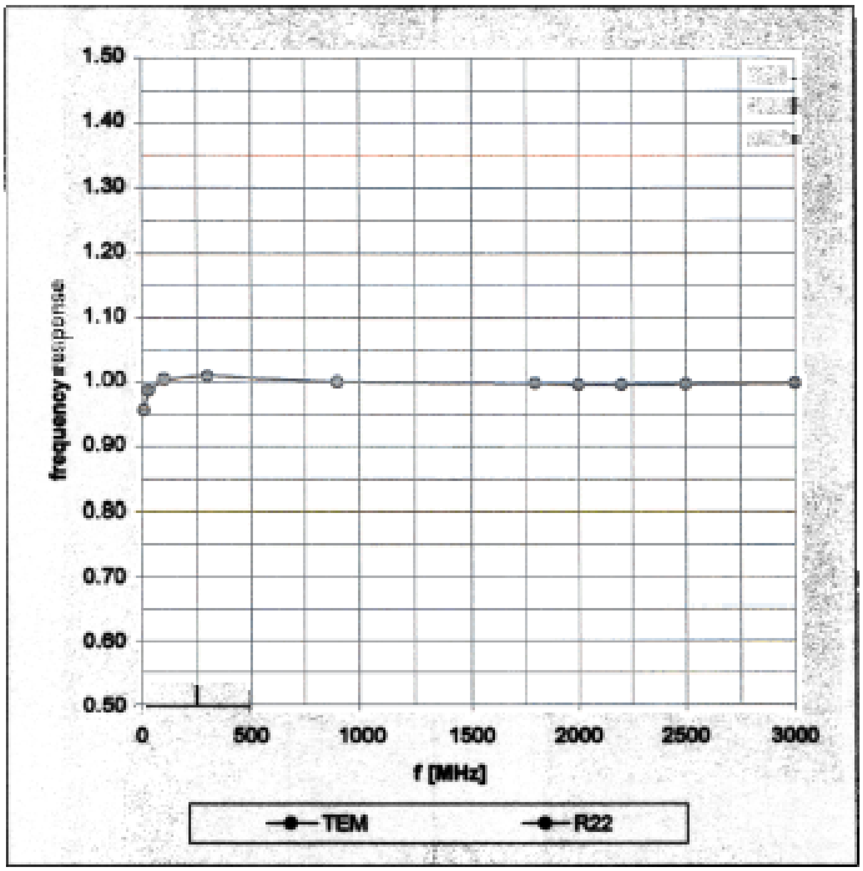


Page

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

Frequency Response of E-Field

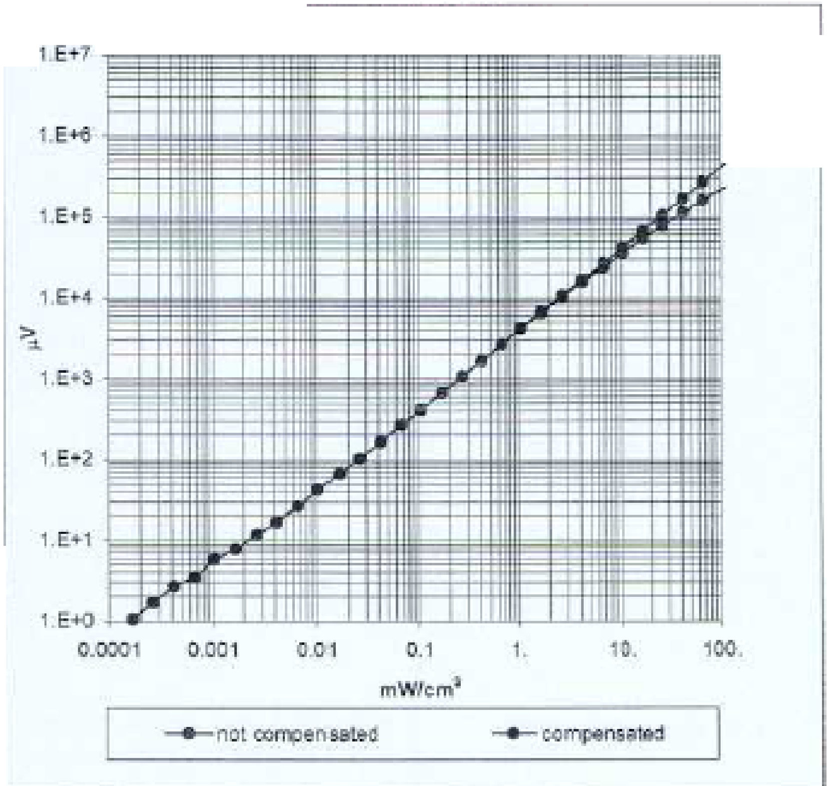
(TEM-Cell:ifi110, Waveguide R22)

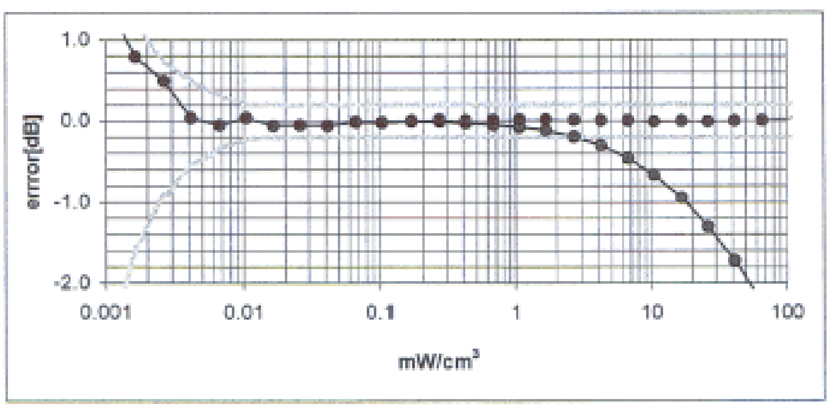


ES3DV2 SN: 3019 **July 12, 2003**

Dynamic Range f(SAR_{brain})

(Waveguide R22)

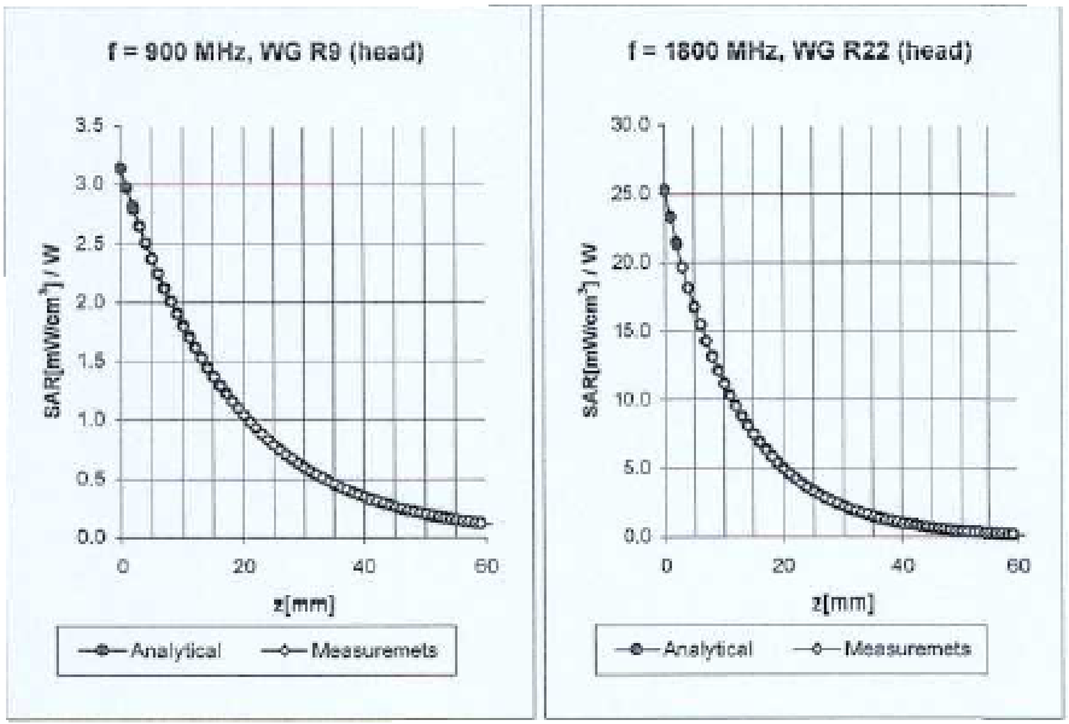




Page 6 of 10

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

Conversion Factor Assessment



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**

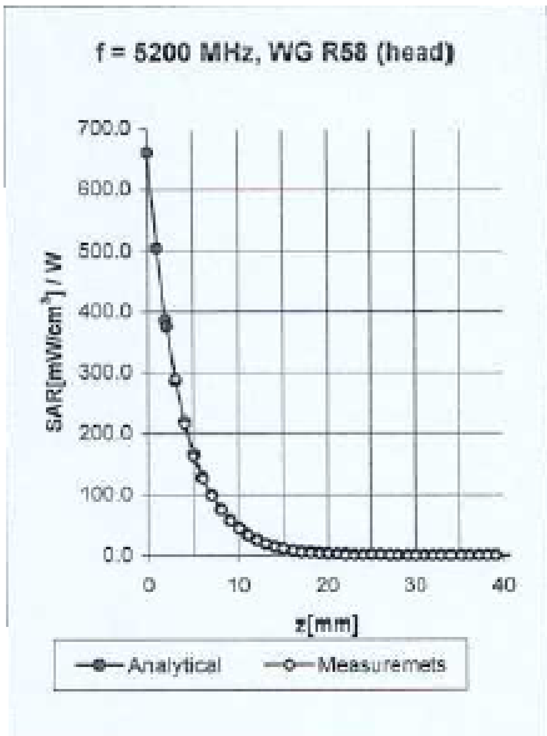
1800 MHz ε_r **= 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

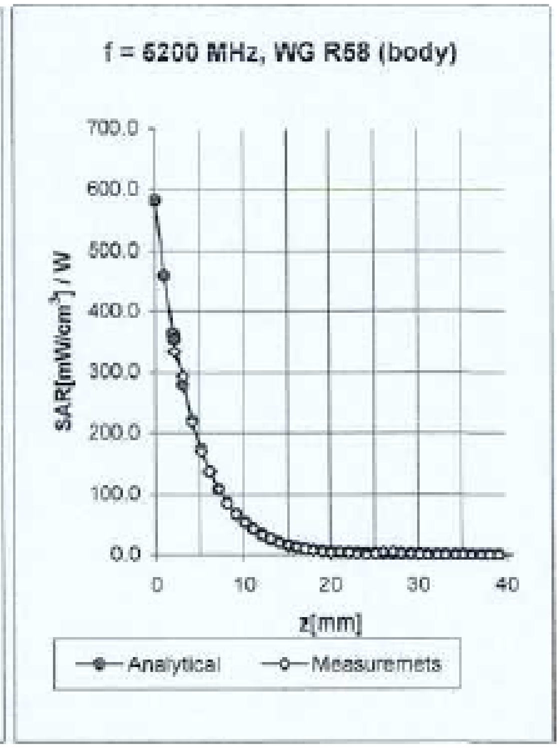
Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

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**

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

Conversion Factor Assessment





Head **5200** **MHz** ε_r **= 36.0 ± 5%** σ **= 4.66 ± 5% mho/m**

Valid for f=4940-5460 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**2.3** ± 14.6% (k=2)	Boundary effect:		
ConvF Y	**2.3** ± 14.6% (k=2)	Alpha	**1.05**	
ConvF Z	**2.3** ± 14.6% (k=2)	Depth	**1.50**	

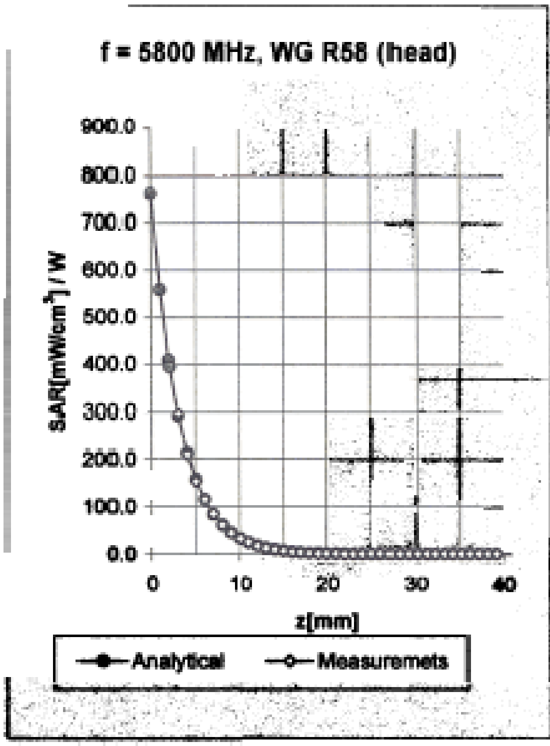
Body **5200** **MHz** ε_r **= 49.0 ± 5%** σ **= 5.30 ± 5% mho/m**

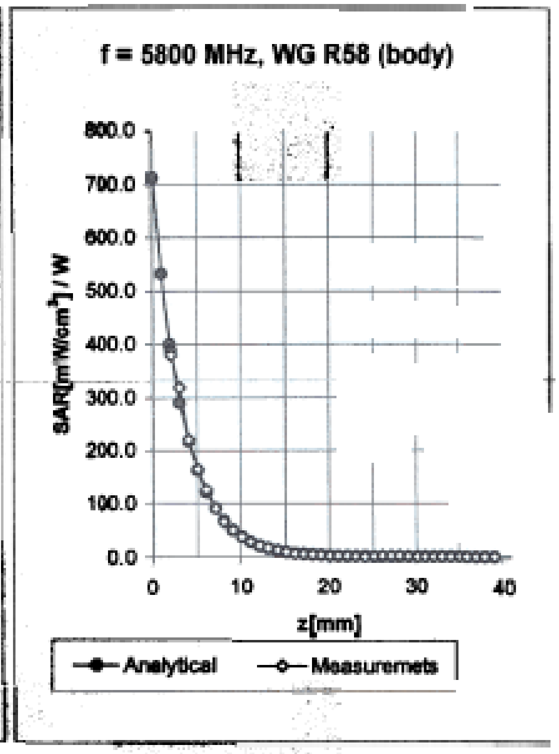
Valid for f=4940-5460 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.4** ± 14.6% (k=2)	Boundary effect:		
ConvF Y	**1.4** ± 14.6% (k=2)	Alpha	**1.01**	
ConvF Z	**1.4** ± 14.6% (k=2)	Depth	**1.85**	

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

Conversion Factor Assessment





Head 5800 MHz ε_r = 35.3 ± 5% σ = 5.27 ± 5% mho/m

Valid for f=5510-6090 MHz with Head Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.8** ± 14.6% (k=2)		Boundary effect:	
ConvF Y	**1.8** ± 14.6% (k=2)		Alpha	**0.90**
ConvF Z	**1.8** ± 14.6% (k=2)		Depth	**1.90**

Body 5800 MHz ε_r = 48.2 ± 5% σ = 6.00 ± 5% mho/m

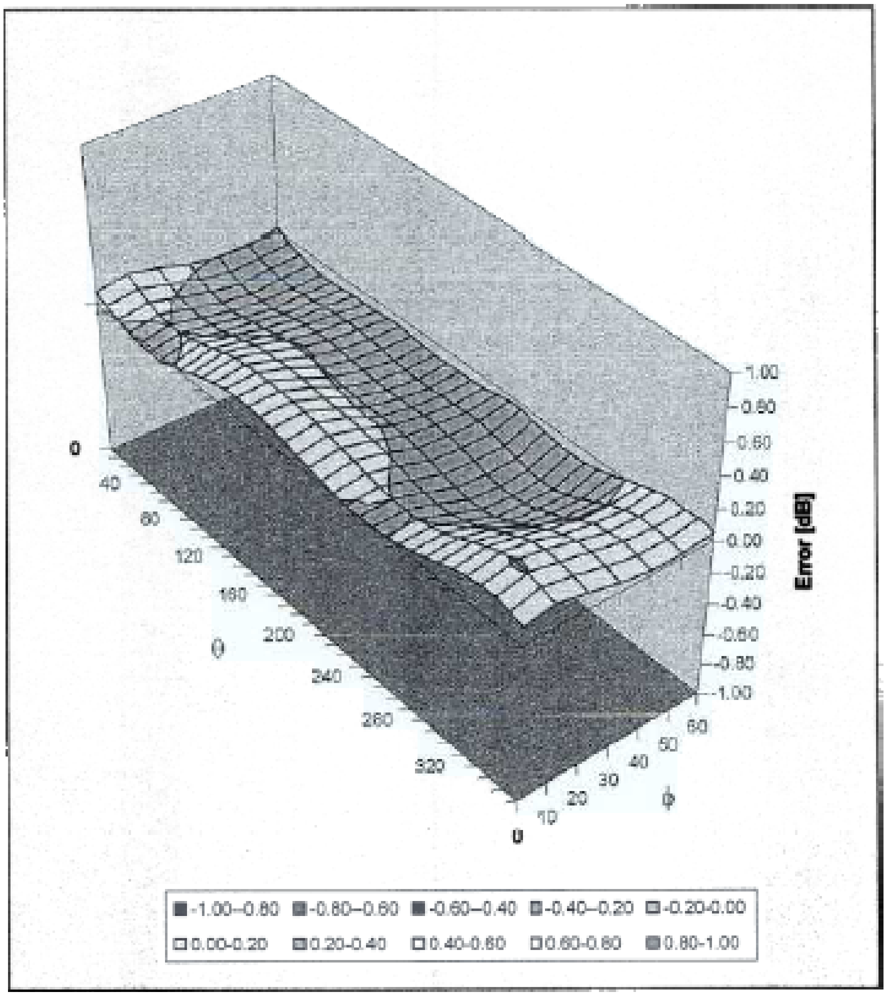
Valid for f=5510-6090 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	**1.2** ± 14.6% (k=2)		Boundary effect:	
ConvF Y	**1.2** ± 14.6% (k=2)		Alpha	**1.18**
ConvF Z	**1.2** ± 14.6% (k=2)		Depth	**1.65**

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

Deviation from Isotropy in HSL

Error (θϕ), f = 900 MHz



Page 10 of 10