SAR TEST REPORT

Report Number: 3047435-002
Project Number: 3047435
September 30, 2003

Evaluation of the
MobileScape Wireless Terminal – Novatel CDMA Module
Model Number: M105X
FCC ID:
QWL-M-105X

FCC Part 2.1093

For

Commerciant, L.P.

Test Performed by:
Intertek
731 Enterprise Drive
Lexington, KY 40510

Test Authorized by:
Commerciant, L.P.
2901 Wilcrest Drive
Houston, TX 77042

Prepared By:________________________Date:____10/8/2003________

Bryan C. Taylor, Team Leader

Approved By:________________________Date:____10/8/2003_______

Suresh Kondapalli , Senior EMC Engineer

The results contained in this report were derived from measurements performed on the identified test samples. Any implied performance of other samples based on this report is dependent on the representative adequacy of the samples tested.

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1 INTRODUCTION

The M105X was evaluated for SAR in accordance with the requirements for RF Exposure compliance testing defined in FCC OET Bulletin 65, Supplement C (Edition 01-01). Testing was performed at the Intertek Testing Services facility in Lexington, Kentucky.

For the evaluation, the dosimetric assessment system DASY3 was used. The phantom employed was the "SAM Twin Phantom". The total uncertainty for the evaluation of the spatial peak SAR values averaged over a cube of 1g tissue mass had been assessed for this system to be ±27.4%.

The device was tested at the maximum output power. This was accomplished using a Rhode & Schwarz CMU-200 base station simulator to force the device into a “call”. Once in a “call” the base station simulator was configured to send the EUT an “all up bits” signal which forced the device to transmit at maximum power output.

The maximum spatial peak SAR value for the sample device averaged over 1g was found to be:

Phantom	Position	Worst Case Extrapolated SAR_{1g} mW/g
Flat Section	Body Mode, Antenna Edge Touching Phantom, Screen Facing Front of Phantom	0.322

Based on the worst case data presented above, the sample tested was found to be in compliance with the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01).

2 JOB DESCRIPTION

2.1 Client information

The MobileScape Wireless Terminal – Novatel CDMA Module has been tested at the request of

Company:	Commerciant, L.P.
	2901 Wilcrest Drive
	Houston, TX 77042
Name of contact:	Daniel Motsinger
Telephone:	713-735-5515
Fax:	713-735-5585

2.2 Test plan reference:

Tests were performed to the following standards:

- FCC Part 2.1093

2.3 Equipment Under Test (EUT)

The M105X was a Mobile Wireless Terminal used for scanning credit cards. The unit operated in the CDMA 1900 band using an internal wire antenna. The following is a detailed description of the EUT.

Product	MobileScape Wireless Terminal – Novatel CDMA Module
EUT Model Number	M105X
EUT Serial Number	Not Labeled
Whether quantity (>1) production is planned	Quantity production is planned.
Cellular Phone standards	CDMA1900
Type(s) of Emission	1M25F9W
RF Output Power	1850-1910 MHz: 24.0 dBm – CDMA1900
Frequency Range	1850 – 1910 CDMA1900
Antenna & Gain	Integrated, non-retractable (internal)
Detachable Antenna ?	No
External input	[ ] Audio [X] Digital Data

EUT receive date: 8/27/2003
EUT receive condition: The EUT was received in good condition with no apparent damage.
Test start date: 8/27/2003
Test completion date: 10/8/2003

The test results in this report pertain only to the item tested.

2.3.1 System Support Equipment

Table 2-1 contains the details of the support equipment associated with the Equipment Under Test during the FCC Part 15 testing.

Table 2-1: System Support Equipment

Description	Manufacturer	Model Number	Serial Number	FCC ID number
9 – 18VDC Car Charger	Glob Tek, Inc.	HCD15-070200	1483	Not Listed
Switch-Mode Power Supply	Commerciant	EPA-101M-07A	DPS070130UM-9FT-RP5-SZ	Not Listed
3.7V Lithium Ion Battery	Ultralife	UBBP01	0212/BF01	Not Listed

2.3.2 Cables associated with EUT

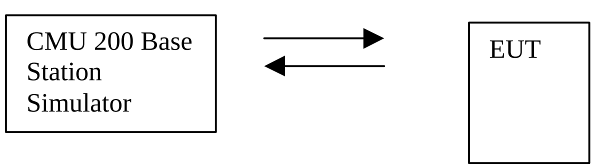
Table 2-2 contains the details of the cables associated with the EUT.

Table 2-2: Interconnecting cables between modules of EUT

Cables					
Description	Length	Shielding	Ferrites	Connection	
				From	To
Adapter cable	9ft	None	None	EUT	Charging adapter

2.3.3 System Block Diagram

The diagram shown below details the interconnection of the EUT and its accessories during FCC Part 15 testing. For specific layout, refer to the test configuration photograph in the relevant section of this report.



2.3.4 Justification

The EUT was operated in the stand-alone configuration.

2.3.5 Mode(s) of operation

The EUT was powered from 3.7Vdc. A 3.7 V dc Lithium-Ion battery was installed during the testing.

2.4 Modifications required for compliance

No modifications were implemented by Interteks.

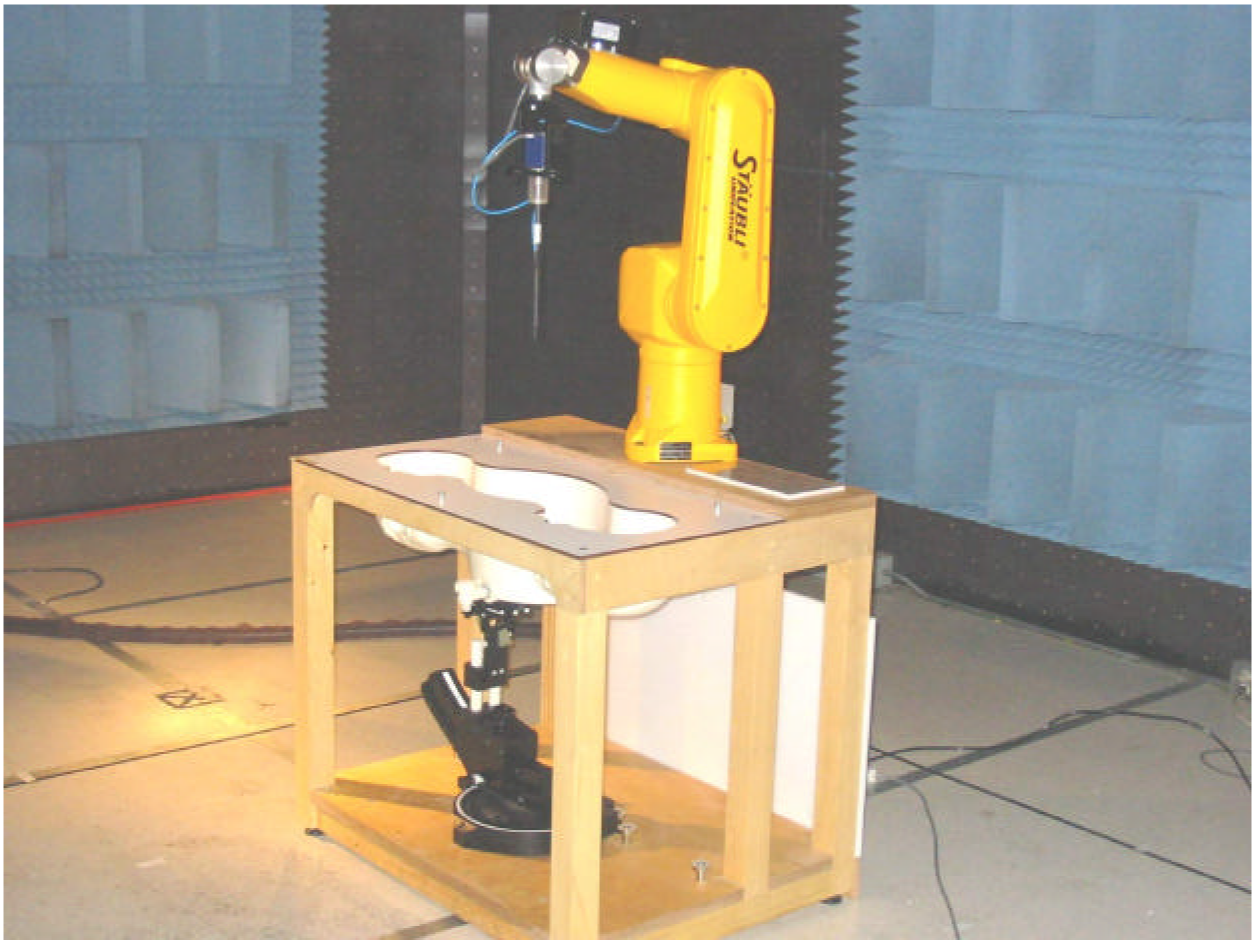
2.5 Related Submittal(s) Grants

None

2.6 Test Site Description

The SAR test site located at 731 Enterprise Drive, Lexington KY 40510 is comprised of the SPEAG model DASY 3 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3]. This system is installed in an ambient-free shielded enclosure with RF absorbing material on the walls and ceiling. The Ambient temperature is controlled to $22.2 \pm 2^{o}C$. Because the HVAC operates as a closed system, the relative humidity remains constant at $50 \pm 5\%$. During the SAR evaluations, the RF ambient conditions are monitored continuously for signals that might interfere with the test results. The tissue simulating liquid is also stored and validated in this area in order to keep it at the same constant ambient temperature as the room.

Figure 2-1: SAR Test Site



2.7 Measurement Uncertainty

The Table below includes the uncertainty budget suggested by the IEEE Std 1528-200X and determined by SPEAG for the DASY3 measurement System. The extended uncertainty (K=2) was assessed to be 27.0 %

Uncertainty Component	Tolerance (± %)	Probability Distribution	Divisor	c_i	Standard Uncertainty, (± %)	v_i^2 or v_{eff}
Measurement System						
Probe Calibration	4.5	Normal	1	1	4.5	Inf.
Axial Isotropy	4.7	Rectangular	√3	$(1-cp)^{1/2}$	1.9	Inf.
Spherical Isotropy	9.6	Rectangular	√3	$\sqrt{c_p}$	3.9	Inf.
Boundary Effect	5.5	Rectangular	√3	1	3.2	Inf.
Linearity	4.7	Rectangular	√3	1	2.7	Inf.
System Detection Limits	1.0	Rectangular	√3	1	0.6	Inf.
Readout Electronics	1.0	Normal	1	1	1.0	Inf.
Response Time	0.8	Rectangular	√3	1	0.5	Inf.
Integration Time	1.4	Rectangular	√3	1	0.8	Inf.
RF Ambient Conditions	3.0	Rectangular	√3	1	1.7	Inf.
Probe Positioner Mechanical Tolerance	0.4	Rectangular	√3	1	0.2	Inf.
Probe Positioning with respect to Phantom Shell	2.9	Rectangular	√3	1	1.7	Inf.
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	3.9	Rectangular	√3	1	2.3	Inf.
Test sample Related						
Test Sample Positioning	6.0	Normal	0.89	1	6.7	12
Device Holder Uncertainty	5.0	Normal	0.84	1	5.9	8
Output Power Variation - SAR drift measurement	7.0	Rectangular	√3	1	4	Inf.
Phantom and Tissue Parameters						
Phantom Uncertainty (shape and thickness tolerances)	4.0	Rectangular	√3	1	2.3	Inf.
Liquid Conductivity Target tolerance	3.0	Rectangular	√3	0.6	1.0	Inf.
Liquid Conductivity - measurement uncertainty	10.0	Rectangular	√3	0.6	3.5	Inf.
Liquid Permittivity Target tolerance	4.0	Rectangular	√3	0.6	1.3	Inf.
Liquid Permittivity - measurement uncertainty	5.0	Rectangular	√3	0.6	1.7	Inf.
Combined Standard Uncertainty					13.7	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)					27.4	

Notes.

1. The Divisor is a function of the probability distribution and degrees of freedom (ν_i and ν_{eff}). See NIST Technical Note TN1297, NIS 81 and NIS 3003.
2. c_i is the sensitivity coefficient that should be applied to convert the variability of the uncertainty component into a variability of SAR.

2.8 Measurement Tractability

All measurements described in this report are traceable to National Institute of Standards and Technology (NIST) standards or appropriate national standards.

3 SPECIFIC ABSORBTION RATE

3.1 Test Limits

The following FCC limits for SAR apply to devices operating in General Population/Uncontrolled Exposure environment:

Exposure (General Population/Uncontrolled Exposure environment)	**SAR (W/kg)**
Average over the whole body	0.08
Spatial Peak (1g)	1.60
Spatial Peak for hands, wrists, feet and ankles (10g)	4.00

3.2 Test Equipment

SAR Measurement System			
EQUIPMENT	**SPECIFICATIONS**	**S/N #**	**Last Cal. Data**
Robot	**Stäubli RX60L**	597412-01	N/A
	Repeatability: ± 0.025mm Accuracy: 0.806×10^{-3} degree Number of Axes: 6		
E-Field Probe	**ER3DV6**	1785	07/28/2003
	Dynamic Range: 5 µW/g to >100 mW/g Tip diameter: 6.8 mm Probe Linearity: ± 0.2 dB (30 MHz to 3 GHz) Axial isotropy: ± 0.2 dB Spherical isotropy: ± 0.2 dB Length: 34.5 cm Distance between the probe tip and the dipole center: 2.7 mm Calibration: 450, 835/900, 1800/1900, 2450 MHz for head & body liquid		
Data Acquisition	**DAE3**	317	N/A
	Measurement Range: 1µV to >200mV Input offset Voltage: < 1µV (with auto zero) Input Resistance: 200 M		
Phantom	**SAM Twin V4.0**	TP-1243	QD000P40CA
Complies with IEEE P1528-200x, draft 6.5 (See certificate in App. C)	Type SAM Twin, Homogenous Shell Material: Fiberglass Thickness: 2 ± 0.2 mm Capacity: 20 liter Size of the flat section: approx. 320 x 230 mm		
Device holder	Non-conductive holder supplied with DASY3, dielectric constant less than 5.0	N/A	N/A
Power Meter	**Boonton 5232 RF Power Meter / Voltmeter**	13601	10/08/03
	Power Meter Frequency Range: 10 kHz to 40 GHz Power Meter Measurement Range: -70 dBm to +44 dBm		
Signal Generator	HP 83620 B	3614A00199	8/21/03
	Frequency Range: 10MHz – 20 GHz Amplitude Range: -110 dBm – 25 dBm		

3.3 Tissue Simulating Liquid Description and Validation

Figure 3-1: Recommended Body Tissue Composition

Simulation Liquid; Frequency: 1900 MHz	
Ingredient	**Body**
Water	40.4
Salt	0.5
Sugar	58.0
HEC	1.0
Bactericide	0.1

Note: The amounts of each ingredient specified in the tables are not the exact amounts of the final test solution. The final test solution was adjusted by adding small amounts of water, sugar, and/or salt to calibrate the solution to meet the proper dielectric parameters.

Figure 3-2: Body Tissue Parameters Measured Just Before SAR Testing

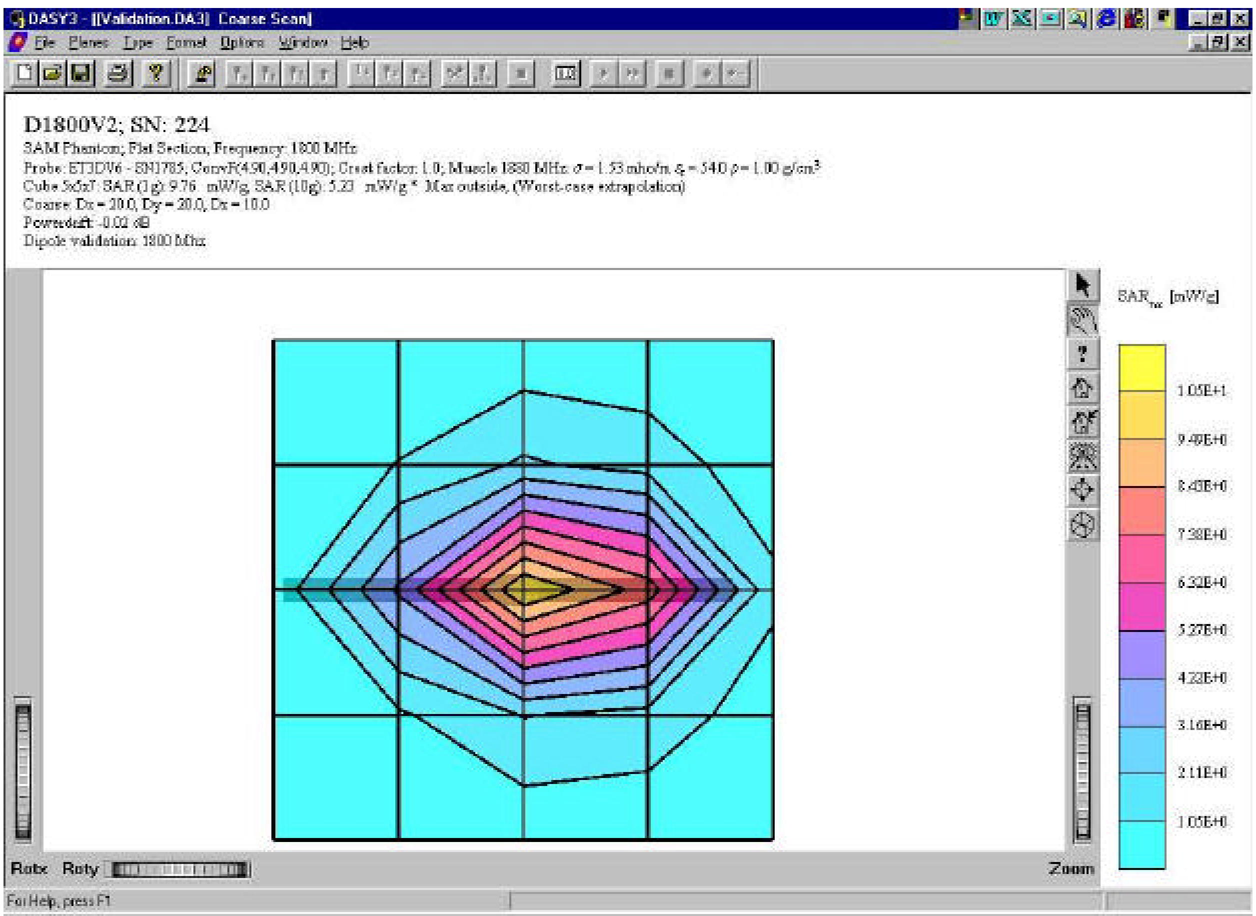
Head Tissue Parameters								
Frequency Measure (MHz)	**Dielectric Constant Target**	**Dielectric Constant Measure**	**Dielectric % Deviation**	**Imaginary Part**	**Conductivity Target**	**Conductivity Measure**	**Conductivity % Deviation**	**Date**
1850	53.3	53.9	1.13	14.4	1.52	1.48	2.56	9/8/2003
1880	53.3	54	1.31	14.6	1.52	1.53	0.39	9/8/2003
1900	53.3	53.9	1.13	14.6	1.52	1.54	1.46	9/8/2003

3.4 Dipole System Validation

Prior to the assessment, the system was verified by using the system validation kit. The validation was performed at 1800 MHz using body tissue.

Figure 3-3: Dipole Validation Data

Reference Dipole Validation								
Frequency Measure (MHz)	**Dipole Type**	**Dipole Serial Number**	**Fluid Type**	**Dipole Power Input**	**Cal. Lab SAR (1g)**	**Measured SAR (1g)**	**% Error SAR (1g)**	**Date**
1800	D1800V2	224	1800 Body	250 mW	9.93	9.76	1.71	9/8/2003



3.4.1 Test Procedure

Prior to any testing, the appropriate fluid was used to fill the phantom to a depth of 15 cm +0.2cm. The fluid parameters were verified and the dipole validation was performed as described in the previous sections.

3.4.2 Conducted Output Power:

Before SAR testing started, the conducted output power of the device was measured. The transmitter output was connected to a calibrated coaxial cable, the other end of which was connected to a CMU-200 Base Station Simulator. The EUT was placed into a call and the transmitter output was read off the CMU-200 in dBm. The power output at the transmitter antenna port was determined by adding the value of the cable insertion loss to the CMU-200 power reading.

Tests were performed at three frequencies (low, middle, and high channels) and on the highest power levels, which can be setup on the transmitters.

3.4.3 Test Positions:

The Device was positioned against the SAM and flat phantoms using the exact procedure described in Supplement C Edition 01 – 01 of Federal Communications Commission, “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, OET Bulletin 65, FCC, Washington, D.C. 20554, 1997.

3.4.4 Reference Power Measurement:

The measurement probe was positioned at a fixed location above the reference point. A power measurement was made with the probe above this reference position so it could used for the assessing the power drift later in the test procedure.

3.4.5 Coarse Scan:

A coarse area scan with a horizontal grid spacing of 20 x 20 mm was performed in order to find the approximate location of the peak SAR value. This scan was performed with the measurement probe at a constant height in the simulating fluid. A two dimensional spline interpolation algorithm was then used to determine the peaks and gradients within the scanned area.

3.4.6 Zoom Scan:

A zoom scan was performed around the approximate location of the peak SAR as determined from the coarse scan. The zoom scan was comprised of a measurement volume of 32 x 32 x 34 mm based on 5 x 5 x 7 points. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

3.4.7 Data Extrapolation:

Since the center of the dipoles in the measurement probe are 2.7 mm away from the tip of the probe, and the distance between the surface and the lowest measurement point is 1.6 mm the data at the surface was extrapolated. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in the Z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

The maximum interpolated value was searched with a straightforward sorting algorithm. Around this maximum, the SAR values averaged over the spatial volumes (1g or 10g) were computed using a 3-D spline interpolation algorithm. The 3-D spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y and z directions). The volume was integrated with a trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

3.4.8 Reference Power Measurement:

The probe was positioned at precisely the same reference point and the reference power measurement was repeated. The difference between the initial reference power and the final one is referred to as the power drift. If the power drift exceeded 5% of the final peak SAR value, the measurement was repeated.

3.4.9 RF Ambient Activity:

During the entire SAR evaluation, the RF ambient activity was monitored using a spectrum analyzer with an antenna connected to it. The spectrum analyzer was tuned to the frequency of measurement and with one trace set to max hold mode. In this way, it was possible to determine if at any point during the SAR measurement there were an interfering ambient signal. If an ambient signal was detected, then the SAR measurement was repeated.

3.5 Test Results

The M105X was compliant with the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01). Since the measured 1-g SAR was more than 3dB below the limit in all configurations tested on the middle channel, testing was not performed on the band edge channels. All scans were done with the EUT touching the flat phantom to simulate the worst case environment.

Body Mode (3 positions) / device touching phantom / CDMA PCS / Crest Factor of 1									
Freq. (MHz)	**Ant. Pos.**	**Battery**	**Test Position**	**Carry Case**	**SAR Drift (dB)**	**Measured 1-g SAR (mW/g)**	**Meas. 10g-SAR (mw/g)**	**Extrapolated Worst Case 1-g SAR (mW/g)**	**Extrapolated Worst Case 10-g SAR (mW/g)**
1880.0	NA	3.7V Li-Ion	Screen Up	None	0.300	0.022	0.015	----	---
1880.0	NA	3.7V Li-Ion	Screen Down	None	-0.240	0.113	0.065	0.119	0.069
1880.0	NA	3.7V Li-Ion	Screen Front With Antenna Next to Phantom	None	-0.070	0.317	0.148	0.322	0.150

Conducted Output Power at the Antenna Port			
EUT Mode	**Frequency MHz**	**Channel**	**Measured Power dBm**
CDMA1900	1851.25	25	23.9
	1880.00	600	23.65
	1908.75	1175	22.19

Figure 3-4: Screen Against Flat Phantom

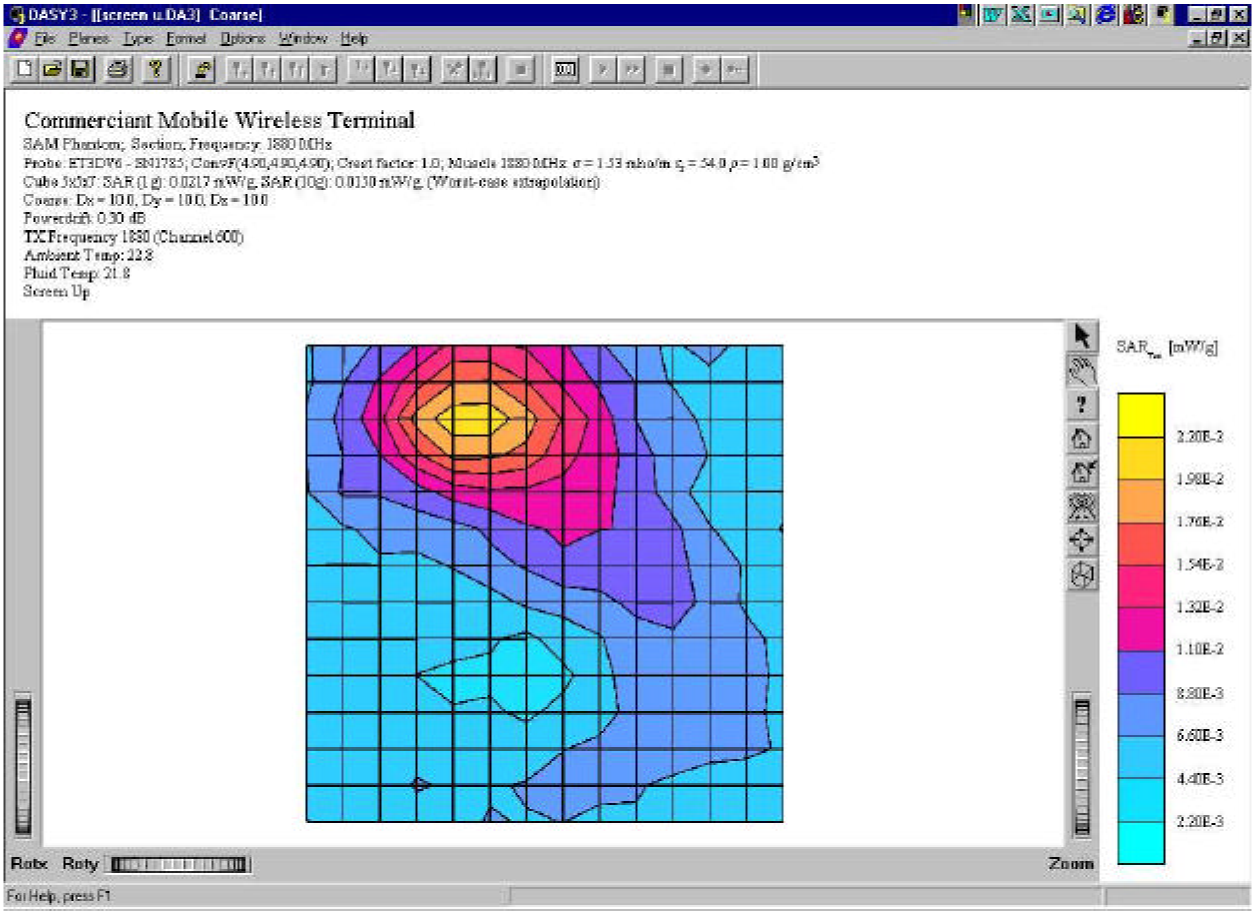


Figure 3-5: Bottom Against Flat Phantom

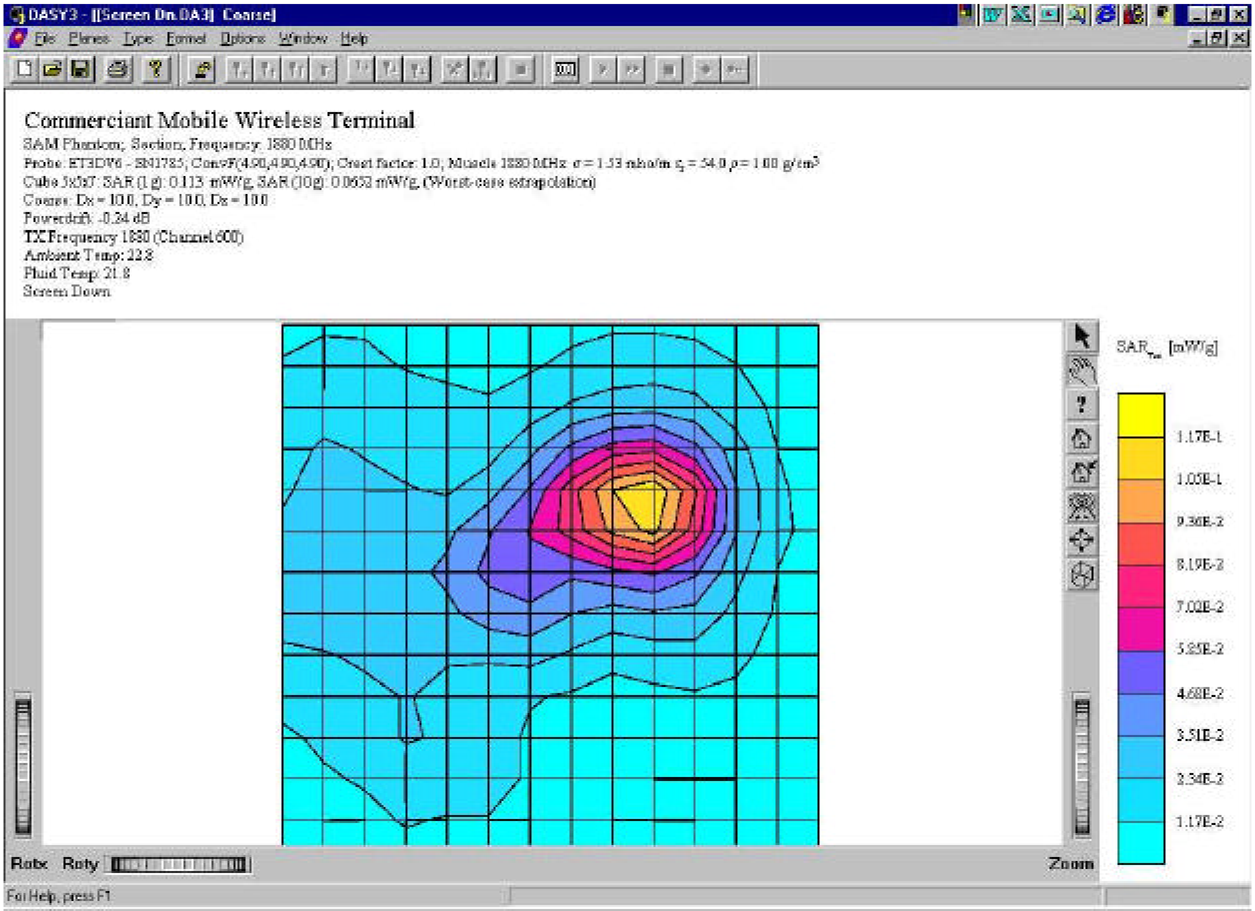
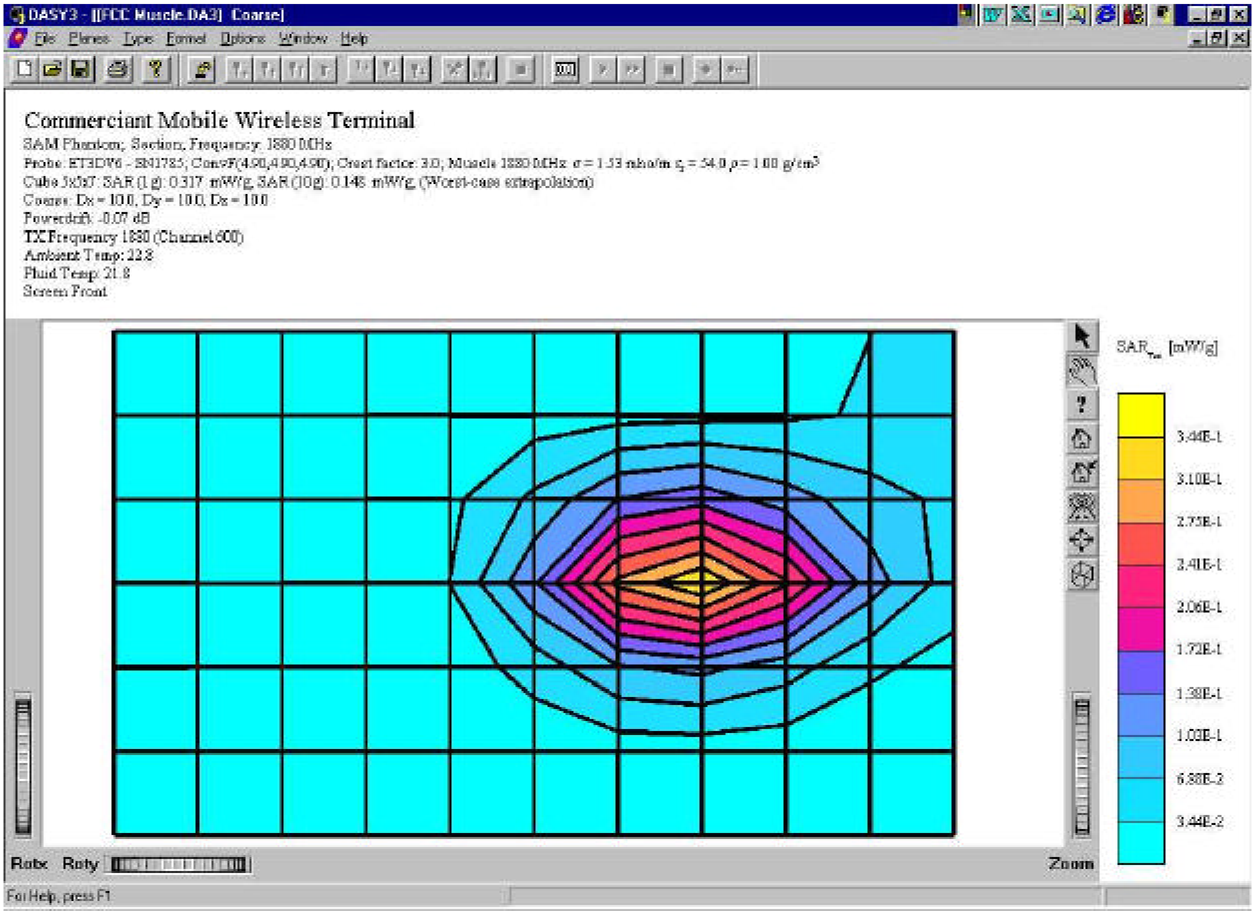


Figure 3-6: Antenna Edge Against Phantom



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

Client ITS / ETL

CALIBRATION CERTIFICATE

Object(s)	ET3DV6 - SN:1785
Calibration procedure(s)	QA CAL-01.v2 Calibration procedure for dosimetric E-field probes
Calibration date:	July 28, 2003
Condition of the calibrated item	In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

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

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (Agilent, No. 20020918)	Sep-03
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Network Analyzer HP 8753E	US37390585	18-Oct-01 (Agilent, No. 24BR1033101)	In house check: Oct 03
Fluke Process Calibrator Type 702	SN: 6295803	3-Sep-01 (ELCAL, No.2360)	Sep-03

	Name	Function	Signature
Calibrated by:	Nico Vetterli	Technician	[signature]
Approved by:	Katja Pokovic	Laboratory Director	[signature]

Date issued: July 28, 2003

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

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Schmid & Partner Engineering AG
speag

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Probe ET3DV6

SN:1785

Manufactured:	May 28, 2003
Last calibration:	July 28, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

ET3DV6 SN:1785 July 28, 2003

DASY - Parameters of Probe: ET3DV6 SN:1785

Sensitivity in Free Space

NormX	1.70	$\mu V/(V/m)^2$
NormY	1.70	$\mu V/(V/m)^2$
NormZ	1.63	$\mu V/(V/m)^2$

Diode Compression

DCP X	97	mV
DCP Y	97	mV
DCP Z	97	mV

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	6.6	± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.6	± 9.5% (k=2)	Alpha	0.42
ConvF Z	6.6	± 9.5% (k=2)	Depth	2.27

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	5.2	± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2	± 9.5% (k=2)	Alpha	0.49
ConvF Z	5.2	± 9.5% (k=2)	Depth	2.55

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	9.1	5.1
SAR_{be} [%]	With Correction Algorithm	0.2	0.4

Head 1800 MHz Typical SAR gradient: 10 % per mm

Probe Tip to Boundary		1 mm	2 mm
SAR_{be} [%]	Without Correction Algorithm	12.8	8.6
SAR_{be} [%]	With Correction Algorithm	0.2	0.1

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.7 ± 0.2	mm

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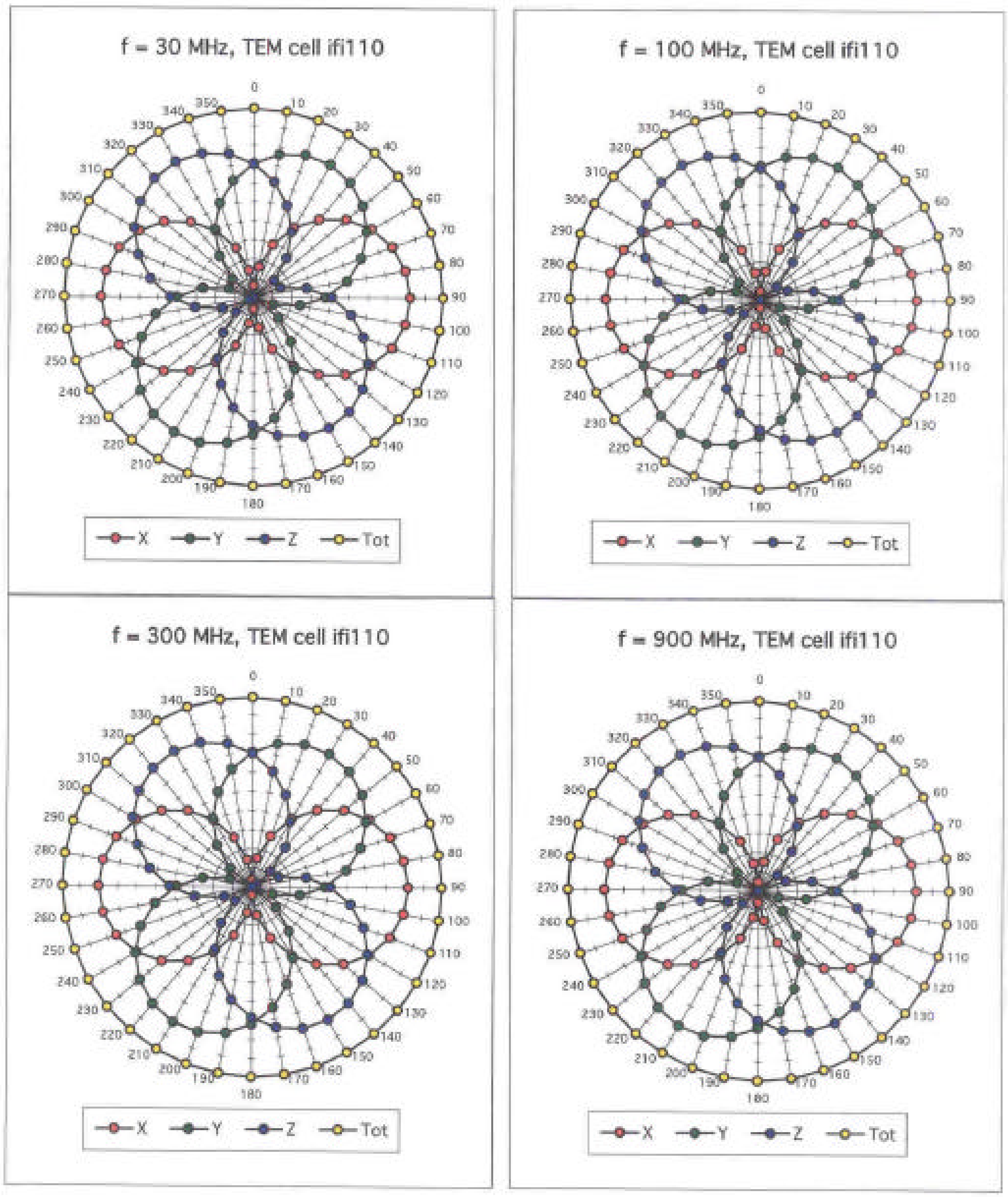
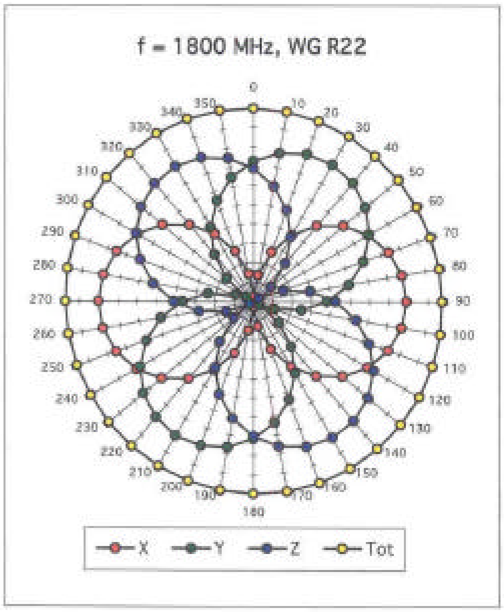
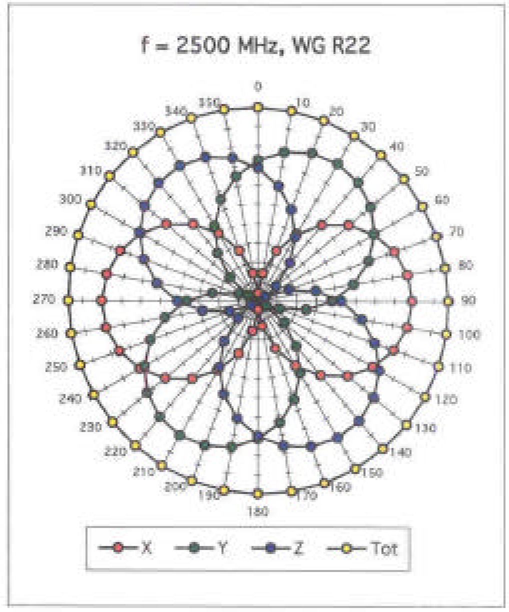
Receiving Pattern (ϕ), $\theta = 0°$

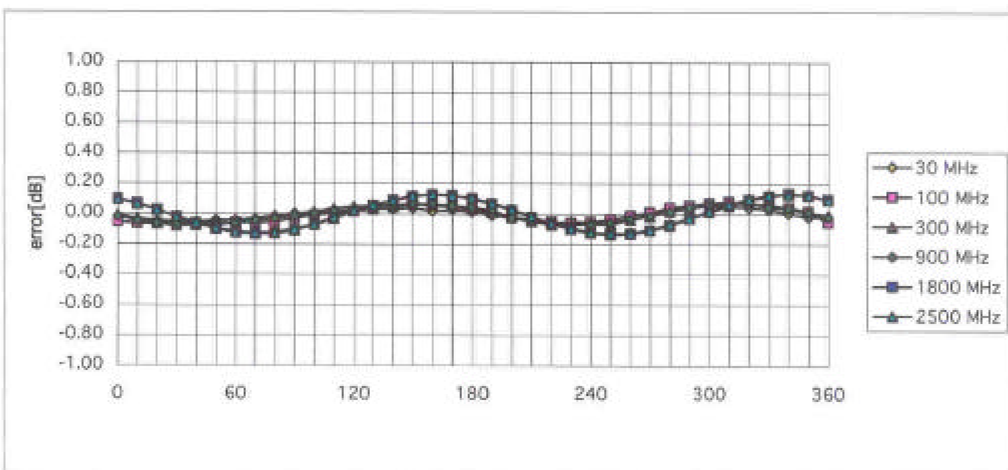


ET3DV6 SN:1785 **July 28, 2003**





Isotropy Error (φ), θ = 0°



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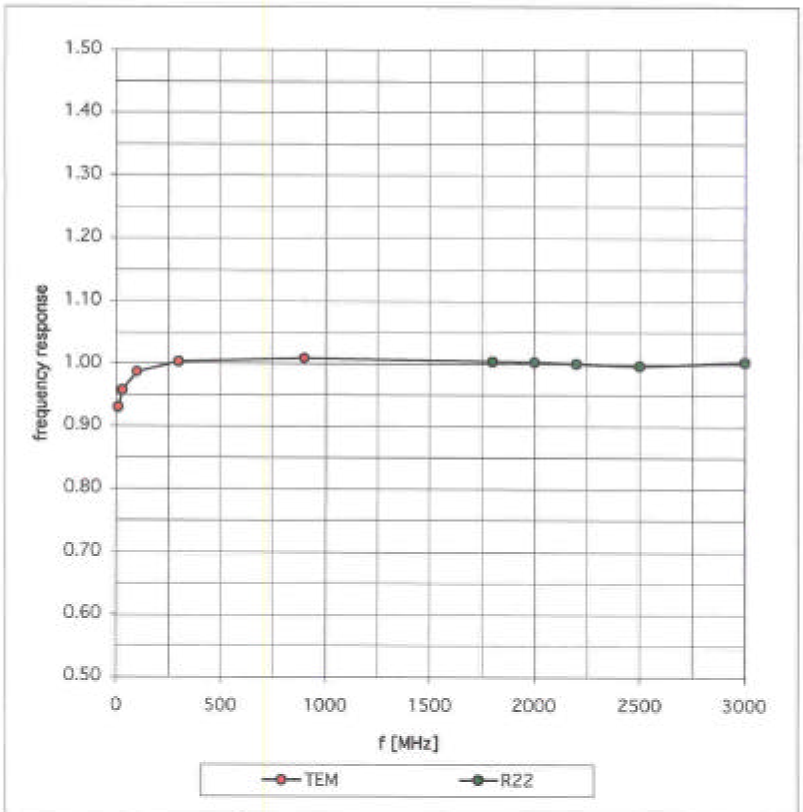
Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)



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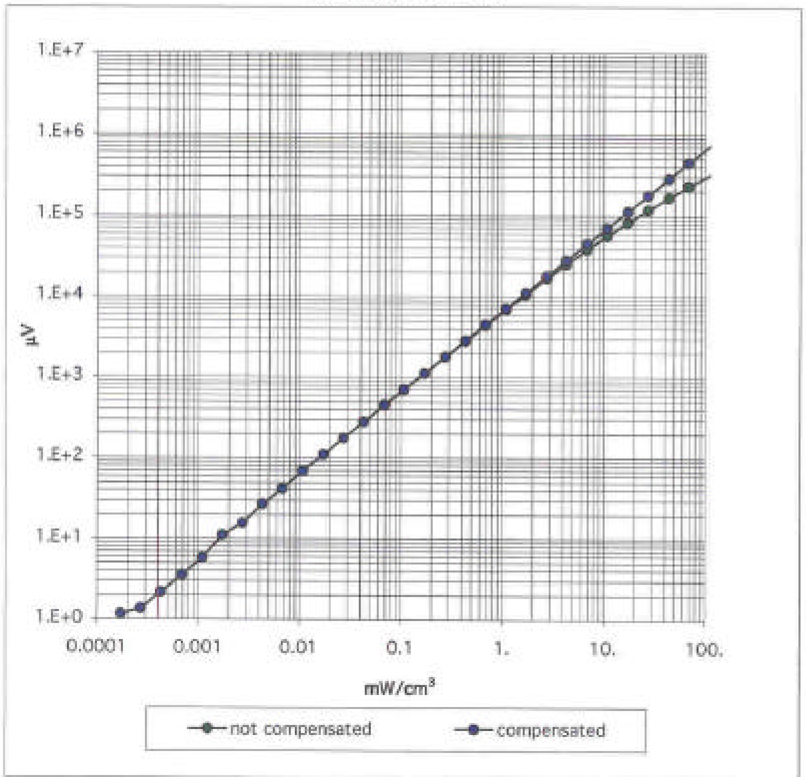
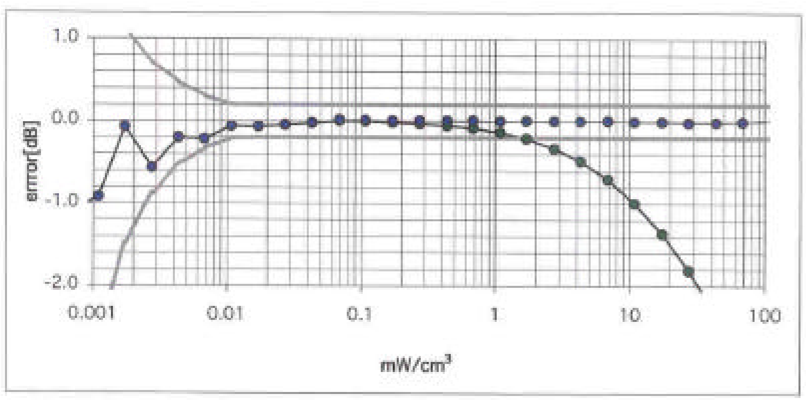
Dynamic Range f(SAR_{brain})

(Waveguide R22)





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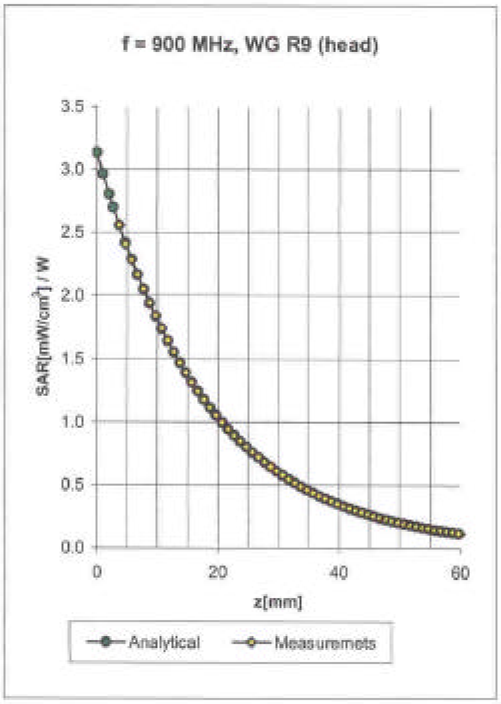
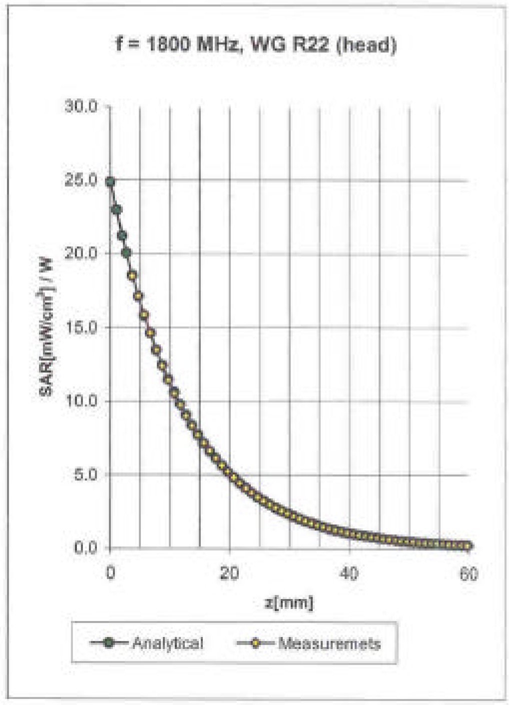
July 28, 2003

Conversion Factor Assessment





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	6.6 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	6.6 ± 9.5% (k=2)	Alpha	0.42
ConvF Z	6.6 ± 9.5% (k=2)	Depth	2.27

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	5.2 ± 9.5% (k=2)	Boundary effect:	
ConvF Y	5.2 ± 9.5% (k=2)	Alpha	0.49
ConvF Z	5.2 ± 9.5% (k=2)	Depth	2.55

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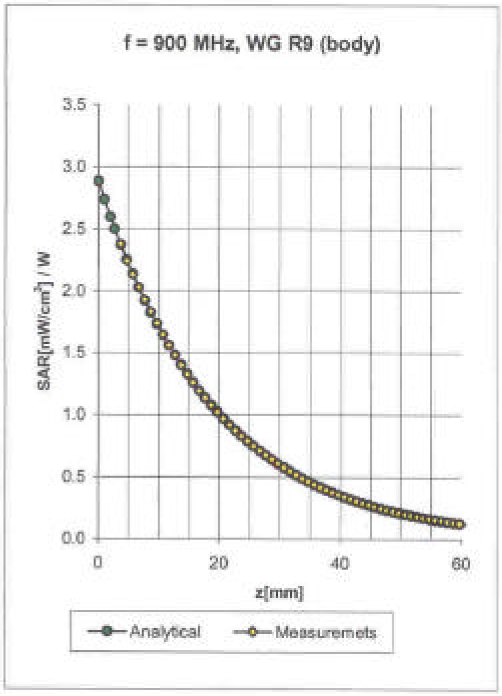
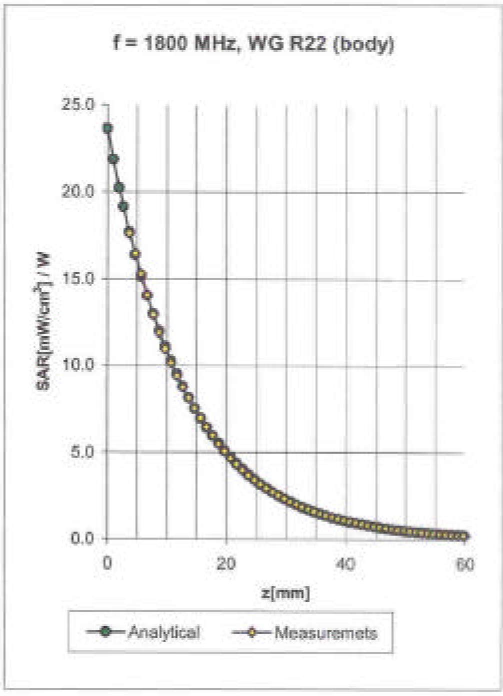
Conversion Factor Assessment





Body 900 MHz ε_r = 55.0 ± 5% σ = 1.05 ± 5% mho/m

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

ConvF X	6.3	± 8.9% (k=2)	Boundary effect:	
ConvF Y	6.3	± 8.9% (k=2)	Alpha	0.43
ConvF Z	6.3	± 8.9% (k=2)	Depth	2.32

Body 1800 MHz ε_r = 53.3 ± 5% σ = 1.52 ± 5% mho/m

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

ConvF X	4.9	± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.9	± 8.9% (k=2)	Alpha	0.55
ConvF Z	4.9	± 8.9% (k=2)	Depth	2.70

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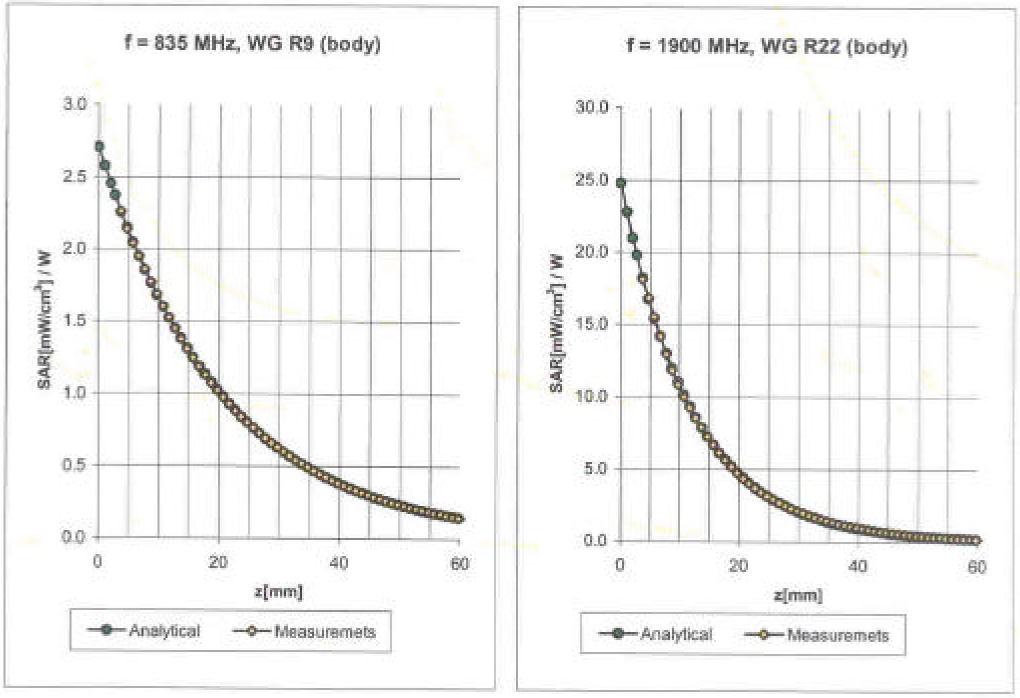
Conversion Factor Assessment



Body	835 MHz	ε_r = 55.2 ± 5%	σ = 0.97 ± 5% mho/m

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

ConvF X	6.3 ± 8.9% (k=2)	Boundary effect:	
ConvF Y	6.3 ± 8.9% (k=2)	Alpha	0.45
ConvF Z	6.3 ± 8.9% (k=2)	Depth	2.17

Body	1900 MHz	ε_r = 53.3 ± 5%	σ = 1.52 ± 5% mho/m

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

ConvF X	4.7 ± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.7 ± 8.9% (k=2)	Alpha	0.61
ConvF Z	4.7 ± 8.9% (k=2)	Depth	2.46

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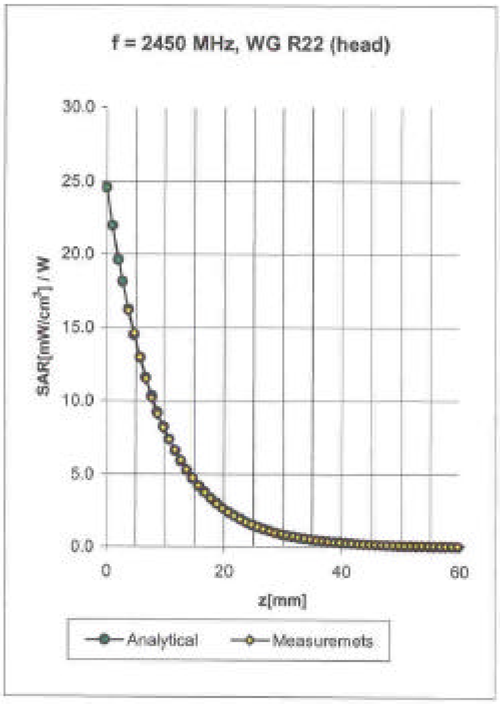
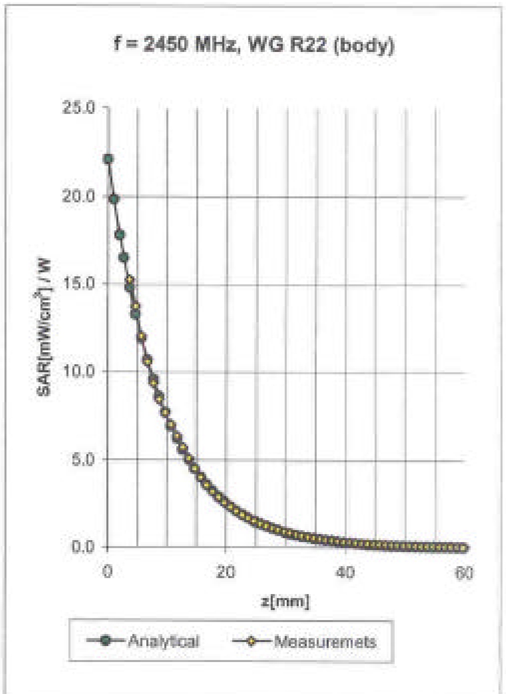
Conversion Factor Assessment





Head 2450 MHz ε_r = 39.2 ± 5% σ = 1.80 ± 5% mho/m

Valid for f=2400-2500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	4.8	± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.8	± 8.9% (k=2)	Alpha	1.01
ConvF Z	4.8	± 8.9% (k=2)	Depth	1.83

Body 2450 MHz ε_r = 52.7 ± 5% σ = 1.95 ± 5% mho/m

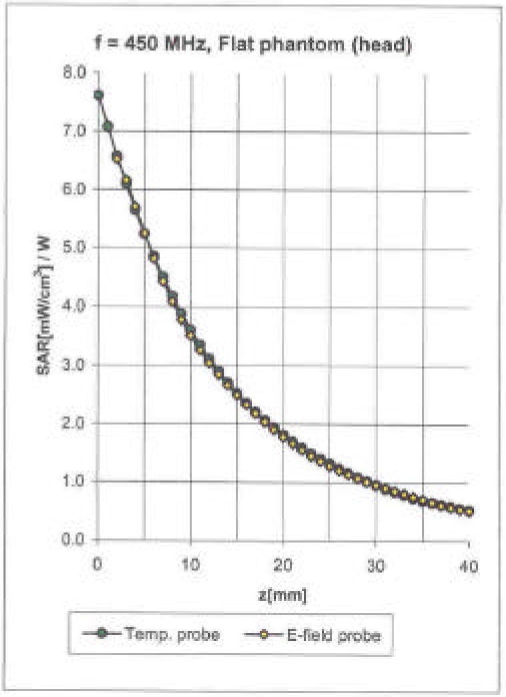
Valid for f=2400-2500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

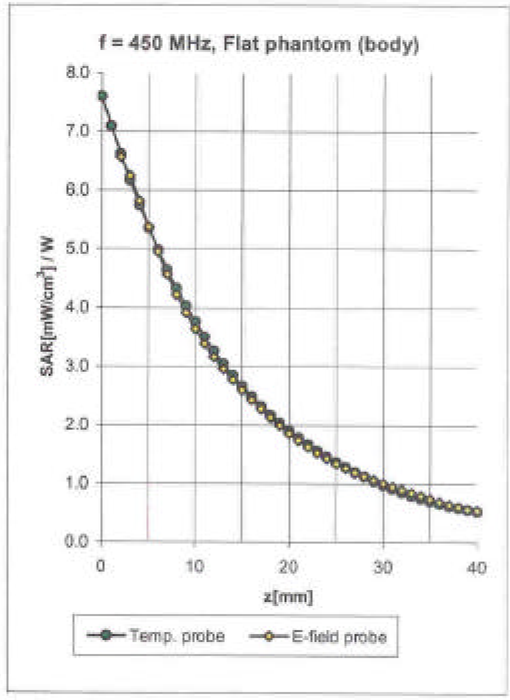
ConvF X	4.4	± 8.9% (k=2)	Boundary effect:	
ConvF Y	4.4	± 8.9% (k=2)	Alpha	1.05
ConvF Z	4.4	± 8.9% (k=2)	Depth	1.66

ET3DV6 SN:1785

July 28, 2003

Conversion Factor Assessment





Head 450 MHz ε_r = 43.5 ± 5% σ = 0.87 ± 5% mho/m

Valid for f=400-500 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	7.0	± 15.5% (k=2)	Boundary effect:	
ConvF Y	7.0	± 15.5% (k=2)	Alpha	0.40
ConvF Z	7.0	± 15.5% (k=2)	Depth	2.22

Body 450 MHz ε_r = 56.7 ± 5% σ = 0.94 ± 5% mho/m

Valid for f=400-500 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	6.5	± 15.5% (k=2)	Boundary effect:	
ConvF Y	6.5	± 15.5% (k=2)	Alpha	0.43
ConvF Z	6.5	± 15.5% (k=2)	Depth	2.36

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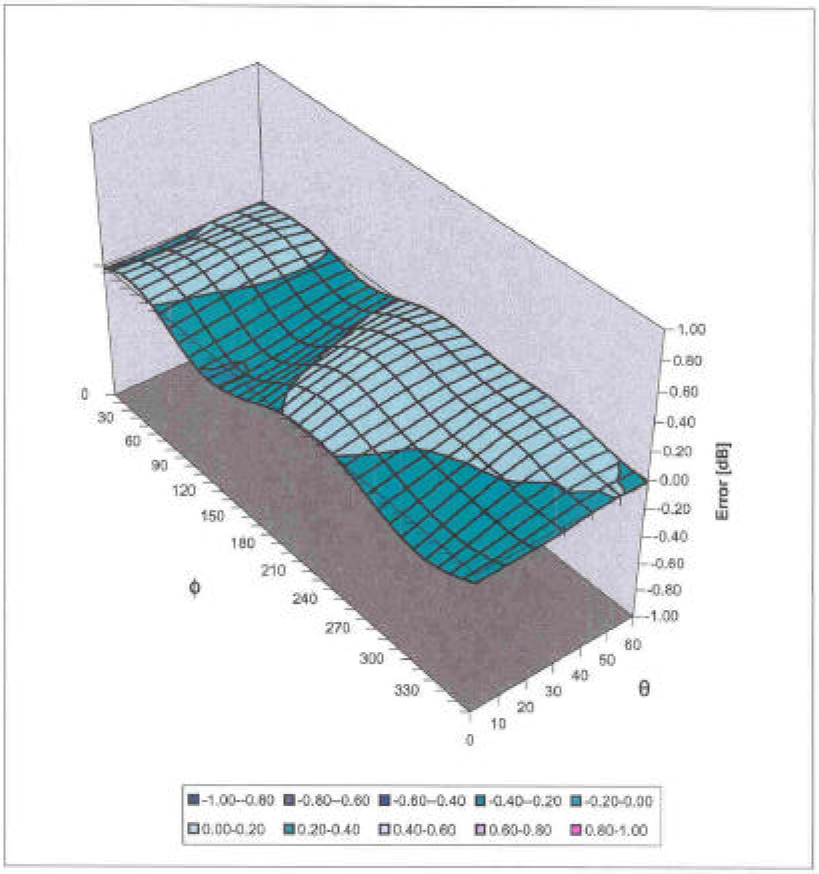
Deviation from Isotropy in HSL

Error (θ,φ), f = 900 MHz



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4 APPENDIX B – PHANTOM CERTIFICATE

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

Certificate of conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 BA
Series No	TP-1002 and higher
Manufacturer / Origin	Untersee Composites Hauptstr. 69 CH-8559 Fruthwilen Switzerland

Tests

The series production process used allows the limitation to test of first articles.
Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

Test	Requirement	Details	Units tested
Shape	Compliance with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness	Compliant with the requirements according to the standards	2mm +/- 0.2mm in specific areas	First article, Samples
Material parameters	Dielectric parameters for required frequencies	200 MHz – 3 GHz Relative permittivity < 5 Loss tangent < 0.05.	Material sample TP 104-5
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards	Liquid type HSL 1800 and others according to the standard.	Pre-series, First article

Standards

[1] CENELEC EN 50361
[2] IEEE P1528-200x draft 6.5
[3] IEC PT 62209 draft 0.9
(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 18.11.2001

Signature / Stamp

Doc No 881 – QD 000 P40 BA – B Page 1 (1)

5 APPENDIX C – 1800 MHZ DIPOLE CALIBRATION CERTIFICATE

Schmid & Partner
Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland, Phone +41 1 245 97 00, Fax +41 1 245 97 79

DASY

Dipole Validation Kit

Type: D1800V2

Serial: 224

Manufactured: December 17, 2002
Calibrated: January 15, 2003

1. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with head simulating glycol solution of the following electrical parameters at 1800 MHz:

Relative Dielectricity	**39.5**	± 5%
Conductivity	**1.36 mho/m**	± 5%

The DASY System with a dosimetric E-field probe ET3DV6 (SN:1507, Conversion factor 5.3 at 1800 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. The included distance holder was used during measurements for accurate distance positioning.

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

2 SAR Measurement with DASY4 System

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

averaged over 1 cm^3 (1 g) of tissue:	**39.7 mW/g**
averaged over 10 cm^3 (10 g) of tissue:	**20.7 mW/g**

3. Dipole Impedance and Return Loss

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

Electrical delay:	**1.208 ns**	(one direction)
Transmission factor:	**0.977**	(voltage transmission, one direction)

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

Feedpoint impedance at 1800 MHz:	Re{Z} = **50.4 Ω**
	Im {Z} = **-3.1 Ω**
Return Loss at 1800 MHz	**-30.2 dB**

4. Handling

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

5. Design

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

6. Power Test

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

Date/Time: 01/15/03 11:35:20

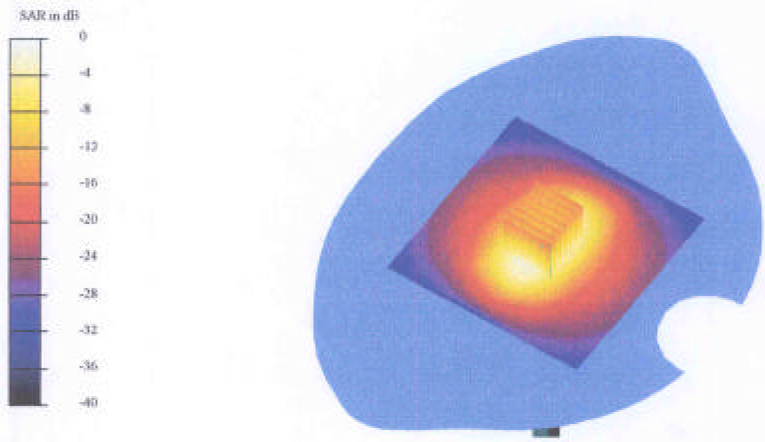
Test Laboratory: SPEAG, Zurich, Switzerland
File Name: SN224_SN1507_HSL1800_150103.da4

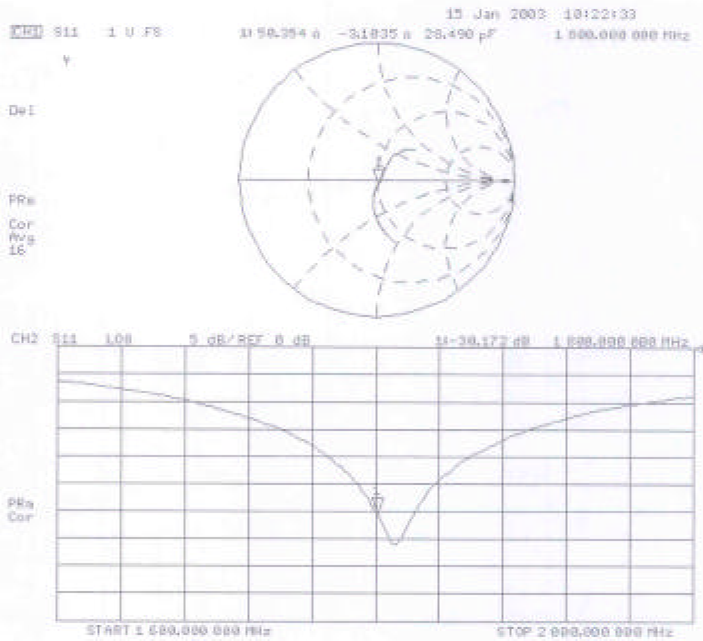
DUT: Dipole 1800 MHz Type & Serial Number: D1800V2 - SN224
Program: Dipole Calibration; Pin = 250 mW; d = 10 mm

Communication System: CW-1800; Frequency: 1800 MHz; Duty Cycle: 1:1
Medium: HSL 1800 MHz (σ = 1.36 mho/m, ε = 39.52, ρ = 1000 kg/m3)
Phantom section: FlatSection

DASY4 Configuration:
- Probe: ET3DV6 - SN1507; ConvF(5.3, 5.3, 5.3); Calibrated: 1/24/2002
- Sensor-Surface: 4mm *(Mechanical Surface Detection)*
- Electronics: DAE3 - SN410; Calibrated: 7/18/2002
- Phantom: SAM 4.0 - TP:1006
- Software: DASY4, V4.0 Build 51

Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm
Reference Value = 94.8 V/m
Peak SAR = 17.7 mW/g
SAR(1 g) = 9.93 mW/g; SAR(10 g) = 5.18 mW/g
Power Drift = 0.005 dB




15 Jan 2003 10:22:33
CH1 S11 1 U FS
Del
Cor
Avg
16
CH2 S11 LOG 5 dB/REF 0 dB
Cor