

Accredited EMC-Test-Laboratory

accredited by:

Regulatory Authority for Telecommunications and Posts (Reg TP)
DAR-No.: TTI-P-G-166/98-30

Federal Motor Transport Authority (KBA)
DAR registration number: KBA-P 00070-97 from January –19-1999

Listed by
FEDERAL COMMUNICATIONS COMMISSION (FCC)
Registration Number: 90462
FCC Website: WWW.FCC.GOV

Test report no.: 4-0484-01-01/01

Type identification : Voyager Lite

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1 General Information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.6. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item.

The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.2 Statement of Compliance

The SAR values found for the video transmitter Voyager Lite are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1 g tissue according the FCC rule §2.1093, the ANSI/IEEE C 95.1:1999 and the NCRP Report Number 86 for uncontrolled environment.

Tester operator:



20.11.2001

Fabien Coulet

Date

Name

Signature

Technical responsibility for area of testing:



20.11.2001

Bernd Rebmann

Date

Name

Signature

1.3 Testing laboratory

CETECOM ICT Services GmbH

Untertürkheimer Straße 6-10, D-66117 Saarbrücken

Germany

Telephone: +49 681 598 - 0

Fax: + 49 681 598 - 8475

e-mail: info@ict.cetecom.de

Internet: <http://www.cetecom.com>

State of accreditation: The Test laboratory SAR is accredited according to DIN EN ISO / IEC 1702545001.

DAR-No.: TTI-P-G-166/98-30

Test location, if different from CETECOM ICT Services GmbH

Name: ---

Street: ---

Town: ---

Country: ---

Phone: ---

Fax: ---

1.4 Details of applicant

Name: Tandberg Television

Street: Schwalbacher Strasse 12

Town: D-65321 Heidenrod Kemel

Country: Germany

Phone: +49 61 2472 390

Fax: +49 61 2472 3929

Contact: Mr. R. Kühn

Phone: +49 61 2472 39 22

1.5 Application details

Date of receipt of application: 30.10.01

Date of receipt of test item: 06.11.01

Date of test: 06.11.01

Person who have been present during the test: Mr Otto

1.6 Test item

Description of test item:

EUT Type: Video transmitter
 Trade Name: Tandberg
 Model: Voyager lite
 SW: --
 Frequency: 2320 – 2500 MHz in 0.1 MHz steps
 Modulation: QPSK
 Max RF output power rad.: 237 mW cond.
 Antenna Type: patch antenna
 Used battery: IDX Endura 50 14.4V Lithium Ion 50W
 Maximum use time: 3 hours

1.7 Test specifications

Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)
Draft IEEE Std 1528-200X: Version 6.4: July 2001

1.7.1 RF exposure limits

Human Exposure	Uncontrolled Environment General Population	Controlled Environment Occupational
Spatial Peak SAR* (Brain)	1.60 mW/g	8.00 mW/g
Spatial Average SAR** (Whole Body)	0.08 mW/g	0.40 mW/g
Spatial Peak SAR*** (Hands/Feet/Ankle/Wrist)	4.00 mW/g	20.00 mW/g

Table 1: RF exposure limits

Notes:

* The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time

** The Spatial Average value of the SAR averaged over the whole body.

*** The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation).

2 Technical test

2.1. Summary of test results

☒ No deviations from the technical specification(s) were ascertained in the course of the tests performed.

☐ The deviations as specified in 2.4 and 2.5 were ascertained in the course of the tests performed.

2.2 Test environment

Ambient temperature: 21°C – 23°C

Tissue simulating liquid: 21°C – 23°C

2.3 Test equipment used

Manufacturer	Device	Type	Serial number	Date of last calibration
Schmid & Partner Engineering AG	Dosimetric E-Fiel Probe	ET3DV6	1558	February 20, 2001
Schmid & Partner Engineering AG	Dosimetric E-Fiel Probe	ET3DV6	1559	February 20, 2001
Schmid & Partner Engineering AG	900 MHz System Validation Dipole	D900V2	102	February 13, 2001
Schmid & Partner Engineering AG	1800 MHz System Validation Dipol	D1800V2	287	February 13, 2001
Schmid & Partner Engineering AG	Data acquisition electronics	DAE3V1	413	January 15, 2001
Schmid & Partner Engineering AG	Software	DASY 3 V3.1c	---	Calibration isn't necessary
Schmid & Partner Engineering AG	Phantom	Pre SAM	---	Calibration isn't necessary
Rohde & Schwarz	Universal Radio Communication Tester	CMU 200	U-972406/000	August 30, 2001
Hewlett Packard	Network Analyser 300 kHz to 3 GHz	HP 8753C	2936A00872	Mai 11, 1998
Agilent	Dielectric Probe Kit	Agilent 85070C	US99360146	March 8, 2001

2.4 Test results (Body SAR)

The table contain the measured SAR values averaged over a mass of 1 g			
Frequency range	Position	Touch on the flat phantom	Limit
2.32 to 2.5 GHz	Patch antennas at the phantom	0.0244 W/kg	1.6 W/kg
2.32 to 2.5 GHz	Transmitter at the phantom.	0.0039 W/kg	1.6 W/kg

Table 3: Test results (Body SAR)

Note1: The used conversion factor during the measurement was 5.40 at 1800MHz, this value was not extrapolated to a frequency of 2400 MHz since use of a conversion of 5.40 is the worst case condition.

2.5 Tissue dielectric properties

The dielectric properties have been measured by the contact probe method at 22-24°C. The following materials are used for producing the tissue-equivalent materials:

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	1.40	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

Table 4: Tissue dielectric properties

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized, 16MΩ+ resistivity

HEC: Hydroxyethyl Cellulose

DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]

Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]ether

2.6 Tissue parameters

Used Target Frequency	Target Head Tissue		Target Body Tissue		Measured Head Tissue		Measured Body Tissue		Measured Date
	ϵ_r	σ [S/m]	ϵ_r	σ [S/m]	ϵ_r	σ [S/m]	ϵ_r	σ [S/m]	
☐ 450	43.5	0.87	56.7	0.94	---	---	---	---	---
☐ 835	41.5	0.90	55.2	0.97	---	---	---	---	---
☐ 900	41.5	0.97	55.0	1.05	---	---	---	---	---
☐ 915	41.5	0.98	55.0	1.06	---	---	---	---	---
☐ 1800 - 2000	40.0	1.40	53.3	1.52	---	---	---	---	---
☒ 2450	39.2	1.80	52.7	1.95	36.3	1.92	53.0	2.14	30 th August 01

Table 5: Parameter of the tissue simulating liquid

2.7 Measurement uncertainties

The overall combined measurement uncertainty of the measurement system is $\pm 12,1\%$ ($K=1$).
The breakdown of the individual uncertainties is as follows:

Calibration Error:					
	Probability Distribution	Standard Uncertainty			
		900 MHz	1500 MHz	1800 MHz	
Incident power	Rectangular	± 1,2 %	± 1,2 %	± 1,2 %	
Mismatch uncertainty	Rectangular	± 0,6 %	± 0,6 %	± 0,6 %	
Exp. fitting error (95% confidence)	Normal	± 0,4 %	± 0,2 %	± 0,2 %	
Liquid permittivity	Rectangular	± 2,3 %	± 2,8 %	± 2,9 %	
Probe positioning	Normal	± 0,5 %	± 0,8 %	± 1.0 %	
Field homogeneity	Rectangular	± 0,6 %	± 1,2 %	± 1,4 %	
Combined Standard Uncertainty		± 2,8 %	± 3,4 %	± 3,6 %	
E-Field Probe Error:					
Error Description	Error	Probability Distribution	Weight	Standard Uncertainty	
Isotropy around axis	± 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	rectangular	1	± 2,5 %	
Calibration error	± 3,6 %	normal	1	± 3,6 %	
Combined Standard Uncertainty:				± 6,9 %	
Source Uncertainty:					
Error Description	Error	Probability Distribution	Weight	Standard Uncertainty	
Device positioning	± 6%	normal	1	± 6%	
Laboratory set-up	± 3 %	normal	1	± 3%	
Combined Standard Uncertainty:				± 6,7 %	
SAR Evaluation Error					
Error Description	Error	Probability Distribution	Weight	Standard Uncertainty	Offset
Data acquisition error	± 1%	rectangular	1	± 0,6 %	
ELF and RF disturbances	± 0,25 %	normal	1	± 0,25 %	
Conductivity assessment	± 10 %	rectangular	1	± 5,8 %	
Extrapolation and boundary effects	± 3 %	normal	1	± 3 %	+ 5 %
Probe positioning	± 0,1 mm	normal	1	± 1 %	
Integration and cube orientation	± 3 %	normal	1	± 3 %	
Cube shape inaccuracies	± 2 %	rectangular	1	± 1.2 %	
Combined Standard Uncertainty:				± 7.4 %	

Combined Uncertainties		
Error Description	Standard Uncertainty	Offset
E-field probe errors	$\pm 6.9 \%$	
SAR evaluation error	$\pm 7.4 \%$	$\pm 5 \%$
Source uncertainty	$\pm 6,7 \%$	
Combined Standard Uncertainty:	$\pm 12.1 \%$	
Expanded Uncertainty (k=2):	$\pm 24,2 \%$	

Table 6: Measurement uncertainties

The measurement uncertainties were performed by Schmid & Partner Engineering AG.

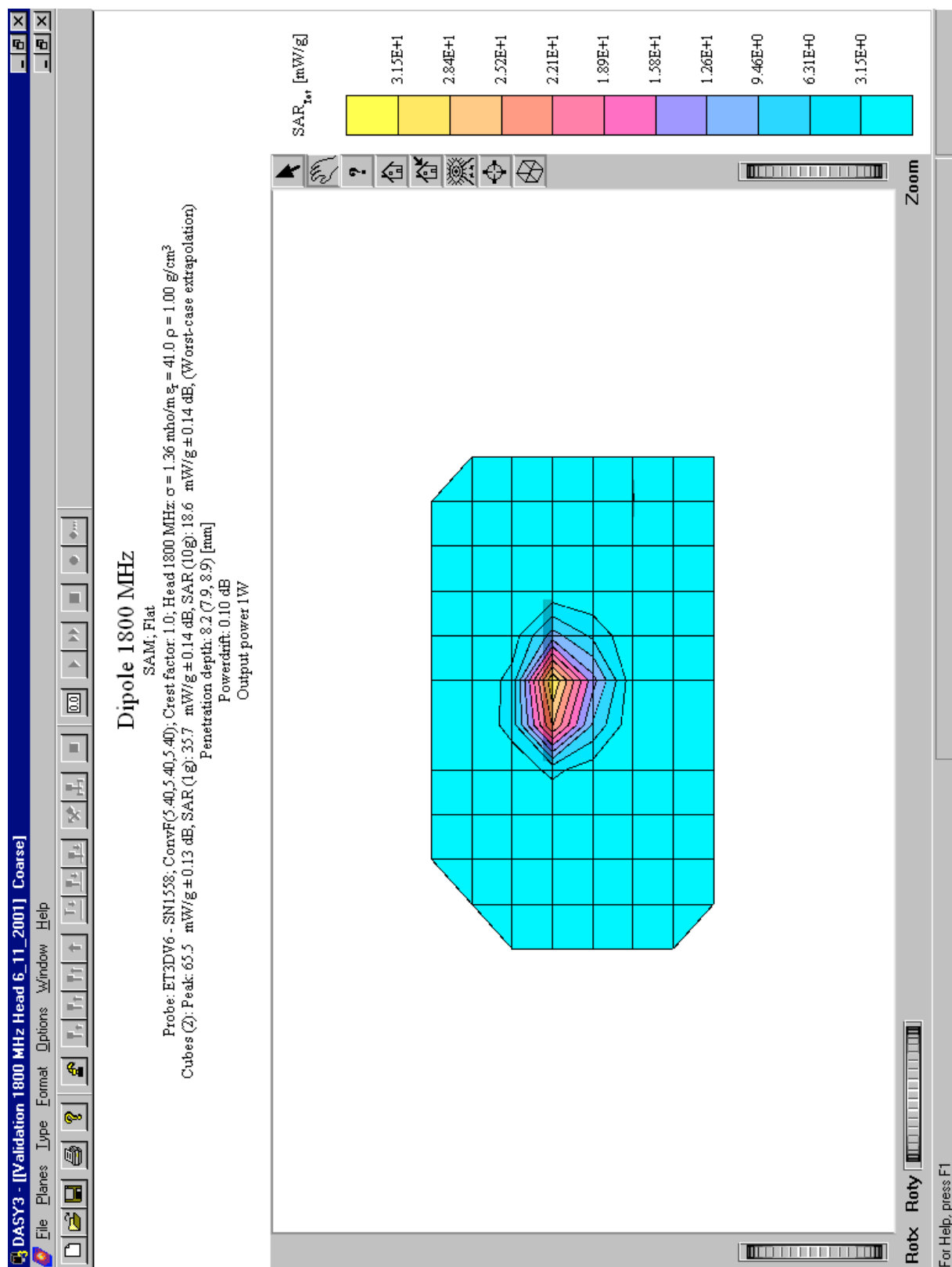
2.8 System validation

The system validation is used for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with 1800 MHz head tissue equivalent material according IEEE Std 1528-200X: 2001. (graphics plots attached).

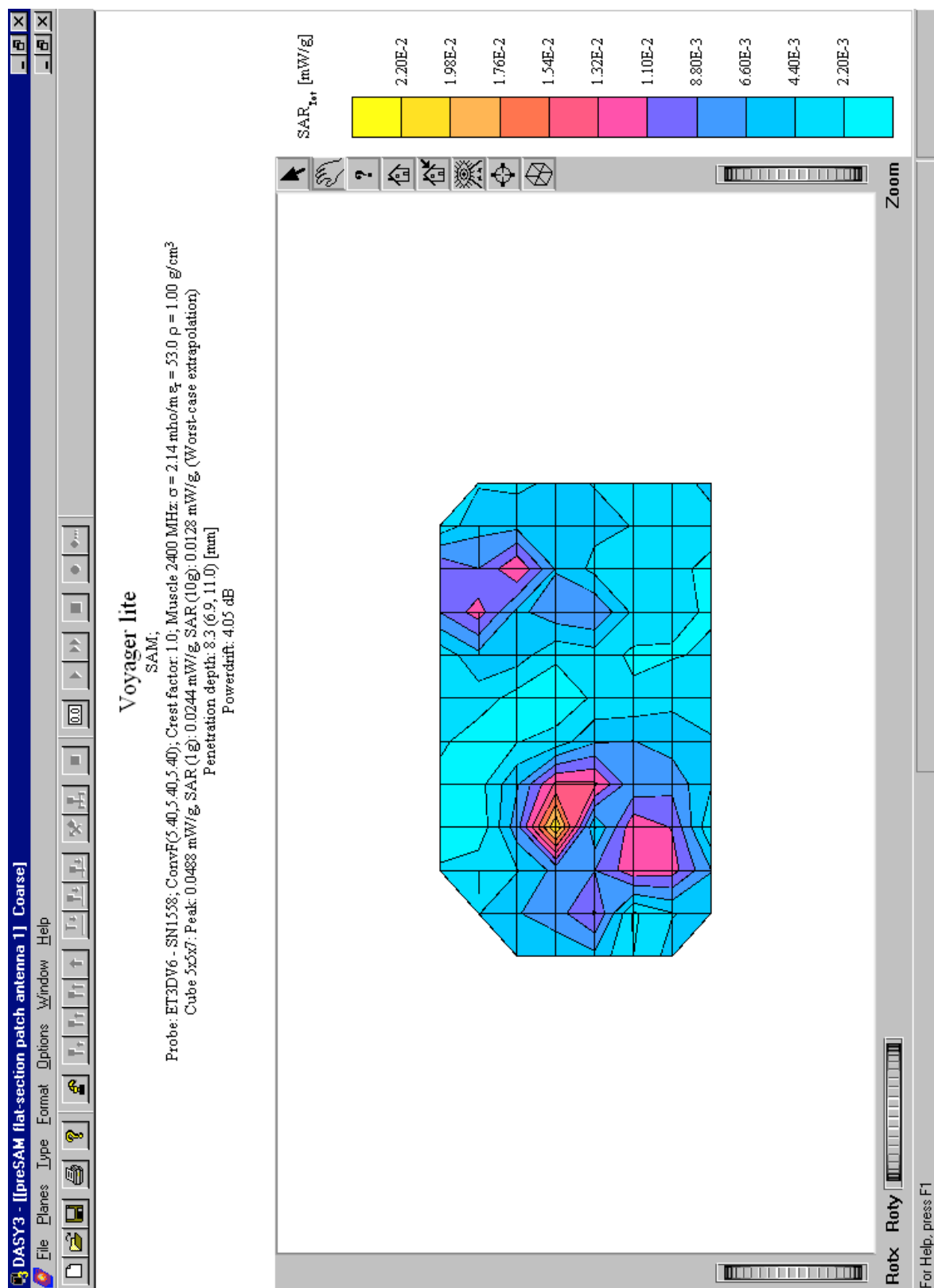
Validation Kit	Frequency	Target SAR _{1g}	Target SAR _{10g}	Measured SAR _{1g}	Measured SAR _{10g}	Measured date
D1800V2, S/N:287	1800 MHz	38.1 mW/g	19.8 mW/g	35.7 mW/g	18.6 mW/g	6/11/2001

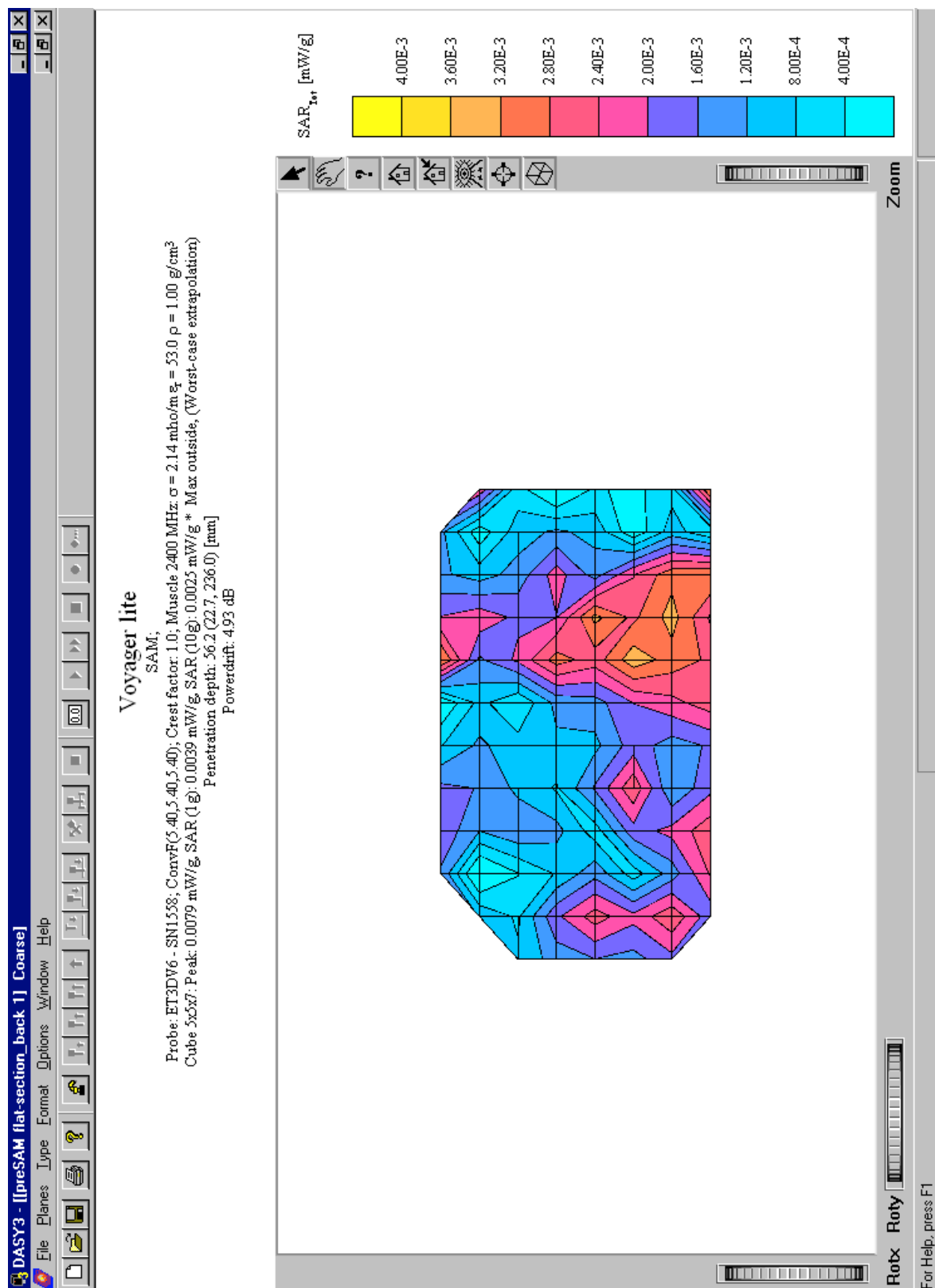
Table 7: Test results (system validation)

Appendix 1: System performance verification



Appendix 2: Measurement results (printout from DASYTM)





Appendix 3: Photo documentation



Photo 1: Measurement System DASY 3



Photo 2: Patch antennas against the body phantom



Photo 3: Patch antennas against the body phantom under view



Photo 4: Patch antennas against the body phantom under view



Photo 5: Body measurement (flat phantom) transmitter with rucksack



Photo 6: EUT out of the rucksack



Photo 7: EUT in the rucksack



Photo 8: Used battery

Appendix 4: Calibration parameters of E-field probe**Schmid & Partner
Engineering AG**

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

x

Calibration Certificate**Dosimetric E-Field Probe**

Type:

ET3DV6

Serial Number:

1558

Place of Calibration:

Zurich

Date of Calibration:

Feb. 20, 2001

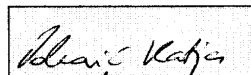
Calibration Interval:

12 months

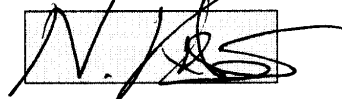
Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

Wherever applicable, the standards used in the calibration process are traceable to international standards. In all other cases the standards of the Laboratory for EMF and Microwave Electronics at the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland have been applied.

Calibrated by:



Approved by:



ET3DV6 SN:1558

DASY3 - Parameters of Probe: ET3DV6 SN:1558**Sensitivity in Free Space**

NormX	1.48 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.35 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.40 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	100 mV
DCP Y	100 mV
DCP Z	100 mV

Sensitivity in Tissue Simulating Liquid

Head	450 MHz	$\epsilon_r = 43.5 \pm 5\%$	$\sigma = 0.87 \pm 10\% \text{ mho/m}$
ConvF X	7.12 extrapolated	Boundary effect:	
ConvF Y	7.12 extrapolated	Alpha	0.18
ConvF Z	7.12 extrapolated	Depth	3.71
Head	900 MHz	$\epsilon_r = 42 \pm 5\%$	$\sigma = 0.97 \pm 10\% \text{ mho/m}$
ConvF X	6.55 $\pm 7\%$ (k=2)	Boundary effect:	
ConvF Y	6.55 $\pm 7\%$ (k=2)	Alpha	0.27
ConvF Z	6.55 $\pm 7\%$ (k=2)	Depth	3.26
Head	1500 MHz	$\epsilon_r = 40.4 \pm 5\%$	$\sigma = 1.23 \pm 10\% \text{ mho/m}$
ConvF X	5.78 interpolated	Boundary effect:	
ConvF Y	5.78 interpolated	Alpha	0.39
ConvF Z	5.78 interpolated	Depth	2.65
Head	1800 MHz	$\epsilon_r = 40 \pm 5\%$	$\sigma = 1.40 \pm 10\% \text{ mho/m}$
ConvF X	5.40 $\pm 7\%$ (k=2)	Boundary effect:	
ConvF Y	5.40 $\pm 7\%$ (k=2)	Alpha	0.45
ConvF Z	5.40 $\pm 7\%$ (k=2)	Depth	2.35

Sensor Offset

Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.9 $\pm$ 0.2	mm