

## **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](mailto: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<br>General Population | Controlled Environment<br>Occupational |
|--------------------------------------------------------|------------------------------------------------|----------------------------------------|
| <b>Spatial Peak SAR*</b><br>(Brain)                    | <b>1.60 mW/g</b>                               | 8.00 mW/g                              |
| <b>Spatial Average SAR**</b><br>(Whole Body)           | 0.08 mW/g                                      | 0.40 mW/g                              |
| <b>Spatial Peak SAR***</b><br>(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<br>(% by weight) | Frequency (MHz)              |       |                              |      |                              |       |                               |      |                                          |      |
|------------------------------|------------------------------|-------|------------------------------|------|------------------------------|-------|-------------------------------|------|------------------------------------------|------|
|                              | <input type="checkbox"/> 450 |       | <input type="checkbox"/> 835 |      | <input type="checkbox"/> 915 |       | <input type="checkbox"/> 1900 |      | <input checked="" type="checkbox"/> 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<br>Frequency                 | Target<br>Head Tissue |                | Target<br>Body Tissue |                | Measured<br>Head Tissue |                | Measured<br>Body Tissue |                | Measured Date              |
|------------------------------------------|-----------------------|----------------|-----------------------|----------------|-------------------------|----------------|-------------------------|----------------|----------------------------|
|                                          | $\epsilon_r$          | $\sigma$ [S/m] | $\epsilon_r$          | $\sigma$ [S/m] | $\epsilon_r$            | $\sigma$ [S/m] | $\epsilon_r$            | $\sigma$ [S/m] |                            |
| <input type="checkbox"/> 450             | 43.5                  | 0.87           | 56.7                  | 0.94           | ---                     | ---            | ---                     | ---            | ---                        |
| <input type="checkbox"/> 835             | 41.5                  | 0.90           | 55.2                  | 0.97           | ---                     | ---            | ---                     | ---            | ---                        |
| <input type="checkbox"/> 900             | 41.5                  | 0.97           | 55.0                  | 1.05           | ---                     | ---            | ---                     | ---            | ---                        |
| <input type="checkbox"/> 915             | 41.5                  | 0.98           | 55.0                  | 1.06           | ---                     | ---            | ---                     | ---            | ---                        |
| <input type="checkbox"/> 1800 - 2000     | 40.0                  | 1.40           | 53.3                  | 1.52           | ---                     | ---            | ---                     | ---            | ---                        |
| <input checked="" type="checkbox"/> 2450 | 39.2                  | 1.80           | 52.7                  | 1.95           | 36.3                    | 1.92           | 53.0                    | 2.14           | 30 <sup>th</sup> 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                    | $\pm 6,7 \%$                    |            |
| <b>Combined Standard Uncertainty:</b> | <b><math>\pm 12.1 \%</math></b> |            |
| <b>Expanded Uncertainty (k=2):</b>    | <b><math>\pm 24,2 \%</math></b> |            |

Table 6: Measurement uncertainties

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

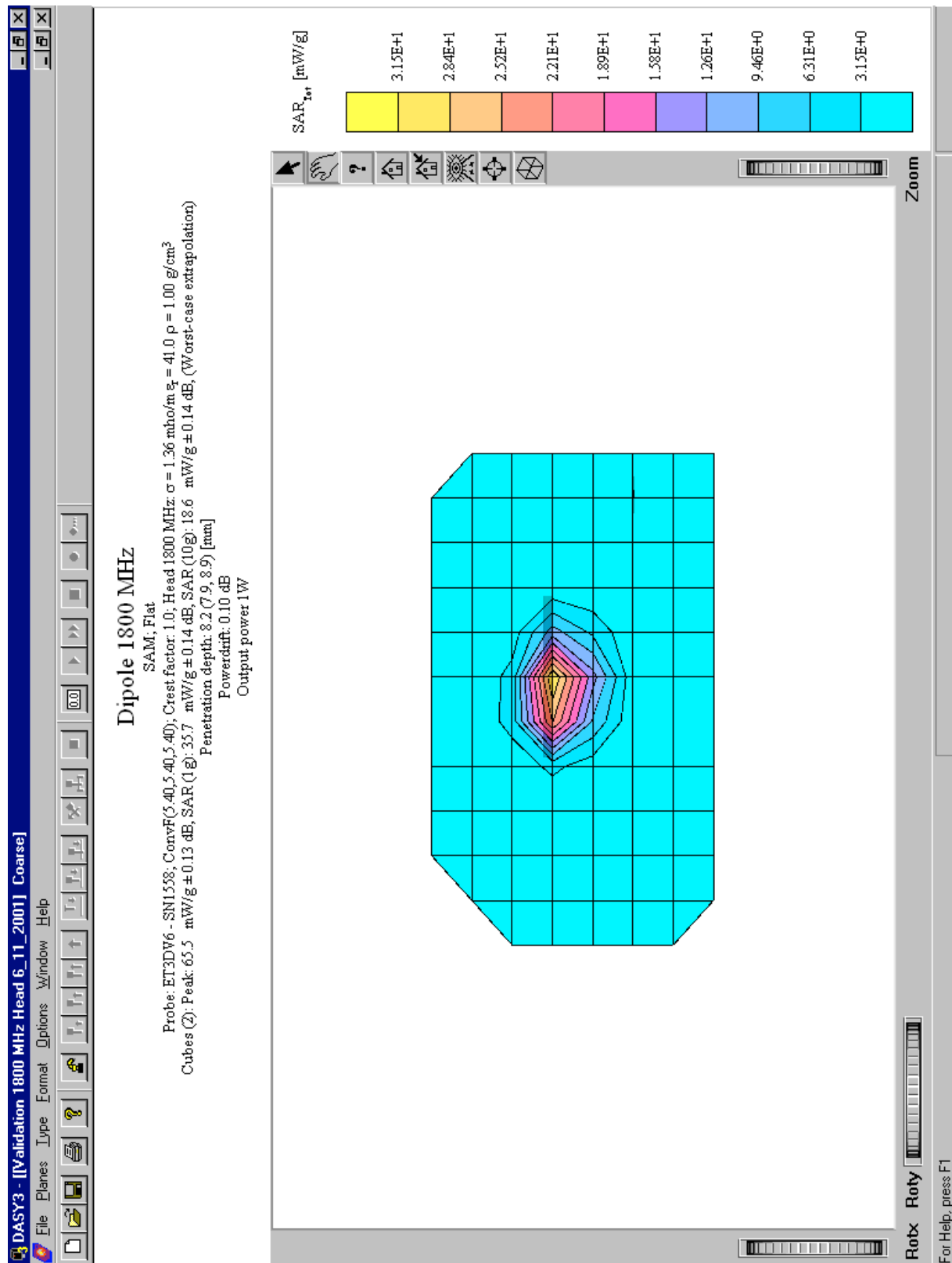
## 2.8 System validation

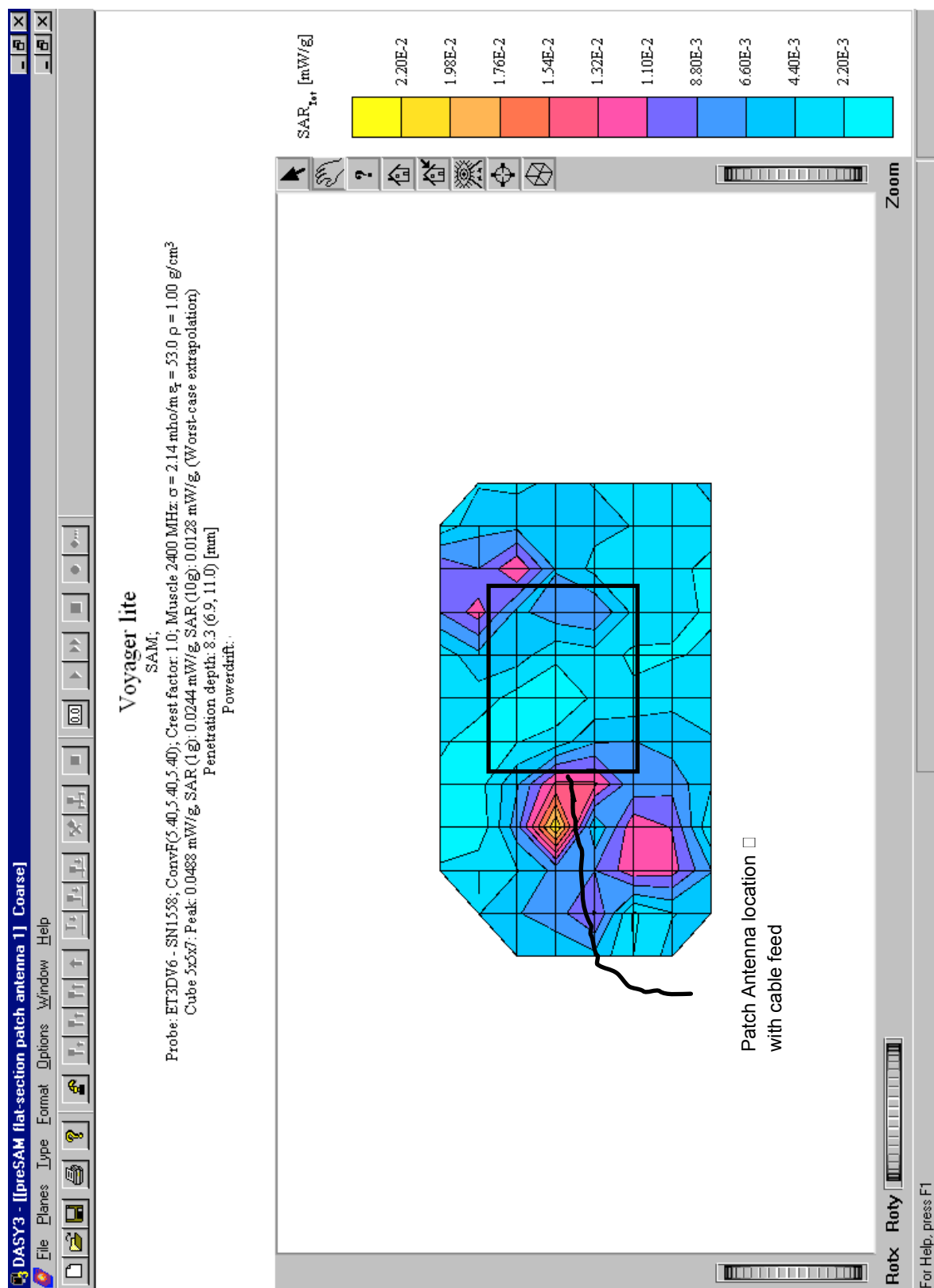
The system validation is used for verifying the accuracy of the complete measurement system and performance of the software. The system validation is performed with 1800 MHz head tissue equivalent material according IEEE Std 1528-200X: 2001. (graphics plots attached).

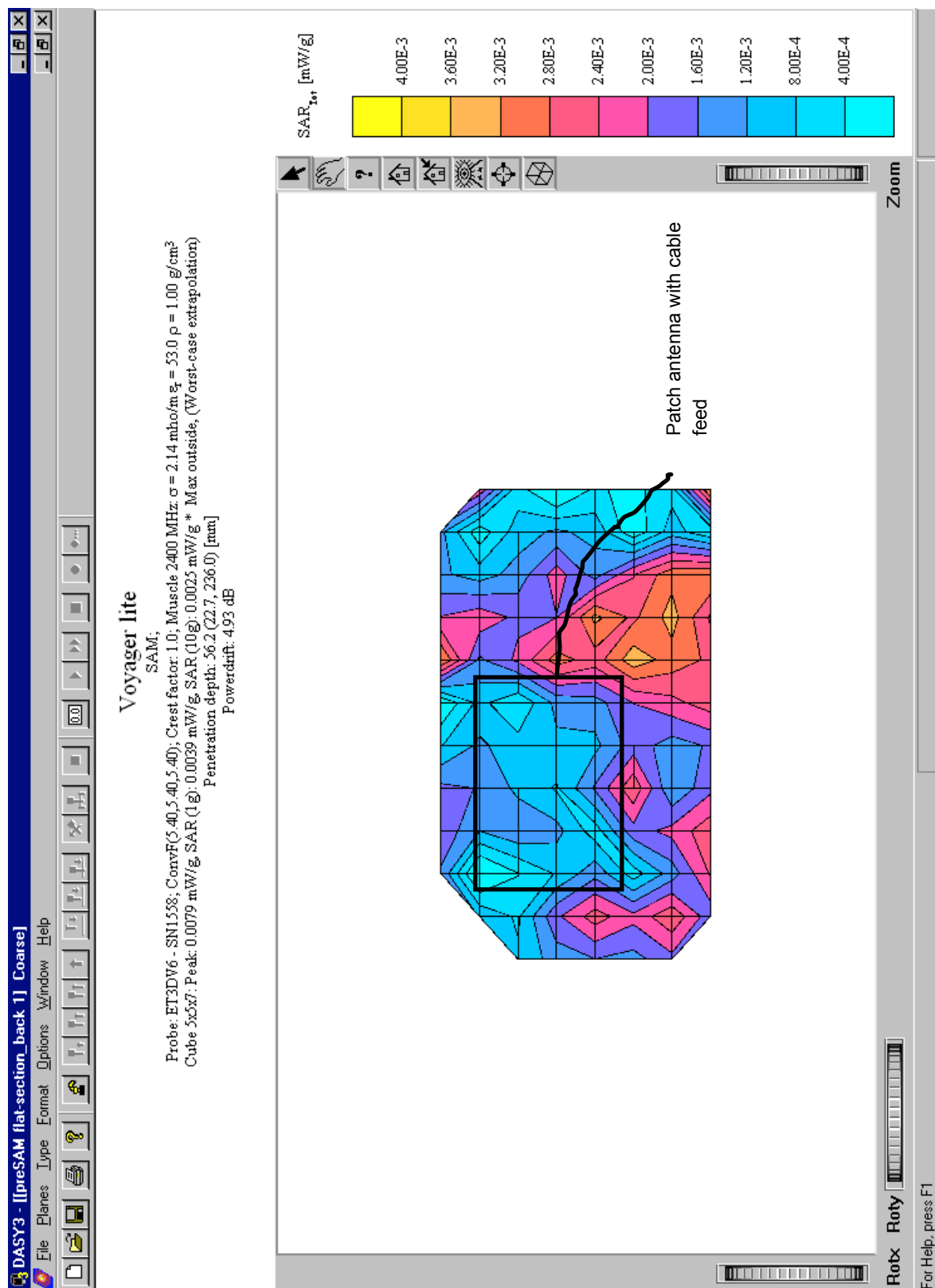
| Validation Kit   | Frequency | Target SAR <sub>1g</sub> | Target SAR <sub>10g</sub> | Measured SAR <sub>1g</sub> | Measured SAR <sub>10g</sub> | Measured date |
|------------------|-----------|--------------------------|---------------------------|----------------------------|-----------------------------|---------------|
| 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 DASY<sup>TM</sup>)**



### Appendix 3: Photo documentation



Photo 1: Measurement System DASY 3



Photo 2: Patch antennas against the body phantom

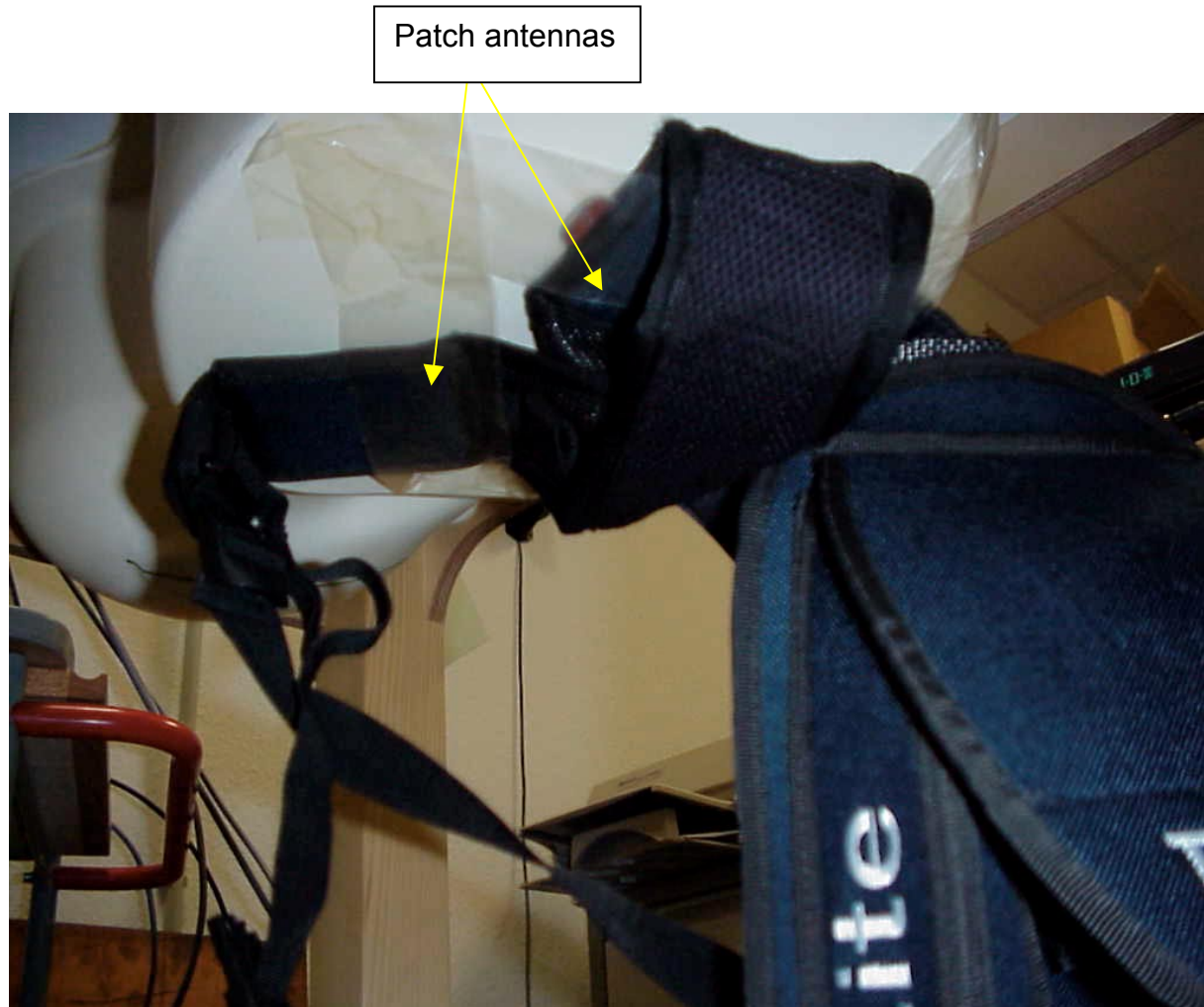


Photo 3: Patch antennas against the body phantom under view



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**

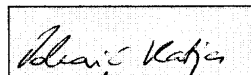
Calibration Interval:

**12 months**

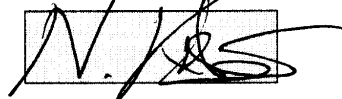
Schmid & Partner Engineering AG hereby certifies, that this device has been calibrated on the date indicated above. The calibration was performed in accordance with specifications and procedures of Schmid & Partner Engineering AG.

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****Diode Compression**

|       |                                                 |       |               |
|-------|-------------------------------------------------|-------|---------------|
| NormX | <b>1.48</b> $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP X | <b>100</b> mV |
| NormY | <b>1.35</b> $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Y | <b>100</b> mV |
| NormZ | <b>1.40</b> $\mu\text{V}/(\text{V}/\text{m})^2$ | DCP Z | <b>100</b> mV |

**Sensitivity in Tissue Simulating Liquid**

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

**Sensor Offset**

|                            |                                 |    |
|----------------------------|---------------------------------|----|
| Probe Tip to Sensor Center | <b>2.7</b>                      | mm |
| Optical Surface Detection  | <b>1.9 <math>\pm</math> 0.2</b> | mm |