Intertek Testing Services
ETL SEMKO

# *Specific Absorption Rate (SAR) Test Report*

for

## Cardionet, Inc.

on the

**CardioNet ECG Monitor With Arrhythmia Detection**
**Model Number: CardioNet Monitor**
**FCC ID: QBI-1005**

Test Report: 30388163
Date of Report: March 25, 2003

Job #: 3038816
Date of Test: March 10 to 11, 2003

A2LA Certificate Number: 1755-01

| | |
|---|---|
| Tested by: | Suresh Kondapalli |
| Reviewed by: David Chernomordik | David Chernomordik, Ph.D., EMC Technical Manager |

Review Date: 3/31/03

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**STATEMENT OF COMPLIANCE**

The Cardionet Monitor, FCC ID: QBI-1005 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 Menlo Park, California.

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 ±27.8%.

The device was tested at their maximum output power declared by the Cardionet Inc.

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

| Phantom | Position | $SAR_{1g}$, mW/g |
|---|---|---|
| Flat Section | 1.5 cm from phantom | 0.89 |

In conclusion, the tested sample device was found to be in compliance with the requirements defined in OET Bulletin 65, Supplement C (Edition 01-01) for body-worn configuration.

## 1.0 JOB DESCRIPTION

1.1 Client Information

The CardioNet Monitor has been tested at the request of:

**Company:** Cardionet, Inc.
510 Market Street
San Diego , CA 92101
USA

**Name of contact:** Mr. Jason Dorsey
**Telephone:** 619/243-7550
**Fax:** 619/243-7700

1.2 Equipment under test (EUT)

**Product Descriptions:**

| **Equipment** | CardioNet ECG Monitor With Arrhythmia Detection | | |
|---|---|---|---|
| Trade Name | CardioNet | P/N. | CardioNet Monitor |
| FCC ID | QBI-1005 | S/N No. | 11006 |
| Category | Portable device | RF Exposure | Uncontrolled Environment |
| Frequency Band | 824 - 849 MHz<br>1850 – 1910 MHz | System | CDMA |

| **EUT Antenna Description** | | | |
|---|---|---|---|
| Type | Monopole | Configuration | Fixed |
| Dimensions | 13.5mm (L), 7mm (D) | Gain | from 0 dBi to –2 dBi |
| Location | Right side Top | | |

**Use of Product:** The Cardionet Monitor constantly monitors patient's heartbeat and sends information to the CardioNet Patient Service Center. When a patient is away from home it uses wireless communication throughout Cellular/ PCS CDMA modem manufactured by Sierra Wireless (SB555 model, FCC ID: N7NSB555).

| | |
|---|---|
| **Manufacturer:** | Cardionet, Inc. |
| **Production is planned:** | [X] Yes, [ ] No |
| **EUT receive date:** | February 18, 2003 |
| **EUT received condition:** | Good working condition prototype. As declared by the Applicant it is identical to the production units. |
| **Test start date:** | March 10, 2003 |
| **Test end date:** | March 11, 2003 |

1.3 Test Plan Reference

FCC Rule: Part 2.1093, FCC's OET Bulletin 65, Supplement C (Edition 01-01)

## 1.4 System Test Configuration

### 1.4.1 System Block Diagram & Support Equipment

The diagram, shown below details test configuration of the equipment under test.

The CardioNet Monitoring System consists of two devices - the CardioNet Sensor and the CardioNet Monitor.

The CardioNet Monitor communicates with the CardioNet Sensor at 902 - 928 MHz (ISM band) and also communicates with CardioNet Patient Service Center in cellular band (824 – 848 MHz) and/or PCS band (1850 – 1910 MHz).

The CardioNet Monitor transmitter operating at ISM band is very low power transmitter (1 mW), The Cellular/ PCS bands transmitter operates at 224 mW power in CDMA mode.

During the SAR test of CDMA transmitter, the ISM transmitter was also active. No Support Equipment was used. The test sample was operated in a test mode that allows control of the transmitter without the need to place actual phone calls. For the purposes of this test the device is commanded to test mode and manually set to the proper channel, transmitter power level and transmit mode of operation. The device was then placed in the SAR Measurement System with a fully charged battery.

1.4.2 Test Position

Two test configurations were used to show compliance with the FCC RF Exposure requirements. In all configurations, the CardioNet Monitor was configured for testing in a typical fashion (as a customer would normally use it). Due to the application and usage of the product, SAR measurements with the human head region are not necessary. Table 1 below describes the setup and condition:

| Table 1, Equipment Setup | |
|---|---|
| **Configuration** | **Description** |
| A | • Back Side 15 mm from phantom. Antenna in horizontal position, distance from antenna to Phantom = 31.5 mm.<br>Simulating close proximity of human body. |
| B | • Front Side 15 mm from phantom. Antenna in horizontal position, distance from antenna to Phantom = 28.5 mm<br>Simulating close proximity of human body. |

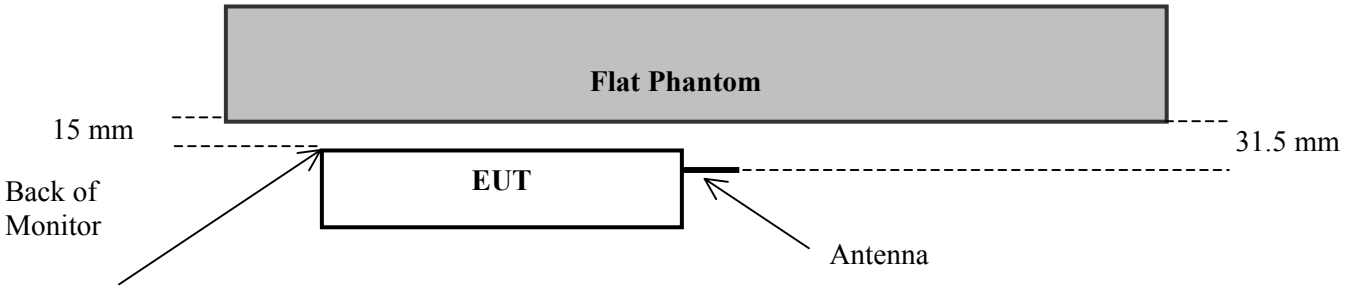



Figure 1: Configuration A Back Side 15mm from Phantom

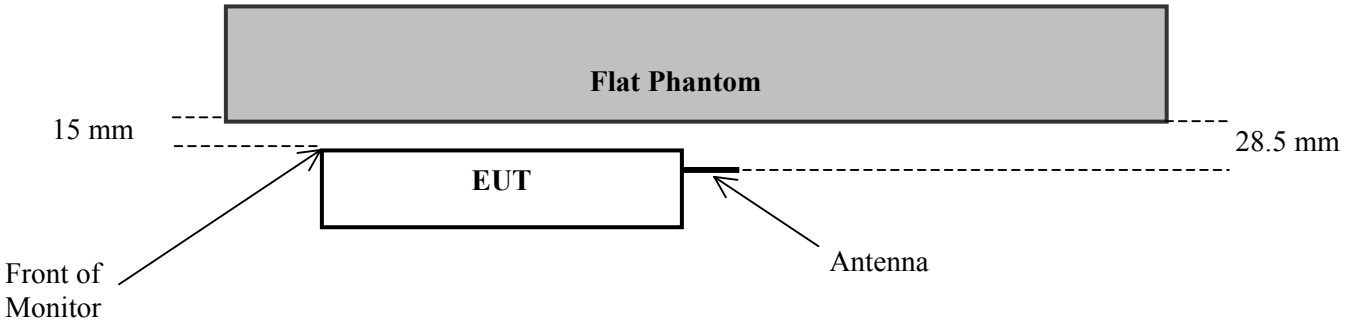



Figure 1: Configuration B Front Side 15mm from Phantom

1.4.3 Test Condition

During tests, the worst case data (max. RF coupling) was determined with following conditions:

| | | | |
|---|---|---|---|
| EUT Antenna | Fixed length | Orientation | N/A |
| Usage | Stand-alone | Distance between antenna axis at the joint and the phantom surface: | 31.5 mm – Back Side 15 mm from phantom. 28.5.5 mm –Front Side 15 mm from phantom |
| Simulating human Body/hand | body | EUT Battery | Unit powered from battery. |
| Power output | Frequency MHz | | **Power Output, dBm** |
| | 824.7 | | 23.5 |
| | 836.5 | | 23.5 |
| | 848.3 | | 23.4 |
| | 1851.25 | | 23.5 |
| | 1880.0 | | 23.4 |
| | 1908.75 | | 23.6 |

The spatial peak SAR values were accessed for lowest, middle and highest operating channels defined by the manufacturer.

Antenna port power measurement was performed, with the power meter, before and after the SAR tests to ensure that the CardioNet Monitor operated at the highest power level.

1.5 Modifications required for compliance

Intertek Testing Services implemented no modifications.

1.6 Additions, deviations and exclusions from standards

No additions, deviations or exclusions have been made from standard.

## 2.0 SAR EVALUATION

### 2.1 SAR Limits

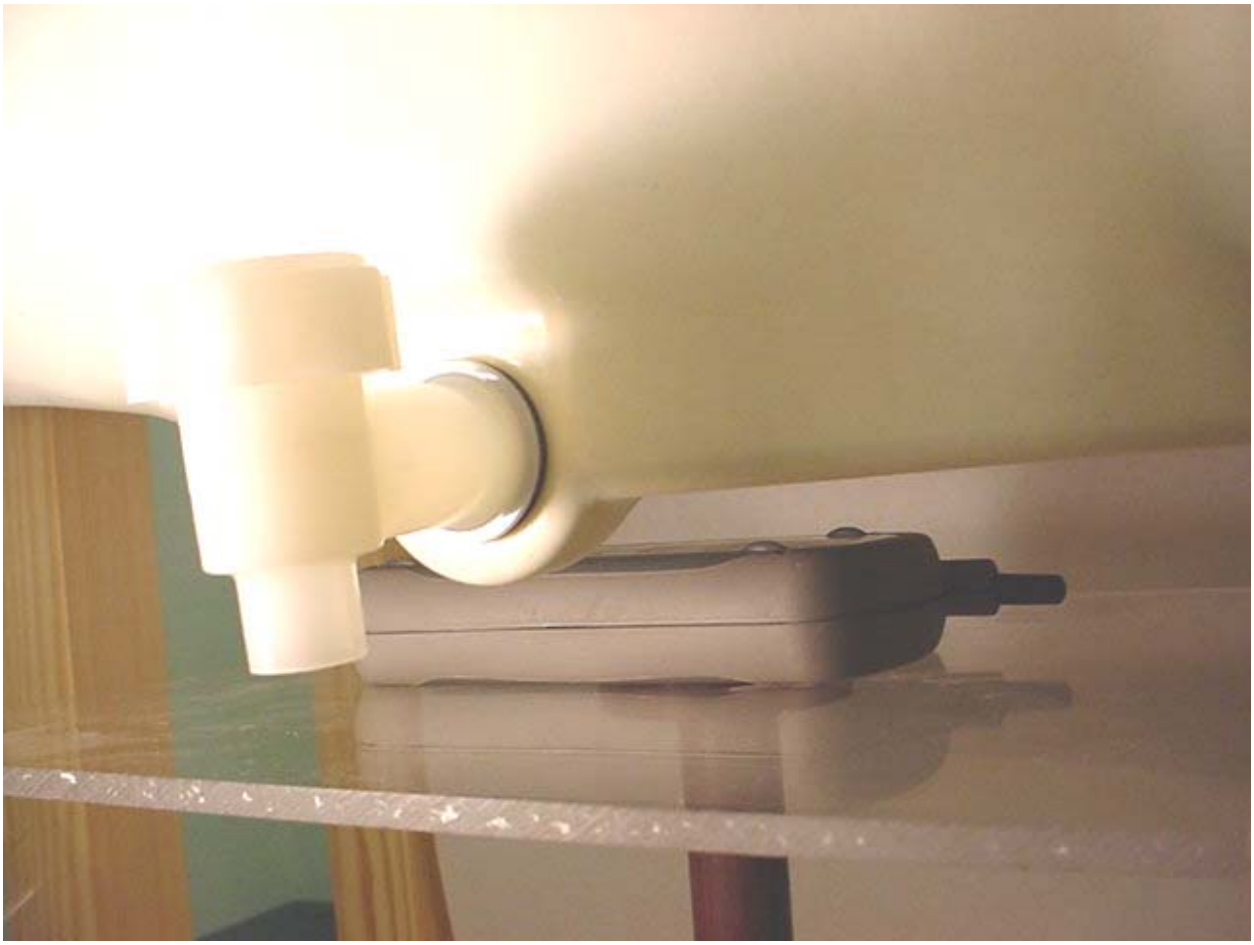
The following FCC limits for SAR apply to devices operate in General Population/Uncontrolled Exposure environment:

| **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 |

2.2 Configuration Photographs

**SAR measurement Test Setup**

**Back Side 15 mm from Phantom**



2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**Back Side 15 mm from Phantom**

2.2 Configuration Photographs (Continued)

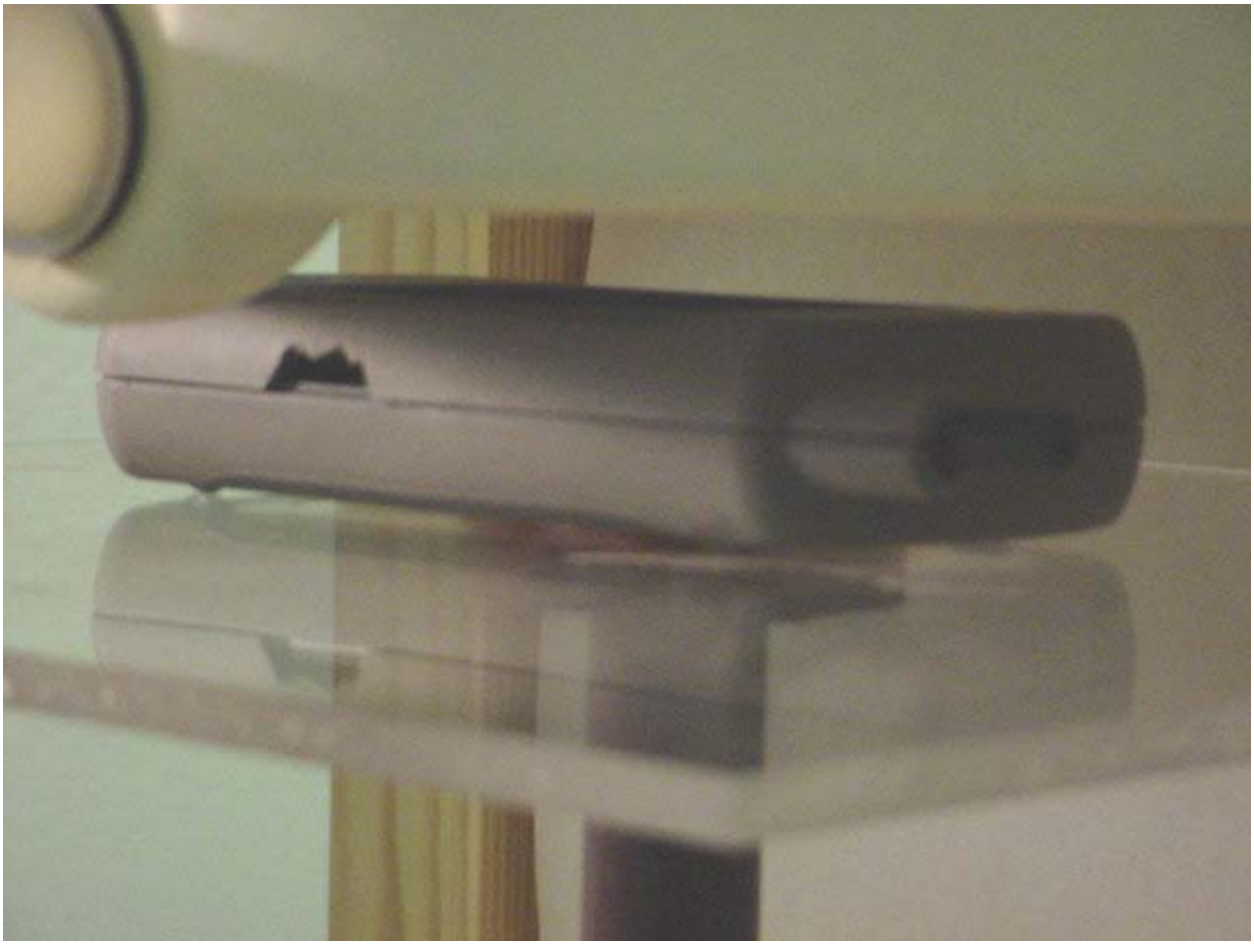
**SAR measurement Test Setup**

**Front Side 15 mm from Phantom**

2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**Front Side 15 mm from Phantom**



2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

2.2 Configuration Photographs (Continued)

**SAR measurement Test Setup**

**EUT Photo**

## 2.3 System Verification

Prior to the assessment, the system was verified to the ±10% of the specifications by using the system validation kit. The validation was performed at 900 MHz. & 1800 MHz.

| Validation kit | Targeted $SAR_{1g}$ (mW/g) | Measured $SAR_{1g}$ (mW/g) | Plot Number |
|---|---|---|---|
| D900V2 | 2.65 | 2.74 | 13 |
| D1800V2 | 9.45 | 10.1 | 14 |

## 2.4 Evaluation Procedures

The SAR evaluation was performed with the following procedures:

a. SAR was measured at a fixed location above the reference point and used as a reference value for the assessing the power drop.

b. The SAR distribution at the exposed side of the flat Phantom was measured at a distance of 30 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20 mm x 20 mm. Based on this data, the area of the maximum absorption was determined by spline interpolation.

c. 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 with the following procedure:

   i) 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 measurement point is 1.6 mm. The extrapolation was based on a least square algorithm. 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.

   ii) The maximum interpolated value was searched with a straightforward algorithm. Around this maximum, the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 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 the trapezoidal algorithm. 1000 points (10 x 10 x 10) were interpolated to calculate the average.

   iii) All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

d. Re-measurements of the SAR value at the same location as in step a. above. If the value changed by more than 5 %, the evaluation was repeated.

## 2.5 Test Results

The results on the following page(s) were obtained when the device was tested in the condition described in this report. Detail measurement data and plots, which reveal information about the location of the maximum SAR with respect to the device, are reported in Appendix A.

## Measurement Results

| **Trade Name:** | CardioNet | **Model No.:** | CardioNet Monitor |
|---|---|---|---|
| **Serial No.:** | Not Labeled | **Test Engineer:** | Suresh Kondapalli |

| **TEST CONDITIONS** | | | |
|---|---|---|---|
| Ambient Temperature | 23.5 °C | Relative Humidity | 55 % |
| Test Signal Source | Test Mode | Signal Modulation | CDMA |
| Output Power Before SAR Test | See Page 8 | Output Power After SAR Test | Within –0.32 to 0.12 dB |
| Test Duration | 20 Min. each test | Number of Battery Change | New battery for each scan |

**Position - 15 mm from Phantom**

| **Frequency MHz** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Position 15 mm From Phantom** | **Plot Number** |
|---|---|---|---|---|---|
| 824 | CDMA | 1 | 0.634 | Front Side | 1 |
| 824 | CDMA | 1 | 0.746 | Back Side | 2 |
| 835 | CDMA | 1 | 0.890 | Front Side | 3 |
| 835 | CDMA | 1 | 1.070 | Back Side | 4 |
| 849 | CDMA | 1 | 0.547 | Front Side | 5 |
| 849 | CDMA | 1 | 0.651 | Back Side | 6 |
| 1850 | CDMA | 1 | 0.132 | Front Side | 9 |
| 1850 | CDMA | 1 | 0.124 | Back Side | 10 |
| 1880 | CDMA | 1 | 0.116 | Front Side | 11 |
| 1880 | CDMA | 1 | 0.094 | Back Side | 12 |
| 1910 | CDMA | 1 | 0.102 | Front Side | 13 |
| 1910 | CDMA | 1 | 0.088 | Back Side | 14 |

**D900V2**

| **Frequency MHz** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
|---|---|---|---|---|---|
| 900 | CW | 1 | 2.74 | 1.75 | 8 |

**D1800V2**

| **Frequency MHz** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
|---|---|---|---|---|---|
| 1800 | CW | 1 | 10.9 | 6.19 | 15 |

| Z-Scan | | | | | |
|---|---|---|---|---|---|
| **Frequency MHz** | **Operating Mode** | **Crest Factor** | **Measured $SAR_{1g}$ (mW/g)** | **Measured $SAR_{10g}$ (mW/g)** | **Plot Number** |
| 835 | CDMA | 1 | 1.07 | 0.804 | 7 |

Note: a) Worst case data were reported
b) Duty cycle factor included in the measured SAR data
c) Uncertainty of the system is not included

## 3.0 TEST EQUIPMENT

### 3.1 Equipment List

The Specific Absorption Rate (SAR) tests were performed with the SPEAG model DASY 3 automated near-field scanning system, which is a package, optimized for dosimetric evaluation of mobile radios [3].

The following major equipment/components were used for the SAR evaluations:

| SAR Measurement System | | | |
|---|---|---|---|
| **EQUIPMENT** | **SPECIFICATIONS** | **S/N #** | **Last Cal. Data** |
| **Robot** | **Stäubi RX60L** | 597412-01 | N/A |
| | Repeatability: ± 0.025mm<br>Accuracy: $0.806 \times 10^{-3}$ degree<br>Number of Axes: 6 | | |
| **E-Field Probe** | **ER3DV4R** | 1576 | 2/27/02 * |
| | Dynamic Range: 5 µW/g to >100 mW/g<br>Tip diameter: 6.8 mm<br>Probe Linearity: ± 0.2 dB (30 MHz to 3 GHz)<br>Axial isotropy: ± 0.2 dB<br>Spherical isotropy: ± 0.4 dB<br>Length: 34.5 cm<br>Distance between the probe tip and the dipole center: 2.7 mm<br>Calibration: 835/900 MHz and 1800/1900 MHz for head & body simulating liquid | | |
| **Data Acquisition** | **DAE3** | 317 | N/A |
| | Measurement Range: 1µV to >200mV<br>Input offset Voltage: < 1µV (with auto zero)<br>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<br>Shell Material: Fiberglass<br>Thickness: 2 ± 0.2 mm<br>Capacity: 20 liter<br>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 |
| **Simulated Tissue** | **Mixture** | N/A | 3/10/03 |
| | Please see section 6.2 for details | | |
| **Power Meter** | **HP 8900D** w/ 84811A sensor | 3607U00673 | 08/27/02 |
| | Frequency Range: 100kHz to 18 GHz<br>Power Range: 300µW to 3W | | |

* See Note on the next page.

Note:
At the time of the test, the calibration interval of the probe was longer than one year. To verify that its calibration remained within acceptable limits, the test results with the Probe Serial #1576 were compared with test results with the Probe Serial # 1577 on April 25, 2003, having last calibration date of February 5, 2003.

Another device was tested on April 22, 2003 at ITS using Probe #1576 and at another test Laboratory (CCS, Compliance Certification Services) using Probe #1577 on April 25,2003. The comparison of the results indicates that SAR readings are with the overall measurement uncertainty requirements of IEEE Standard 1528-200X. The comparison of the results obtained with two probes is below:

| SAR mW/g Measured with Probe # 1576 (ITS) | SAR mW/g Measured with Probe # 1577 (CCS) | Variance |
|---|---|---|
| 0.326 | 0.280 | +16.4% |
| 0.183 | 0.197 | -7.1% |
| 0.245 | 0.239 | +2.5% |

Additionally, the system validation, performed with the Dipoles at the time of Cardionet Monitor testing was within 10% of the target values (in particular: +8.6% for 900 MHz, and +0.5% for 1800 MHz).

Based on this information, we can conclude that the conversion factors for Probe # 1576 are still within the tolerance (± 8.9%) and the test results for Cardionet Monitor are valid.

3.2 Muscle Tissue Simulating Liquid

| **Muscle Ingredients Frequency (835 MHz)** | |
|---|---|
| Sugar | 41.76% |
| HEC | 1.21% |
| Water | 56.0% |
| Bactericide | 0.27% |
| Salt | 0.76% |

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

| **Frequency (MHz)** | **$\varepsilon_r$ *** | **$\sigma$ *(mho/m)** | **$\rho$ **(kg/m$^3$)** |
|---|---|---|---|
| 835 | 53.2 | 0.98 | 1000 |

* *Worst case uncertainty of the HP 85070A dielectric probe kit*
** *Worst-case assumption*

| **Muscle Ingredients Frequency (1800 MHz)** | |
|---|---|
| Water | 52.90 % |
| Salt | 0.181% |
| DGBE Diethylene Glycol | 44.92% |
| ton X-100 (Polyethylene Glycol Mono) Ether | 0.1 % |

The dielectric parameters were verified prior to assessment using the HP 85070A dielectric probe kit and the HP 8753C network Analyzer. The dielectric parameters were:

| **Frequency (MHz)** | **$\varepsilon_r$*** | **$\sigma$ *(mho/m)** | **$\rho$ **(kg/m$^3$)** |
|---|---|---|---|
| 1800 | 55.8 | 1.49 | 1000 |

* *Worst case uncertainty of the HP 85070A dielectric probe kit*
** *Worst-case assumption*

3.3 E-Field Probe Calibration

The manufacturer in the TEM cell ifi 110 calibrated probes. To ensure consistency, a strict protocol was followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution was performed by comparison with temperature measurement and computer simulations. Probe calibration factors are included in Appendix B.

3.4 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 27.8 %

| **Uncertainty Component** | **Tolerance (± %)** | **Probability Distribution** | **Divisor** | $c_i$ | **Standard Uncertainty, (± %)** | $v_i^2$ **or** $v_{eff}$ |
|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | |
| Probe Calibration | 4.7 | Normal | 1 | 1 | 4.7 | Inf. |
| Axial Isotropy | 4.7 | Rectangular | √3 | $(1\text{-}cp)^{1/2}$ | 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 | 4.0 | Inf. |
| **Phantom and Tissue Parameters** | | | | | | |
| Phantom Uncertainty (shape and thickness tolerances) | 4.0 | Rectangular | √3 | 1 | 2.3 | Inf. |
| Liquid Conductivity Target tolerance | 5.0 | Rectangular | √3 | 0.6 | 1.7 | Inf. |
| Liquid Conductivity - measurement uncertainty | 10.0 | Rectangular | √3 | 0.6 | 3.5 | Inf. |
| Liquid Permittivity Target tolerance | 5.0 | Rectangular | √3 | 0.6 | 1.7 | Inf. |
| Liquid Permittivity - measurement uncertainty | 5.0 | Rectangular | √3 | 0.6 | 1.7 | Inf. |
| **Combined Standard Uncertainty** | | | | | 13.9 | |
| **Expanded Uncertainty** (95% CONFIDENCE INTERVAL) | | | | | 27.8 | |

Notes.

1. The Divisor is a function of the probability distribution and degrees of freedom ($\nu_i$ and $\nu_{eff}$). 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.

## 3.5 Measurement Tractability

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

## 4.0 WARNING LABEL INFORMATION - USA

See users manual.

## 5.0 REFERENCES

1] ANSI, *ANSI/IEEE C95.1-1991: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300 GHz*, The Institute of electrical and Electronics Engineers, Inc., New York, NY CardioNet Monitor7, 1992

[2] 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] Thomas Schmid, Oliver Egger, and Niels Kuster, "Automated E-field scanning system for dosimetric assessments", *IEEE Transaction on Microwave Theory and Techniques*, vol. 44, pp. 105-113, Jan. 1996.

[4] Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetic evaluation of mobile communications equipment with know precision", IEICE Transactions on Communications, vol. E80-B, no. 5, pp.645-652, May 1997.

5] NIS81, NAMAS, "The treatment of uncertainty in EMC measurement", Tech. Rep., NAMAS Executive, National Physical Laboratory, Teddinton, Middlesex, England, 1994.

6] Barry N. Tayor and Chris E. Kuyatt, "Guidelines for evaluating and expressing the uncertainty of NIST measurement results", Tech. Rep., National Institute of Standards and Technology, 1994.

## 6.0 DOCUMENT HISTORY

| Revision/ Job Number | Writer Initials | Date | Change |
|---|---|---|---|
| 1.0 /3038816 | SS | March 25, 2003 | Original document |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**APPENDIX A - SAR Evaluation Data**

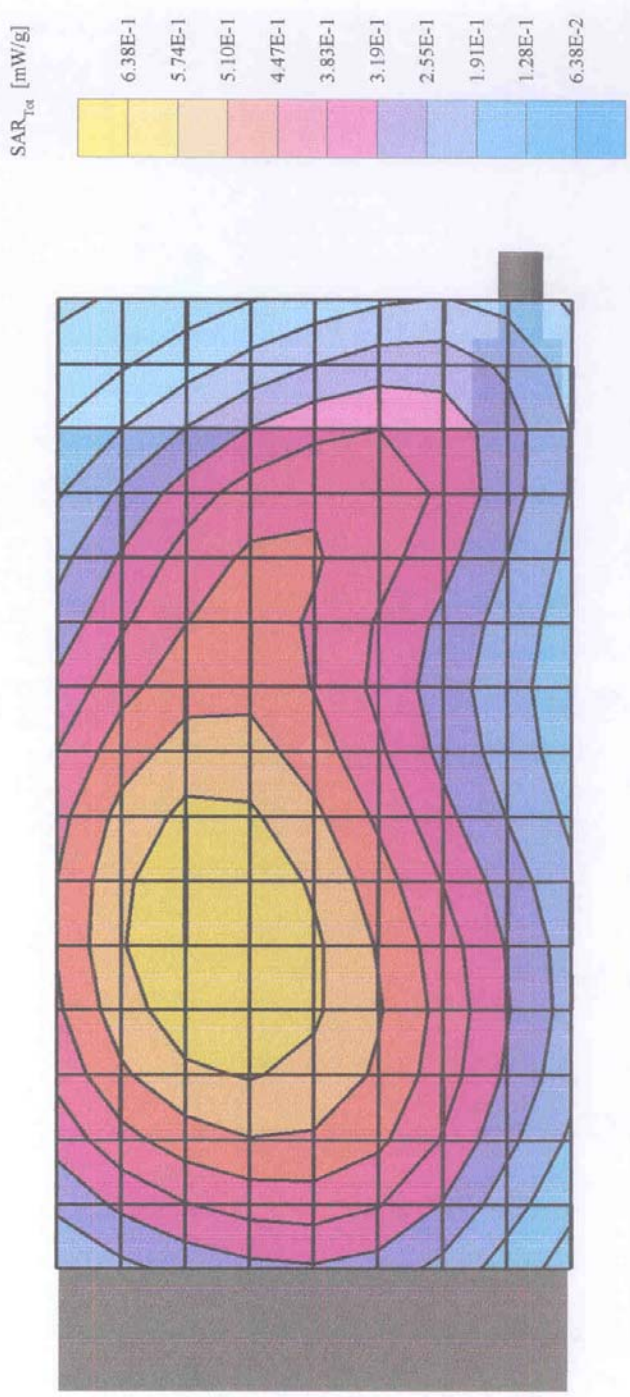
Please note that the graphical visualization of the phone position onto the SAR distribution gives only limited information on the current distribution of the device, since the curvature of the head results in graphical distortion. Full information can only be obtained either by H-field scans in free space or SAR evaluation with a flat phantom.

**Power drift** is the measurement of power drift of the device over one complete SAR scan.

03/10/03

CadioNet Monitor CDMA

SAM Phantom; Flat Section; Frequency: 824 MHz; Amb Temp: 22.5C; Liquid Temp: 20.5C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: $\sigma$ = 0.98 mho/m $\varepsilon_r$ = 55.2 $\rho$ = 1.00 g/cm$^3$
Cube 5x5x7: SAR (1g): 0.634 mW/g, SAR (10g): 0.477 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.01 dB, Front Side 15mm from Phantom

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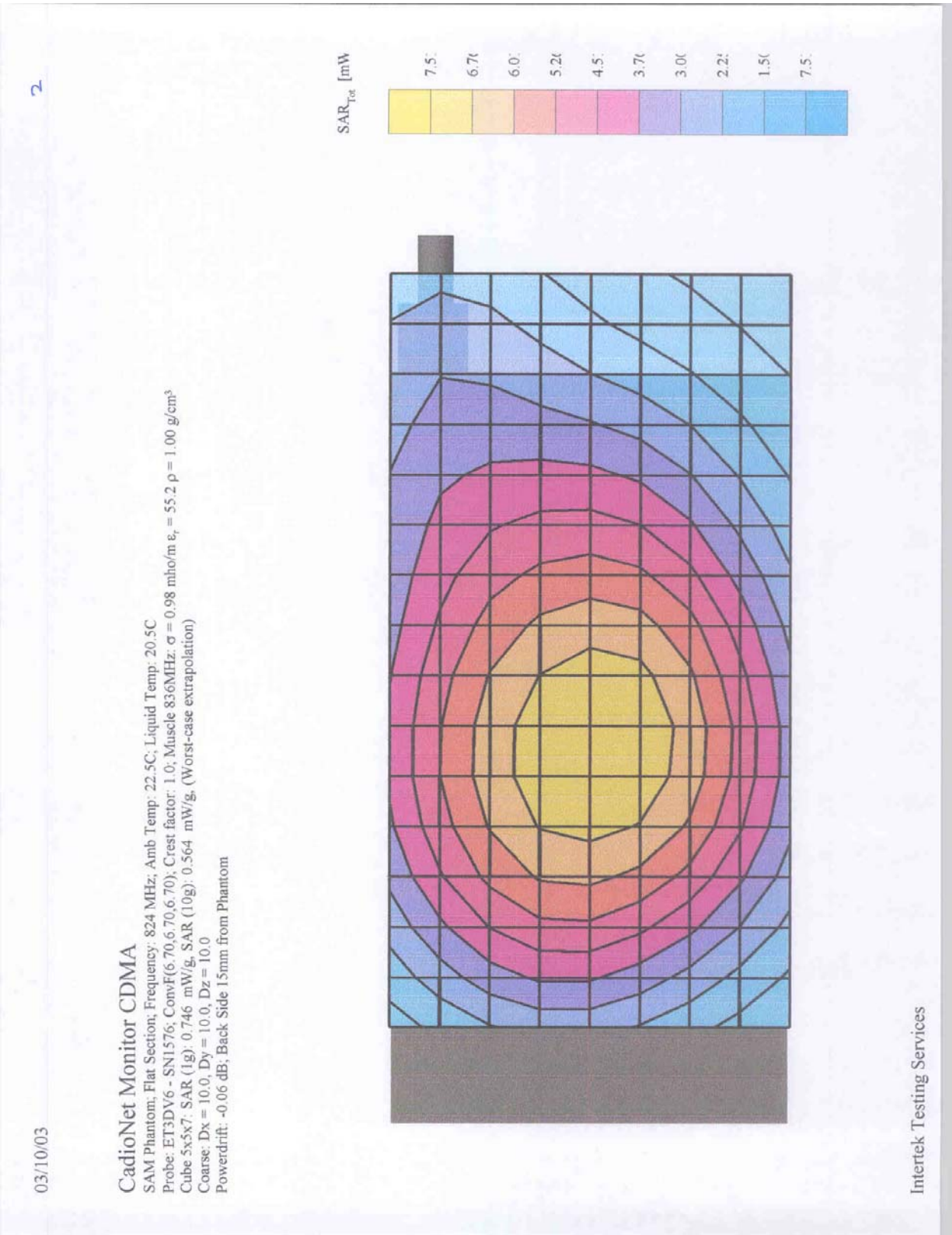
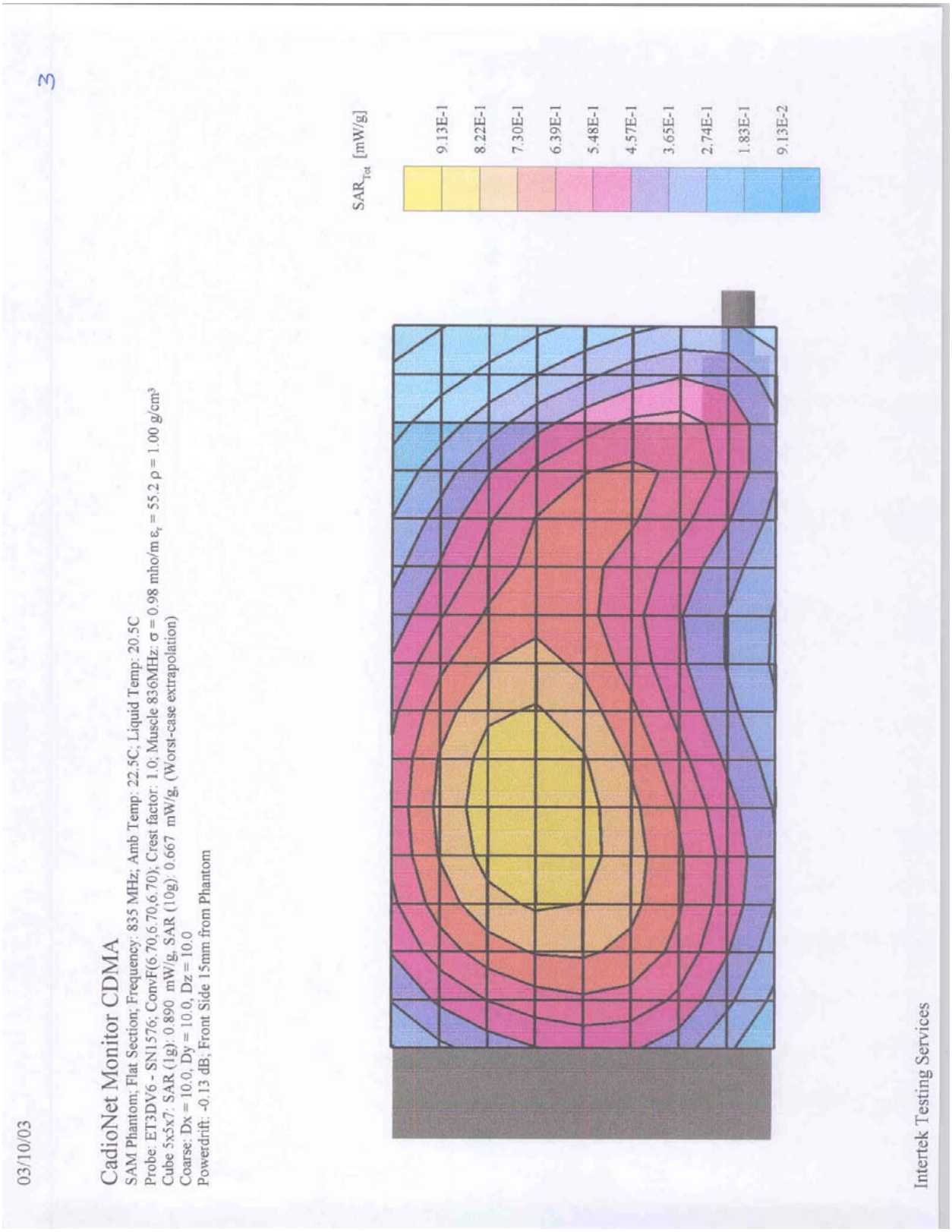
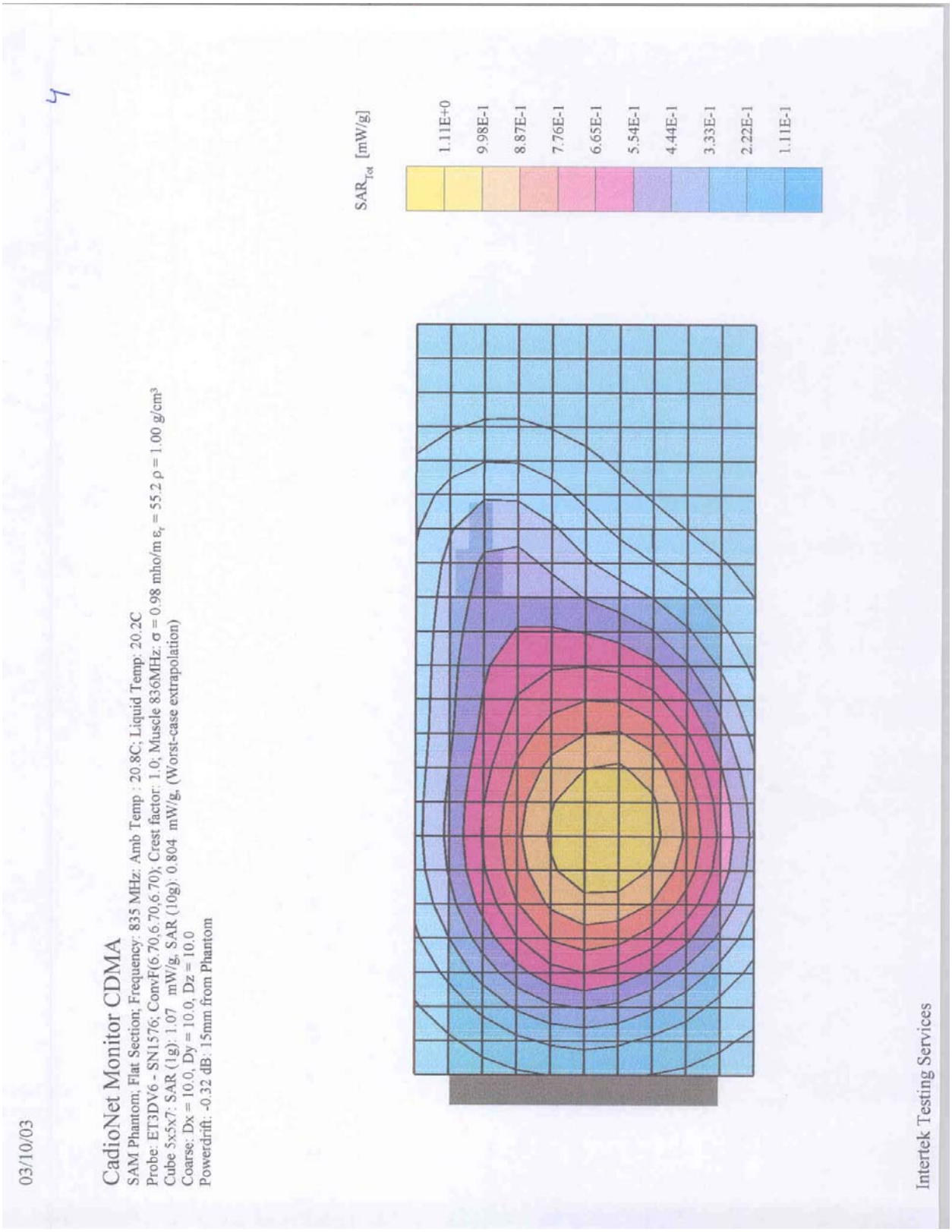
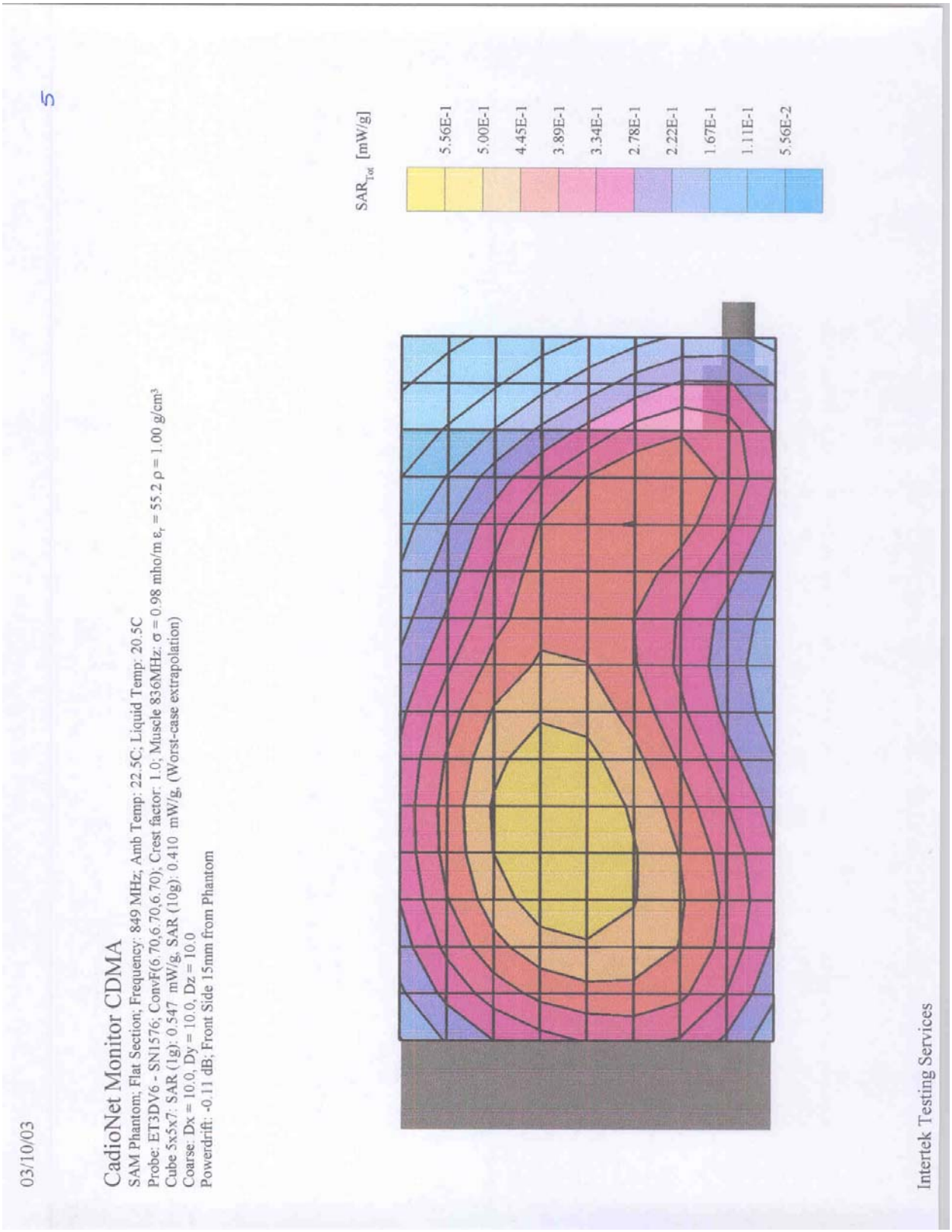
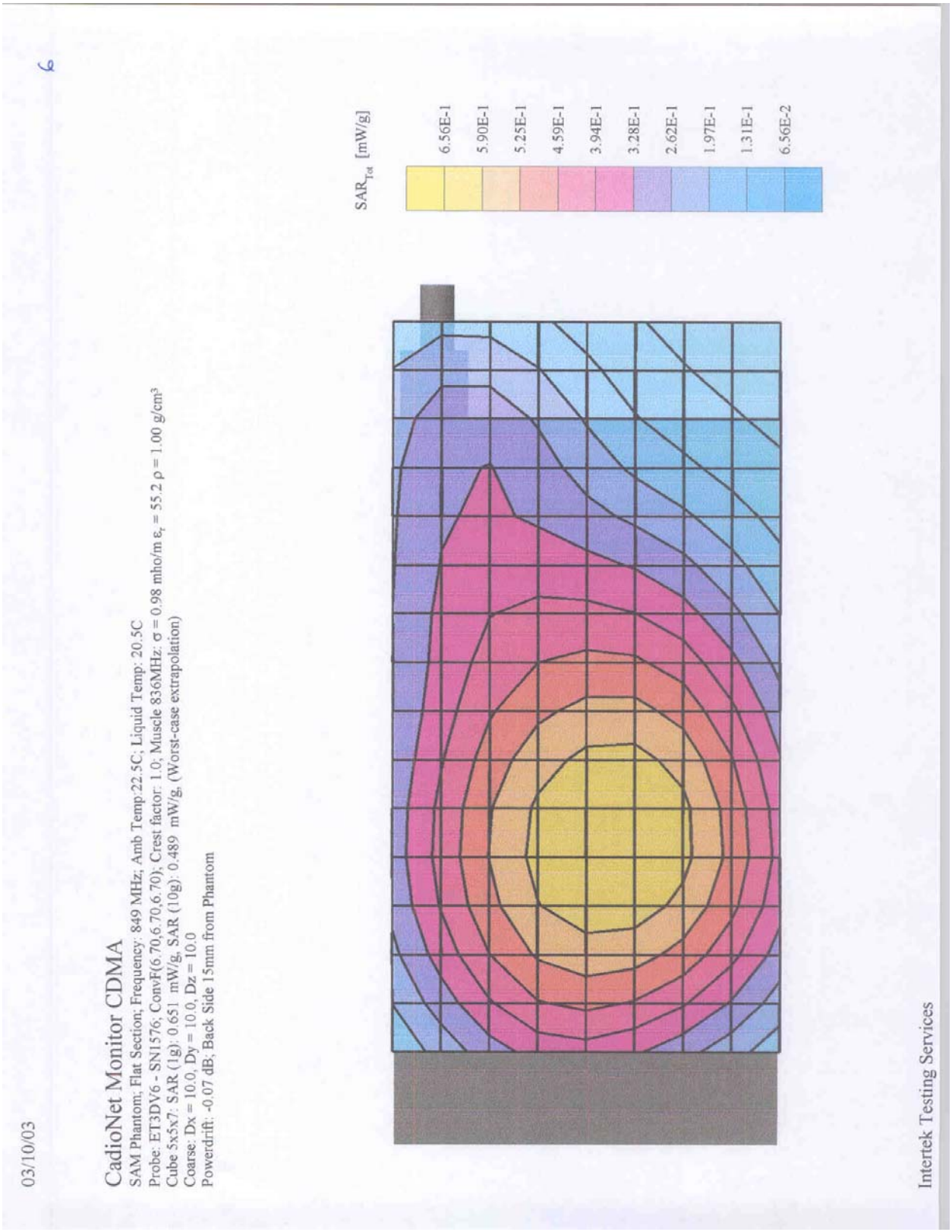

2
03/10/03
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 824 MHz; Amb Temp: 22.5C; Liquid Temp: 20.5C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: σ = 0.98 mho/m εr = 55.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.746 mW/g, SAR (10g): 0.564 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.06 dB; Back Side 15mm from Phantom
SARTot [mW
7.5
6.7
6.0
5.2
4.5
3.7
3.0
2.2
1.5
7.5
Intertek Testing Services


03/10/03
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 835 MHz; Amb Temp: 22.5C; Liquid Temp: 20.5C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: σ = 0.98 mho/m εr = 55.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.890 mW/g, SAR (10g): 0.667 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.13 dB; Front Side 15mm from Phantom
SARTot [mW/g]
9.13E-1
8.22E-1
7.30E-1
6.39E-1
5.48E-1
4.57E-1
3.65E-1
2.74E-1
1.83E-1
9.13E-2
Intertek Testing Services


03/10/03
4
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 835 MHz; Amb Temp : 20.8C; Liquid Temp: 20.2C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: σ = 0.98 mho/m εr = 55.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 1.07 mW/g, SAR (10g): 0.804 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.32 dB; 15mm from Phantom
SARTot [mW/g]
1.11E+0
9.98E-1
8.87E-1
7.76E-1
6.65E-1
5.54E-1
4.44E-1
3.33E-1
2.22E-1
1.11E-1
Intertek Testing Services


03/10/03
5
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 849 MHz; Amb Temp: 22.5C; Liquid Temp: 20.5C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: σ = 0.98 mho/m εr = 55.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.547 mW/g, SAR (10g): 0.410 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.11 dB; Front Side 15mm from Phantom
SARTot [mW/g]
5.56E-1
5.00E-1
4.45E-1
3.89E-1
3.34E-1
2.78E-1
2.22E-1
1.67E-1
1.11E-1
5.56E-2
Intertek Testing Services


03/10/03
6
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 849 MHz; Amb Temp:22.5C; Liquid Temp: 20.5C
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: σ = 0.98 mho/m εr = 55.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.651 mW/g, SAR (10g): 0.489 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.07 dB; Back Side 15mm from Phantom
SARTot [mW/g]
6.56E-1
5.90E-1
5.25E-1
4.59E-1
3.94E-1
3.28E-1
2.62E-1
1.97E-1
1.31E-1
6.56E-2
Intertek Testing Services

03/10/03

7

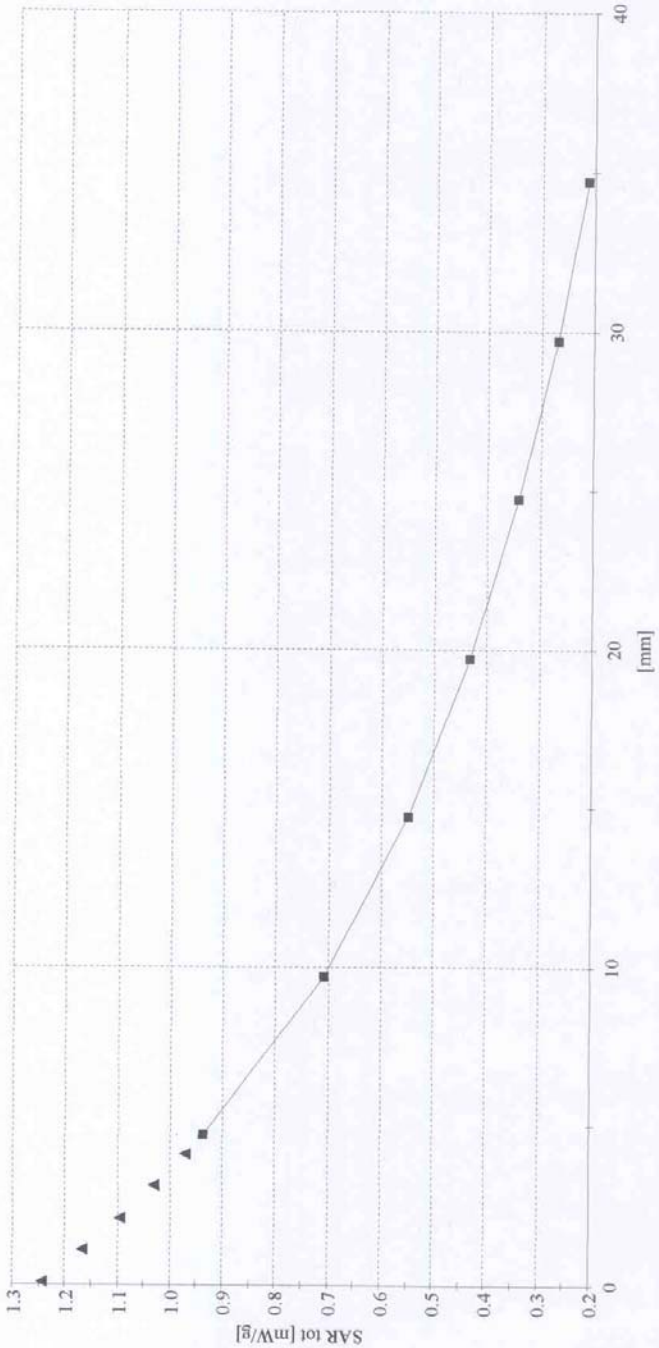
CadioNet Monitor CDMA

SAM Phantom; Flat Section; Frequency: 835 MHz

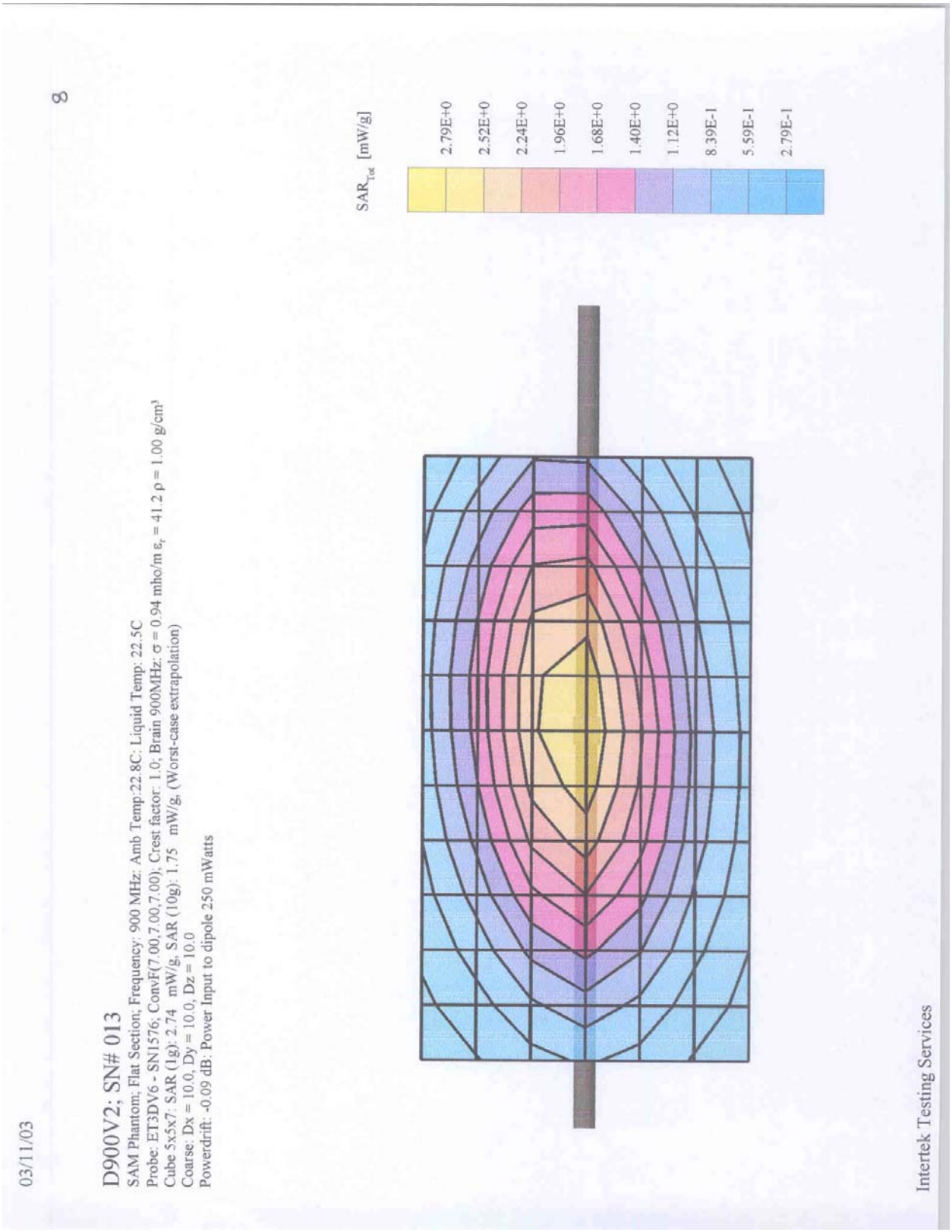
Probe: ET3DV6 - SN1576; ConvF(6.70,6.70,6.70); Crest factor: 1.0; Muscle 836MHz: $\sigma = 0.98$ mho/m $\varepsilon_r = 55.2$ $\rho = 1.00$ g/cm$^3$

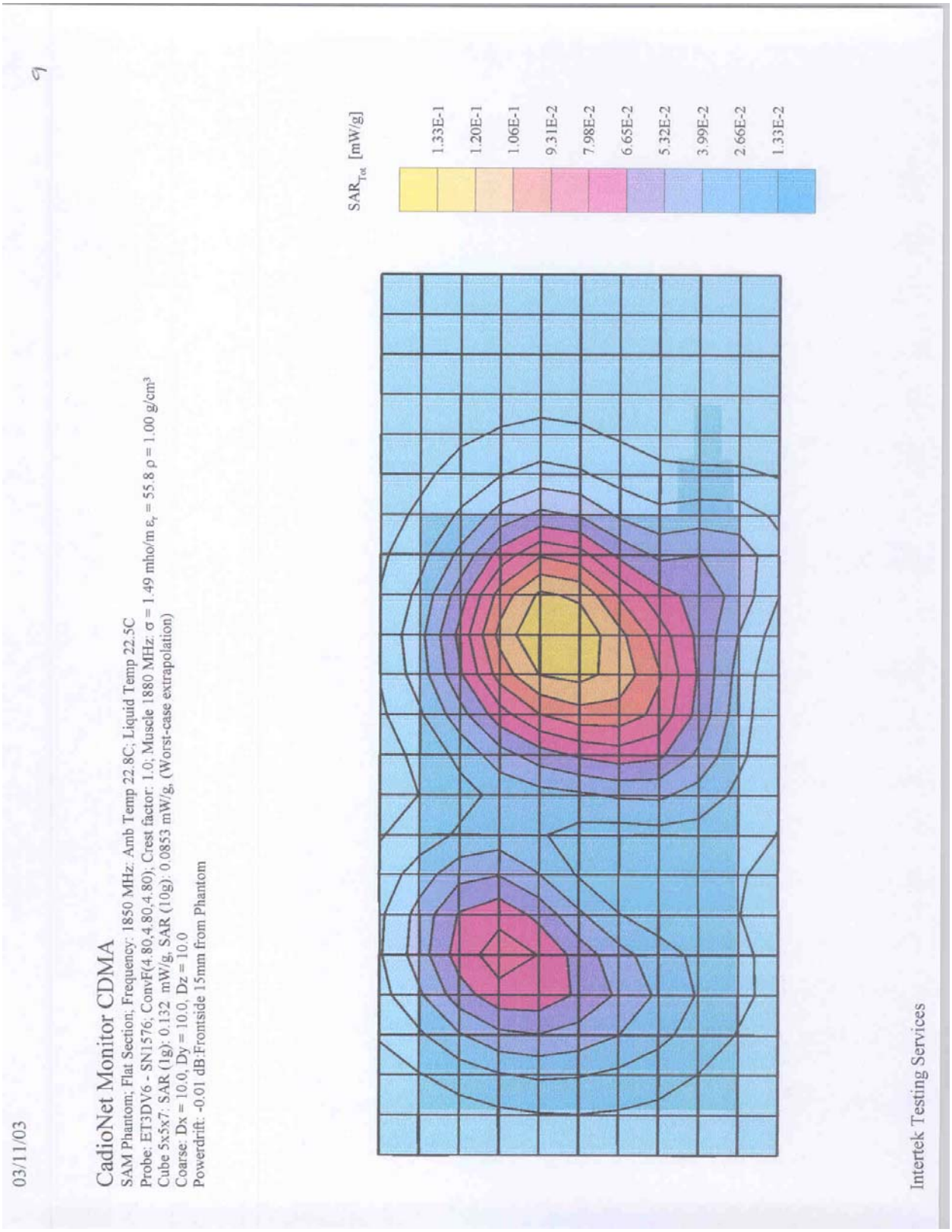
Cube 5x5x7: SAR (1g): 1.07 mW/g, SAR (10g): 0.804 mW/g, (Worst-case extrapolation)

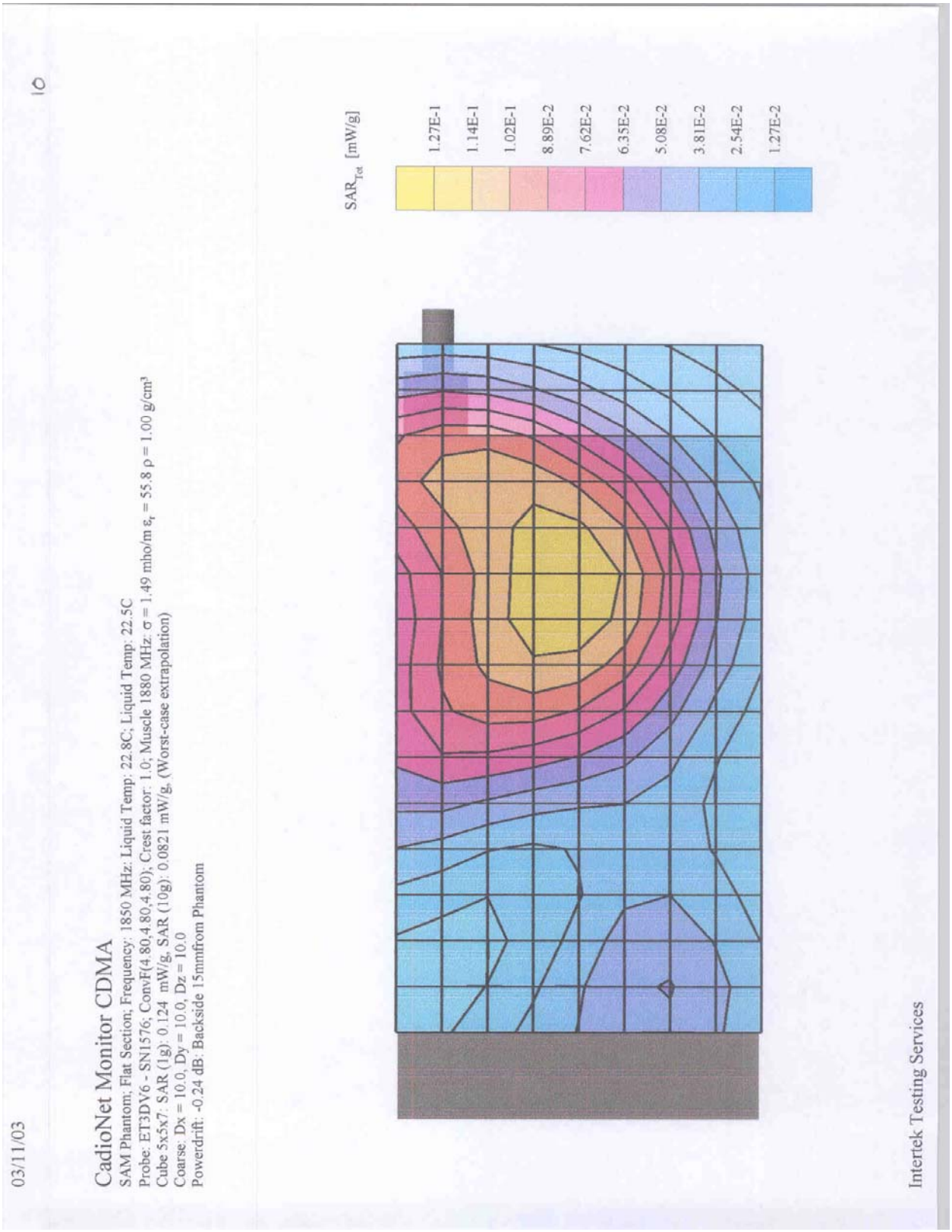
Cube 5x5x7: Dx = 8.0, Dy = 8.0, Dz = 5.0

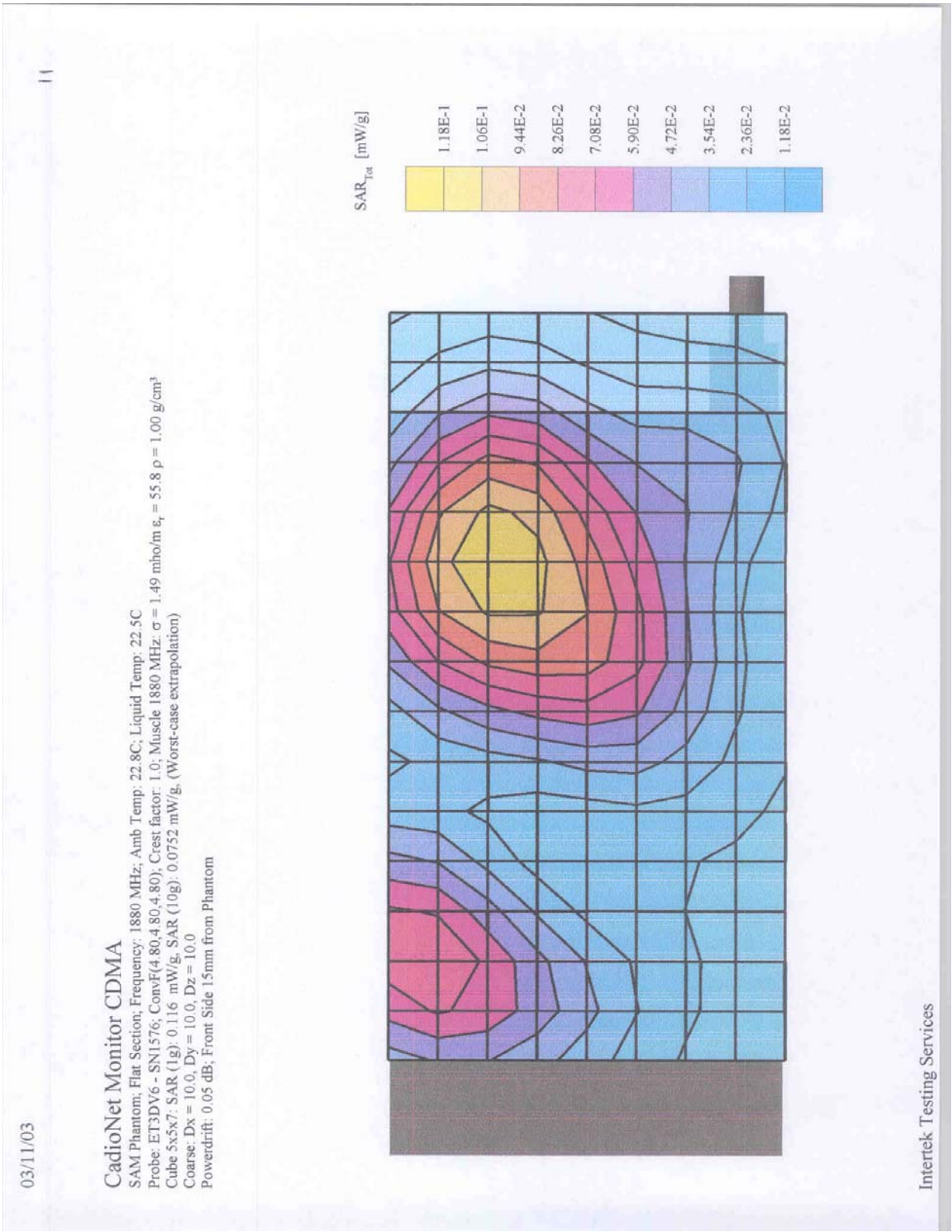



Intertek Testing Services


03/11/03
8
D900V2; SN# 013
SAM Phantom; Flat Section; Frequency: 900 MHz; Amb Temp:22.8C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(7.00,7.00,7.00); Crest factor: 1.0; Brain 900MHz: σ = 0.94 mho/m εr = 41.2 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 2.74 mW/g, SAR (10g): 1.75 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.09 dB; Power Input to dipole 250 mWatts
SARTot [mW/g]
2.79E+0
2.52E+0
2.24E+0
1.96E+0
1.68E+0
1.40E+0
1.12E+0
8.39E-1
5.59E-1
2.79E-1
Intertek Testing Services


03/11/03
9
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 1850 MHz; Amb Temp 22.8C; Liquid Temp 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: σ = 1.49 mho/m εr = 55.8 ρ = 1.00 g/cm3
Cube 5x5x7: SAR (1g): 0.132 mW/g, SAR (10g): 0.0853 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.01 dB;Frontside 15mm from Phantom
SARTot [mW/g]
1.33E-1
1.20E-1
1.06E-1
9.31E-2
7.98E-2
6.65E-2
5.32E-2
3.99E-2
2.66E-2
1.33E-2
Intertek Testing Services


03/11/03
10
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 1850 MHz; Liquid Temp: 22.8C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: σ = 1.49 mho/m εr = 55.8 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.124 mW/g, SAR (10g): 0.0821 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.24 dB; Backside 15mmfrom Phantom
SARTot [mW/g]
1.27E-1
1.14E-1
1.02E-1
8.89E-2
7.62E-2
6.35E-2
5.08E-2
3.81E-2
2.54E-2
1.27E-2
Intertek Testing Services

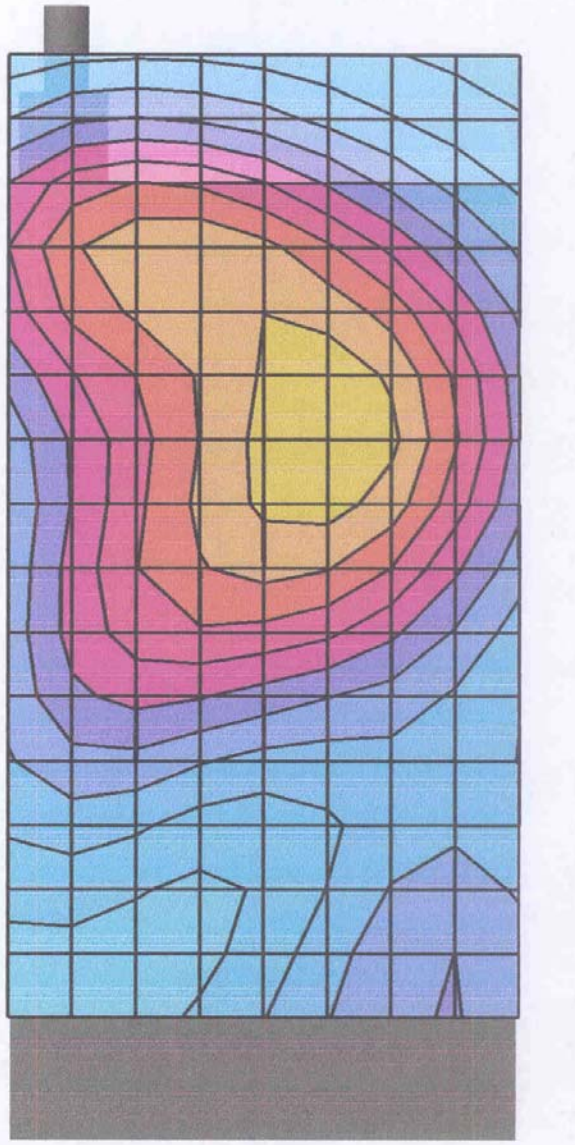

03/11/03
11
CadioNet Monitor CDMA
SAM Phantom; Flat Section; Frequency: 1880 MHz; Amb Temp: 22.8C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: σ = 1.49 mho/m εr = 55.8 ρ = 1.00 g/cm³
Cube 5x5x7: SAR (1g): 0.116 mW/g, SAR (10g): 0.0752 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: 0.05 dB; Front Side 15mm from Phantom
SARTot [mW/g]
1.18E-1
1.06E-1
9.44E-2
8.26E-2
7.08E-2
5.90E-2
4.72E-2
3.54E-2
2.36E-2
1.18E-2
Intertek Testing Services

03/11/03

12

CadioNet Monitor CDMA

SAM Phantom; Flat Section; Frequency: 1880 MHz; Amb Temp: 22.8C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: $\sigma$ = 1.49 mho/m $\varepsilon_r$ = 55.8 $\rho$ = 1.00 g/cm$^3$
Cube 5x5x7: SAR (1g): 0.0938 mW/g, SAR (10g): 0.0614 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.03 dB; Back Side 15mm from Phantom

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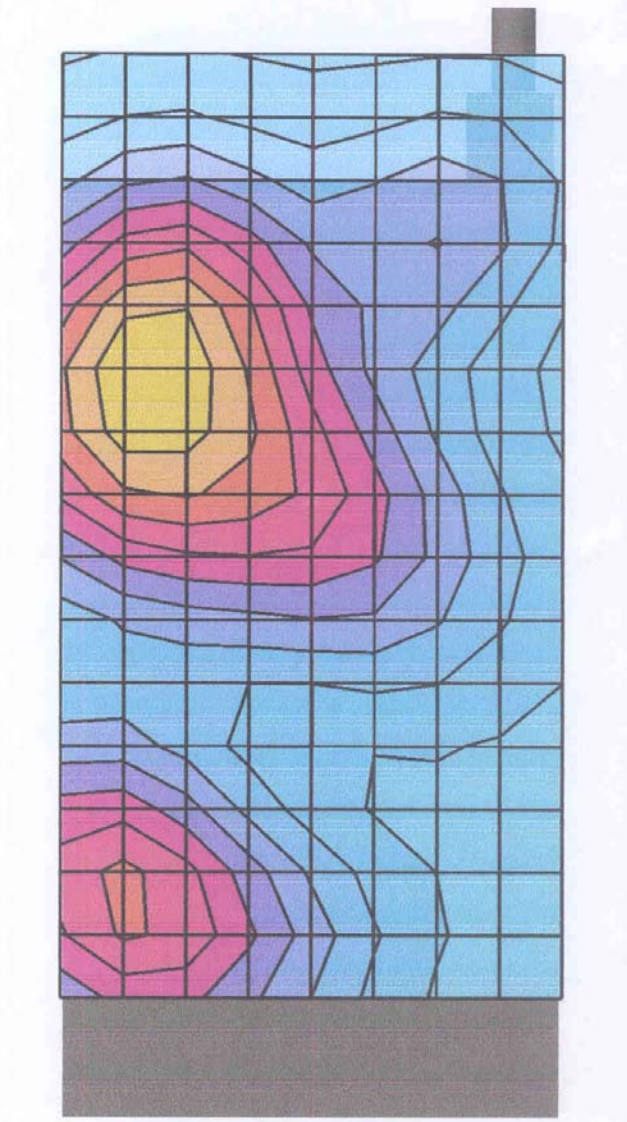
03/11/03

13

CadioNet Monitor CDMA

SAM Phantom; Flat Section; Frequency: 1910 MHz; Amb Temp: 22.8C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: $\sigma$ = 1.49 mho/m $\varepsilon_r$ = 55.8 $\rho$ = 1.00 g/cm$^3$
Cube 5x5x7: SAR (1g): 0.102 mW/g, SAR (10g): 0.0650 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.11 dB: Front side 15mm from Phantom

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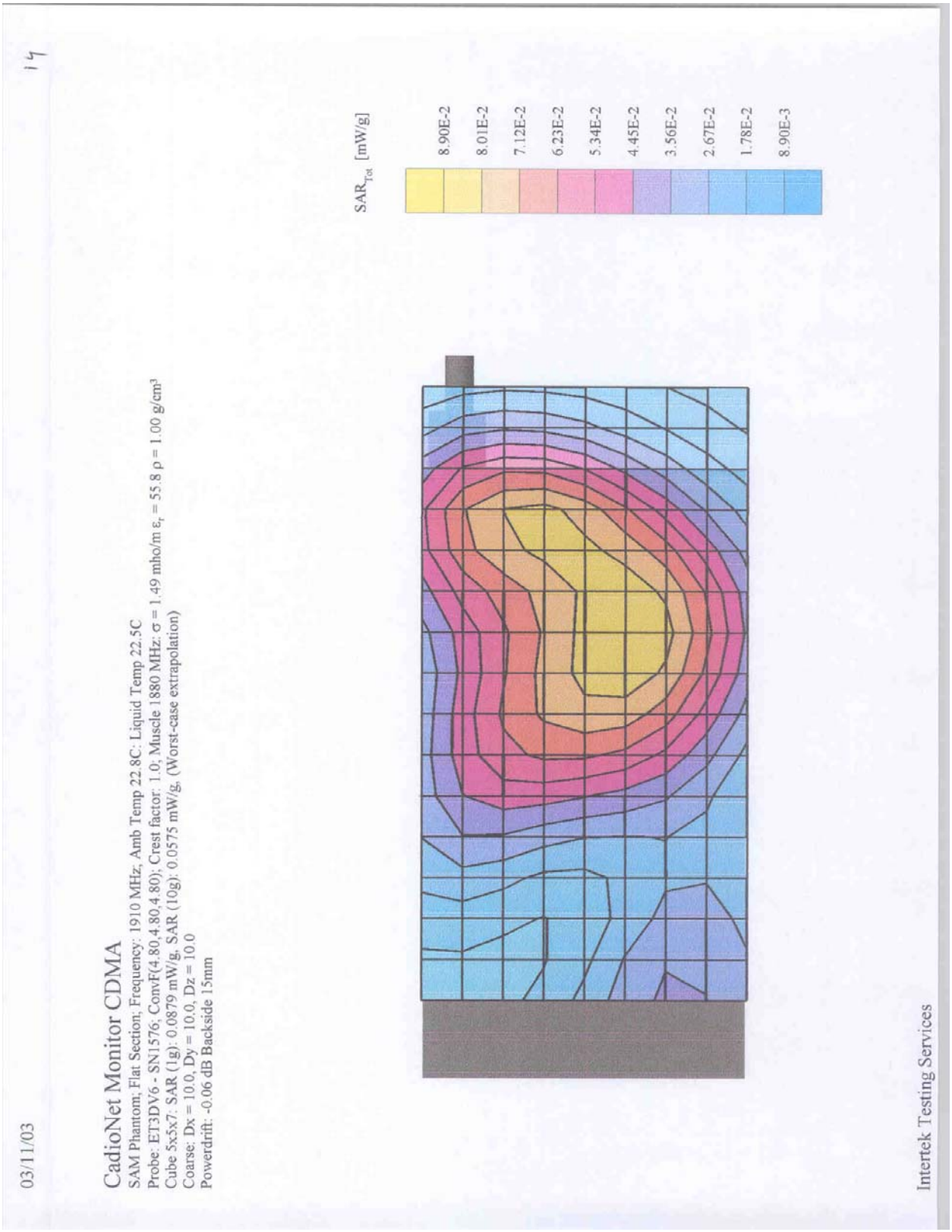
03/11/03
14
CadioNet Monitor CDMA
SAM Phantom, Flat Section, Frequency: 1910 MHz, Amb Temp 22.8C; Liquid Temp 22.5C
Probe: ET3DV6 - SN1576; ConvF(4.80,4.80,4.80); Crest factor: 1.0; Muscle 1880 MHz: σ = 1.49 mho/m εr = 55.8 ρ = 1.00 g/cm3
Cube 5x5x7: SAR (1g): 0.0879 mW/g, SAR (10g): 0.0575 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: -0.06 dB Backside 15mm
SARTot [mW/g]
8.90E-2
8.01E-2
7.12E-2
6.23E-2
5.34E-2
4.45E-2
3.56E-2
2.67E-2
1.78E-2
8.90E-3
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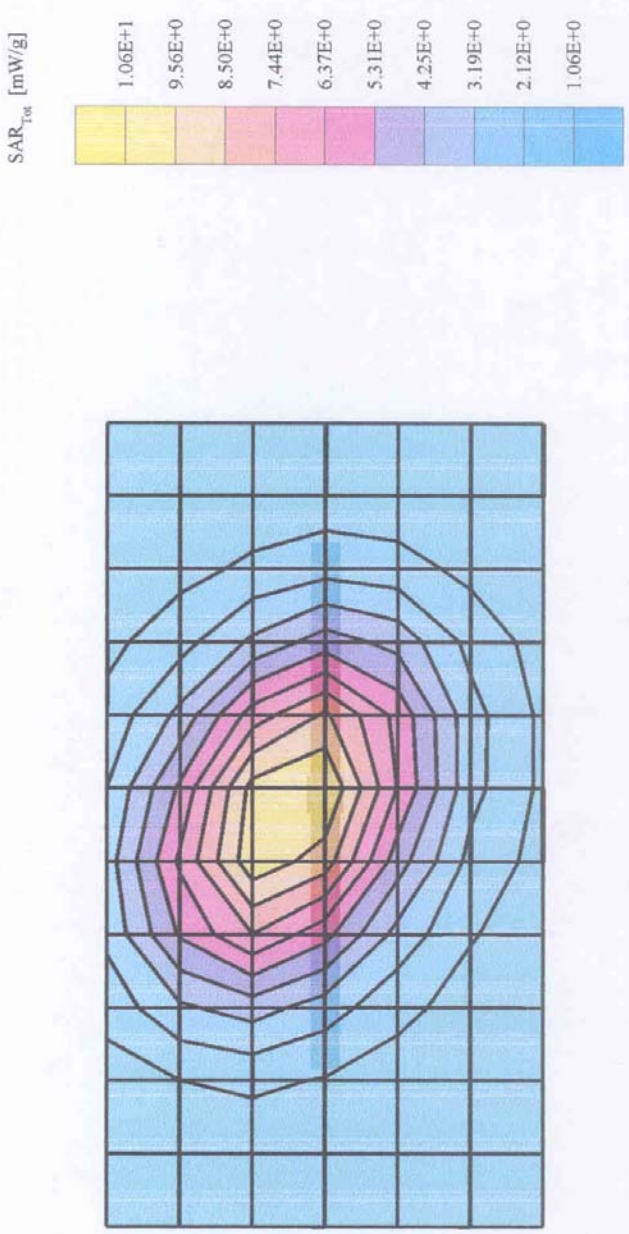
03/10/03

15

D1800V2; SN: 224

SAM Phantom; Flat Section; Frequency: 1800 MHz; Amb Temp: 23.0C; Liquid Temp: 22.5C
Probe: ET3DV6 - SN1576; ConvF(5.40,5.40,5.40); Crest factor: 1.0; Brain 1800MHz: $\sigma$ = 1.35 mho/m $\varepsilon_r$ = 40.9 $\rho$ = 1.00 g/cm$^3$
Cube 5x5x7: SAR (1g): 10.9 mW/g, SAR (10g): 6.19 mW/g, (Worst-case extrapolation)
Coarse: Dx = 10.0, Dy = 10.0, Dz = 10.0
Powerdrift: 0.12 dB; Power input to Dipole 250mWatts

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**APPENDIX B - E-Field Probe Calibration Data**

See attached.

Schmid & Partner
Engineering AG

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

# Calibration Certificate

## Dosimetric E-Field Probe

| | |
|---|---|
| Type: | **ET3DV6** |
| Serial Number: | **1576** |
| Place of Calibration: | **Zurich** |
| Date of Calibration: | **February 27, 2002** |
| 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:

Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland, Telephone +41 1 245 97 00, Fax +41 1 245 97 79

# Probe ET3DV6

## SN:1576

| | |
|---|---|
| Manufactured: | April 6, 2001 |
| Last calibration: | April 20, 2001 |
| Recalibrated: | February 27, 2002 |

Calibrated for System DASY3

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**ET3DV6 SN:1576** **February 27, 2002**

# DASY3 - Parameters of Probe: ET3DV6 SN:1576

## Sensitivity in Free Space

| | | |
|---|---|---|
| NormX | **1.77** | $\mu V/(V/m)^2$ |
| NormY | **1.81** | $\mu V/(V/m)^2$ |
| NormZ | **1.76** | $\mu V/(V/m)^2$ |

## Diode Compression

| | | |
|---|---|---|
| DCP X | **98** | mV |
| DCP Y | **98** | mV |
| DCP Z | **98** | mV |

## Sensitivity in Tissue Simulating Liquid

**Head 900 MHz** $\varepsilon_r$ **= 41.5 ± 5%** $\sigma$ **= 0.97 ± 5% mho/m**
**Head 835 MHz** $\varepsilon_r$ **= 41.5 ± 5%** $\sigma$ **= 0.90 ± 5% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **7.0** | ± 9.5% (k=2) | Boundary effect: | |
| ConvF Y | **7.0** | ± 9.5% (k=2) | Alpha | **0.30** |
| ConvF Z | **7.0** | ± 9.5% (k=2) | Depth | **2.51** |

**Head 1800 MHz** $\varepsilon_r$ **= 40.0 ± 5%** $\sigma$ **= 1.40 ± 5% mho/m**
**Head 1900 MHz** $\varepsilon_r$ **= 40.0 ± 5%** $\sigma$ **= 1.40 ± 5% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **5.4** | ± 9.5% (k=2) | Boundary effect: | |
| ConvF Y | **5.4** | ± 9.5% (k=2) | Alpha | **0.45** |
| ConvF Z | **5.4** | ± 9.5% (k=2) | Depth | **2.30** |

## Boundary Effect

**Head 900 MHz Typical SAR gradient: 5 % per mm**

| Probe Tip to Boundary | | **1 mm** | **2 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 7.6 | 4.3 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.3 | 0.5 |

**Head 1800 MHz Typical SAR gradient: 10 % per mm**

| Probe Tip to Boundary | | **1 mm** | **2 mm** |
|---|---|---|---|
| $SAR_{be}$ [%] | Without Correction Algorithm | 9.7 | 6.6 |
| $SAR_{be}$ [%] | With Correction Algorithm | 0.2 | 0.3 |

## Sensor Offset

| | | |
|---|---|---|
| Probe Tip to Sensor Center | **2.7** | mm |
| Optical Surface Detection | **1.9 ± 0.2** | mm |

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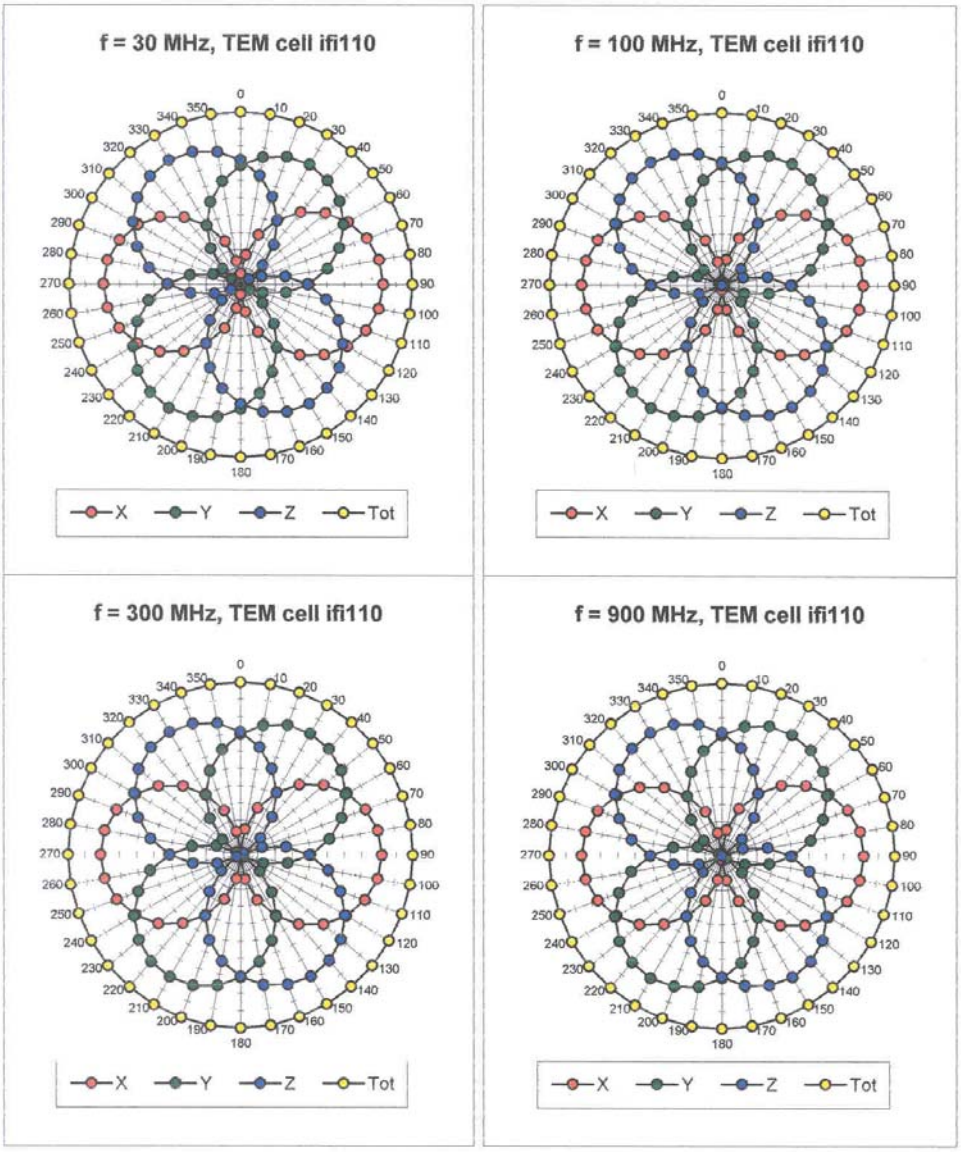
**ET3DV6 SN:1576** **February 27, 2002**

## Receiving Pattern (ϕ), θ = 0°

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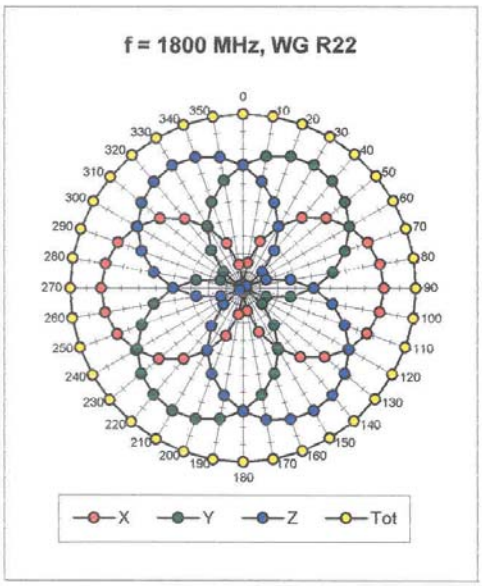
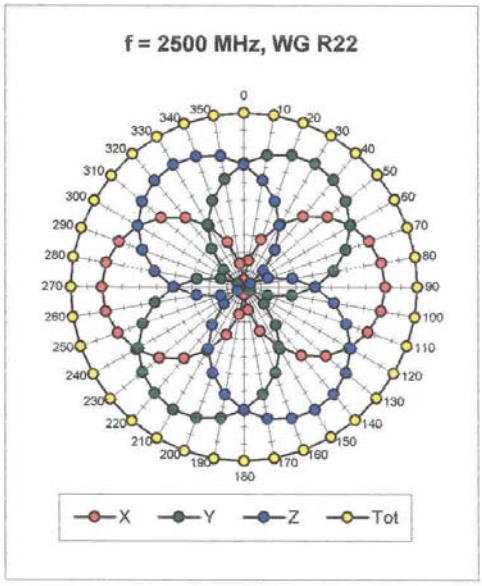
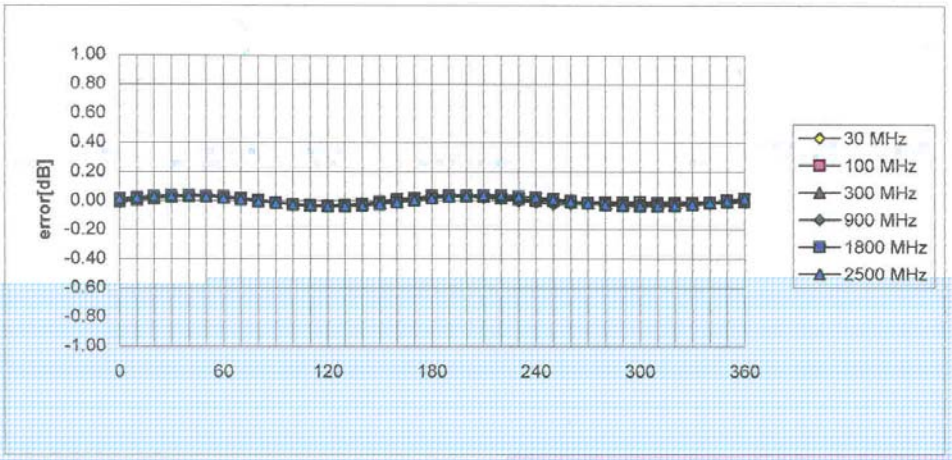
**ET3DV6 SN:1576** **February 27, 2002**




## Isotropy Error (ϕ), θ = 0°

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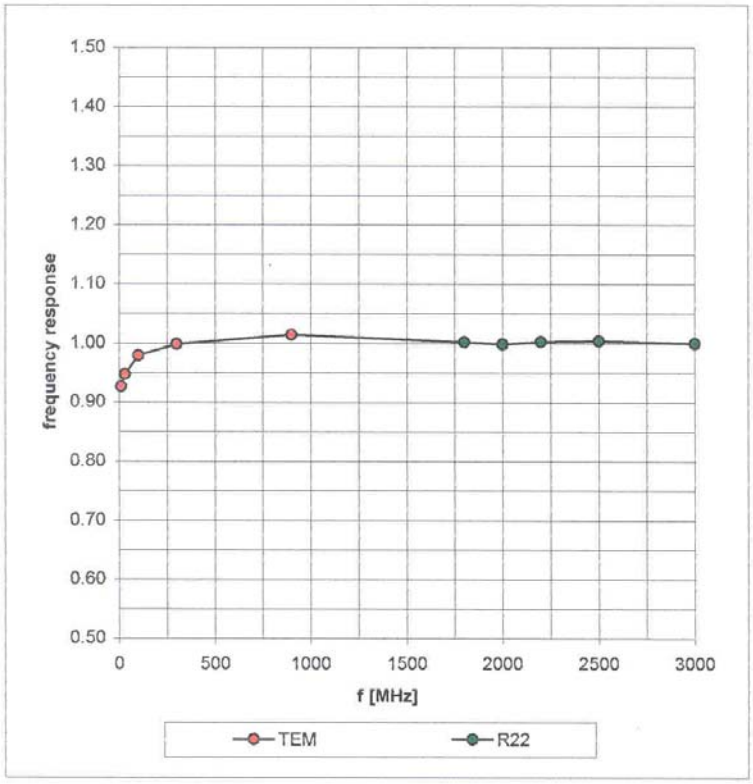
ET3DV6 SN:1576 February 27, 2002

## Frequency Response of E-Field

( TEM-Cell:ifi110, Waveguide R22)

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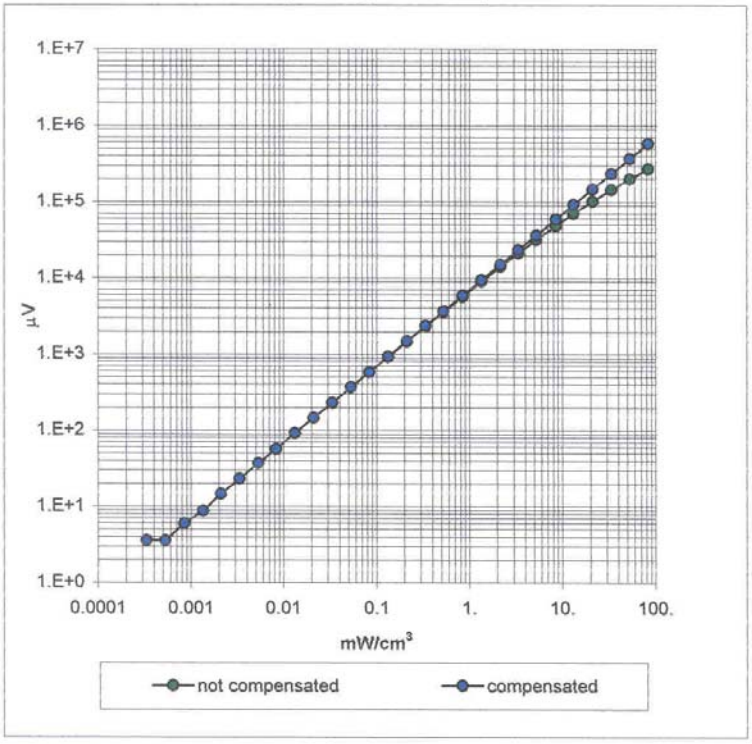
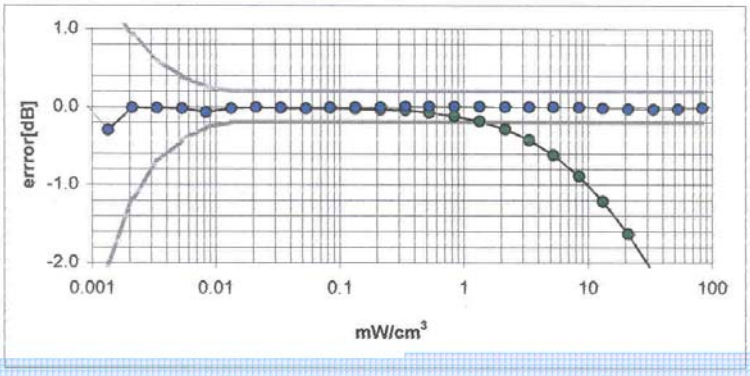
**ET3DV6 SN:1576** **February 27, 2002**

## Dynamic Range f($SAR_{brain}$)

**( Waveguide R22 )**

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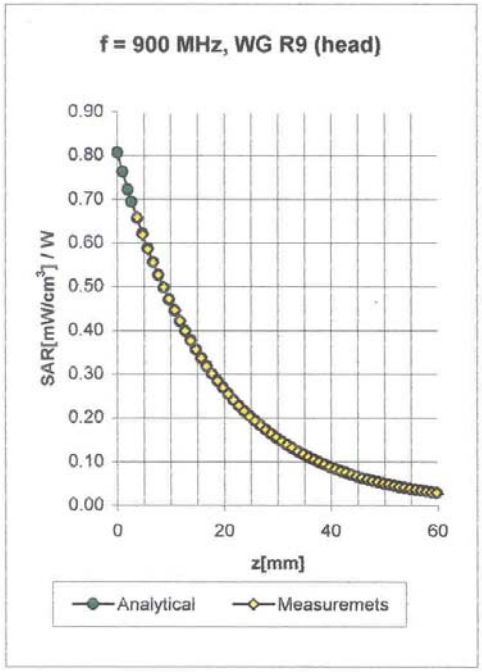
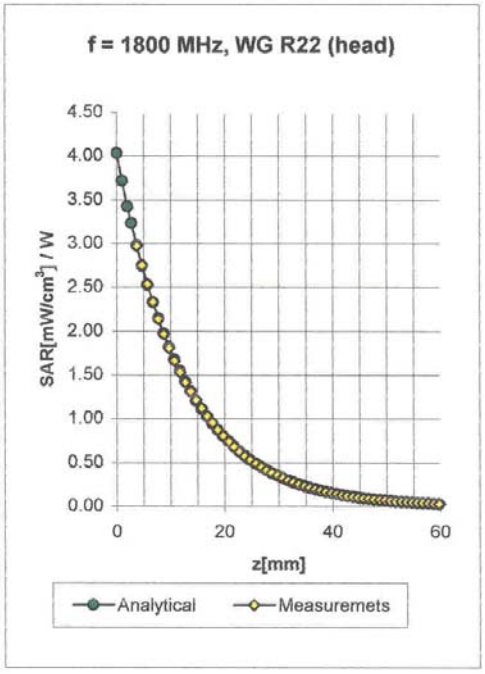
## Conversion Factor Assessment




| | | | | | |
|---|---|---|---|---|---|
| **Head** | **900 MHz** | | **$\varepsilon_r$ = 41.5 ± 5%** | **σ = 0.97 ± 5% mho/m** | |
| **Head** | **835 MHz** | | **$\varepsilon_r$ = 41.5 ± 5%** | **σ = 0.90 ± 5% mho/m** | |
| | ConvF X | **7.0** ± 9.5% (k=2) | | Boundary effect: | |
| | ConvF Y | **7.0** ± 9.5% (k=2) | | Alpha | **0.30** |
| | ConvF Z | **7.0** ± 9.5% (k=2) | | Depth | **2.51** |

| | | | | | |
|---|---|---|---|---|---|
| **Head** | **1800 MHz** | | **$\varepsilon_r$ = 40.0 ± 5%** | **σ = 1.40 ± 5% mho/m** | |
| **Head** | **1900 MHz** | | **$\varepsilon_r$ = 40.0 ± 5%** | **σ = 1.40 ± 5% mho/m** | |
| | ConvF X | **5.4** ± 9.5% (k=2) | | Boundary effect: | |
| | ConvF Y | **5.4** ± 9.5% (k=2) | | Alpha | **0.45** |
| | ConvF Z | **5.4** ± 9.5% (k=2) | | Depth | **2.30** |

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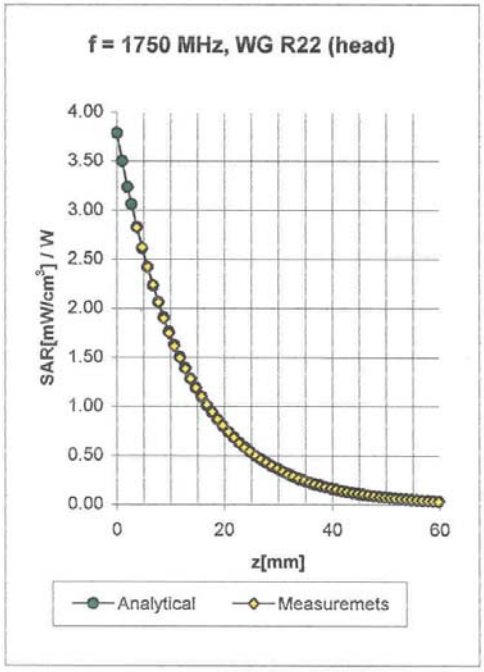
## Conversion Factor Assessment




**Head** **1750 MHz** **$\varepsilon_r$ = 40.0 ± 5%** **σ = 1.40 ± 5% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **5.4** | ± 8.9% (k=2) | Boundary effect: | |
| ConvF Y | **5.4** | ± 8.9% (k=2) | Alpha | **0.45** |
| ConvF Z | **5.4** | ± 8.9% (k=2) | Depth | **2.27** |

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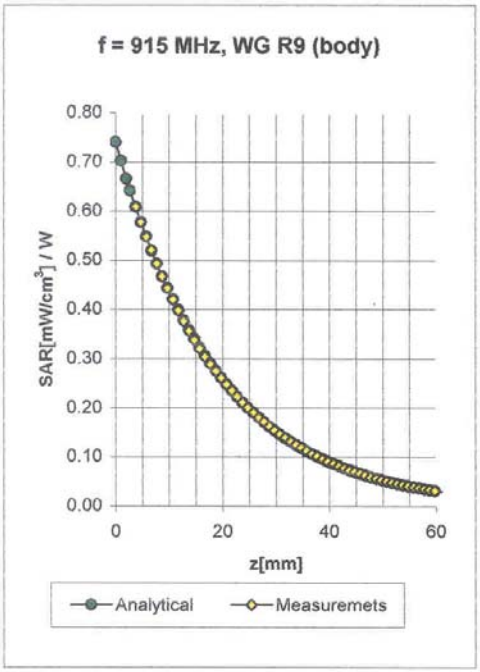
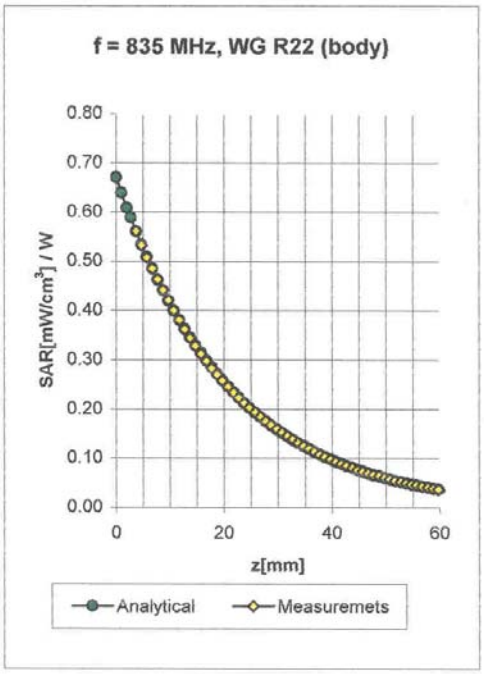
## Conversion Factor Assessment




**Body** **915 MHz** **$\varepsilon_r$ = 55.0 ± 5%** **σ = 1.06 ± 5% mho/m**

| | | | |
|---|---|---|---|
| ConvF X | **6.7** ± 8.9% (k=2) | Boundary effect: | |
| ConvF Y | **6.7** ± 8.9% (k=2) | Alpha | **0.45** |
| ConvF Z | **6.7** ± 8.9% (k=2) | Depth | **2.01** |

**Body** **835 MHz** **$\varepsilon_r$ = 55.2 ± 5%** **σ = 0.97 ± 5% mho/m**

| | | | |
|---|---|---|---|
| ConvF X | **6.7** ± 8.9% (k=2) | Boundary effect: | |
| ConvF Y | **6.7** ± 8.9% (k=2) | Alpha | **0.34** |
| ConvF Z | **6.7** ± 8.9% (k=2) | Depth | **2.37** |

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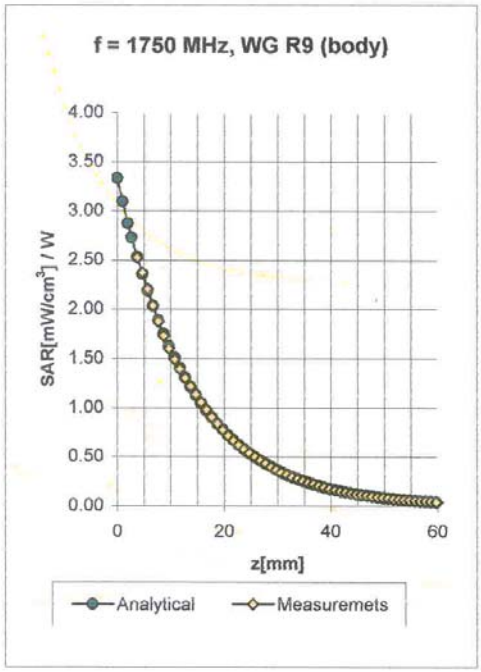
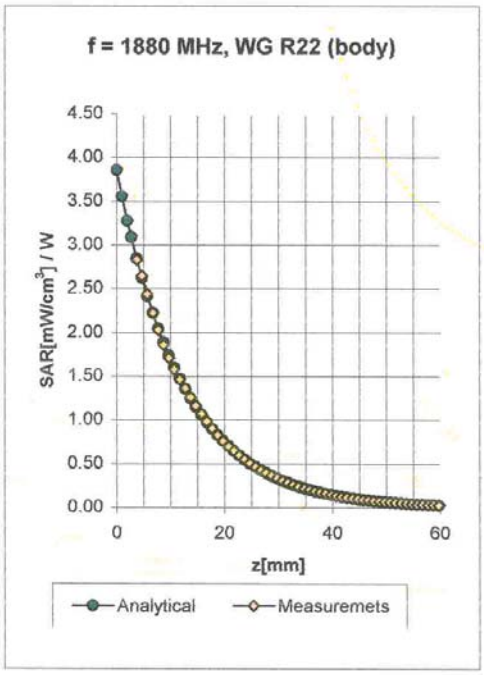
## Conversion Factor Assessment




**Body** **1750 MHz** $\varepsilon_r$ **= 53.3 ± 5%** $\sigma$ **= 1.52 ± 5% mho/m**

| | | | |
|---|---|---|---|
| ConvF X | **5.1** ± 8.9% (k=2) | Boundary effect: | |
| ConvF Y | **5.1** ± 8.9% (k=2) | Alpha | **0.51** |
| ConvF Z | **5.1** ± 8.9% (k=2) | Depth | **2.31** |

**Body** **1880 MHz** $\varepsilon_r$ **= 53.3 ± 5%** $\sigma$ **= 1.52 ± 5% mho/m**

| | | | |
|---|---|---|---|
| ConvF X | **4.8** ± 8.9% (k=2) | Boundary effect: | |
| ConvF Y | **4.8** ± 8.9% (k=2) | Alpha | **0.63** |
| ConvF Z | **4.8** ± 8.9% (k=2) | Depth | **2.10** |

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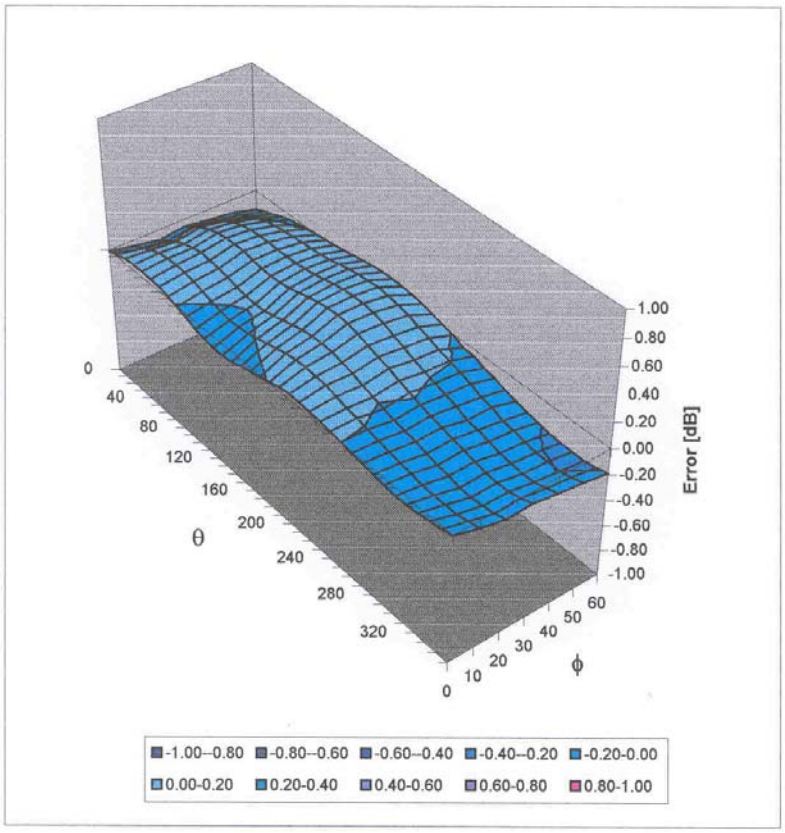
## Deviation from Isotropy in HSL

Error (θ,ϕ), f = 900 MHz

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**APPENDIX C – 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<br>Hauptstr. 69<br>CH-8559 Fruthwilen<br>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<br>Relative permittivity < 5<br>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**

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