Celltech
Testing and Engineering Services Lab

September 13, 2001

Federal Communications Commission
Equipment Approval Services
7435 Oakland Mills Road
Columbia, MD 21046
Attn: Joe Dichoso

**SUBJECT: TOPAZ3, L.L.C.**
**FCC ID: O7KPL450A**
**731 Confirmation No.: EA101329**
**Correspondence Ref. No.: 20546**

Dear Joe:

On behalf of Topaz3, L.L.C. we hereby submit our response to Item #1 of your e-mail dated September 07, 2001 requesting additional information for the subject application.

At the time the device was evaluated for RF exposure, the thickness of the planar phantom had not yet been addressed by the manufacturer. The system was validated at the time of the device evaluation and the target numbers were achieved to within the measurement error allotted. Due to the recent reported increase in the thickness of phantom from the required 2.0mm to 3.2mm, the manufacturer reported new system validation target values for our newly calibrated 1800MHz and 900MHz dipoles. At 1800MHz with a separation distance of 10mm from the center of the dipole axis to the fluid, and at 900MHz with separation distances of 15mm, the new target values are lower then expected by 12% and 8% respectively. As the frequency is reduced further, the error due to the increased phantom thickness becomes less significant. Since the manufacturer has not given target values for other frequencies, it is estimated by extrapolation that at 450MHz the actual measured SAR values are approximately 5% lower than expected. This would cause both face-held and body-worn RF exposure evaluations to be approximately 5% lower than reported since they were both performed in the planar section of the phantom.

Please find attached the revised SAR test report showing the extrapolated SAR values and reported increase in phantom thickness from the system manufacturer. This device is intended to be granted for Controlled Exposure/Occupational, and in both face-held and body-worn configurations there is sufficient margin for SAR at a 100% duty cycle with a spatial peak limit of 8.0W/Kg.

If you have any questions or comments concerning the above, please do not hesitate to contact me.

Sincerely,

Shawn McMillen
General Manager
Celltech Research Inc.
Testing & Engineering Lab

cc: Topaz3 L.L.C.
Rhein Tech Labs

# MC0300: Change in Procedure of Dipole Calibration

## Procedure Before February 2000

The distance between the dipole axis and head tissue simulating liquid was based on the specifications given by the vendor manufacturing the generic twin phantom. The specifications for the shell thickness were 2 ± 0.2 mm at the location where the phone touches the head as well as at the location of dipole validation in the flat phantom area. The thickness of the first phantom was carefully verified using the robot, which is a very tedious and time consuming procedure. Afterward, Schmid & Partner Engineering AG (SPEAG) relied on the manufacturer's specifications, since suitable equipment for routine validation of the shell thickness was not available before January 2000.

## Rationale for Change of Procedure

During the course of closing the remaining gaps of quality control of our products and production, SPEAG purchased the hall effect wall thickness gauge MINITEST FH4100 of ElektroPhysik in January 2000. This instrumentation enables measurement of the shell thickness with a precision of better than ±0.1 mm. Verification of the phantoms revealed that the production variability in the regions of validation is considerably larger, i.e., about 2.8 ± 0.4 mm, which is due to an unnotified change in the production method of the vendor. The mean and deviation were estimated thereafter based on a limited number of samples.

The thickness of the phantom used for dipole calibration has a thickness of 3.2 ± 0.1 mm. In other words, the distances between the dipole axis and the liquid were 16.2 mm and not 15 mm below 1 GHz and 11.2 instead of 10 mm above 1 GHz. Therefore, an incorrect distance is stated in all calibration documents issued before February 2000. This does not effect laboratories using the generic twin phantom, only those groups which use other phantoms.

## Changes in Procedure (effective February 2000)

1) Rigorous quality control of the new phantoms and conduct of the calibration at the correct distances of 15 mm and 10 mm respectively.

2) Provision of the corrected calibration distance as well as of extrapolated values for the distances 15, 15.5 and 16 mm for customers using phantoms other than the generic twin phantom. The latter are extrapolated values based on a series of measurements conducted with different dipoles which therefore have slightly enhanced uncertainties.

Suggested on: 15. 04. 2000 by: [signature]

Approved on: 16. 04. 2000 by: [signature]

**Schmid & Partner Engineering AG**

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

# D900V2 – SN:054 Summary of Dipole Data (June 20, 2001)

## SAR Measurement

In the Table 1 averaged measured and extrapolated SAR values are normalized to a dipole input power of 1W (forward power). The dipole was position below the flat phantom filled with head-tissue simulating liquid (ε=42.4, σ=0.97).

| Distance (mm) | SAR (1g) mW/g | SAR (10g) mW/g | Validation Repeatability (Standard deviation) | Method |
|---|---|---|---|---|
| **15.0** | **11.12** | **7.04** | **± 4%** | **Calibrated** |
| 15.5 | 10.76 | 6.86 | ± 5% | Extrapolated |
| 16.0 | 10.43 | 6.69 | ± 5% | Extrapolated |
| 16.2 [1] | 10.30 | 6.62 | ± 5% | Extrapolated |

In the Table 2 averaged measured and extrapolated SAR values are normalized to a dipole input power of 1W (forward power). The dipole was position below the flat phantom filled with head-tissue simulating liquid (ε=41.0, σ=0.86).

| Distance (mm) | SAR (1g) mW/g | SAR (10g) mW/g | Validation Repeatability (Standard deviation) | Method |
|---|---|---|---|---|
| **15.0** | **10.12** | **6.52** | **± 4%** | **Calibrated** |
| 15.5 | 9.79 | 6.35 | ± 5% | Extrapolated |
| 16.0 | 9.49 | 6.19 | ± 5% | Extrapolated |
| 16.2 [1] | 9.37 | 6.13 | ± 5% | Extrapolated |

## Dipole Impedance and Return Loss

The transformation parameters from the SMA-connector to the dipole feedpoint are:

| | | |
|---|---|---|
| Electrical delay: | **1.413 ns** | (one direction) |
| Transmission factor: | **0.989** | (voltage transmission, one direction) |

[1] As explained in the document "MC0300: Change in Procedure of Dipole Calibration" of April 15th, 2000, the distance between the dipole axis and liquid was 1.2 mm more than stated in the original documents issued before February 2000. The extrapolated values and the given uncertainties have been carefully evaluated and have been validated by measurements and computations.

**Schmid & Partner Engineering AG**

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

# D1800V2 – SN:247 Summary of Dipole Data (June 20, 2001)

## SAR Measurement

In the Table 1 averaged measured and extrapolated SAR values are normalized to a dipole input power of 1W (forward power). The dipole was position below the flat phantom filled with head-tissue simulating liquid ($\varepsilon$=40.0, $\sigma$=1.36).

| Distance (mm) | SAR (1g) mW/g | SAR (10g) mW/g | Validation Repeatability (Standard deviation) | Method |
|---|---|---|---|---|
| **10.0** | **38.7** | **20.1** | **± 4%** | **Calibrated** |
| 10.5 | 36.8 | 19.3 | ± 5% | Extrapolated |
| 11.0 | 35.1 | 18.6 | ± 5% | Extrapolated |
| 11.2 [1] | 34.5 | 18.3 | ± 5% | Extrapolated |

In the Table 2 averaged measured and extrapolated SAR values are normalized to a dipole input power of 1W (forward power). The dipole was position below the flat phantom filled with head-tissue simulating liquid ($\varepsilon$=40.1, $\sigma$=1.71).

| Distance (mm) | SAR (1g) mW/g | SAR (10g) mW/g | Validation Repeatability (Standard deviation) | Method |
|---|---|---|---|---|
| **10.0** | **43.6** | **21.6** | **± 4%** | **Calibrated** |
| 10.5 | 41.5 | 20.8 | ± 5% | Extrapolated |
| 11.0 | 39.6 | 20.1 | ± 5% | Extrapolated |
| 11.2 [1] | 38.9 | 19.8 | ± 5% | Extrapolated |

## Dipole Impedance and Return Loss

The transformation parameters from the SMA-connector to the dipole feedpoint are:

| | | |
|---|---|---|
| Electrical delay: | **1.208 ns** | (one direction) |
| Transmission factor: | **0.995** | (voltage transmission, one direction) |

[1] As explained in the document "MC0300: Change in Procedure of Dipole Calibration" of April 15th, 2000, the distance between the dipole axis and liquid was 1.2 mm more than stated in the original documents issued before February 2000. The extrapolated values and the given uncertainties have been carefully evaluated and have been validated by measurements and computations.

# CERTIFICATE OF COMPLIANCE
# SAR EVALUATION

| **Test Lab:** | **Applicant Information:** |
|---|---|
| **CELLTECH RESEARCH INC.**<br>Testing and Engineering Lab<br>1955 Moss Court<br>Kelowna, B.C.<br>Canada V1Y 9L3<br>Phone: 250 - 860-3130<br>Fax: 250 - 860-3110<br>Toll Free: 1-877-545-6287<br>e-mail: info@celltechlabs.com<br>web site: www.celltechlabs.com | **TOPAZ3, LLC**<br>10828 NW Air World Drive,<br>Kansas City, Missouri 64153-1238 |

| | |
|---|---|
| **FCC ID:** | **O7KPL450A** |
| **Model(s):** | **PL2445** |
| **EUT Type:** | **Portable UHF PTT Radio Transceiver** |
| **Modulation:** | **FM (UHF Band)** |
| **Tx Frequency Range:** | **450.0125 - 489.9875 MHz** |
| **Max. Power Tested:** | **2.16 Watts (Conducted)** |
| **No. of Channels:** | **4** |
| **FCC Rule Part(s):** | **2.1093; ET Docket 96-326** |

This wireless portable device has been shown to be compliant for localized Specific Absorption Rate (SAR) for controlled environment/occupational exposure limits specified in ANSI/IEEE Std. C95.1-1992 and has been tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3-1999.

I attest to the accuracy of data. All measurements were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Celltech Research Inc. certifies that no party to this application has been denied FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

**Shawn McMillen**
**General Manager**
**Celltech Research Inc.**

# TABLE OF CONTENTS

## *1.0 INTRODUCTION*

This measurement report shows compliance of the TOPAZ3 PL2445 Portable UHF PTT Radio Transceiver FCC ID: O7KPL450A with the regulations and procedures specified in FCC Part 2.1093, ET Docket 96-326 Rules (controlled exposure) for mobile and portable devices. The test procedures, as described in American National Standards Institute C95.1-1992 (1), FCC OET Bulletin 65-1997 were employed. A description of the product and operating configuration, detailed summary of the test results, methodology and procedures used in the evaluation, equipment used, and the various provisions of the rules are included within this test report.

## *2.0 DESCRIPTION of Equipment Under Test (EUT)*

| | | | |
|---|---|---|---|
| **Rule Part(s)** | FCC 2.1093;<br>ET Docket 96.326 | **Modulation** | FM (UHF Band) |
| **EUT Type** | Portable UHF PTT Radio Transceiver | **Tx Frequency Range (MHz)** | 450.0125 - 489.9875 |
| **Model No.(s)** | PL2445 | **Max. RF Output Power Tested** | 2.16 Watts (Conducted) |
| **Serial No.** | Pre-production | **Power Supply** | 7.2V NiMH Battery |
| **Antenna Type** | Whip | **Antenna Length** | 153 mm |


*Front of EUT*


*Right Side of EUT*


*Left Side of EUT*


*Back of EUT*


*EUT with Holster*

## *3.0 SAR MEASUREMENT SYSTEM*

Celltech Research SAR measurement facility utilizes the Dosimetric Assessment System (DASY™) manufactured by Schmid & Partner Engineering AG (SPEAG™) of Zurich, Switzerland. The DASY system is comprised of the robot controller, computer, near-field probe, probe alignment sensor, and the generic twin phantom containing brain or muscle equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The Staubli robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card. The DAE3 utilizes a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe-mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.


*DASY3 SAR Measurement System*

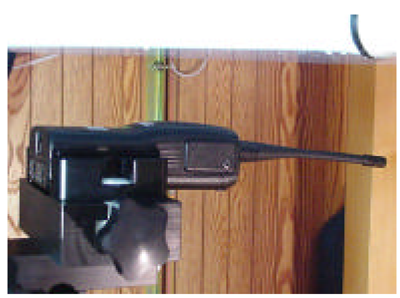
## *4.0 MEASUREMENT SUMMARY*

The measurement results were obtained with the EUT tested in the conditions described in this report. Detailed measurement data and plots showing the maximum SAR location of the EUT are reported in Appendix A.

**Face-Held SAR Measurements**

| Frequency (MHz) | Chan. | Mode | Cond. Power (Watts) | Antenna Position | Separ. Dist. (cm) | SAR (w/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR values with 3.2mm phantom | | Extrapolated SAR values for 2.0mm phantom | |
| | | | | | | 100% Duty Cycle | 50% Duty Cycle | 100% Duty Cycle | 50% Duty Cycle |
| 450.0125 | Low | CW | 2.06 | Fixed | 4.0 | 0.913 | 0.457 | 0.959 | 0.480 |
| 470.0125 | Mid | CW | 2.16 | Fixed | 4.0 | 0.939 | 0.470 | 0.986 | 0.493 |
| 489.9875 | High | CW | 2.01 | Fixed | 4.0 | 0.876 | 0.438 | 0.920 | 0.460 |
| **Mixture Type: Brain<br>Dielectric Constant: 48.9<br>Conductivity: 0.61** | | | **ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak Controlled Exposure/Occupational<br>BRAIN: 8.0 W/kg (averaged over 1 gram)** | | | | | | |

Notes:
1. The actual thickness of the flat phantom shell as reported by the system manufacturer is 3.2mm instead of the required 2.0mm thickness. As a result of the increased thickness, the measured SAR values were approximately 5% lower than expected. The final SAR values were extrapolated from the measured SAR values and calculated for a 2.0mm flat phantom shell thickness.
2. The SAR values found were below the maximum limit of 8.0 w/kg (controlled exposure).
3. The highest face-held SAR value found was 0.986 w/kg (based on 100% duty cycle & 2.0mm phantom).



Face-held SAR Test Setup

***MEASUREMENT SUMMARY (CONT.)***

## Body-Worn SAR Measurements with Metal Belt Clip

| Frequency (MHz) | Chan. | Mode | Cond. Power (Watts) | Antenna Position | Belt-Clip Separation Distance (cm) | SAR (w/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR values with 3.2mm phantom | | Extrapolated SAR values for 2.0mm phantom | |
| | | | | | | 100% Duty Cycle | 50% Duty Cycle | 100% Duty Cycle | 50% Duty Cycle |
| 450.0125 | Low | CW | 2.06 | Fixed | 1.0 | 6.73 | 3.37 | 7.07 | 3.54 |
| 470.0125 | Mid | CW | 2.16 | Fixed | 1.0 | 6.44 | 3.22 | 6.76 | 3.38 |
| 489.9875 | High | CW | 2.01 | Fixed | 1.0 | 5.29 | 2.65 | 5.55 | 2.78 |
| Mixture Type: Muscle<br>Dielectric Constant: 57.5<br>Conductivity: 0.84 | | | ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak Controlled Exposure/Occupational<br>BODY: 8.0 W/kg (averaged over 1 gram) | | | | | | |

Notes:

1. The actual thickness of the flat phantom shell as reported by the system manufacturer is 3.2mm instead of the required 2.0mm thickness. As a result of the increased thickness, the measured SAR values were approximately 5% lower than expected. The final SAR values were extrapolated from the measured SAR values and calculated for a 2.0mm flat phantom shell thickness.
2. The SAR values found were below the maximum limit of 8.0 w/kg (controlled exposure).
3. The highest SAR level found was 7.07 w/kg (based on 100% duty cycle & 2.0mm phantom).
4. The EUT was tested for body-worn SAR with the attached metal belt-clip providing a 1.0cm separation distance between the back of the EUT and the outer surface of the planar phantom.

Body-worn SAR Test Setup
with 1.0cm Belt-Clip

***MEASUREMENT SUMMARY (CONT.)***

**<u>Body-Worn SAR Measurements with Leather Belt-Holster</u>**

| Frequency (MHz) | Chan. | Mode | Cond. Power (Watts) | Antenna Position | Holster Separation Distance (cm) | SAR (w/kg) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured SAR values with 3.2mm phantom | | Extrapolated SAR values for 2.0mm phantom | |
| | | | | | | 100% Duty Cycle | 50% Duty Cycle | 100% Duty Cycle | 50% Duty Cycle |
| 450.0125 | Low | CW | 2.06 | Fixed | 0.9 | 3.92 | 1.96 | 4.12 | 2.06 |
| 470.0125 | Mid | CW | 2.16 | Fixed | 0.9 | 4.03 | 2.015 | 4.23 | 2.12 |
| 489.9875 | High | CW | 2.01 | Fixed | 0.9 | 3.64 | 1.82 | 3.82 | 1.91 |
| **Mixture Type: Muscle<br>Dielectric Constant: 57.5<br>Conductivity: 0.84** | | | **ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak Controlled Exposure/Occupational<br>BODY: 8.0 W/kg (averaged over 1 gram)** | | | | | | |

Notes:

1. The actual thickness of the flat phantom shell as reported by the system manufacturer is 3.2mm instead of the required 2.0mm thickness. As a result of the increased thickness, the measured SAR values were approximately 5% lower than expected. The final SAR values were extrapolated from the measured SAR values and calculated for a 2.0mm flat phantom shell thickness.
2. The SAR values found were below the maximum limit of 8.0 w/kg (controlled exposure).
3. The highest SAR value found was 4.23 w/kg (based on 100% duty cycle & 2.0mm phantom).
4. The EUT was tested for body-worn SAR with the attached leather belt-holster providing a 0.9cm separation distance between the back of the EUT and the outer surface of the planar phantom.

Body-worn SAR Test Setup
with 0.9cm Belt-Holster

## *5.0 DETAILS OF SAR EVALUATION*

The TOPAZ3 PL2445 Portable UHF PTT Radio Transceiver FCC ID: O7KPL450A was found to be compliant for localized Specific Absorption Rate (controlled exposure) based on the following test provisions and conditions:

1) The EUT was tested in a face-held configuration with the front of the device placed parallel to and at a nominal distance of 4.0cm from the outer surface of the planar phantom.
2) The EUT was tested in a body-worn configuration with the attached metal belt-clip providing a 1.0cm separation distance between the back of the EUT and the outer surface of the planar phantom.
3) The EUT was tested in a body-worn configuration with the attached leather belt-holster providing a 0.9cm separation distance between the back of the EUT and the outer surface of the planar phantom.
4) The EUT was evaluated for SAR at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimize drift. The conducted power levels were checked before and after each test.
5) The conducted power was measured according to the procedures described in FCC Part 2.1046.
6) The device was operated continuously in the transmit mode for the duration of the test.
7) The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the device and its antenna. This location was then related to a phantom that possesses human like facial attributes. The hot spot location of the EUT occurred around the mounting point of the antenna. In a normal operating position this places the hotspot just below the left eye.
8) The EUT was tested with a fully charged battery.

## *6.0 EVALUATION PROCEDURES*

The Specific Absorption Rate (SAR) evaluation was performed in the following manner:

a. (i) The evaluation was performed in an applicable area of the phantom depending on the type of device being tested. For devices held to the ear during normal operation, both the left and right ear positions were evaluated at the center frequency of the band at maximum power. The ear position that produced the greatest SAR determined which side of the phantom would be used for the entire evaluation. FCC OET Bulletin 65, Supplement C dictated the test position of the device relative to the phantom.

(ii) For face-held and body-worn devices, or devices which can be operated within 20cm of the body, the planar section of the phantom was used.

b. The SAR was determined by a pre-defined procedure within the DASY3 software. Upon completion of a reference and optical surface check, the exposed region of the phantom was scanned near the inner surface with a grid spacing of 20mm x 20mm.

c. For frequencies below 500MHz a 4x4x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. For frequencies above 500MHz a 5x5x7 matrix was performed. SAR values were then calculated using a 3-D spline interpolation algorithm and averaged over spatial volumes of 1 and 10 grams.

d. If the EUT had any appreciable drift over the course of the evaluation, then the EUT was re-evaluated. Any unusual anomalies over the course of the test also warranted a re-evaluation.

## *7.0 SAR SAFETY LIMITS*

| **EXPOSURE LIMITS** | **SAR (W/Kg)** | |
|---|---|---|
| | **(General Population / Uncontrolled Exposure Environment)** | **(Occupational / Controlled Exposure Environment)** |
| Spatial Average (averaged over the whole body) | 0.08 | 0.4 |
| Spatial Peak (averaged over any 1g of tissue) | 1.60 | 8.0 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10g) | 4.0 | 20.0 |

Notes:
1. Uncontrolled environments are defined as locations where there is potential exposure of individuals who have no knowledge or control of their potential exposure.
2. Controlled environments are defined as locations where there is potential exposure of individuals who have knowledge of their potential exposure and can exercise control over their exposure.

## *8.0 SYSTEM VALIDATION*

Prior to the assessment, the system was verified in the planar region of the phantom. For devices operating below 1GHz, an 835MHz dipole or 900MHz was used, depending on the operating frequency of the EUT. For devices operating above 1GHz, an 1800MHz dipole was used. A forward power of 250mW was applied to the dipole and system was verified to a tolerance of $\pm$10%. Following the validation, the fluid remained or was changed depending on the particular part of the body being evaluated. The applicable verifications are below (see Appendix B for validation test plot).

| **Dipole Validation Kit** | **Target SAR 1g (w/kg)** | **Measured SAR 1g (w/kg)** |
|---|---|---|
| D835V2 | 2.06 | 2.02 |

## *9.0 SIMULATED TISSUES*

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellulose (HEC) gelling agent and saline solution. Preservation with a bactericide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The fluid was prepared according to standardized procedures and measured for dielectric parameters (permitivity and conductivity).

| INGREDIENT | MIXTURE | | |
|---|---|---|---|
| | **835MHz Brain % (Validation)** | **450MHz Brain %** | **450MHz Muscle %** |
| Water | 40.1 | 42.0 | 50.0 |
| Sugar | 58.1 | 56.0 | 48.2 |
| Salt | 0.7 | 1.7 | 1.6 |
| HEC | 1.0 | 0.1 | 0.1 |
| Bactericide | 0.1 | 0.2 | 0.1 |

## *10.0 TISSUE PARAMETERS*

The dielectric parameters of the fluids were verified prior to the SAR evaluation using an 85070C Dielectric Probe Kit and an 8753E Network Analyzer. The dielectric parameters of the fluid are as follows:

| **Equivalent Tissue (450MHz)** | **Dielectric Constant $e_r$** | **Conductivity s (mho/m)** | **r (Kg/m$^3$** |
|---|---|---|---|
| Brain (835MHz Validation) | 44.2 ± 5% | 0.80 ± 5% | 1000 |
| Brain | 48.9 ± 5% | 0.61 ± 5% | 1000 |
| Muscle | 57.5 ± 5% | 0.84 ± 5% | 1000 |

## *11.0 ROBOT SYSTEM SPECIFICATIONS*

**Specifications**

| | |
|---|---|
| **POSITIONER:** | Stäubli Unimation Corp. Robot Model: RX60L |
| **Repeatability:** | 0.02 mm |
| **No. of axis:** | 6 |

**Data Acquisition Electronic (DAE) System**

**Cell Controller**

| | |
|---|---|
| **Processor:** | Pentium III |
| **Clock Speed:** | 450 MHz |
| **Operating System:** | Windows NT |
| **Data Card:** | DASY3 PC-Board |

**Data Converter**

| | |
|---|---|
| **Features:** | Signal Amplifier, multiplexer, A/D converter, and control logic |
| **Software:** | DASY3 software |
| **Connecting Lines:** | Optical downlink for data and status info.<br>Optical uplink for commands and clock |

**PC Interface Card**

| | |
|---|---|
| **Function:** | 24 bit (64 MHz) DSP for real time processing<br>Link to DAE3<br>16 bit A/D converter for surface detection system<br>serial link to robot<br>direct emergency stop output for robot |

**E-Field Probe**

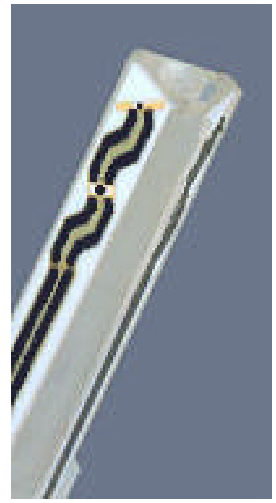
| | |
|---|---|
| **Model:** | ET3DV6 |
| **Serial No.:** | 1387 |
| **Construction:** | Triangular core fiber optic detection system |
| **Frequency:** | 10 MHz to 6 GHz |
| **Linearity:** | ± 0.2 dB (30 MHz to 3 GHz) |

**Phantom**

| | |
|---|---|
| **Phantom:** | Generic Twin |
| **Shell Material:** | Fiberglass |
| **Thickness:** | Left/Right Head - 2.0 ± 0.1 mm<br>Planar Phantom - 3.2 ± 0.1 mm |

## *12.0 PROBE SPECIFICATION (ET3DV6)*

Construction: Symmetrical design with triangular core
Built-in shielding against static charges
PEEK enclosure material (resistant to organic solvents, e.g. glycol)
Calibration: In air from 10 MHz to 2.5 GHz
In brain simulating tissue at frequencies of 900 MHz
and 1.8 GHz (accuracy ± 8%)
Frequency: 10 MHz to > 6 GHz; Linearity: ± 0.2 dB
(30 MHz to 3 GHz)
Directivity: ± 0.2 dB in brain tissue (rotation around probe axis)
± 0.4 dB in brain tissue (rotation normal to probe axis)
Dynam. Rnge: 5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Srfce. Detect. ± 0.2 mm repeatability in air and clear liquids over
diffuse reflecting surfaces
Dimensions: Overall length: 330 mm
Tip length: 16 mm
Body diameter: 12 mm
Tip diameter: 6.8 mm
Distance from probe tip to dipole centers: 2.7 mm
Application: General dosimetry up to 3 GHz
Compliance tests of mobile phone


ET3DV6 E-Field Probe

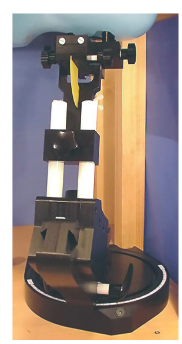
## *13.0 GENERIC TWIN PHANTOM*

The generic twin phantom is a fiberglass shell phantom with a 2.0mm left and right head shell thickness and a 3.2mm flat planar area. The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections.


Generic Twin Phantom

## *14.0 DEVICE HOLDER*

The DASY3 device holder has two scales for device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear openings). The plane between the ear openings and the mouth tip has a rotation angle of 65°.


Device Holder

## *15.0 TEST EQUIPMENT LIST*

| SAR MEASUREMENT SYSTEM | | |
|---|---|---|
| ***EQUIPMENT*** | ***SERIAL NO.*** | ***CALIBRATION DATE*** |
| **DASY3 System** | | |
| -Robot | 599396-01 | N/A |
| -ET3DV6 E-Field Probe | 1387 | Sept 1999 |
| -DAE | 383 | Sept 1999 |
| -835MHz Validation Dipole | 411 | Aug 1999 |
| -900MHz Validation Dipole | 054 | Aug 1999 |
| -1800MHz Validation Dipole | 247 | Aug 1999 |
| -Generic Twin Phantom V3.0 | N/A | N/A |
| **85070C Dielectric Probe Kit** | N/A | N/A |
| **Gigatronics 8652A Power Meter** | 1835272 | Oct 1999 |
| -Power Sensor 80701A | 1833535 | Oct 1999 |
| -Power Sensor 80701A | 1833542 | Oct 1999 |
| **E4408B Spectrum Analyzer** | US39240170 | Nov 1999 |
| **8594E Spectrum Analyzer** | 3543A02721 | Mar 2000 |
| **8753E Network Analyzer** | US38433013 | Nov 1999 |
| **8648D Signal Generator** | 3847A00611 | N/A |
| **5S1G4 Amplifier Research Power Amplifier** | 26235 | N/A |

## *16.0 MEASUREMENT UNCERTAINTIES*

| Uncertainty Description | Error | Distribution | Weight | Standard Deviation | Offset |
|---|---|---|---|---|---|
| **Probe Uncertainty** | | | | | |
| Axial isotropy | ±0.2 dB | U-Shaped | 0.5 | ±2.4 % | |
| Spherical isotropy | ±0.4 dB | U-Shaped | 0.5 | ±4.8 % | |
| Isotropy from gradient | ±0.5 dB | U-Shaped | 0 | ± | |
| Spatial resolution | ±0.5 % | Normal | 1 | ±0.5 % | |
| Linearity error | ±0.2 dB | Rectangle | 1 | ±2.7 % | |
| Calibration error | ±3.3 % | Normal | 1 | ±3.3 % | |
| **SAR Evaluation Uncertainty** | | | | | |
| Data acquisition error | ±1 % | Rectangle | 1 | ±0.6 % | |
| ELF and RF disturbances | ±0.25 % | Normal | 1 | ±0.25 % | |
| Conductivity assessment | ±5 % | Rectangle | 1 | ±5.8 % | |
| **Spatial Peak SAR Evaluation Uncertainty** | | | | | |
| Extrapolated boundary effect | ±3 % | Normal | 1 | ±3 % | ±5 % |
| Probe positioning error | ±0.1 mm | Normal | 1 | ±1 % | |
| Integrated and cube orientation | ±3 % | Normal | 1 | ±3 % | |
| Cube Shape inaccuracies | ±2 % | Rectangle | 1 | ±1.2 % | |
| Device positioning | ±6 % | Normal | 1 | ±6 % | |
| **Combined Uncertainties** | | | | ±11.7 % | ±5 % |

Measurement uncertainties in SAR measurements are difficult to quantify due to several variables including biological, physiological, and environmental.

According to ANSI/IEEE C95.3, the overall uncertainties are difficult to assess and will vary with the type of meter and usage situation. However, accuracy's of ± 1 to 3 dB can be expected in practice, with greater uncertainties in near-field situations and at higher frequencies (shorter wavelengths), or areas where large reflecting objects are present. Under optimum measurement conditions, SAR measurement uncertainties of at least ± 2dB can be expected.

According to CENELEC, typical worst-case uncertainty of field measurements is ± 5 dB.
For well-defined modulation characteristics the uncertainty can be reduced to ± 3 dB.

## *17.0 REFERENCES*

(1) ANSI, *ANSI/IEEE C95.1: 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 10017, 1992;*

(2) Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, FCC, Washington, D.C. 20554, 1997;

(3) Thomas Schmid, Oliver Egger, and Neils Kuster, "Automated E-field scanning system for dosimetric assessments", IEEE *Transaction on Microwave Theory and Techniques*, Vol. 44, pp. 105 – 113, January, 1996.

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

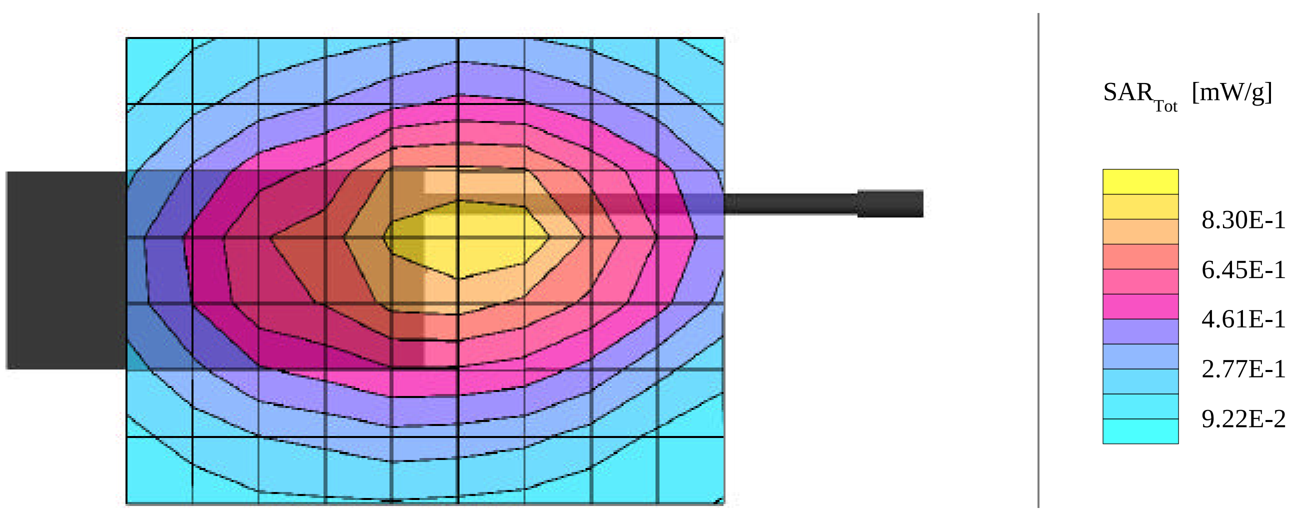
## *APPENDIX A - SAR MEASUREMENT DATA*

The manufacturer of the DASY3 generic twin phantom has determined that the planar section used during face-held and body-worn SAR RF exposure evaluations is 3.2mm, as opposed to the 2.0mm required thickness (OET Bulletin 65, Supplement C). As a result of this increased thickness the SAR evaluation reported an approximate 5% lower assessed value. Please note that the shell thickness of the left and right head of the generic twin phantom is the required 2.0mm.

# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Brain: $\sigma$ = 0.61 mho/m $\varepsilon_r$ = 48.9 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 0.913 mW/g, SAR (10g): 0.659 mW/g

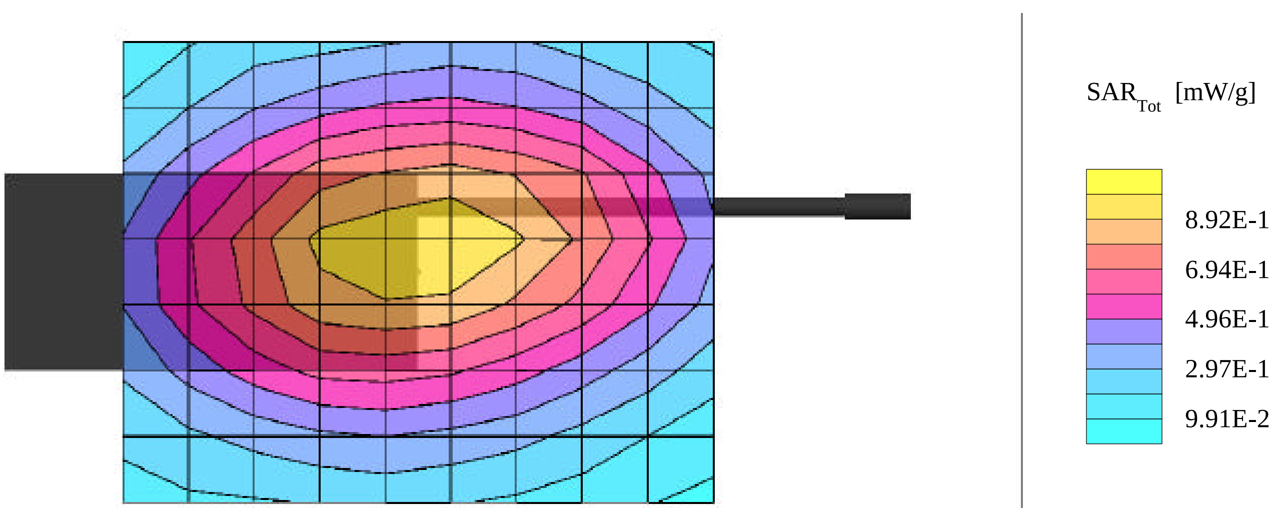
Face-held SAR with 4.0cm Separation Distance
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Low Channel [450.0125 MHz]
Conducted Power: 2.06 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Brain: σ = 0.61 mho/m $\varepsilon_r$ = 48.9 ρ = 1.00 g/cm³
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 0.939 mW/g, SAR (10g): 0.722 mW/g

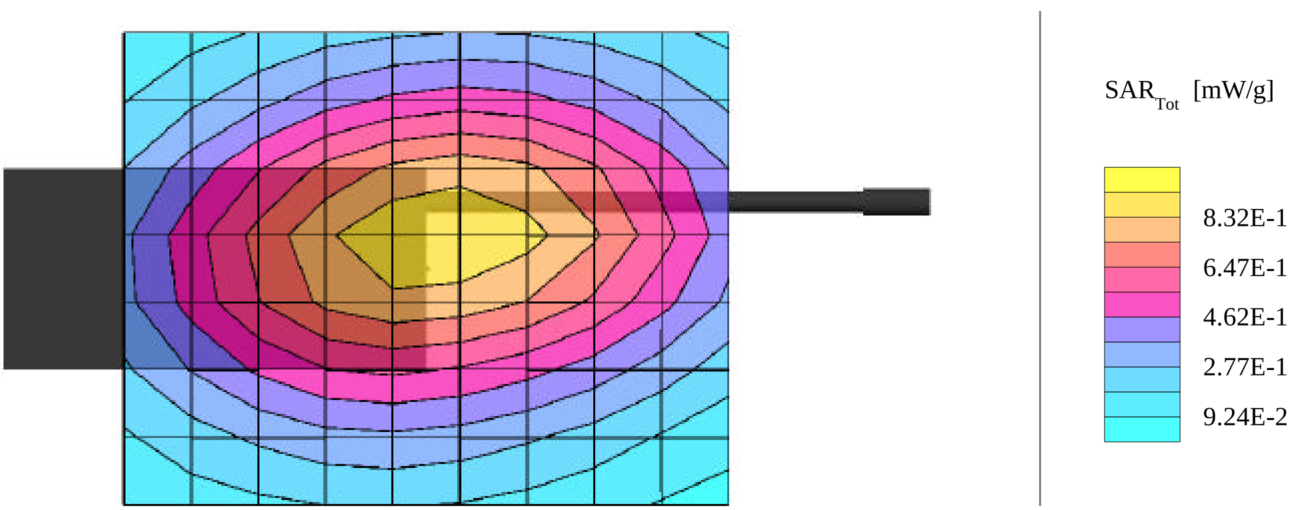
Face-held SAR with 4.0cm Separation Distance
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Mid Channel [470.0125 MHz]
Conducted Power: 2.16 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Brain: $\sigma$ = 0.61 mho/m $\varepsilon_r$ = 48.9 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 0.876 mW/g, SAR (10g): 0.672 mW/g

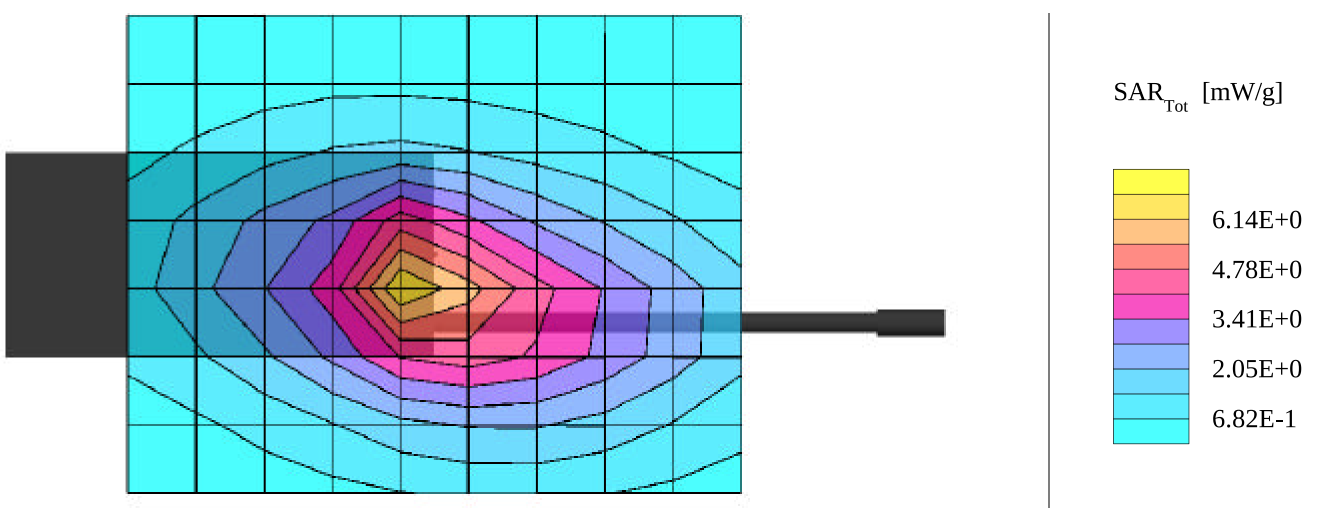
Face-held SAR with 4.0cm Separation Distance
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
High Channel [489.9875 MHz]
Conducted Power: 2.01 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 6.73 mW/g, SAR (10g): 4.34 mW/g

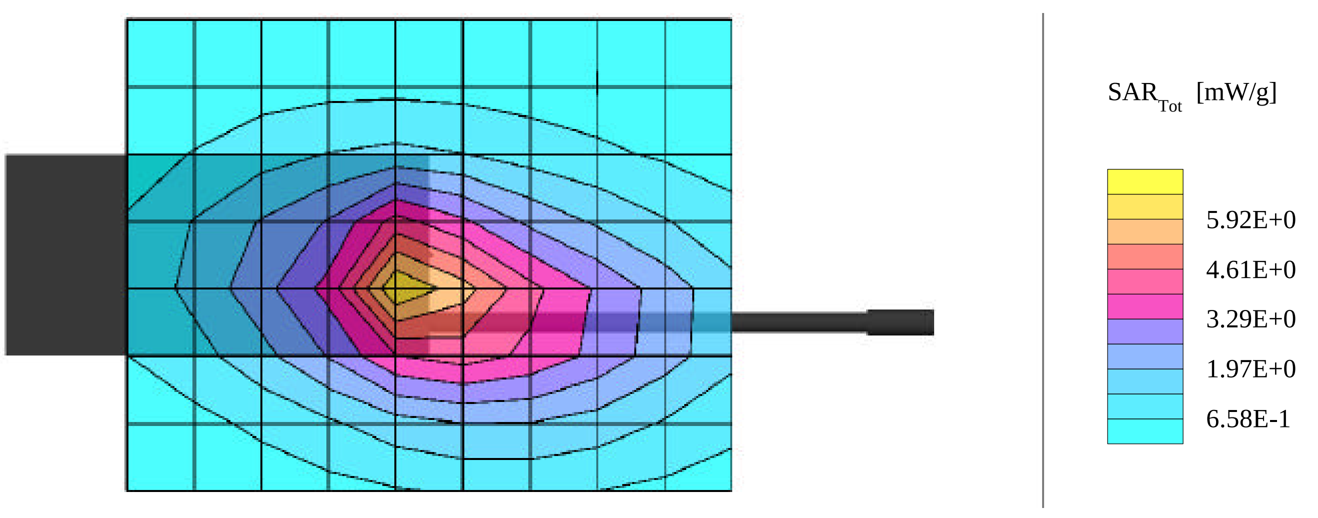
Body-worn SAR with 1.0cm Metal Belt-Clip
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Low Channel [450.0125 MHz]
Conducted Power: 2.06 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 6.44 mW/g, SAR (10g): 4.14 mW/g

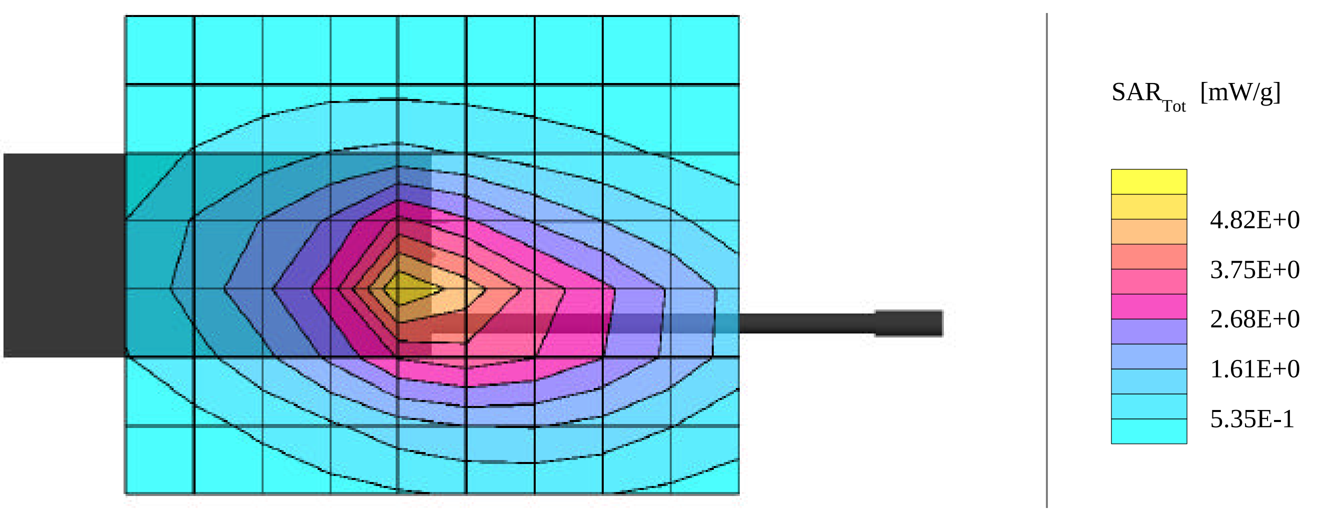
Body-worn SAR with 1.0cm Metal Belt-Clip
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Mid Channel [470.0125 MHz]
Conducted Power: 2.16 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 5.29 mW/g, SAR (10g): 3.42 mW/g

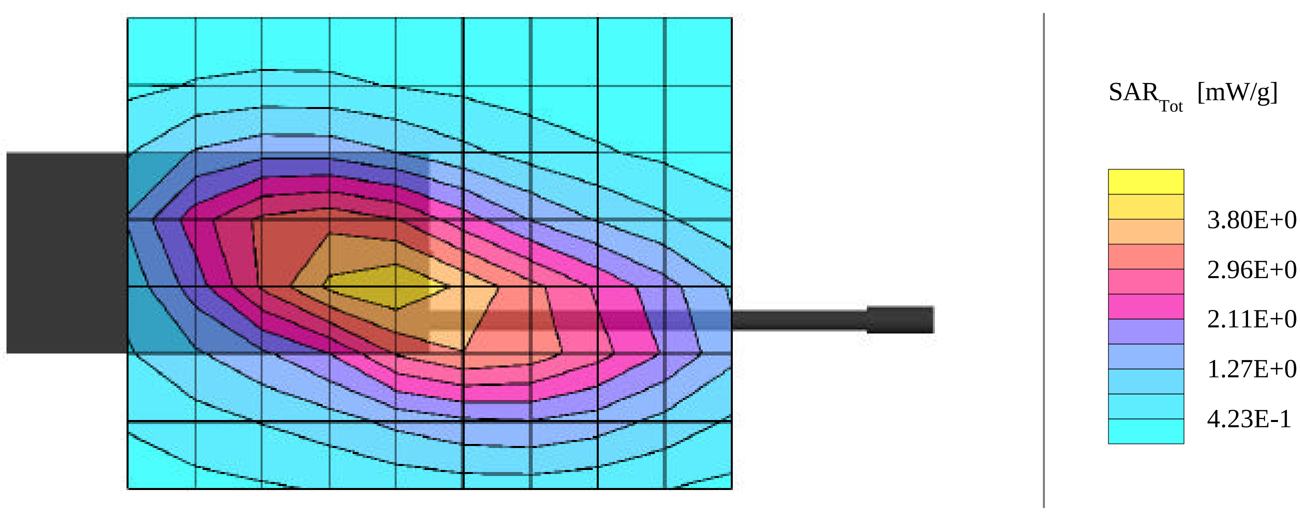
Body-worn SAR with 1.0cm Metal Belt-Clip
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
High Channel [489.9875 MHz]
Conducted Power: 2.01 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm³
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 3.92 mW/g, SAR (10g): 2.80 mW/g

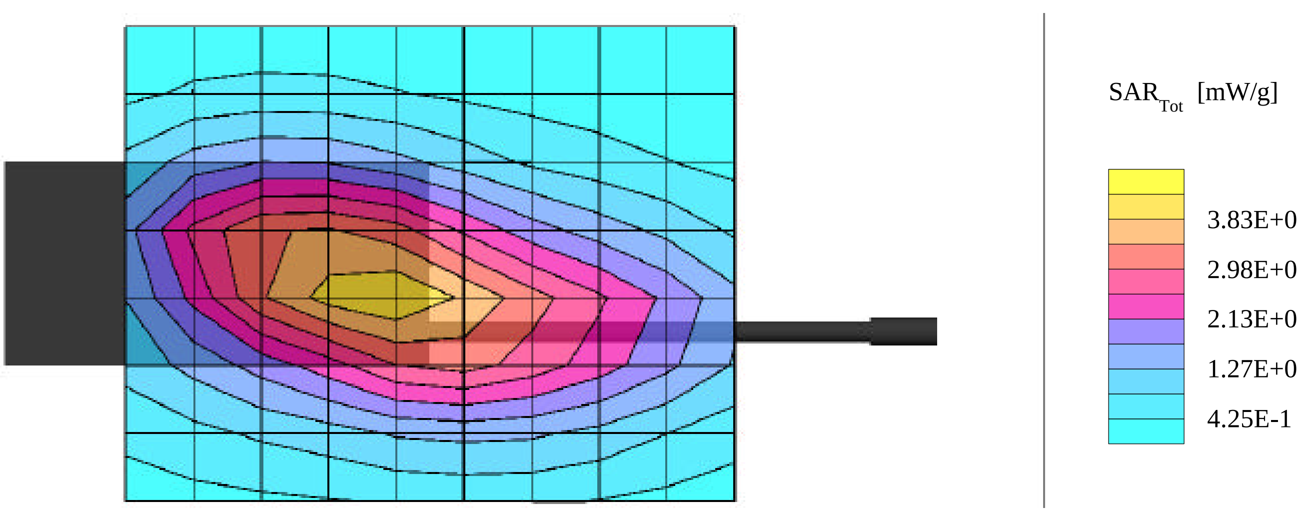
Body-worn SAR with 0.9cm Leather Belt-Holster
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Low Channel [450.0125 MHz]
Conducted Power: 2.06 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 4.03 mW/g, SAR (10g): 2.92 mW/g

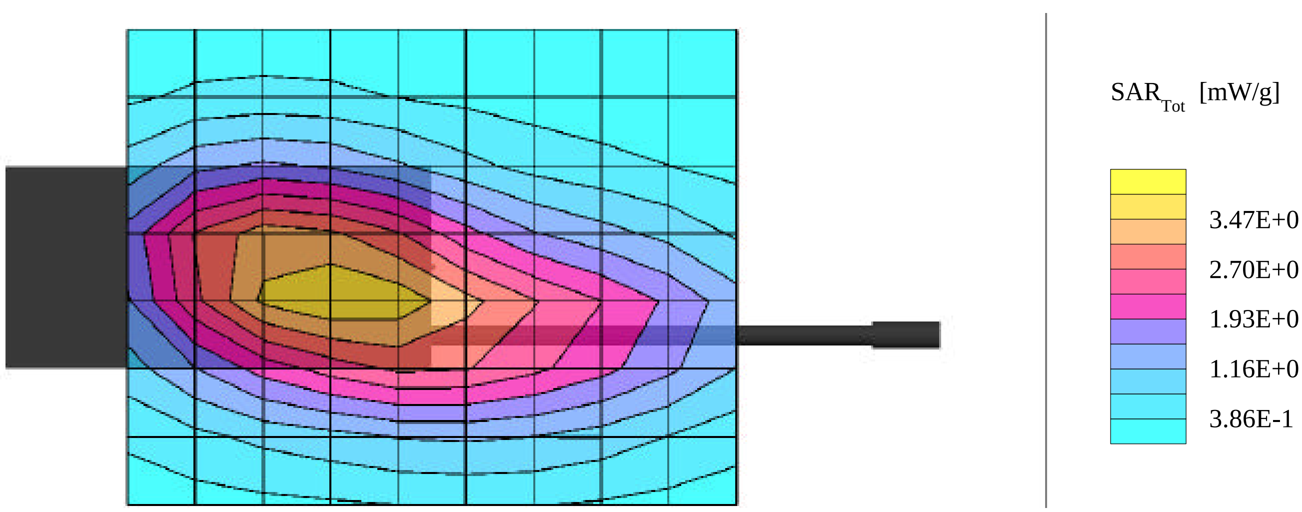
Body-worn SAR with 0.9cm Leather Belt-Holster
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
Mid Channel [470.0125 MHz]
Conducted Power: 2.16 Watts
Date Tested: May 31, 2001



# Topaz3 LLC FCC ID: O7KPL450A

Generic Twin Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1387; ConvF(6.76,6.76,6.76); Crest factor: 1.0
450MHz Muscle: $\sigma$ = 0.84 mho/m $\varepsilon_r$ = 57.5 $\rho$ = 1.00 g/cm$^3$
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0;
Cube 4x4x7
SAR (1g): 3.64 mW/g, SAR (10g): 2.69 mW/g

Body-worn SAR with 0.9cm Leather Belt-Holster
Portable UHF PTT Radio Transceiver
Topaz3 Model: PL2445
Continuous Wave Mode
High Channel [489.9875 MHz]
Conducted Power: 2.01 Watts
Date Tested: May 31, 2001

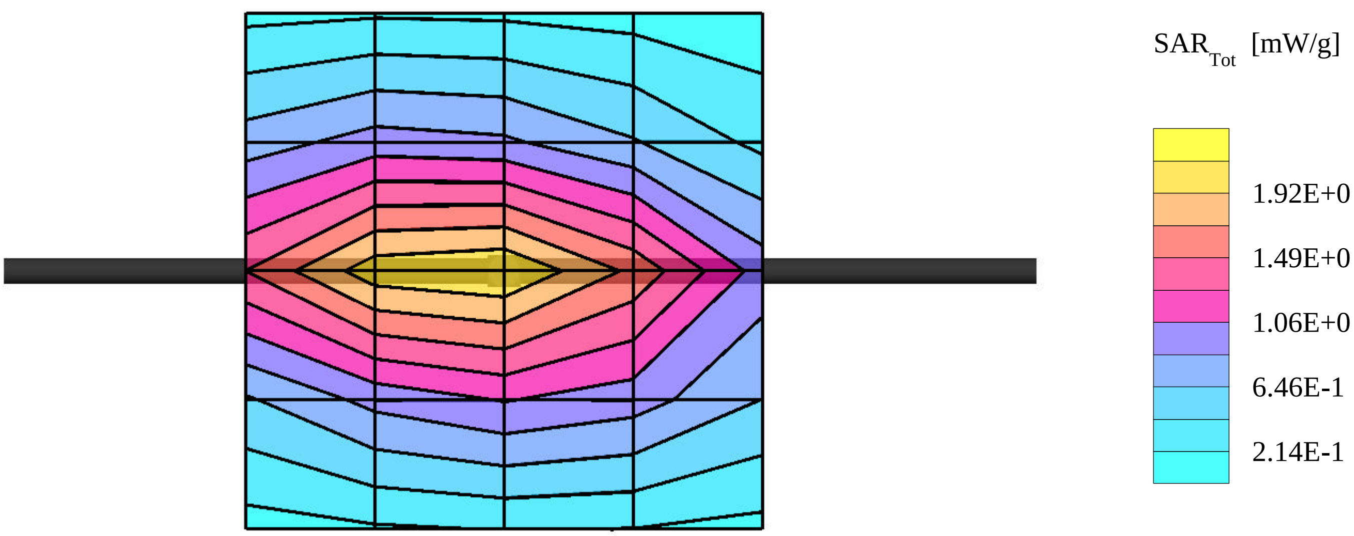


## *APPENDIX B - DIPOLE VALIDATION*

# Dipole 835 MHz

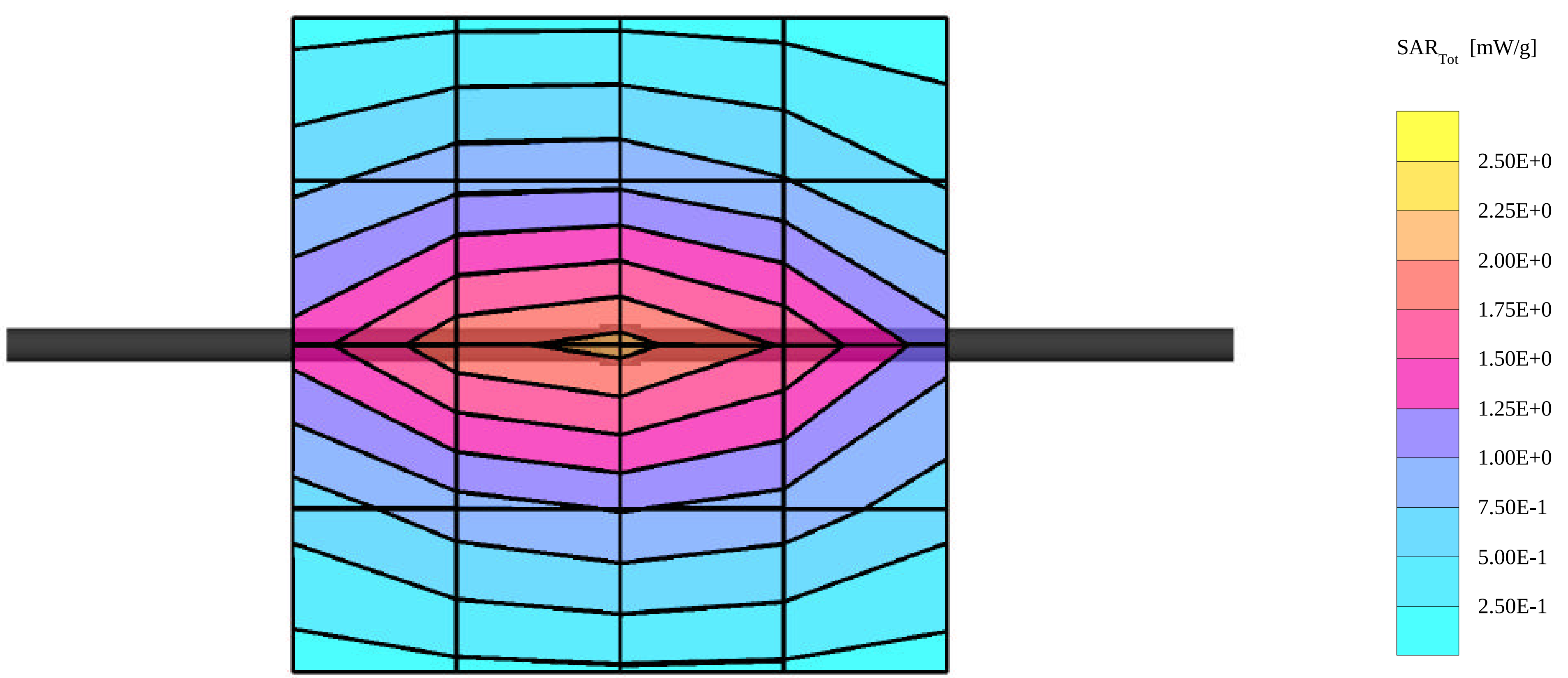
Generic Twin Phantom; Flat Section; Position: (90°,90°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Brain 835 MHz: $\sigma$ = 0.80 mho/m $\varepsilon_r$ = 44.2 $\rho$ = 1.00 g/cm³
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 2.02 mW/g, SAR (10g): 1.34 mW/g

Validation Date: May 31, 2001



# Validation Dipole D835V2 SN:411, d = 15mm

Frequency: 835 MHz; Antenna Input Power: 250 [mW]
Generic Twin Phantom; Flat Section; Grid Spacing: Dx = 20.0, Dy = 20.0, Dz = 10.0
Probe: ET3DV5 - SN1342/DAE3; ConvF(5.75,5.75,5.75); Brain 835 MHz: $\sigma$ = 0.80 mho/m $\varepsilon_r$ = 44.2 $\rho$ = 1.00 g/cm$^3$
Cubes (2): Peak: 3.07 mW/g ± 0.05 dB, SAR (1g): 2.06 mW/g ± 0.05 dB, SAR (10g): 1.38 mW/g ± 0.05 dB, (Worst-case extrapolation)
Penetration depth: 13.6 (12.7, 14.8) [mm]
Powerdrift: -0.00 dB



## *APPENDIX C - PROBE CALIBRATION*

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 08 60, Fax +41 1 280 08 64

# Probe ET3DV6

## SN:1387

Manufactured: September 21, 1999
Last calibration: September 22, 1999

Calibrated for System DASY3

# DASY3 - Parameters of Probe: ET3DV6 SN:1387

## Sensitivity in Free Space

| | | |
|---|---|---|
| NormX | **1.55** | $\mu V/(V/m)^2$ |
| NormY | **1.65** | $\mu V/(V/m)^2$ |
| NormZ | **1.64** | $\mu V/(V/m)^2$ |

## Diode Compression

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

## Sensitivity in Tissue Simulating Liquid

**Brain 450 MHz** $e_r$ **= 48 ± 5%** **s = 0.50 ± 10% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **6.76** | extrapolated | Boundary effect: | |
| ConvF Y | **6.76** | extrapolated | Alpha | **0.30** |
| ConvF Z | **6.76** | extrapolated | Depth | **2.52** |

**Brain 900 MHz** $e_r$ **= 42.5 ± 5%** **s = 0.86 ± 10% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **6.34** | ± 7% (k=2) | Boundary effect: | |
| ConvF Y | **6.34** | ± 7% (k=2) | Alpha | **0.47** |
| ConvF Z | **6.34** | ± 7% (k=2) | Depth | **2.25** |

**Brain 1500 MHz** $e_r$ **= 41 ± 5%** **s = 1.32 ± 10% mho/m**

| | | | | |
|---|---|---|---|---|
| ConvF X | **5.78** | interpolated | Boundary effect: | |
| ConvF Y | **5.78** | interpolated | Alpha | **0.69** |
| ConvF Z | **5.78** | interpolated | Depth | **1.88** |

**Brain 1800 MHz** $e_r$ **= 41 ± 5%** **s = 1.69 ± 10% mho/m**

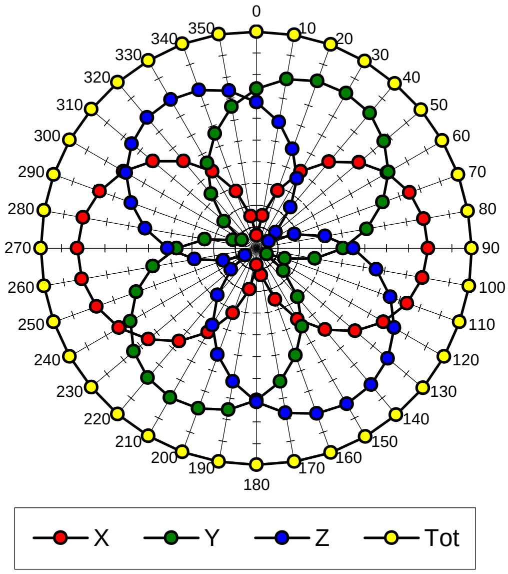
| | | | | |
|---|---|---|---|---|
| ConvF X | **5.50** | ± 7% (k=2) | Boundary effect: | |
| ConvF Y | **5.50** | ± 7% (k=2) | Alpha | **0.81** |
| ConvF Z | **5.50** | ± 7% (k=2) | Depth | **1.70** |

## Sensor Offset

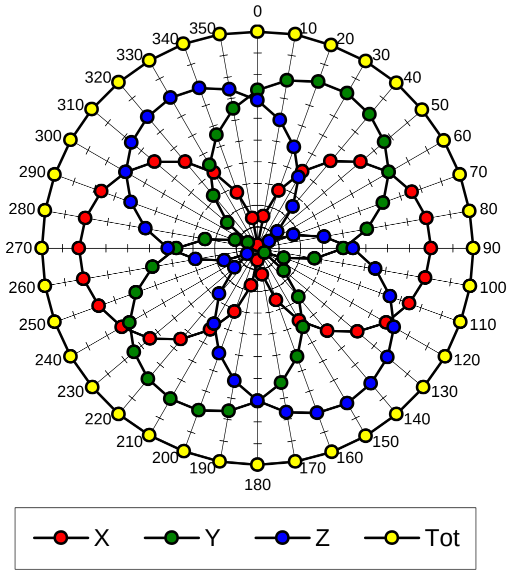
| | | |
|---|---|---|
| Probe Tip to Sensor Center | **2.7** | mm |
| Optical Surface Detection | **1.6 ± 0.2** | mm |

# Receiving Pattern (φ), θ = 0°

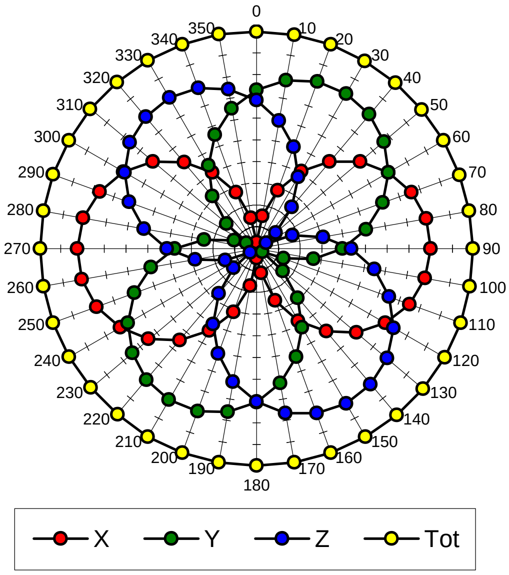
**f = 30 MHz, TEM cell ifi110**



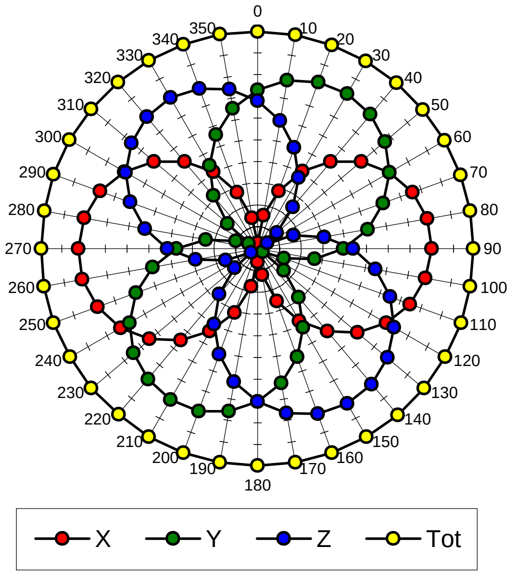

**f = 100 MHz, TEM cell ifi110**

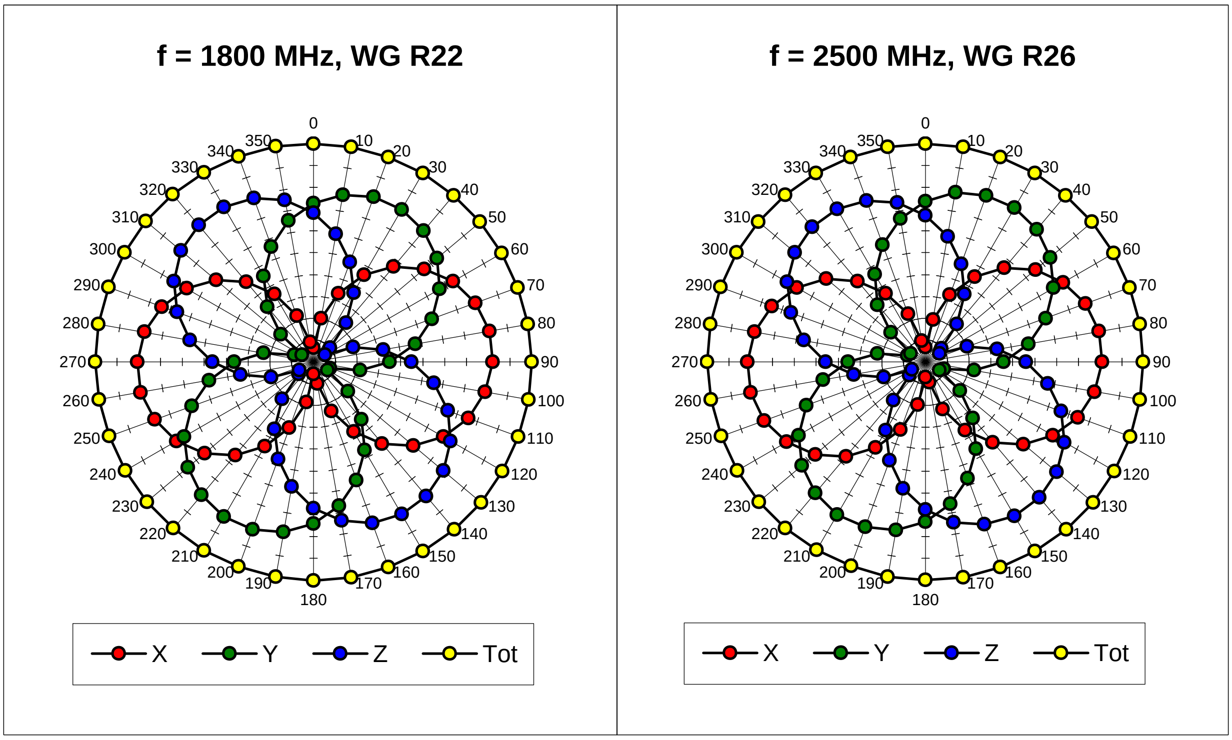



**f = 300 MHz, TEM cell ifi110**

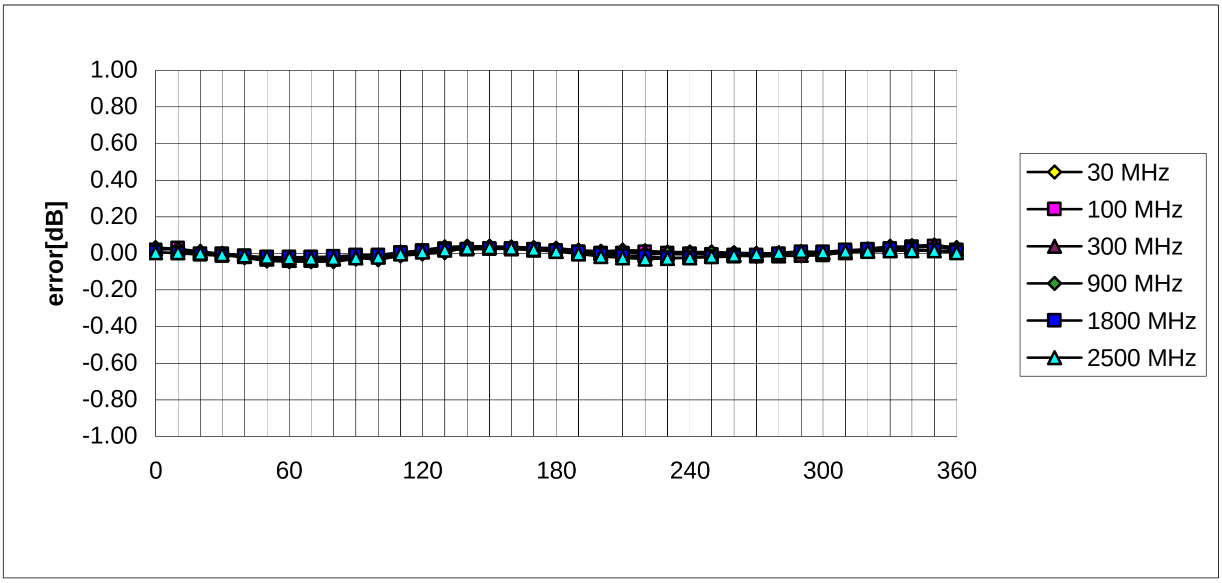



**f = 900 MHz, TEM cell ifi110**



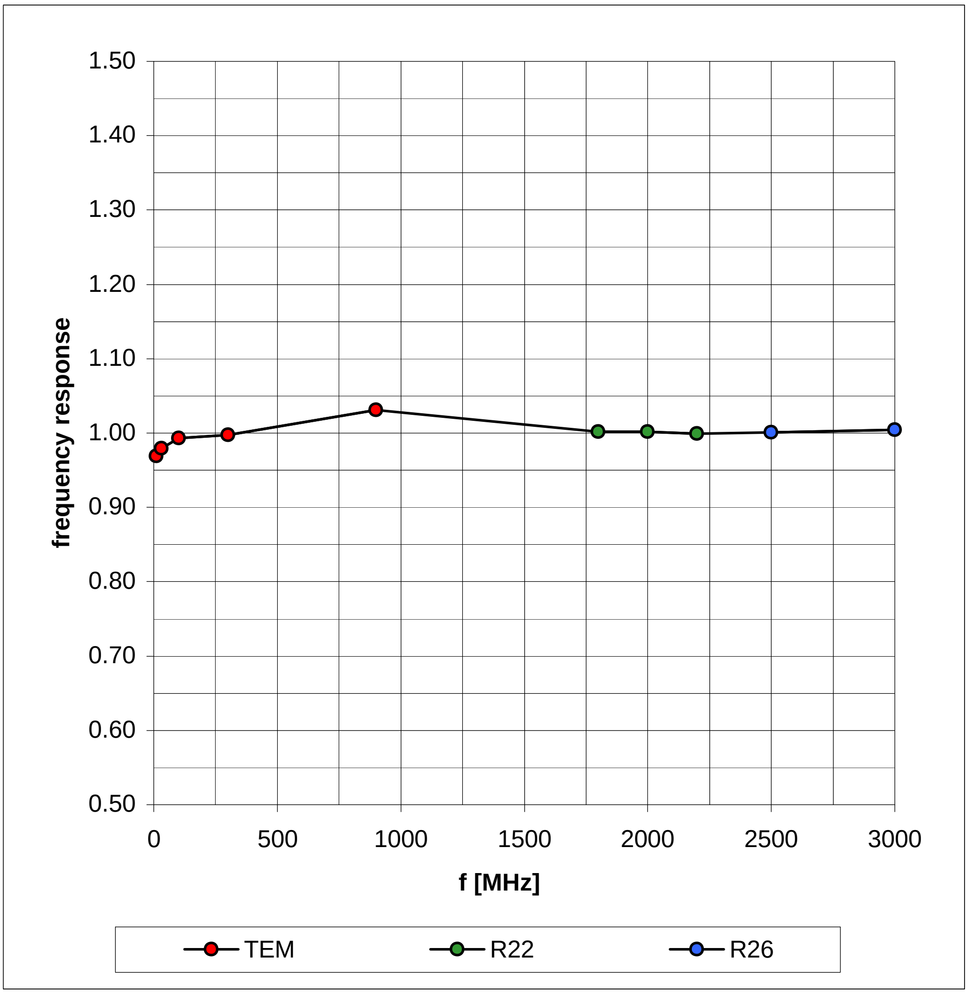



# Isotropy Error (f), q = 0°



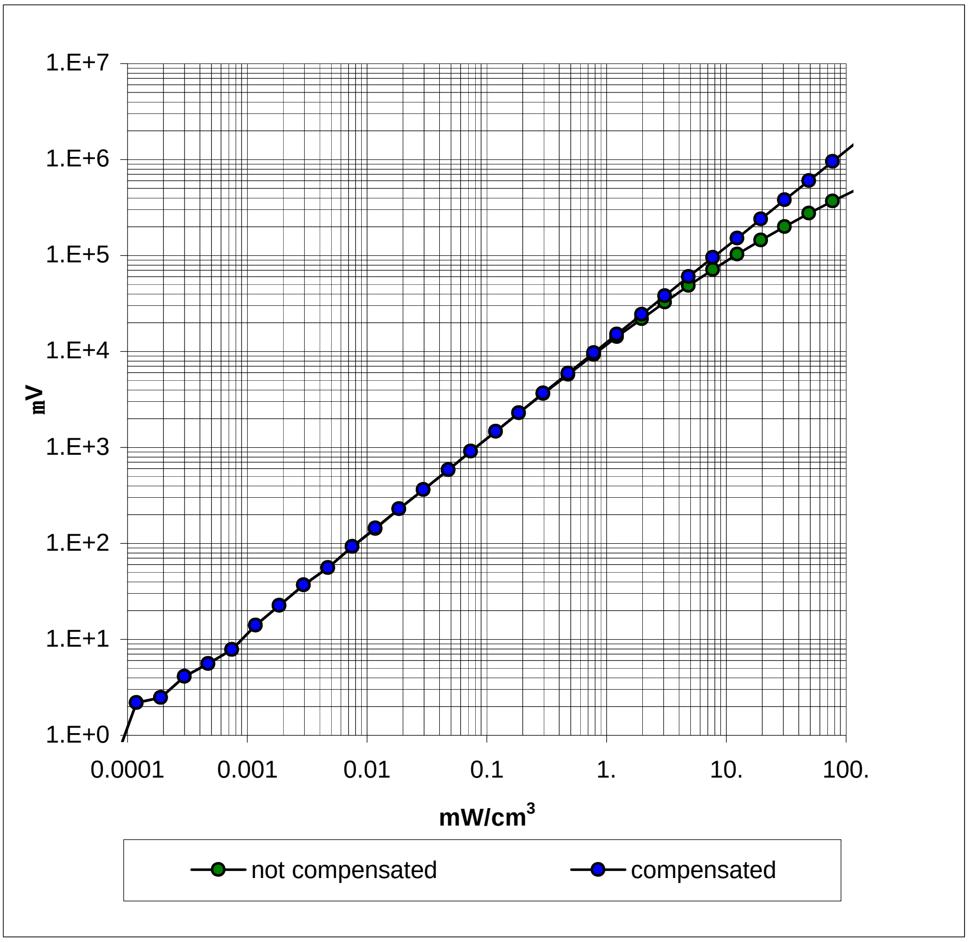
# Frequency Response of E-Field

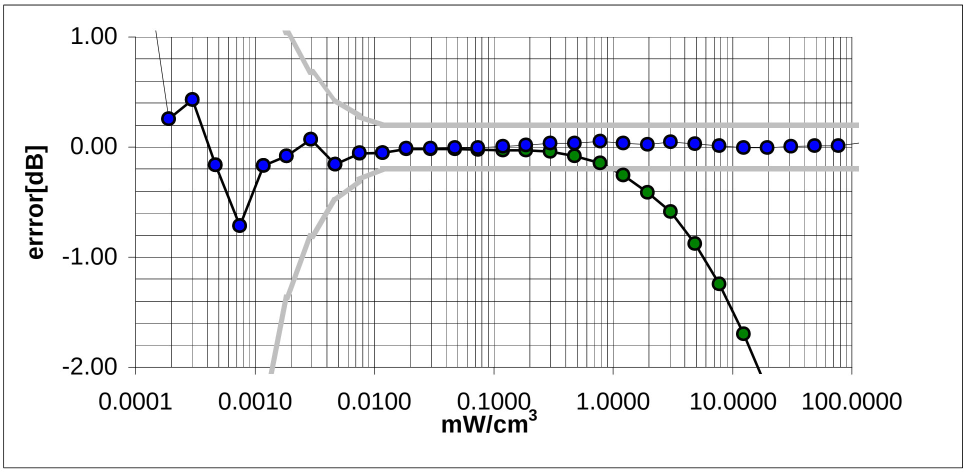
**( TEM-Cell:ifi110, Waveguide R22, R26 )**



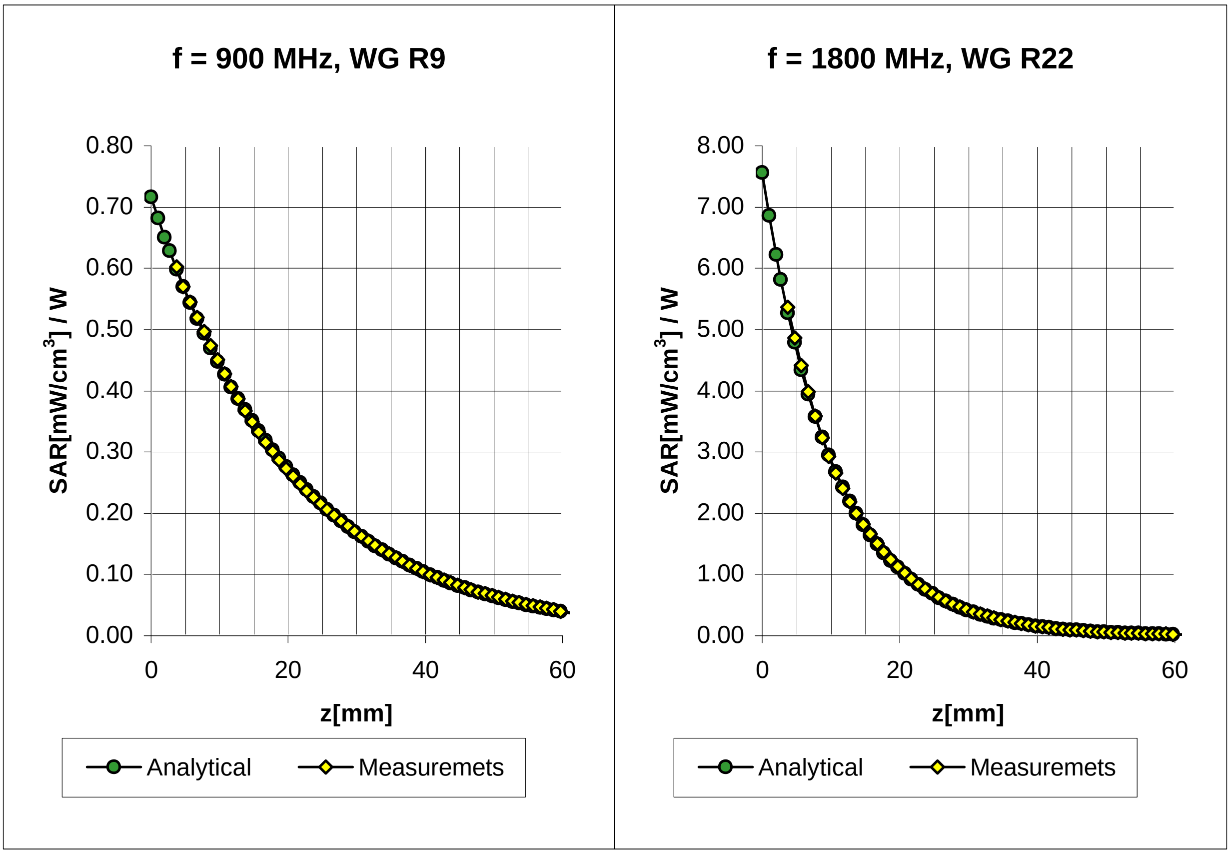
# Dynamic Range f($SAR_{brain}$)

**( TEM-Cell:ifi110 )**



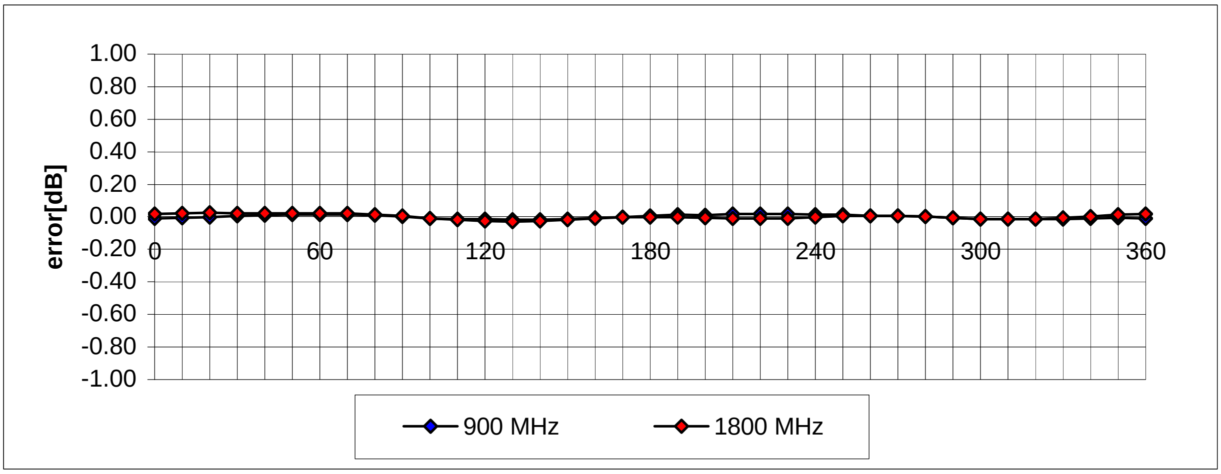



# Conversion Factor Assessment




# Receiving Pattern (f)

## ( in brain tissue, z = 5 mm )

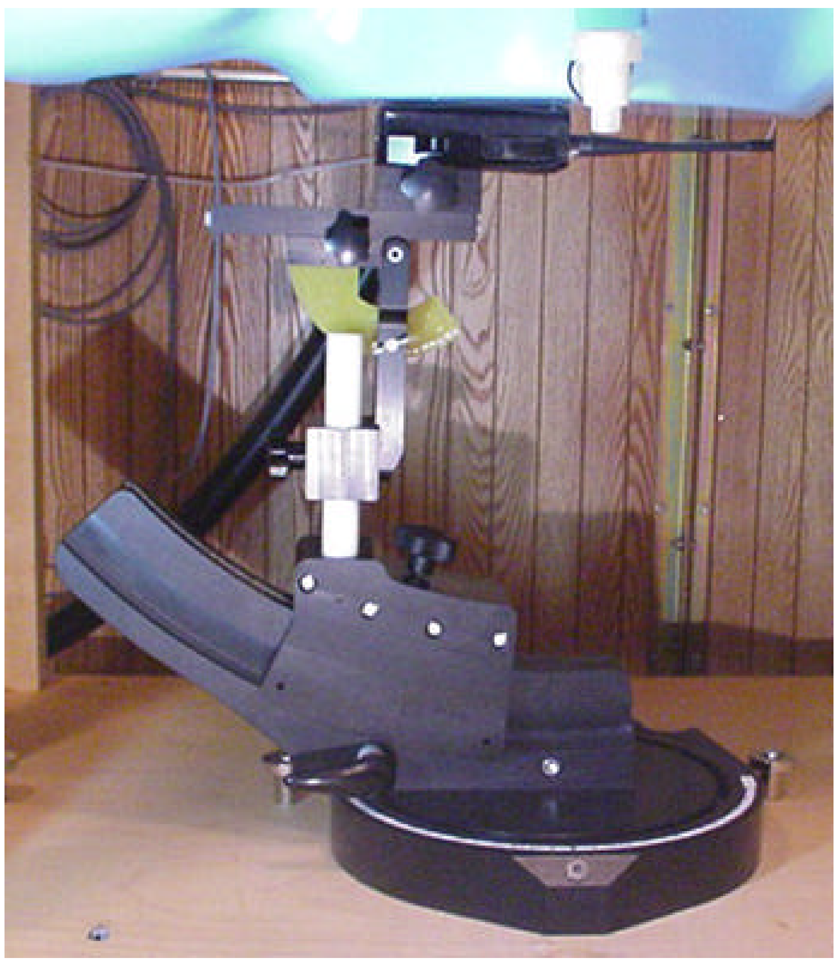


## *APPENDIX D - SAR TEST SETUP PHOTOGRAPHS*

## FACE-HELD SAR TEST SETUP PHOTOGRAPHS
## 4.0cm Separation Distance

**BODY-WORN SAR TEST SETUP PHOTOGRAPHS**
**with 1.0cm Metal Belt-Clip**

**BODY-WORN SAR TEST SETUP PHOTOGRAPHS**
**with 0.9cm Leather Belt-Holster**



***APPENDIX E - EUT PHOTOGRAPHS***

## EUT PHOTOGRAPHS


**EUT PHOTOGRAPHS**
**with 1.0cm Metal Belt-Clip**

# EUT PHOTOGRAPHS
## with 0.9cm Leather Belt-Holster


## EUT PHOTOGRAPHS
## 0.9cm Leather Belt-Holster