CERTIFICATE OF COMPLIANCE
SAR EVALUATION

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Applicant Information:

RELM WIRELESS CORPORATION
7100 Technology Drive
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FCC Rule Part(s):	**2.1093; ET Docket 96-326**
FCC ID:	**ARURPV516A**
Model(s):	**RPV516A**
EUT Type:	**Portable VHF PTT Radio Transceiver**
Modulation:	**FM**
Tx Frequency Range:	**150.05 - 173.95 MHz**
Conducted Power Tested:	**5.3 Watts**
Antenna Type:	**Helical Whip**
Battery Type:	**7.2VDC, 1100mAh, Ni-Cd**
Body-Worn Accessory:	**1.4cm Belt-Clip**

Celltech Research Inc. declares under its sole responsibility that this device was found to be in compliance with the Specific Absorption Rate (SAR) RF exposure requirements specified in OET Bulletin 65, Supplement C, Edition 01-01 (General Population/Uncontrolled Exposure), and was tested in accordance with the appropriate measurement standards, guidelines, and recommended practices specified in American National Standards Institute C95.1-1992.

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.

This test report shall not be reproduced partially, or in full, without the prior written approval of Celltech Research Inc. The results and statements contained in this report pertain only to the device(s) evaluated.

Shawn McMillen
General Manager
Celltech Research Inc.

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1.0 INTRODUCTION

This measurement report shows compliance of the RELM WIRELESS CORP. Model: RPV516A Portable VHF PTT Radio Transceiver FCC ID: ARURPV516A with the regulations and procedures specified in FCC Part 2.1093, ET Docket 96-326 Rules. The test procedures, as described in American National Standards Institute C95.1-1992 (see reference [1]), and FCC OET Bulletin 65, Supplement C, Edition 01-01 (see reference [2]) 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 ET Docket 96.326	**Modulation**	FM
EUT Type	Portable VHF PTT Radio Transceiver	**Tx Frequency Range (MHz)**	150.05 - 173.95
FCC ID	ARURPV516A	**Conducted Power Tested**	5.3 Watts
Model No.(s)	RPV516A	**Antenna Type(s)**	Helical Whip
Serial No.	Pre-production	**Power Supply**	Ni-Cd Battery (DC 7.2V 1100mAh)

Front of EUT

Back of EUT

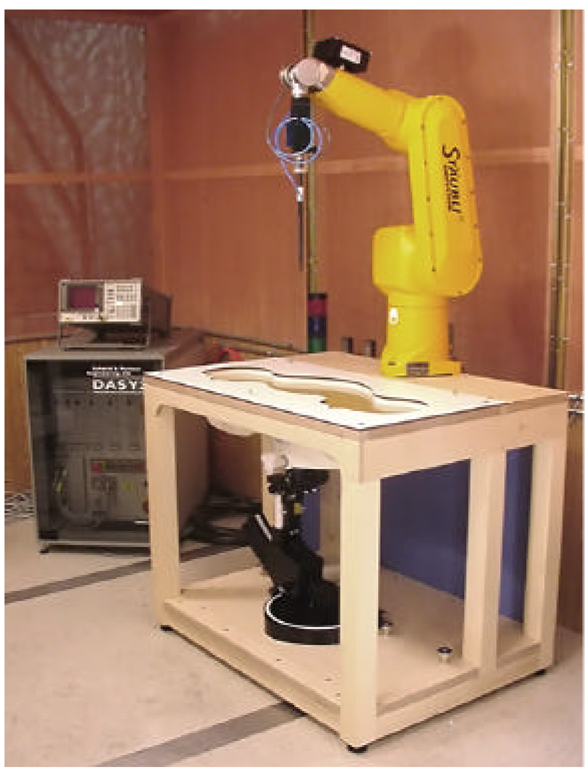

Left Side of EUT


Right Side of EUT


EUT with Speaker/Mic

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 SAM phantom containing brain or body 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 with SAM phantom

4.0 SAR 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

Freq. (MHz)	Channel	Mode	Conducted Power (W)	Antenna Position	Separation Distance (cm)	SAR (w/kg)	
						100% Duty Cycle	50% Duty Cycle
150.05	Low	CW	5.3	Fixed	2.5	0.374	0.187
162.50	Mid	CW	5.3	Fixed	2.5	0.251	0.126
173.95	High	CW	5.3	Fixed	2.5	0.138	0.069
Mixture Type: Brain Dielectric Constant: 52.6 Conductivity: 0.76			**ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak - Uncontrolled Exposure/General Population BRAIN: 1.6 W/kg (averaged over 1 gram)**				

Notes:

1. The SAR values found were below the maximum limit of 1.6 w/kg (uncontrolled exposure).
2. The highest face-held SAR value found was 0.374 w/kg (100% duty cycle).
3. The EUT was tested for face-held SAR with a 2.5 cm separation distance between the front of the EUT and the outer surface of the planar phantom.
4. Ambient TEMPERATURE: 23.1 °C
   Relative HUMIDITY: 57.3 %
   Atmospheric PRESSURE: 100.2 kPa
5. Fluid Temperature ≈ 23 °C
6. During the entire test the conducted power was maintained to within 5% of the initial conducted power.

Face-held SAR Test Setup
2.5cm Separation Distance

Body-Worn SAR Measurements

Freq. (MHz)	Channel	Mode	Conducted Power (W)	Antenna Position	Belt-Clip Separation Distance (cm)	SAR (w/kg)	
						100% Duty Cycle	50% Duty Cycle
150.05	Low	CW	5.3	Fixed	1.4	0.965	0.483
162.50	Mid	CW	5.3	Fixed	1.4	0.645	0.323
173.95	High	CW	5.3	Fixed	1.4	0.138	0.069
Mixture Type: Body Dielectric Constant: 62.2 Conductivity: 0.80			**ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak - Uncontrolled Exposure/General Population BODY: 1.6 W/kg (averaged over 1 gram)**				

Notes:

1. The SAR values found were below the maximum limit of 1.6 w/kg (uncontrolled exposure).
2. The highest body-worn SAR value found was 0.965 w/kg (100% duty cycle).
3. The EUT was tested for body-worn SAR with a speaker-microphone. The attached belt-clip provided a 1.4cm separation distance between the back of the EUT and the outer surface of the planar phantom.
4. Ambient TEMPERATURE: 23.1 °C
   Relative HUMIDITY: 57.3 %
   Atmospheric PRESSURE: 100.2 kPa
5. Fluid Temperature ≈ 23 °C
6. During the entire test the conducted power was maintained to within 5% of the initial conducted power.

Body-worn SAR Test Setup
with Speaker-Microphone
& 1.4cm Belt-Clip

5.0 DETAILS OF SAR EVALUATION

The RELM WIRELESS CORP. Model: RPV516A Portable VHF PTT Radio Transceiver FCC ID: ARURPV516A was found to be compliant for localized Specific Absorption Rate (SAR) 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 the outer surface of the planar phantom and with a 2.5cm separation distance.
2. The EUT was tested in a body-worn configuration with a speaker-microphone. The attached belt-clip was touching the outer surface of the planar phantom and provided a 1.4cm separation distance between the back of the EUT and the outer surface of the planar phantom.
3. 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 level was checked before and after each test.
4. The conducted power was measured according to the procedures described in FCC Part 2.1046.
5. The location of the maximum spatial SAR distribution (Hot Spot) was determined relative to the device and its antenna.
6. The EUT was tested with a fully charged battery.

Note: Under continuous transmission the antenna became very warm and began to droop slightly. The device was cooled for brief periods during the evaluation in order to stabilize the antenna. The lower than expected SAR values reported for this particular EUT operating at the rated power levels can be attributed to excessive heating in the plastic antenna housing.

6.0 EVALUATION PROCEDURES

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

a. (i) The evaluation was performed in the 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 in accordance with FCC OET Bulletin 65, Supplement C (Edition 01-01).
   (ii) For body-worn and face-held devices 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.
e. The E-field probe conversion factors outside the calibrated points were determined as follows:
   - In brain and body tissue between 750MHz and 1GHz, the conversion factor decreases approximately 1.3% per 100MHz frequency increase.
   - In brain and body tissue between 1.6GHz and 2GHz, the conversion factor decreases approximately 1% per 100MHz frequency increase.

   For body tissue around 900MHz (permittivity about 30% higher and conductivity about 15% higher than brain tissue):
   - The conversion factor in body tissue is approximately 3% lower than for brain tissue for the same frequency.

7.0 SYSTEM VALIDATION

Prior to the assessment, the system was verified in the planar section of the phantom with a 900MHz dipole for devices operating below 1GHz, and an 1800MHz dipole for devices operating above 1GHz. A forward power of 250mW was applied to the dipole and system was verified to a tolerance of $\pm$10%. The applicable verifications are as follows (see Appendix B for validation test plot):

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D900V2	2.78	2.76

8.0 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:

TISSUE PARAMETERS FOR DIPOLE VALIDATION			
Brain Equivalent Tissue	**Dielectric Constant e_r**	**Conductivity s (mho/m)**	**r (Kg/m^3)**
900MHz (Target)	41.5 ±5%	0.97 ±5%	1000
900MHz (Measured) 10/16/01	42.4	0.97	1000

BRAIN TISSUE PARAMETERS - EUT EVALUATION			
Equivalent Tissue	**Dielectric Constant e_r**	**Conductivity s (mho/m)**	**r (Kg/m^3)**
150MHz Brain (Target)	52.3 ±5%	0.76 ±5%	1000
150MHz Brain (Measured: 10/16/01)	52.6	0.76	1000

BODY TISSUE PARAMETERS - EUT EVALUATION			
Equivalent Tissue	**Dielectric Constant e_r**	**Conductivity s (mho/m)**	**r (Kg/m^3)**
150MHz Body (Target)	61.9 ±5%	0.80 ±5%	1000
150MHz Body (Measured: 10/16/01)	62.2	0.80	1000

9.0 SIMULATED TISSUES

The brain and body 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 %		
	900MHz Brain (Validation)	150MHz Brain	150MHz Body
Water	51.07	38.35	46.6
Sugar	47.31	55.5	49.7
Salt	1.15	5.15	2.6
HEC	0.23	0.9	1.0
Bactericide	0.24	0.1	0.1

10.0 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.

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. Optical uplink for commands and clock

PC Interface Card

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

E-Field Probe

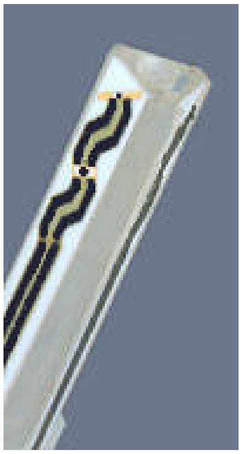
Model:	ET3DV6
Serial No.:	1590
Construction:	Triangular core fiber optic detection system
Frequency:	10 MHz to 6 GHz
Linearity:	± 0.2 dB (30 MHz to 3 GHz)

Phantom

Type:	SAM V4.0C
Shell Material:	Fiberglass
Thickness:	2.0 ± 0.1 mm
Volume:	Approx. 20 liters

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

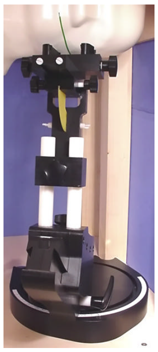
13.0 SAM PHANTOM V4.0C

The SAM phantom V4.0C is a fiberglass shell phantom with a 2.0mm shell thickness for left and right head and flat planar area integrated in a wooden table. The shape of the fiberglass shell corresponds to the phantom defined by SCC34-SC2. The device holder positions are adjusted to the standard measurement positions in the three sections.


SAM 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°. 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.


Device Holder

15.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
EQUIPMENT	***SERIAL NO.***	***CALIBRATION DATE***
DASY3 System -Robot -ET3DV6 E-Field Probe -DAE -900MHz Validation Dipole -1800MHz Validation Dipole -SAM Phantom V4.0C	 599396-01 1590 370 054 247 N/A	 N/A Mar 2001 Sept 1999 June 2001 June 2001 N/A
85070C Dielectric Probe Kit	N/A	N/A
Gigatronics 8652A Power Meter -Power Sensor 80701A -Power Sensor 80701A	1835272 1833535 1833542	Oct 1999 Jan 2001 Feb 2001
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: 1992.*

(2) Federal Communications Commission, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields", OET Bulletin 65, Supplement C (Edition 01-01), FCC, Washington, D.C. 20554: June 2001.

(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.

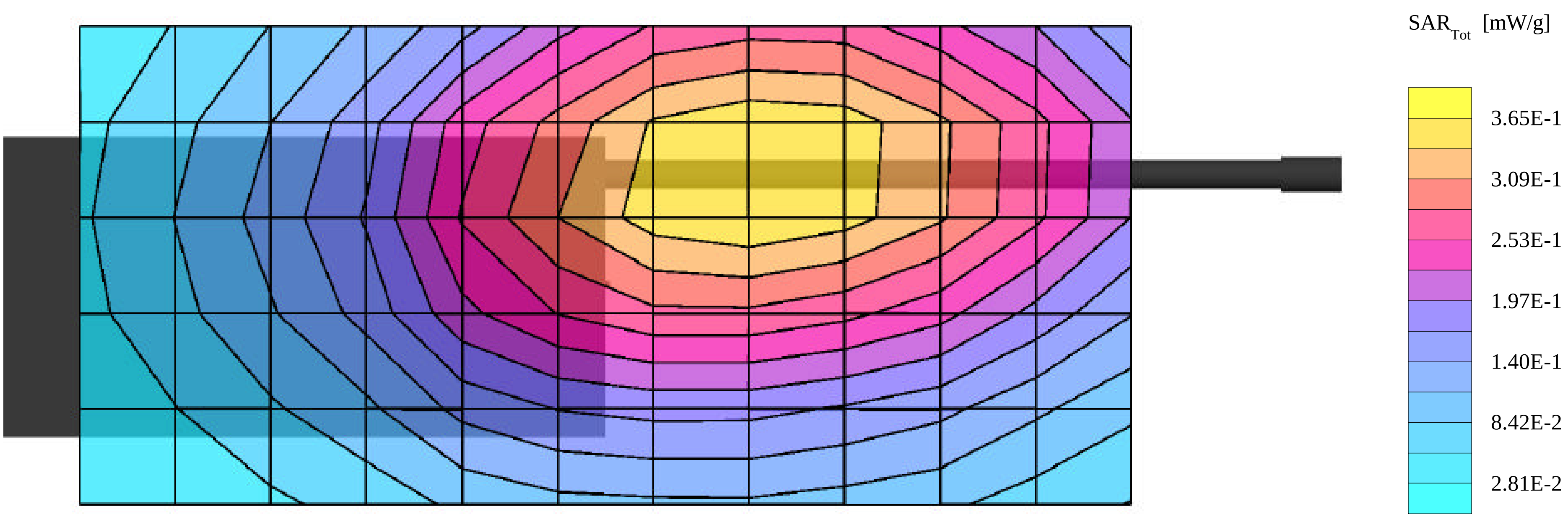
(4) Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with know precision", IEICE Transactions of Communications, vol. E80-B, no. 5, pp. 645 – 652: May 1997.

APPENDIX A - SAR MEASUREMENT DATA

RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.71,7.71,7.71); Crest factor: 1.0
150 MHz Brain : σ = 0.76 mho/m ε_r = 52.3 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.374 mW/g, SAR (10g): 0.282 mW/g

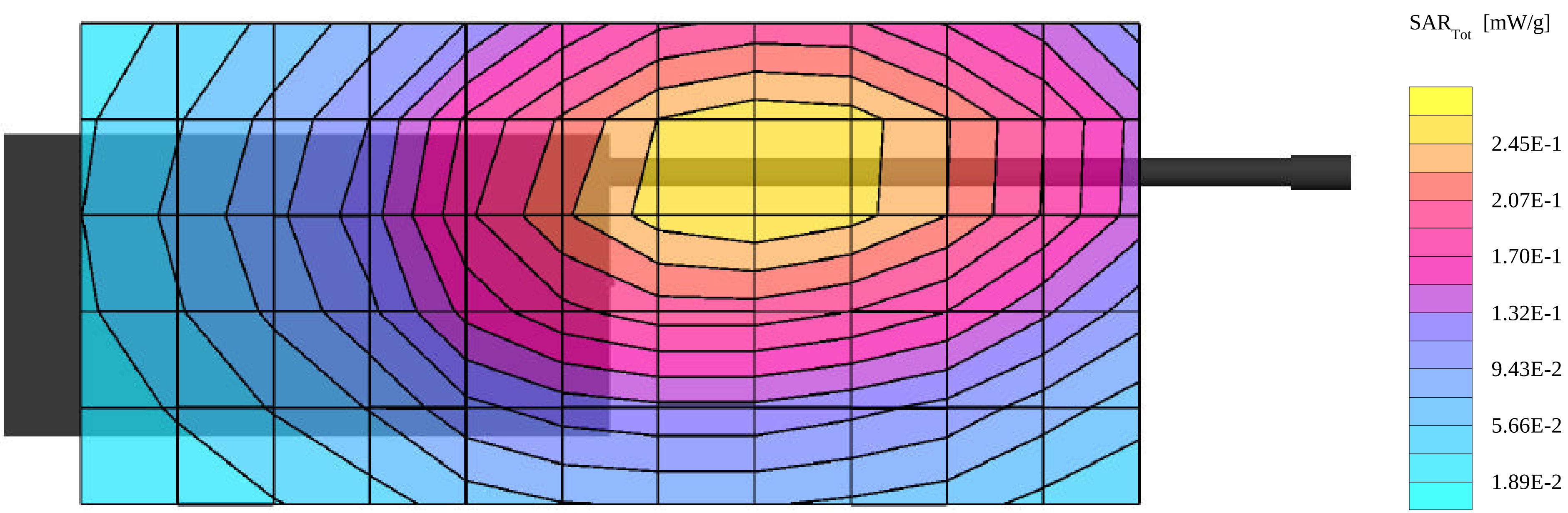
Face SAR at 2.5 cm Separation Distance
Relm Wireless Model: RPV516A
Continuous Wave Mode
Low Channel (150.05 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.71,7.71,7.71); Crest factor: 1.0
150 MHz Brain : σ = 0.76 mho/m ε_r = 52.3 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.251 mW/g , SAR (10g): 0.187 mW/g

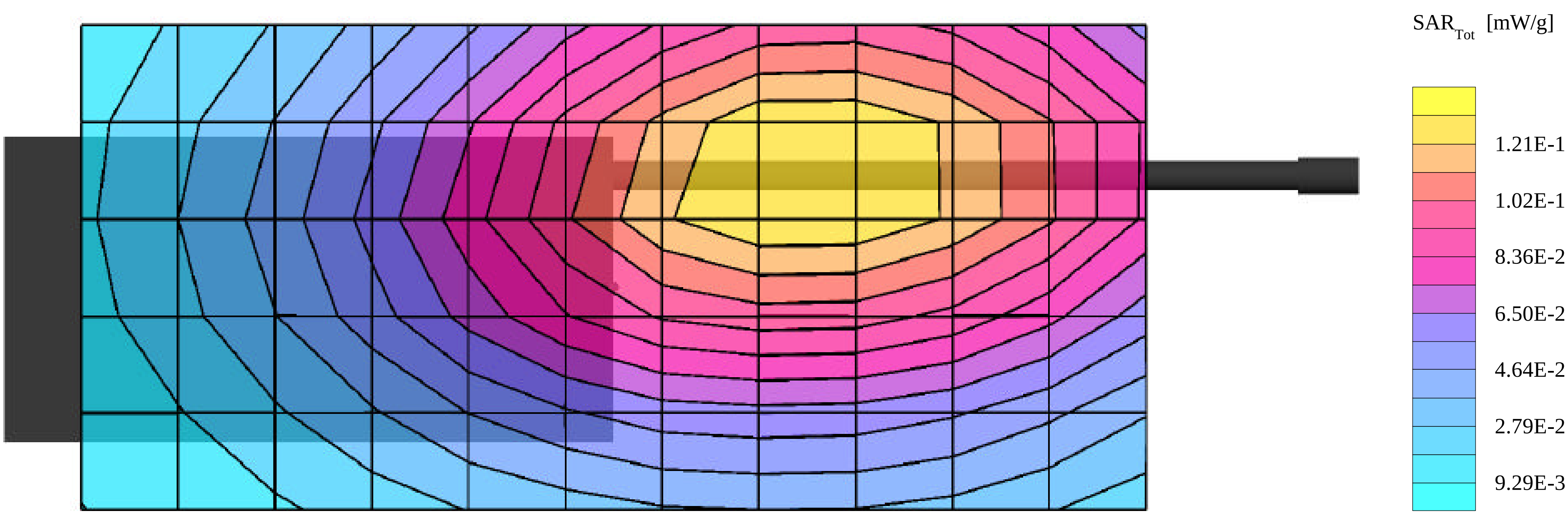
Face SAR at 2.5 cm Separation Distance
Relm Wireless Model: RPV516A
Continuous Wave Mode
Mid Channel (162.50 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (90°,90°)
Probe: ET3DV6 - SN1590; ConvF(7.71,7.71,7.71); Crest factor: 1.0
150 MHz Brain : σ = 0.76 mho/m ϵ_r = 52.3 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.138 mW/g, SAR (10g): 0.104 mW/g

Face SAR at 2.5 cm Separation Distance
Relm Wireless Model: RPV516A
Continuous Wave Mode
High Channel (173.95 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001

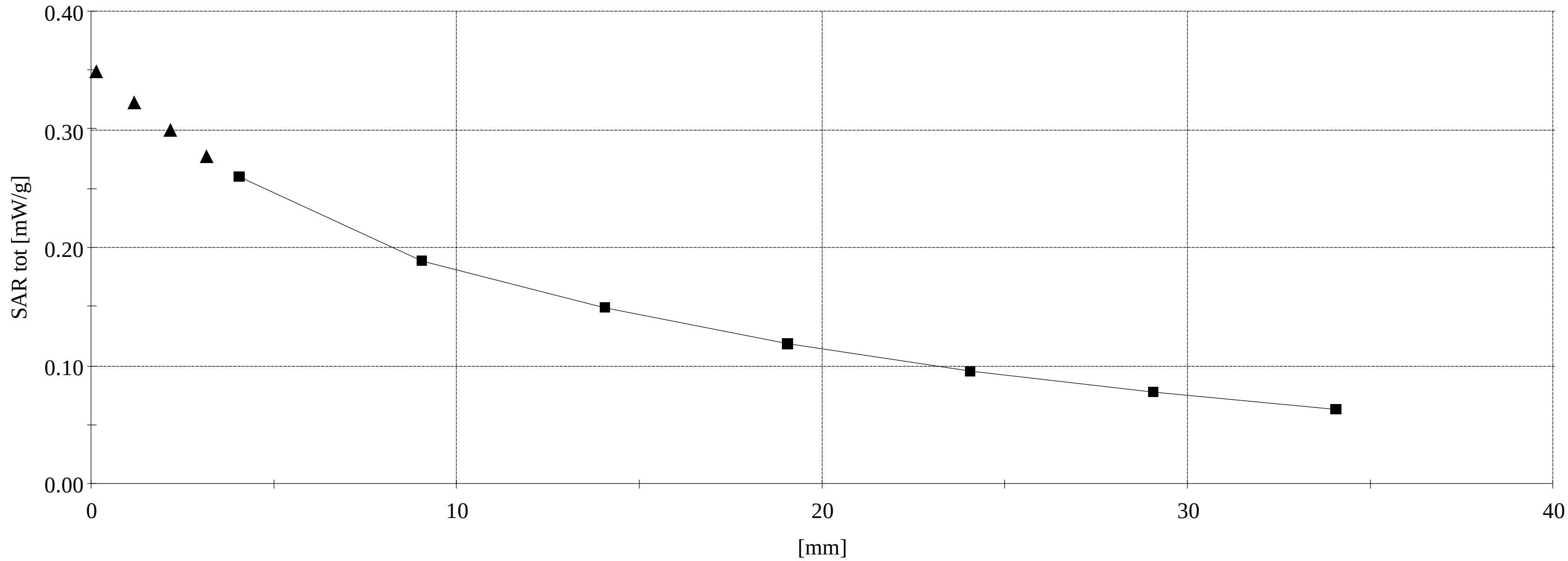


RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section
Probe: ET3DV6 - SN1590; ConvF(7.71,7.71,7.71); Crest factor: 1.0
150 MHz Brain : σ = 0.76 mho/m ε_r = 52.3 ρ = 1.00 g/cm^3
Cube 4x4x7

Z-Axis Extrapolation at Peak SAR Location

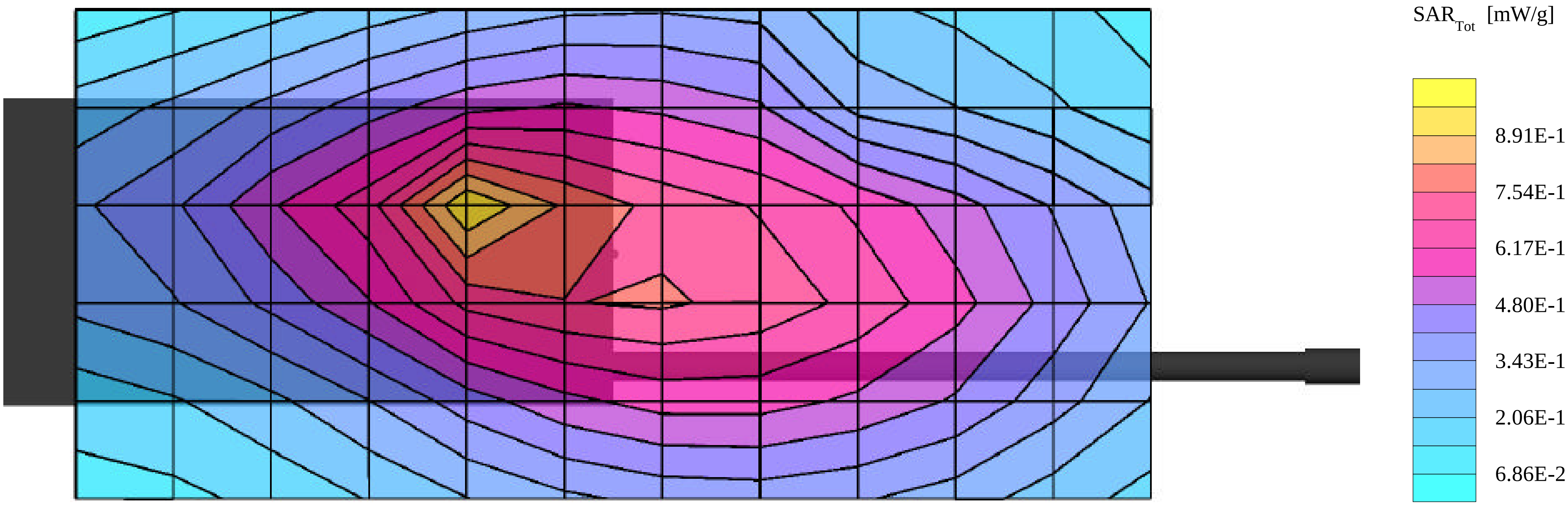
Face SAR at 2.5 cm Separation Distance
Relm Wireless Model: RPV516A
Continuous Wave Mode
Low Channel (150.05 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.65,7.65,7.65); Crest factor: 1.0
150 MHz Muscle: σ = 0.80 mho/m ε_r = 61.9 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.965 mW/g, SAR (10g): 0.612 mW/g

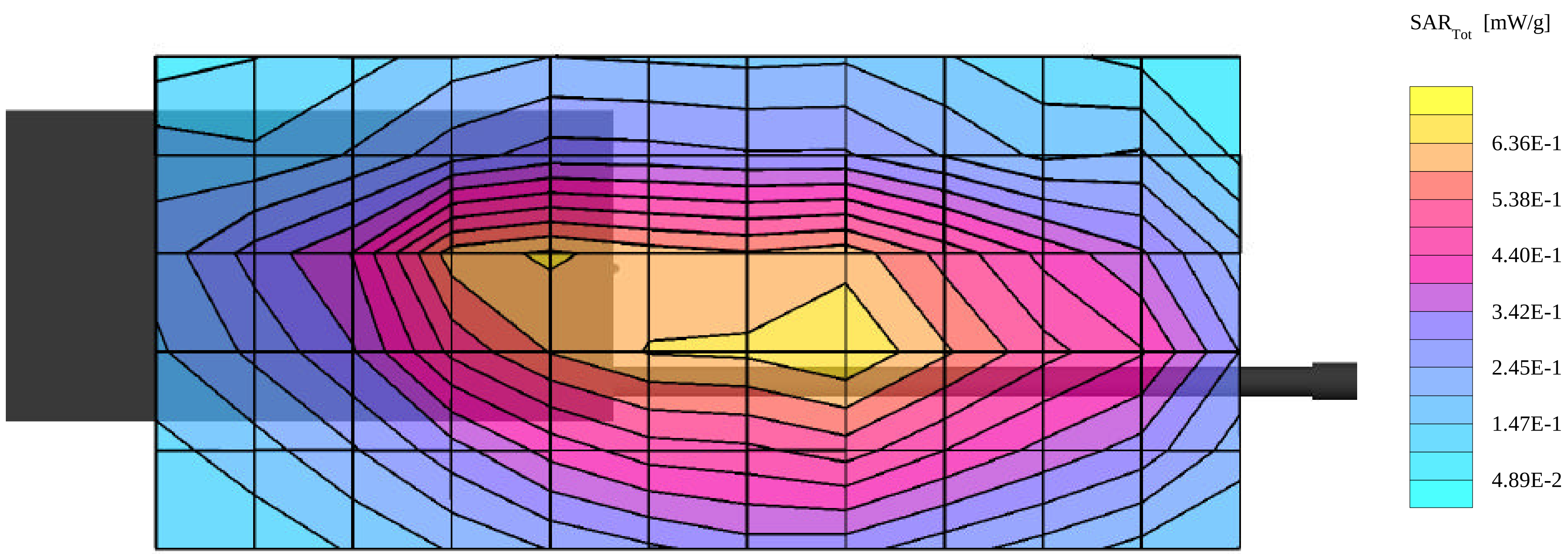
Body SAR with 1.4 cm Belt-Clip Separation
Relm Wireless Model: RPV516A
Continuous Wave Mode
Low Channel (150.05 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.65,7.65,7.65); Crest factor: 1.0
150 MHz Muscle: σ = 0.80 mho/m ε_r = 61.9 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.645 mW/g, SAR (10g): 0.468 mW/g

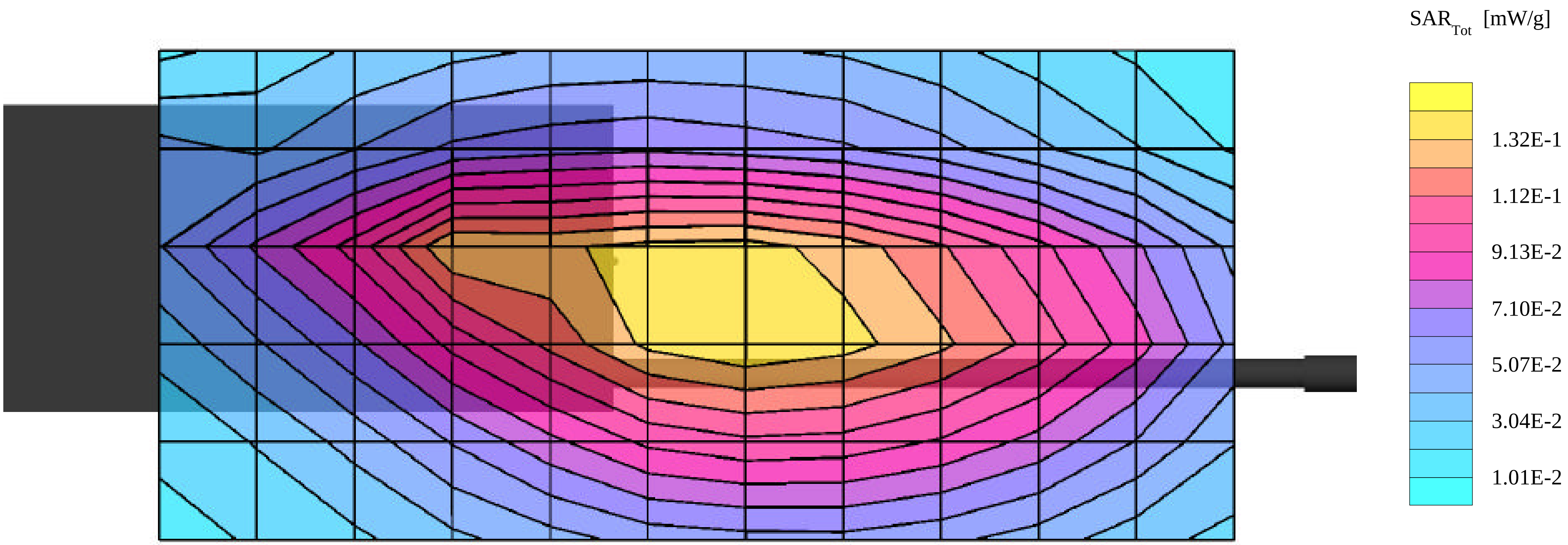
Body SAR with 1.4 cm Belt-Clip Separation
Relm Wireless Model: RPV516A
Continuous Wave Mode
Mid Channel (162.50 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section; Position: (270°,270°)
Probe: ET3DV6 - SN1590; ConvF(7.65,7.65,7.65); Crest factor: 1.0
150 MHz Muscle: σ = 0.80 mho/m ε_r = 61.9 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 4x4x7
SAR (1g): 0.138 mW/g , SAR (10g): 0.103 mW/g

Body SAR with 1.4 cm Belt-Clip Separation
Relm Wireless Model: RPV516A
Continuous Wave Mode
High Channel (173.95 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001

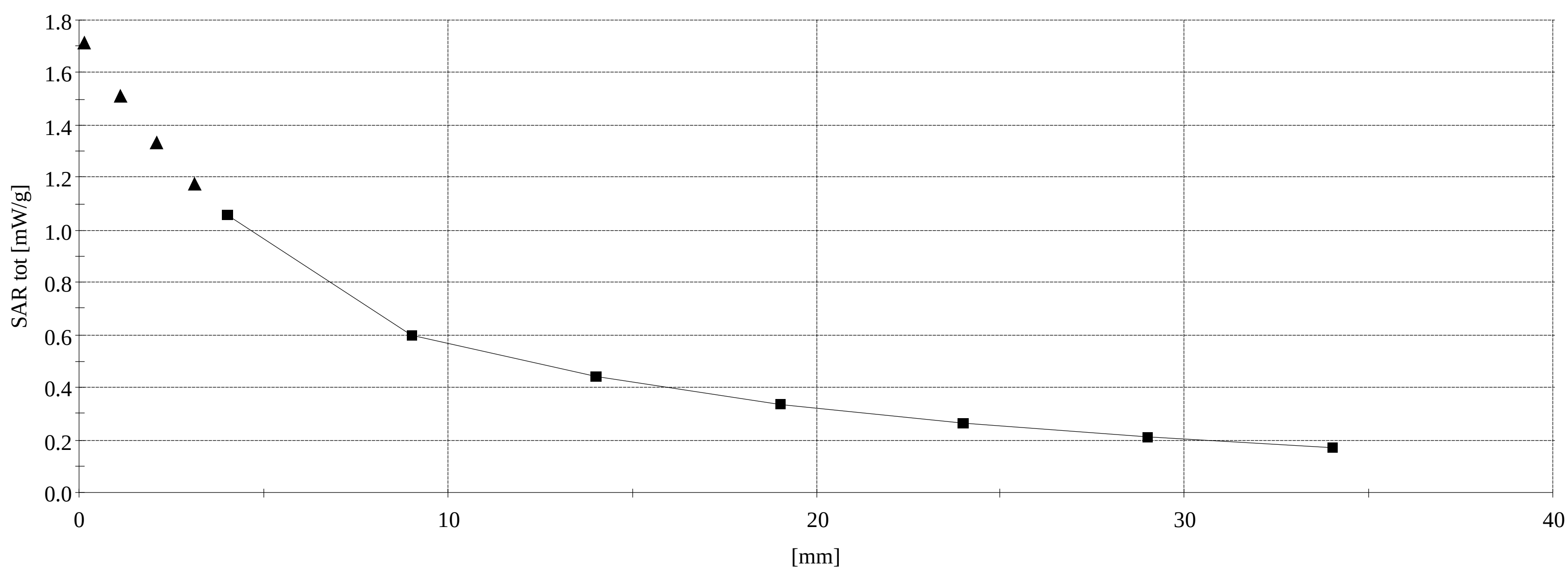


RELM Wireless Corporation FCC ID: ARURPV516A

SAM Phantom; Flat Section
Probe: ET3DV6 - SN1590; ConvF(7.65,7.65,7.65); Crest factor: 1.0;
150 MHz Muscle: σ = 0.80 mho/m ε_r = 61.9 ρ = 1.00 g/cm^3
Cube 4x4x7

Z-Axis Extrapolation at Peak SAR Location

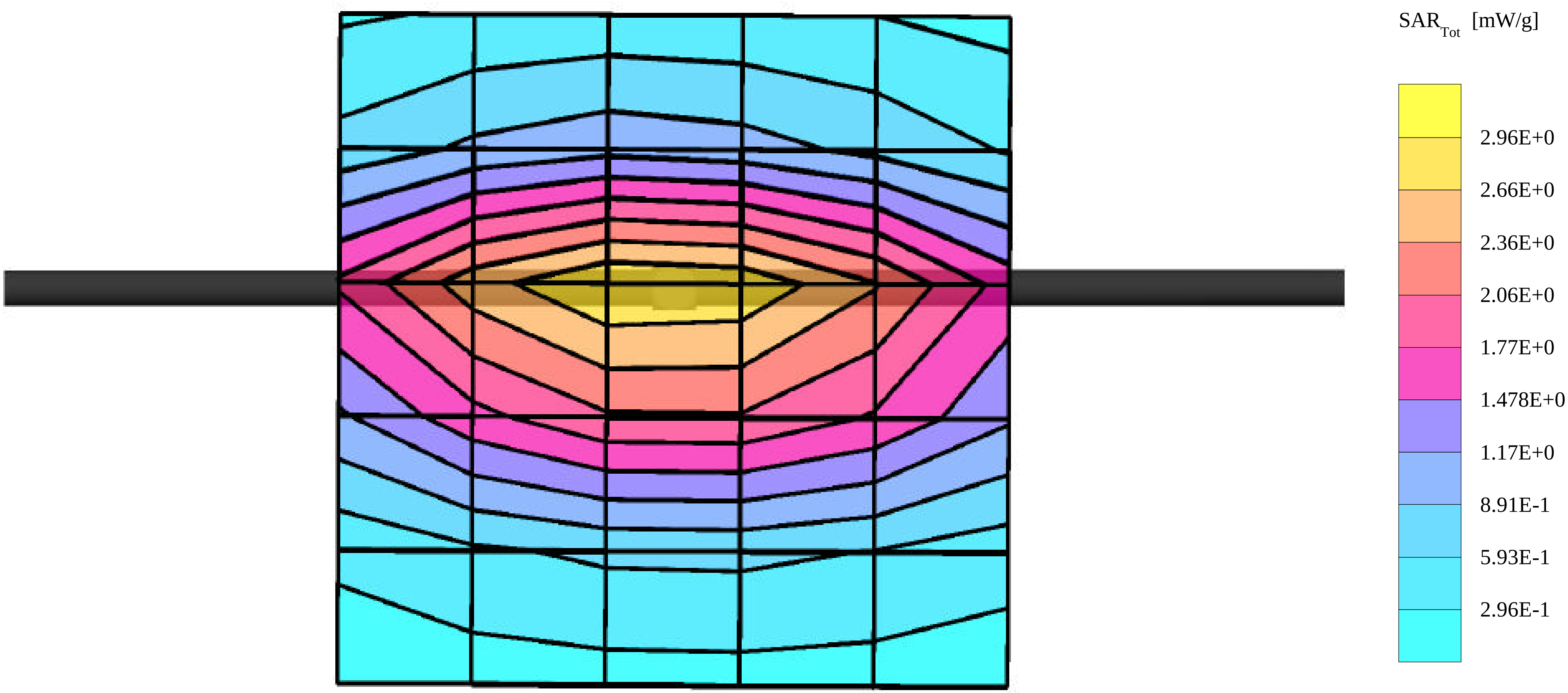
Body SAR with 1.4 cm Belt-Clip Separation
Relm Wireless Model: RPV516A
Continuous Wave Mode
Low Channel (150.05 MHz)
Conducted Power: 5.3 Watts
Date Tested: October 16, 2001



APPENDIX B - DIPOLE VALIDATION

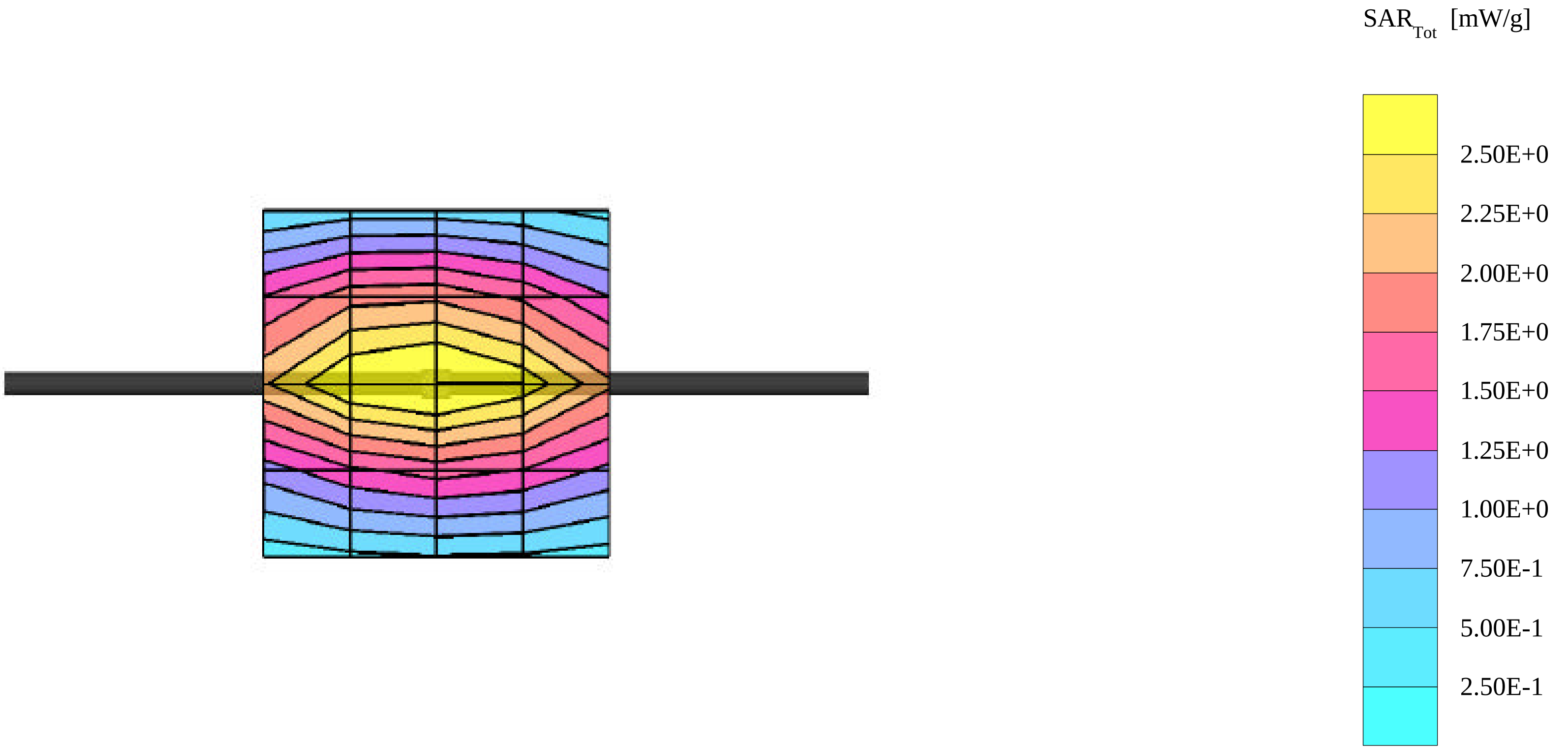
Dipole 900 MHz

SAM Phantom; Flat Section; - Validation Date: October 16, 2001
Probe: ET3DV6 - SN1590; ConvF(6.83,6.83,6.83); Crest factor: 1.0; Brain 900 MHz: σ = 0.97 mho/m ε_r = 42.4 ρ = 1.00 g/cm³
Cubes (2): Peak: 4.47 mW/g ± 0.00 dB, SAR (1g): 2.76 mW/g ± 0.00 dB, SAR (10g): 1.74 mW/g ± 0.00 dB, (Worst-case extrapolation)
Penetration depth: 11.5 (10.4, 12.9) [mm]
Powerdrift: -0.02 dB



Validation Dipole D900V2 SN:054, d = 15 mm

Frequency: 900 MHz; Antenna Input Power: 250 [mW]
Generic Twin Phantom; Flat Section; Grid Spacing:Dx = 15.0, Dy = 15.0, Dz = 10.0
Probe: ET3DV6 - SN1507; ConvF(6.27,6.27,6.27); Crest factor: 1.0; IEEE1528 900 MHz: σ = 0.97 mho/m ε_r = 42.4 ρ = 1.00 g/cm³
Cubes (2): Peak: 4.47 mW/g ± 0.05 dB, SAR (1g): 2.78 mW/g ± 0.04 dB, SAR (10g): 1.76 mW/g ± 0.02 dB, (Worst-case extrapolation)
Penetration depth: 11.5 (10.3, 13.2) [mm]
Powerdrift: -0.00 dB



APPENDIX C - PROBE CALIBRATION

Probe ET3DV6

SN:1590

Manufactured: March 19, 2001
Calibrated: March 26, 2001

Calibrated for System DASY3

DASY3 - Parameters of Probe: ET3DV6 SN:1590

Sensitivity in Free Space

NormX	**1.77**	$\mu V/(V/m)^2$
NormY	**1.91**	$\mu V/(V/m)^2$
NormZ	**1.67**	$\mu V/(V/m)^2$

Diode Compression

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

Sensitivity in Tissue Simulating Liquid

Head **450 MHz** e_r **= 43.5 ± 5%** s **= 0.87 ± 10% mho/m**

ConvF X	**7.36**	extrapolated	Boundary effect:	
ConvF Y	**7.36**	extrapolated	Alpha	**0.29**
ConvF Z	**7.36**	extrapolated	Depth	**2.72**

Head **900 MHz** e_r **= 42 ± 5%** s **= 0.97 ± 10% mho/m**

ConvF X	**6.83**	± 7% (k=2)	Boundary effect:	
ConvF Y	**6.83**	± 7% (k=2)	Alpha	**0.37**
ConvF Z	**6.83**	± 7% (k=2)	Depth	**2.48**

Head **1500 MHz** e_r **= 40.4 ± 5%** s **= 1.23 ± 10% mho/m**

ConvF X	**6.13**	interpolated	Boundary effect:	
ConvF Y	**6.13**	interpolated	Alpha	**0.47**
ConvF Z	**6.13**	interpolated	Depth	**2.17**

Head **1800 MHz** e_r **= 40 ± 5%** s **= 1.40 ± 10% mho/m**

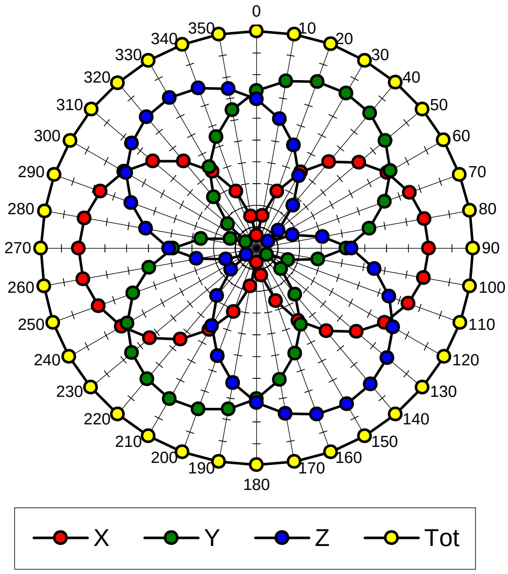
ConvF X	**5.78**	± 7% (k=2)	Boundary effect:	
ConvF Y	**5.78**	± 7% (k=2)	Alpha	**0.53**
ConvF Z	**5.78**	± 7% (k=2)	Depth	**2.01**

Sensor Offset

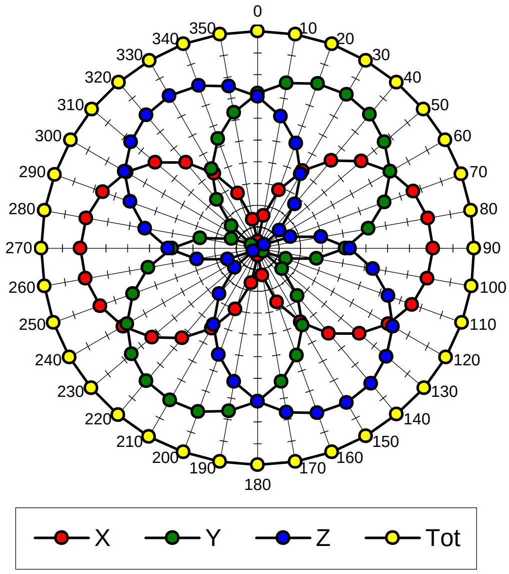
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.2 ± 0.2**	mm

Receiving Pattern (φ), θ = 0°

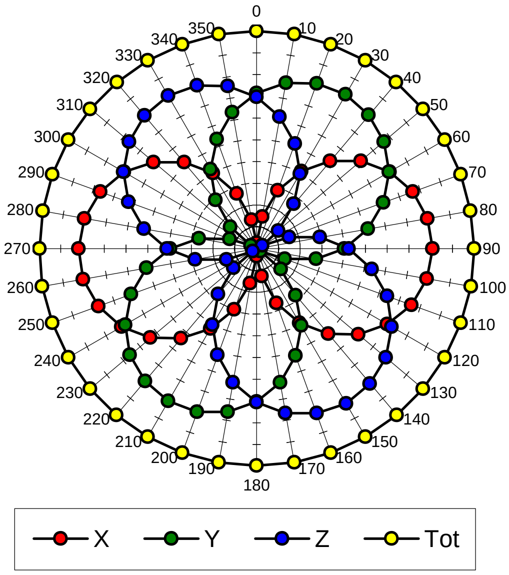
f = 30 MHz, TEM cell ifi110



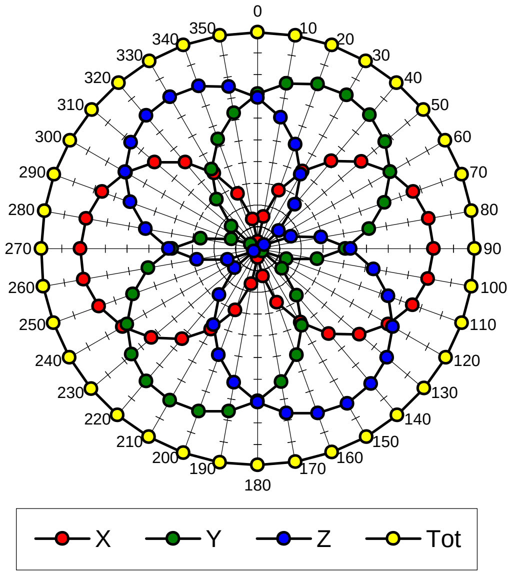
f = 100 MHz, TEM cell ifi110

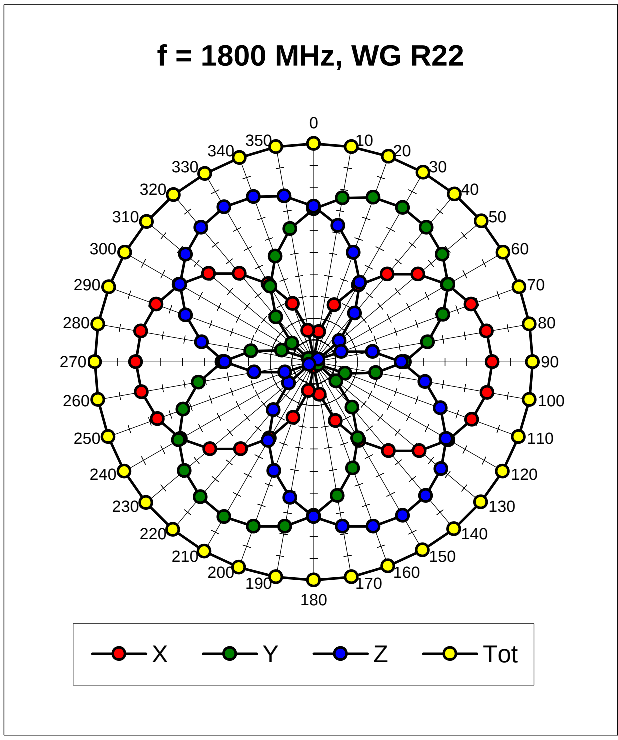


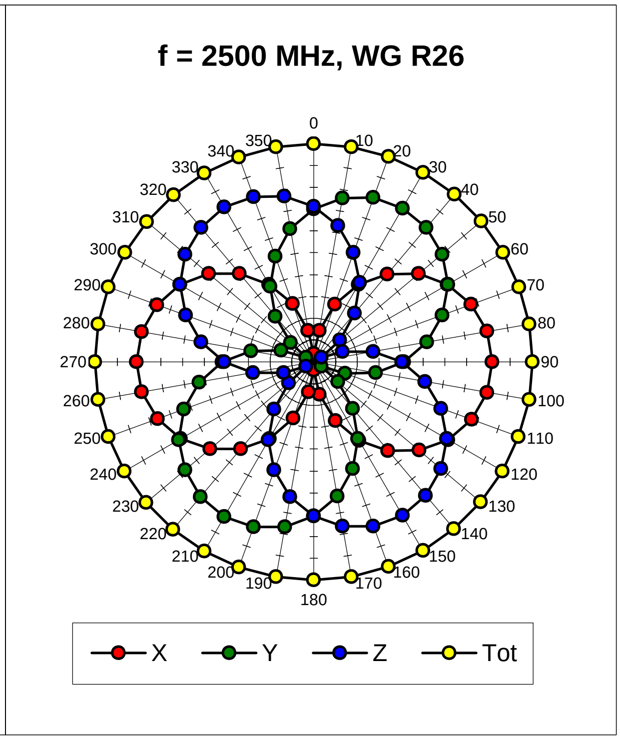
f = 300 MHz, TEM cell ifi110



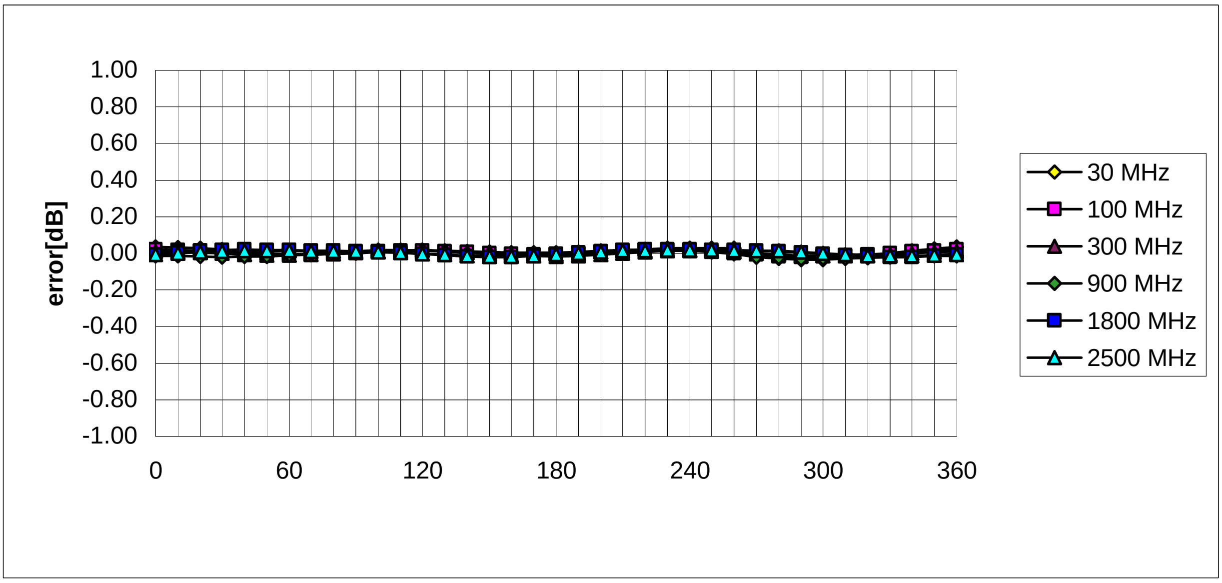
f = 900 MHz, TEM cell ifi110





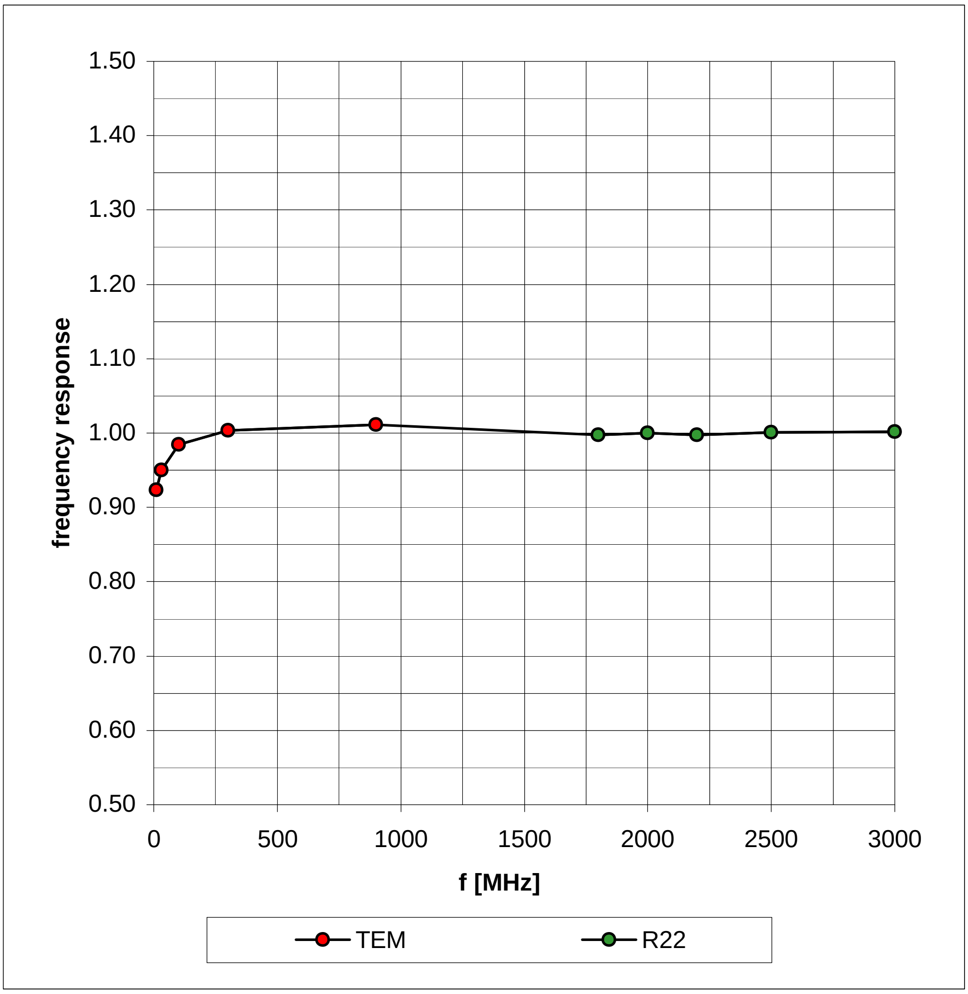


Isotropy Error (f), q = 0°



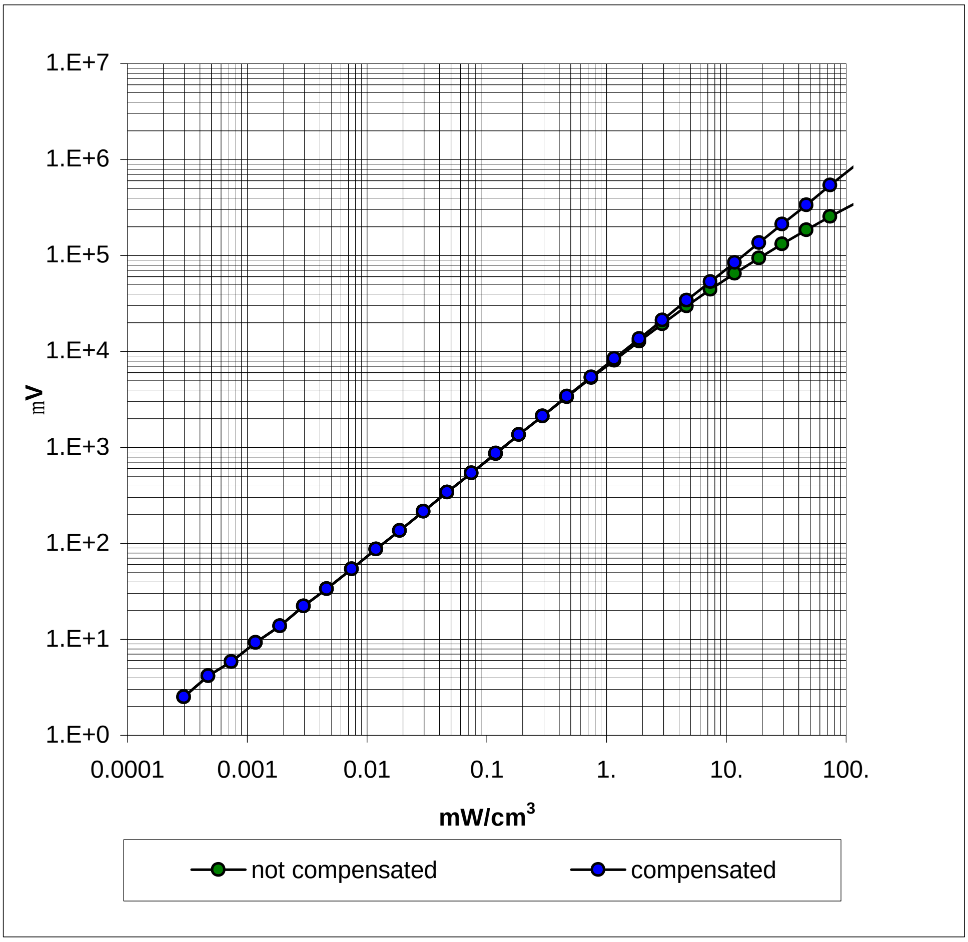
Frequency Response of E-Field

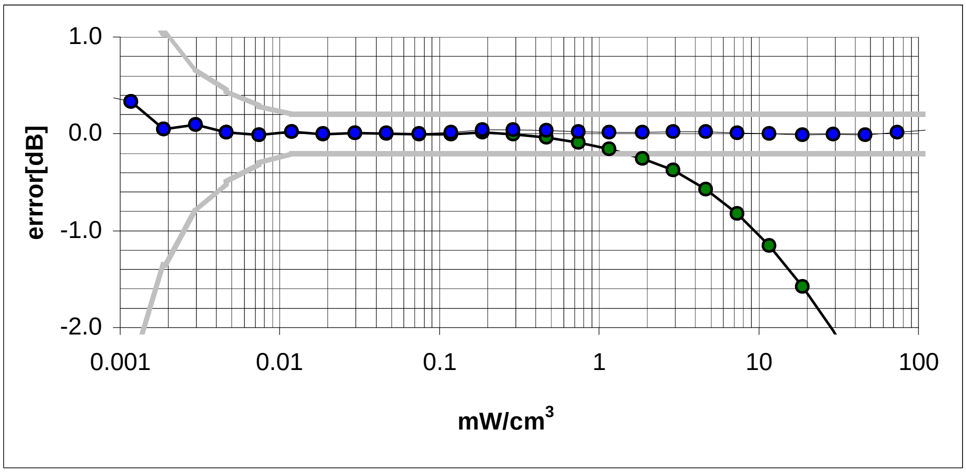
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SAR_{brain})

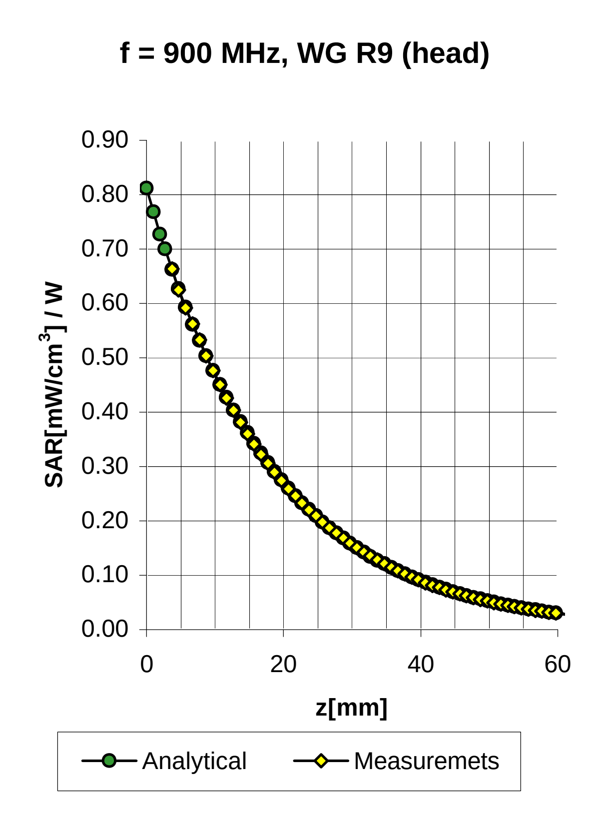
(TEM-Cell:ifi110)

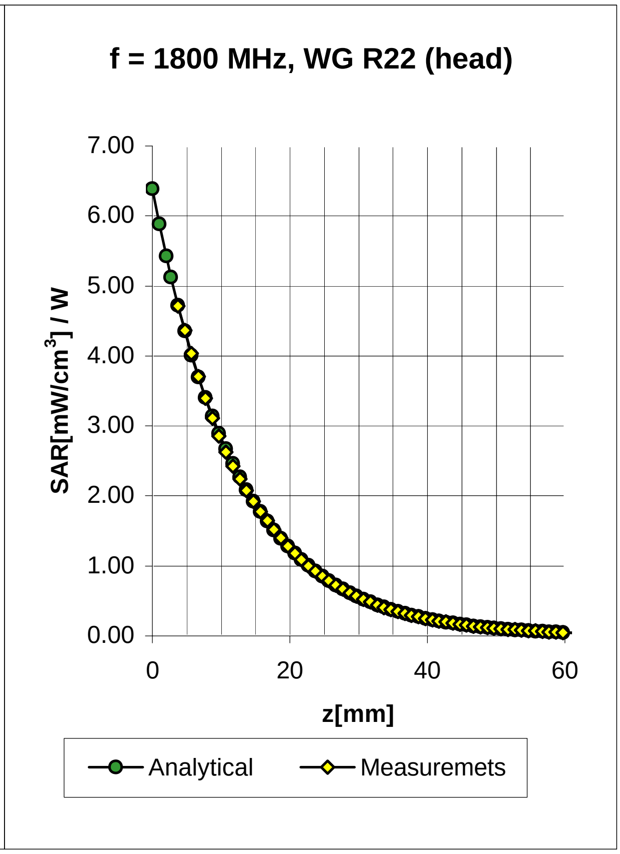




ET3DV6 SN:1590

Conversion Factor Assessment





Head **900 MHz** e_r **= 42 ± 5%** s **= 0.97 ± 10% mho/m**

ConvF X	**6.83**	± 7% (k=2)	Boundary effect:	
ConvF Y	**6.83**	± 7% (k=2)	Alpha	**0.37**
ConvF Z	**6.83**	± 7% (k=2)	Depth	**2.48**

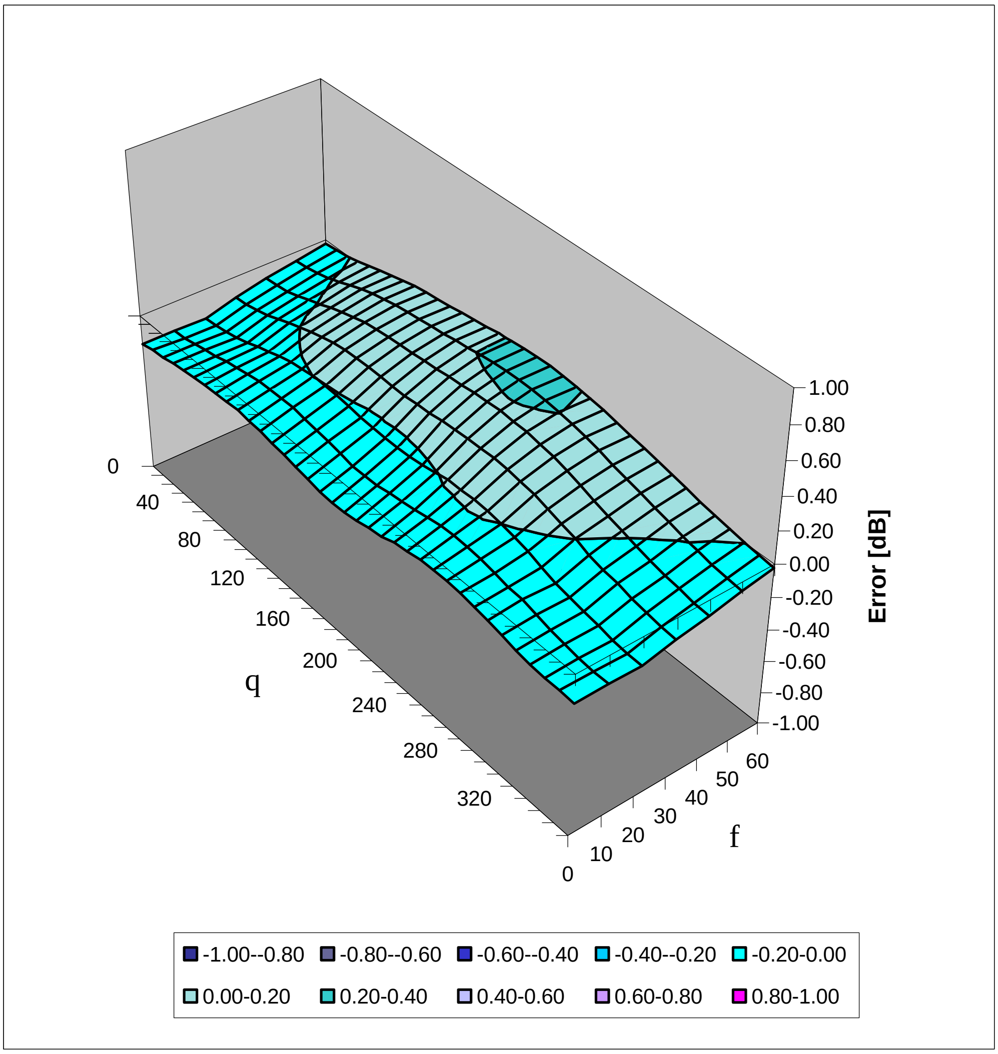
Head **1800 MHz** e_r **= 40 ± 5%** s **= 1.40 ± 10% mho/m**

ConvF X	**5.78**	± 7% (k=2)	Boundary effect:	
ConvF Y	**5.78**	± 7% (k=2)	Alpha	**0.53**
ConvF Z	**5.78**	± 7% (k=2)	Depth	**2.01**

ET3DV6 SN:1590

Deviation from Isotropy in HSL

Error (q,f), f = 900 MHz



APPENDIX D - DETERMINATION OF E-FIELD PROBE CONVERSION NUMBERS

Determination of Probe Conversion Factors for 150MHz

Since at this time there exists no experimental method in determining E-field probe conversion factors for frequencies below 800MHz, the following procedure was carried out to give an approximation of the probe conversion factors for 150MHz.

The accuracy of the system was determined based on the two calibrated test frequencies of 900 and 1800MHz, using validation dipoles as supplied by the manufacturer. The measured results were found to be within the specified tolerances. For conversion factors outside these two frequencies a linear extrapolation was performed as per the manufacturer's recommendations. In order to determine the accuracy of the conversion factors, 300 and 450MHz dipoles were constructed in accordance with IEEE Std. P1528. The two dipoles were then characterized for SAR using the appropriate head simulating fluid for the given frequencies in a planar phantom as prescribed in IEEE Std. P1528. The table below indicates the analytical target values for each dipole with the associated measured results.

Frequency (MHz)	Analytical SAR @ 1W input averaged over 1 gram	Measured SAR @ 1W input averaged over 1 gram	Delta D	Fluid Parameters
300	3.0	3.51	17.0%	ε_r=45.3
				σ=0.87
450	4.9	5.77	17.8%	ε_r=43.5
				σ=0.87

The extrapolated head conversion factors determined for 300 and 450MHz resulted in SAR values being 17.0% and 17.8% greater than expected for each frequency respectively. It is assumed that as this extrapolation is extended down to 150MHz, the resulting SAR will again be overestimated by at least 17%.
The body conversion factors were determined based on a combination of the obtained data from the validations, and numerical modeling results from an identical probe from the same manufacturer.

The following two pages show examples of the conversion factors that were derived through numerical modeling for a probe of similar properties.

Dosimetric E-Field Probe ET3DV6 **EXAMPLE**

Head Tissue Conversion Factor (± standard deviation)

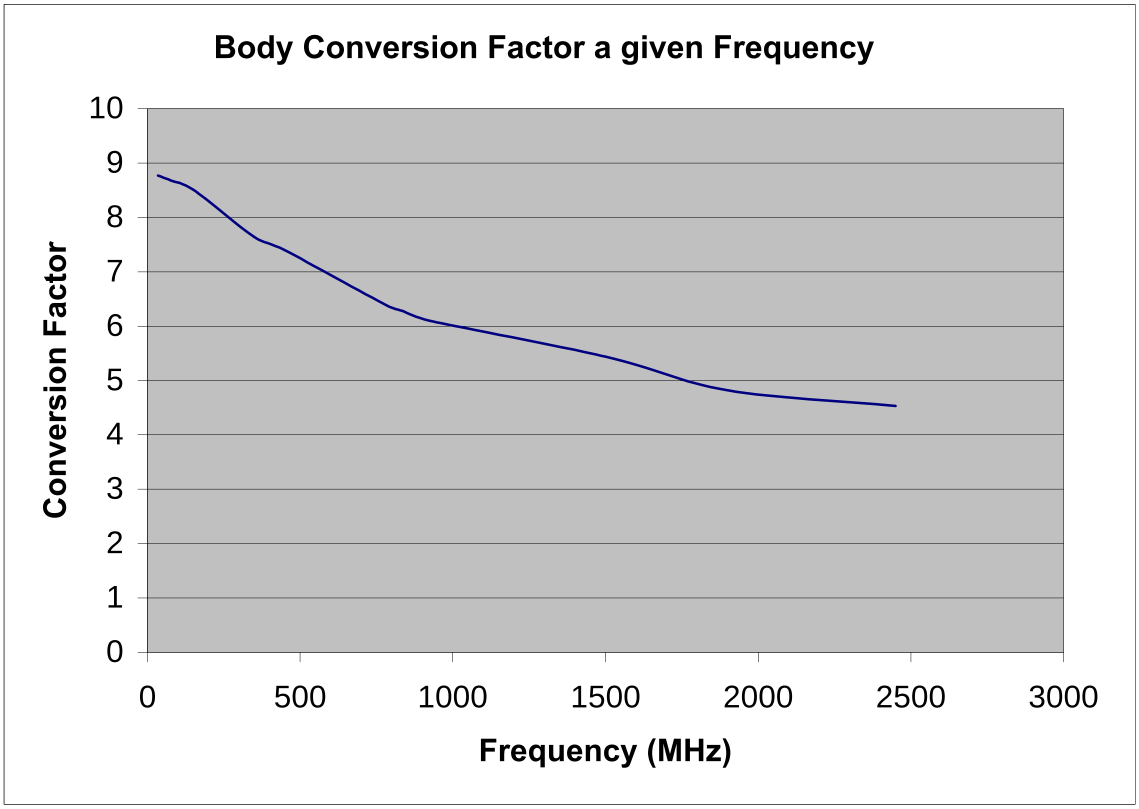
400 MHz	ConvF	7.64 ± 8%	ε_r = 44.4 σ = 0.87 mho/m CENELEC Head Tissue
835 MHz	ConvF	6.54 ± 8%	ε_r = 42.5 σ = 0.98 mho/m CENELEC Head Tissue
900 MHz	ConvF	6.41 ± 8%	ε_r = 42.3 σ = 0.99 mho/m CENELEC Head Tissue
350 MHz	ConvF	7.76 ± 8%	ε_r = 44.7 σ = 0.87 mho/m IEEE Head Tissue
450 MHz	ConvF	7.52 ± 8%	ε_r = 43.5 σ = 0.87 mho/m IEEE Head Tissue
835 MHz	ConvF	6.53 ± 8%	ε_r = 41.5 σ = 0.90 mho/m IEEE Head Tissue
925 MHz	ConvF	6.37 ± 8%	ε_r = 41.45 σ = 0.98 mho/m IEEE Head Tissue
1500 MHz	ConvF	6.04 ± 8%	ε_r = 40.43 σ = 1.23 mho/m IEEE Head Tissue
1900 MHz	ConvF	5.41 ± 8%	ε_r = 40.0 σ = 1.40 mho/m IEEE Head Tissue
2450 MHz	ConvF	5.18 ± 8%	ε_r = 39.2 σ = 1.8 mho/m IEEE Head Tissue
2450 MHz	ConvF	5.40 ± 8%	ε_r = 37.2 σ = 2.09 mho/m H1800 at 2450 MHz

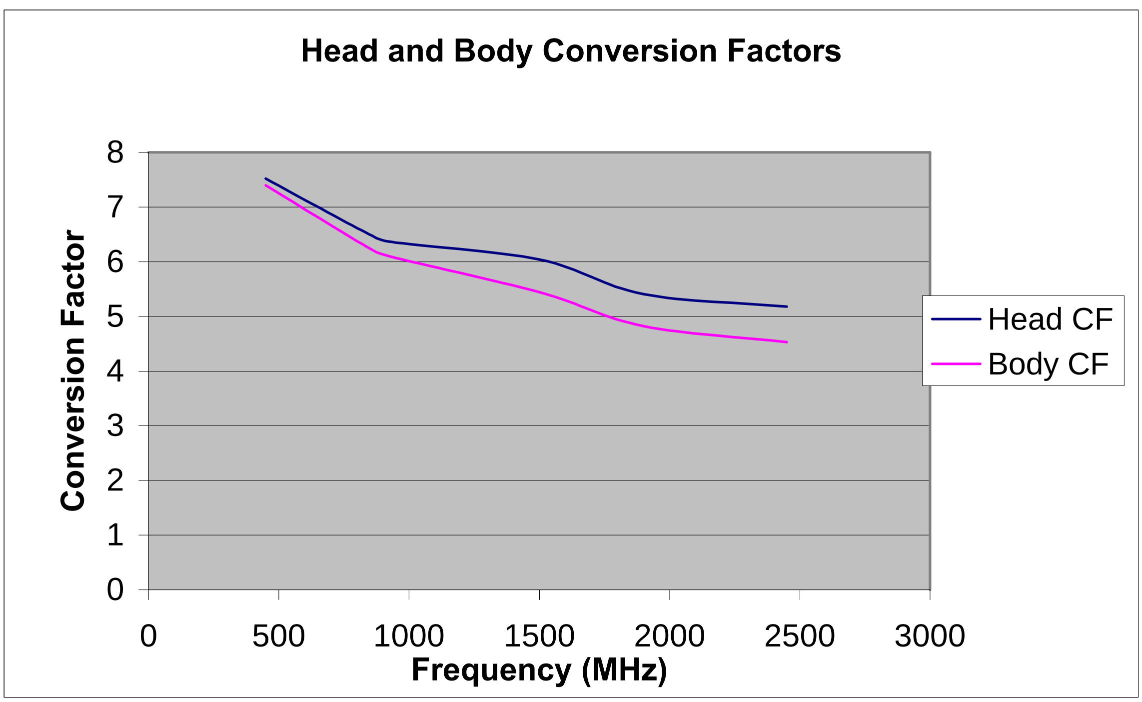
Dosimetric E-Field Probe ET3DV6

EXAMPLE

Body Tissue Conversion Factor (± standard deviation)

35 MHz	ConvF	8.77 ± 15%	ε_r = 85.19 σ = 0.69 mho/m FCC Body Tissue
75 MHz	ConvF	8.68 ± 10%	ε_r = 69.93 σ = 0.72 mho/m FCC Body Tissue
150 MHz	ConvF	8.51 ± 8%	ε_r = 62.68 σ = 0.75 mho/m FCC Body Tissue
350 MHz	ConvF	7.64 ± 8%	ε_r = 58.41 σ = 0.80 mho/m FCC Body Tissue
450 MHz	ConvF	7.40 ± 8%	ε_r = 57.62 σ = 0.83 mho/m FCC Body Tissue
784 MHz	ConvF	6.38 ± 8%	ε_r = 56.25 σ = 0.93 mho/m FCC Body Tissue
835 MHz	ConvF	6.28 ± 8%	ε_r = 56.11 σ = 0.95 mho/m FCC Body Tissue
925 MHz	ConvF	6.10 ± 8%	ε_r = 55.9 σ = 0.98 mho/m FCC Body Tissue
1500 MHz	ConvF	5.44 ± 8%	ε_r = 54.87 σ = 1.23 mho/m FCC Body Tissue
1900 MHz	ConvF	4.82 ± 8%	ε_r = 54.3 σ = 1.45 mho/m FCC Body Tissue
2450 MHz	ConvF	4.53 ± 8%	ε_r = 53.57 σ = 1.81 mho/m FCC Body Tissue


Body Conversion Factor a given Frequency
Conversion Factor
10
9
8
7
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
Frequency (MHz)


Head and Body Conversion Factors
Conversion Factor
8
7
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
3000
Frequency (MHz)
Head CF
Body CF

Frequency	Head Conversion Factors	Body Conversion Factors	Delta D
450	7.52	7.40	1.62
835	6.53	6.28	3.98
925	6.37	6.10	4.43
1500	6.04	5.44	11.02
1900	5.41	4.82	12.24
2450	5.18	4.53	14.35

Conclusion:

Based on the results from the 300 and 450MHz validations, the derived conversion factors should over-estimate the SAR for a device operating in the 150MHz band by approximately 17%. In addition, the above graphs and tabular results show that the probe conversion factors vary only slightly between head and body as the frequency approaches 450MHz. It is therefore safe to assume that as the frequency is further extended to 150MHz, the difference in the conversion factors between head and body will be less significant. Therefore, for this reason only one conversion factor is reported for both head and body at 150MHz.

APPENDIX E - SAR SENSITIVITIES

Application Note: SAR Sensitivities

Introduction

The measured SAR-values in homogeneous phantoms depend strongly on the electrical parameters of the liquid. Liquids with exactly matching parameters are difficult to produce; there is always a small error involved in the production or measurement of the liquid parameters. The following sensitivities allow the estimation of the influence of small parameter errors on the measured SAR values. The calculations are based on an approximation formula [1] for the SAR of an electrical dipole near the phantom surface and a adapted plane wave approximation for the penetration depth. The sensitivities are given in percent SAR change per percent change in the controlling parameter:

$$S(x) = \frac{d\,SAR / SAR}{d\,x / x}$$

The controlling parameters x are:

- ε : permitivity
- σ : conductivity
- ρ : brain density (= one over integration volume)

For example: If The liquid permitivity increases by 2 percent and the sensitivity of the SAR to permitivity is -0.6 then the SAR will decrease by 1.2 percent.

The sensitivities are given for surface SAR values and averaged SAR values for 1 g and 10 g cubes and for dipole distances d of 10mm (for frequencies below 1000 MHz) and 15mm (for frequencies above 1000 MHz) from the liquid surface.

Liquid parameters are as proposed in the new standards (e.g., IEEE 1528).

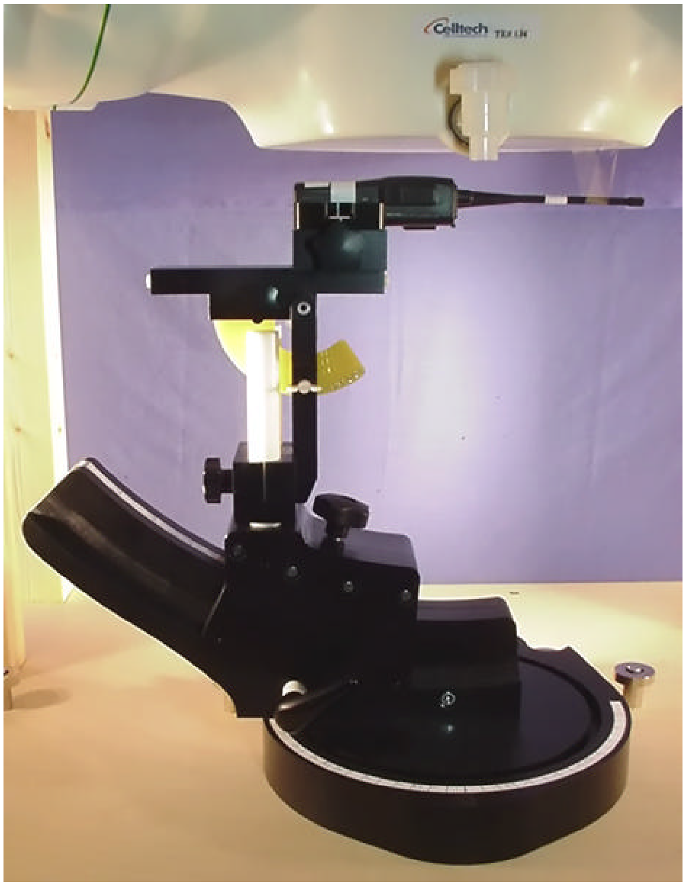
References

[1] N. Kuster and Q. Balzano, “Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300 MHz”, *IEEE Transacions on Vehicular Technology*, vol. 41(1), pp. 17-23, 1992.

Parameter		ε	σ	ρ
f=300 MHz (εr=45.3, σ=0.87S/m, ρ=1g/cm³)				
d=15mm:	**Surface**	- 0.41	+ 0.48	—
	1 g	- 0.33	+ 0.28	0.08
	10 g	- 0.26	+ 0.09	0.16
f=450 MHz (εr=43.5, σ=0.87S/m, ρ=1g/cm³)				
d=15mm:	**Surface**	- 0.56	+ 0.67	—
	1 g	- 0.46	+ 0.43	0.09
	10 g	- 0.37	+ 0.22	0.17
f=835 MHz (εr=41.5, σ=0.90S/m, ρ=1g/cm³)				
d=15mm:	**Surface**	- 0.70	+ 0.86	—
	1 g	- 0.57	+ 0.59	0.10
	10 g	- 0.45	+ 0.35	0.18
f=900 MHz (εr=41.5, σ=0.97S/m, ρ=1g/cm³)				
d=15mm:	**Surface**	- 0.69	+ 0.86	—
	1 g	- 0.55	+ 0.57	0.10
	10 g	- 0.44	+ 0.32	0.19
f=1450 MHz (εr=40.5, σ=1.20/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.73	+ 0.91	—
	1 g	- 0.55	+ 0.55	0.12
	10 g	- 0.42	+ 0.27	0.22
f=1800 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.73	+ 0.92	—
	1 g	- 0.52	+ 0.51	0.14
	10 g	- 0.38	+ 0.21	0.24
f=1900 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.73	+ 0.93	—
	1 g	- 0.53	+ 0.51	0.14
	10 g	- 0.39	+ 0.22	0.24
f=2000 MHz (εr=40.0, σ=1.40S/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.74	+ 0.94	—
	1 g	- 0.53	+ 0.52	0.14
	10 g	- 0.39	+ 0.22	0.24
f=2450 MHz (εr=39.2, σ=1.80S/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.74	+ 0.93	—
	1 g	- 0.49	+ 0.41	0.17
	10 g	- 0.34	+ 0.12	0.28
f=3000 MHz (εr=38.5, σ=2.40S/m, ρ=1g/cm³)				
d=10mm:	**Surface**	- 0.75	+ 0.90	—
	1 g	- 0.45	+ 0.28	0.21
	10 g	- 0.32	+ 0.02	0.31

APPENDIX F - SAR TEST SETUP PHOTOGRAPHS

FACE-HELD SAR TEST SETUP PHOTOGRAPHS
2.5cm Separation Distance



BODY-WORN SAR TEST SETUP PHOTOGRAPHS
with 1.4cm Belt-Clip