CERTIFICATE OF COMPLIANCE
SAR EVALUATION

Test Lab:	**Applicant:**
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FCC ID:	**OCCHWC-3000**
Model(s):	**HWC-3000**
Equipment Type:	**Dual-Mode AMPS/CDMA Cellular Phone**
FCC Classification:	**Licensed Non-Broadcast Transmitter Held to Ear (TNE)**
FCC Rule Part(s):	**2.1093; ET Docket 96.326**
Tx Frequency Range:	**824.04 - 848.97 MHz (AMPS)** **824.70 - 848.31 MHz (CDMA)**
Rx Frequency Range:	**869.04 - 893.97 MHz (AMPS)** **869.70 - 893.31 MHz (CDMA)**
Max. RF Output Power:	**0.230 Watts ERP (AMPS)** **0.172 Watts ERP (CDMA)**

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in ANSI/IEEE Std. C95.3-1999. (See test report).

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.

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1.0 INTRODUCTION

This measurement report shows compliance of the HANWHA CORPORATION Model: HWC-3000 Dual-Mode AMPS/CDMA Cellular Phone FCC ID: OCCHWC-3000 with FCC Part 2, 1093, ET Docket 96-326 Rules 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)

EUT Type	Dual-Mode Cellular Phone (AMPS/CDMA)	**FCC ID**	OCCHWC-3000
Equipment Class	Licensed Non-Broadcast Transmitter Held to Ear (TNE)	**Model No.(s)**	HWC-3000
FCC Rule Part(s)	§ 2.1093, Docket 96-326	**Application Type**	Part 22 Certification
Tx Frequency Range (MHz)	824.04 – 848.97 (AMPS) 824.70 - 848.31 (CDMA)	**S/N No.**	Pre-production
Rx Frequency Range (MHz)	869.04 - 893.97 (AMPS) 869.70 - 893.31 (CDMA)	**Max. RF Output Power**	0.230W ERP (AMPS) 0.172W ERP (CDMA)
Modulation(s)	AMPS / CDMA	**Battery Type(s)**	Li-ion Standard 1050mAh
Antenna Type	Retractable Whip (λ/4 Helical)	**Antenna Length**	114.2 mm

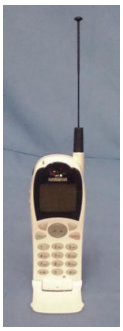


Figure 1. Front of EUT

Figure 2. Rear of EUT

Figure 3 & 4. Sides of EUT

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 (see Figure 6). 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.

Figure 5. 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.

HEAD SAR TEST RESULTS – AMPS MODE

Frequency (MHz)	Channel	Modulation	Conducted Power (dBm)	Battery Type	Antenna Position	SAR (w/kg)
824.04	991	Unmodulated Carrier	24.1	Standard	Retracted	0.681
824.04	991	Unmodulated Carrier	24.1	Standard	Extended	1.38
836.49	383	Unmodulated Carrier	25.0	Standard	Retracted	0.582
836.49	383	Unmodulated Carrier	25.0	Standard	Extended	1.45
848.97	799	Unmodulated Carrier	25.3	Standard	Retracted	0.496
848.97	799	Unmodulated Carrier	25.3	Standard	Extended	1.44
Mixture Type: BRAIN **Dielectric Constant: 44.2** **Conductivity: 0.80**			**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 are below the maximum limit of 1.6 w/kg.
2. The worst-case head SAR value found was 1.45 w/kg.
3. The EUT was tested using the standard battery, which is the only battery option for this handset.
4. All modes of operation were investigated and the worst-case SAR levels are reported).

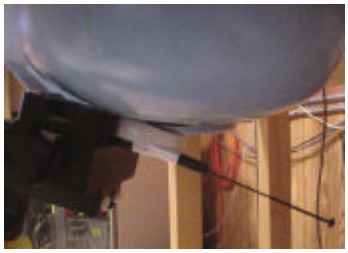


Figure 6. Head SAR Test Setup

MEASUREMENT SUMMARY (CONT.)

HEAD SAR TEST RESULTS – CDMA MODE

Frequency (MHz)	Channel	Modulation	Conducted Power (dBm)	Battery Type	Antenna Position	SAR (w/kg)
824.70	1013	CDMA	24.0	Standard	Retracted	0.603
824.70	1013	CDMA	24.0	Standard	Extended	1.30
835.89	363	CDMA	24.0	Standard	Retracted	0.470
835.89	363	CDMA	24.0	Standard	Extended	1.19
848.31	777	CDMA	24.0	Standard	Retracted	0.373
848.31	777	CDMA	24.0	Standard	Extended	1.09
Mixture Type: BRAIN **Dielectric Constant: 44.2** **Conductivity: 0.80**			**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 are below the maximum limit of 1.6 w/kg.
2. The worst-case head SAR value found was 1.30 w/kg.
3. The EUT was tested using the standard battery, which is the only battery option for this handset.
4. All modes of operation were investigated and the worst-case SAR levels are reported.

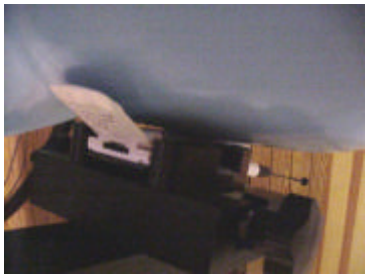


Figure 7. Head SAR Test Setup

MEASUREMENT SUMMARY (CONT.)

BODY SAR TEST RESULTS – AMPS MODE

Frequency (MHz)	Channel	Modulation	Conducted Power (dBm)	Separation Distance (cm)	Antenna Position	SAR (w/kg)
824.04	991	Unmodulated Carrier	24.1	1.0	Extended	0.739
836.49	383	Unmodulated Carrier	25.0	1.0	Extended	1.02
848.97	799	Unmodulated Carrier	25.3	1.0	Extended	0.612
Mixture Type: Muscle **Dielectric Constant: 56.1** **Conductivity: 0.95**		**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 are below the maximum limit of 1.6 w/kg.
2. The worst-case body SAR value found was 1.02 w/kg.
3. The EUT was tested for body SAR with a separation distance of 1.0cm between the back of the phone and the outer surface of the phantom without the use of a belt-clip/body-holster.
4. The EUT was tested using the standard battery, which is the only battery option for this handset.
5. All modes of operation were investigated and the worst-case SAR levels are reported.

Figure 8. Body SAR Test Setup

MEASUREMENT SUMMARY (CONT.)

BODY SAR TEST RESULTS – CDMA MODE

Frequency (MHz)	Channel	Modulation	Conducted Power (dBm)	Separation Distance (cm)	Antenna Position	SAR (w/kg)
824.70	1013	CDMA	24.0	1.0	Extended	0.895
835.89	363	CDMA	24.0	1.0	Extended	0.584
848.31	777	CDMA	24.0	1.0	Extended	0.540
Mixture Type: Muscle **Dielectric Constant: 56.1** **Conductivity: 0.95**			**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 are below the maximum limit of 1.6 w/kg.
2. The worst-case body SAR value found for CDMA mode was 0.895 w/kg.
3. The EUT was tested for body SAR with a separation distance of 1.0cm between the back of the phone and the outer surface of the phantom without the use of a belt-clip/body-holster.
4. The EUT was tested using the standard battery, which is the only battery option for this handset.
5. All modes of operation were investigated and the worst-case SAR levels are reported.

Figure 9. Body SAR Test Setup

5.0 SAR SAFETY LIMITS

EXPOSURE LIMITS (General populations/Uncontrolled Exposure Environment)	**SAR** (W/Kg)
Spatial Average (averaged over the whole body)	0.08
Spatial Peak (averaged over any 1g of tissue)	1.60
Spatial Peak (hands/wrists/feet/ankles averaged over 10g)	4.00

Notes: 1. The FCC SAR safety limits specified in the table above apply to devices operated in the General Population / Uncontrolled Exposure environment.
2. Uncontrolled environments are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

6.0 DETAILS OF SAR EVALUATION

The HANWHA CORPORATION HWC-3000 Dual-Mode AMPS/CDMA Cellular Phone FCC ID: OCCHWC-3000 was found to be compliant for localized specific absorption rate (SAR) based on the following test provisions and conditions:

1) The handset was placed in a normal operating position with the center of the ear-piece aligned with the ear canal on the phantom.
2) With the ear-piece touching the phantom the center line of the handset was aligned with an imaginary plane (X and Y axis) consisting of three lines connecting both ears and the mouth.
3) The handset was gradually moved towards the cheek until any point of the mouth-piece or keypad touched the cheek.
4) The EUT was tested in a body-worn configuration. The handset was placed on the device holder with the back of the phone facing parallel to the outer surface of the planar phantom with a 1.0cm spacing between the back of the phone/antenna and the outer surface of the planar phantom.
5) SAR measurements were evaluated at maximum power and the unit was operated for an appropriate period prior to the evaluation in order to minimize drift.
6) The device was keyed to operate 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 handset and its antenna.
8) The EUT was tested with a fully charged battery.

7.0 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 worn about 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 side, which produced the greatest SAR, determined which side of the phantom would be used for the entire evaluation. The positioning of the head worn device relative to the phantom was dictated by FCC OET bulletin 65 Supp., C.

(ii) For body worn devices or devices which can be operated within 20 cm of the body, the planar section of the phantom was used. The type of device being evaluated dictated the distance of the EUT to the outer surface of the planar phantom.

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. A 5x5x7 matrix was performed around the greatest spatial SAR distribution found during the area scan of the applicable exposed region. 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.

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 ±5%. The applicable verification(s) is/are as follows (see Appendix B for validation test plot):

Dipole Validation Kit	Target SAR 1g (w/kg)	Measured SAR 1g (w/kg)
D835V2	2.06	2.01

9.0 SIMULATED TISSUES

The brain and muscle mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution. Preservation with a bacteriacide is added and visual inspection is made to ensure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the tissue.

INGREDIENT	FREQUENCY	
	835MHz Brain %	835MHz Muscle %
Water	40.4	52.4
Sugar	56.0	45.0
Salt	2.5	1.4
HEC	0.1	1.0
Bactericide	1.0	0.2

10.1 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 (800-850MHz)	Dielectric Constant $å_r$	Conductivity ó (mho/m)	ñ (Kg/m^3)
Brain	44.2 ± 5%	0.80 ± 10%	1000
Muscle	56.1 ± 5%	0.95 ± 10%	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. 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.:	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:	2.0 ± 0.1 mm

12.0 TEST EQUIPMENT LIST

SAR MEASUREMENT SYSTEM		
EQUIPMENT	***S/N #***	***CALIB. DATE***
DASY3 System -Robot -ET3DV6 E-Field Probe -DAE -835MHz Validation Dipole -900MHz Validation Dipole -1800MHz Validation Dipole -Generic Twin Phantom V3.0	 599396-01 1387 383 411 054 247 N/A	 N/A Sept 1999 Sept 1999 Aug 1999 Aug 1999 Aug 1999 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 Oct 1999 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

13.0 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	±10 %	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. However, the estimated measurement uncertainties in SAR are less than 15-25 %.

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.

14.0 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.

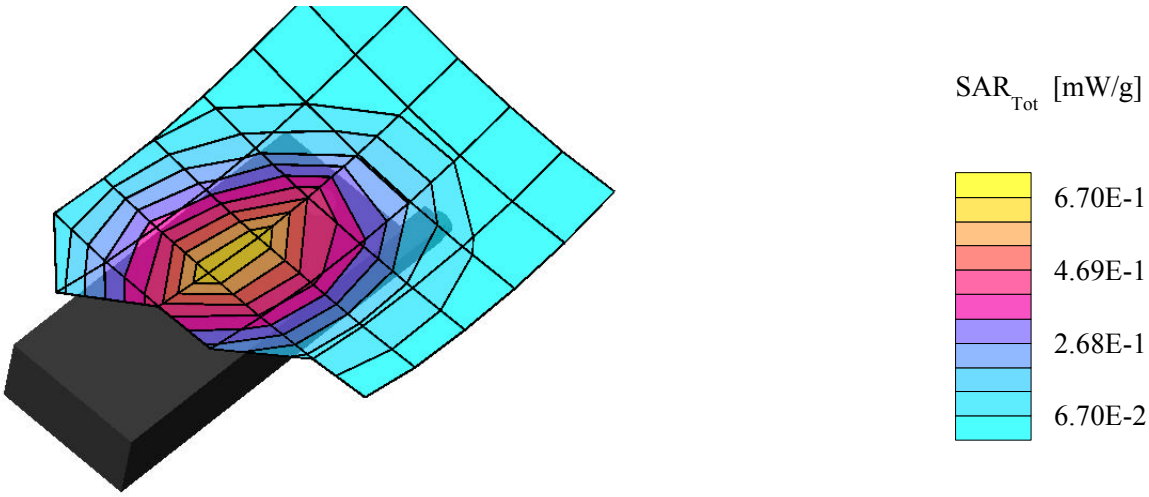
(4) Niels Kuster, Ralph Kastle, and Thomas Schmid, "Dosimetric evaluation of mobile communications equipment with know precision", IEICE Transactions of Communications, vol. E80-B, no. 5, pp. 645 – 652, May 1997.

APPENDIX "A" - SAR MEASUREMENT DATA

HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.681 mW/g, SAR (10g): 0.471 mW/g

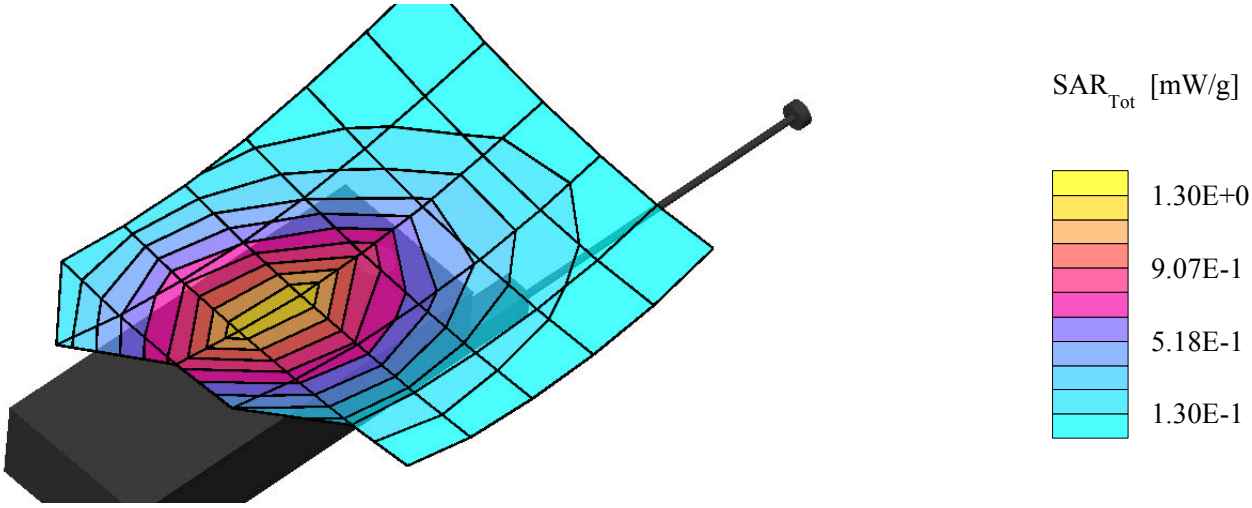
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna In
Channel 991 [824.04MHz]
Conducted Power 24.1dBm
Date Tested: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Brain 835 MHz: σ = 0.80 mho/m ε_r = 44.2 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.38 mW/g, SAR (10g): 0.969 mW/g

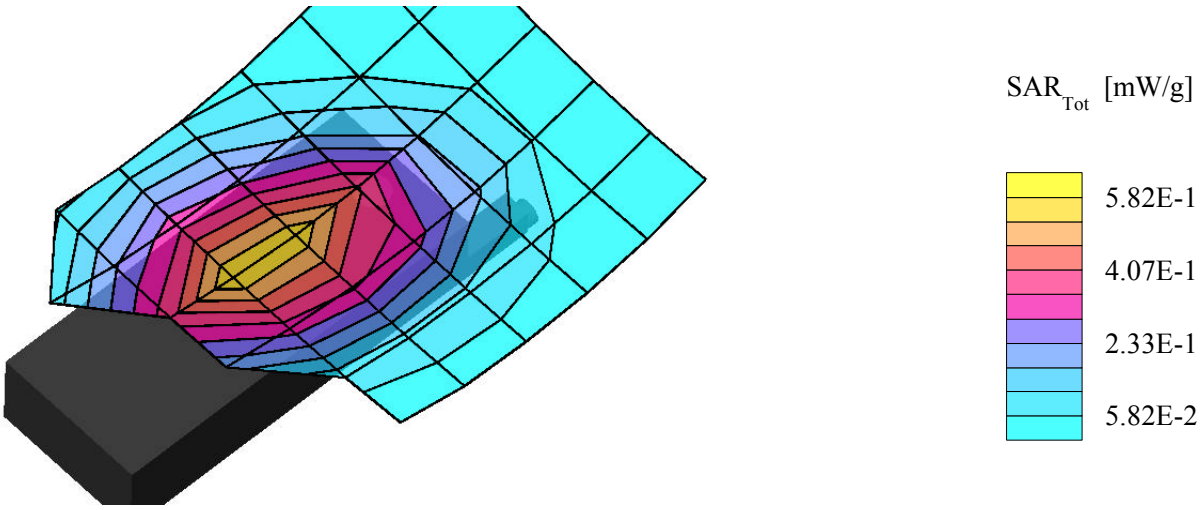
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 991 [824.04MHz]
Conducted Power 24.1dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.582 mW/g, SAR (10g): 0.406 mW/g

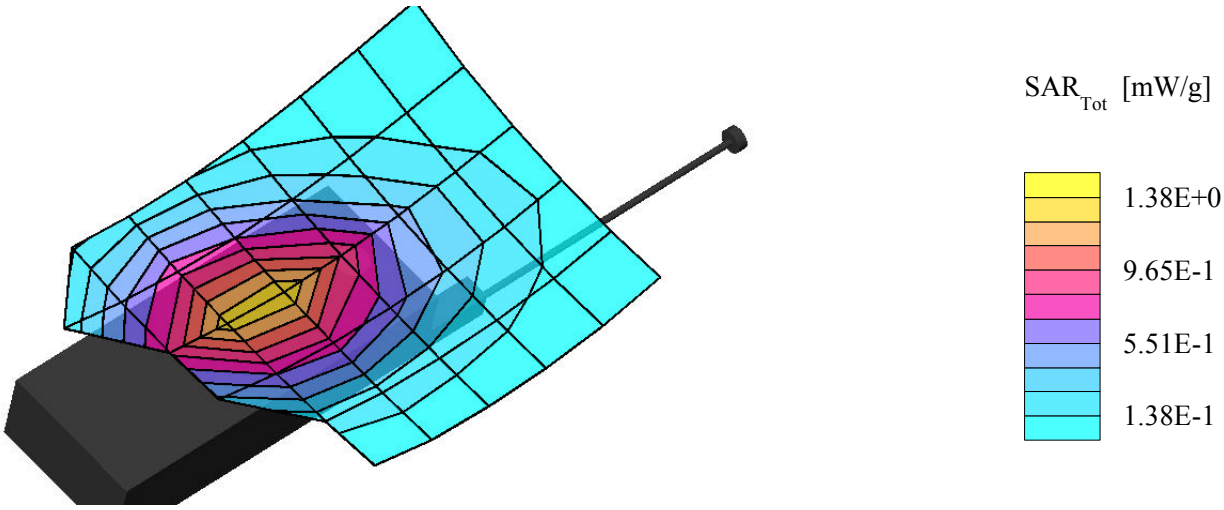
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna In
Channel 383 [836.49MHz]
Conducted Power 25.0dBm
Date Tested: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Brain 835 MHz: σ = 0.80 mho/m ε_r = 44.2 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.45 mW/g, SAR (10g): 1.01 mW/g

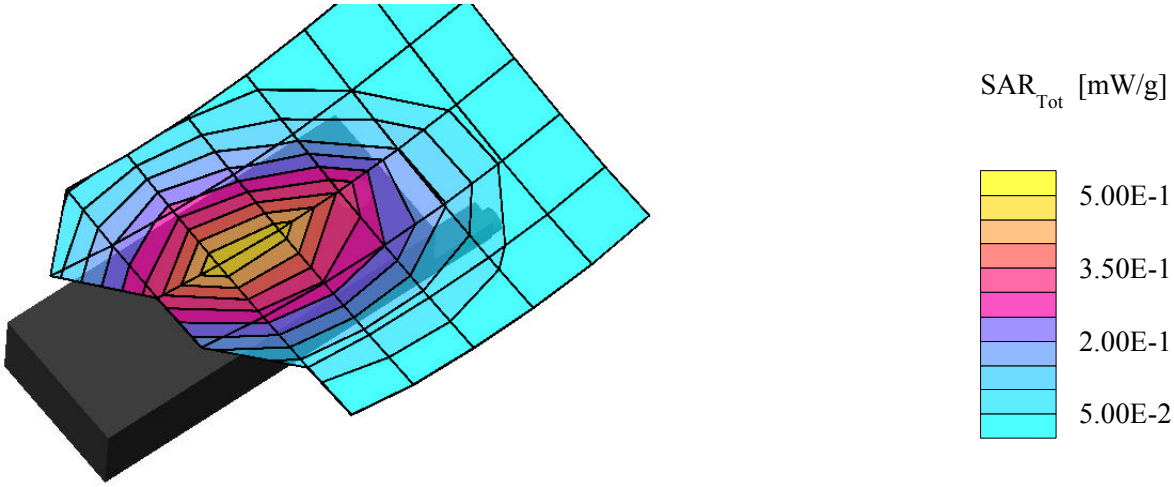
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 383 [836.49MHz]
Conducted Power 25.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.496 mW/g, SAR (10g): 0.341 mW/g

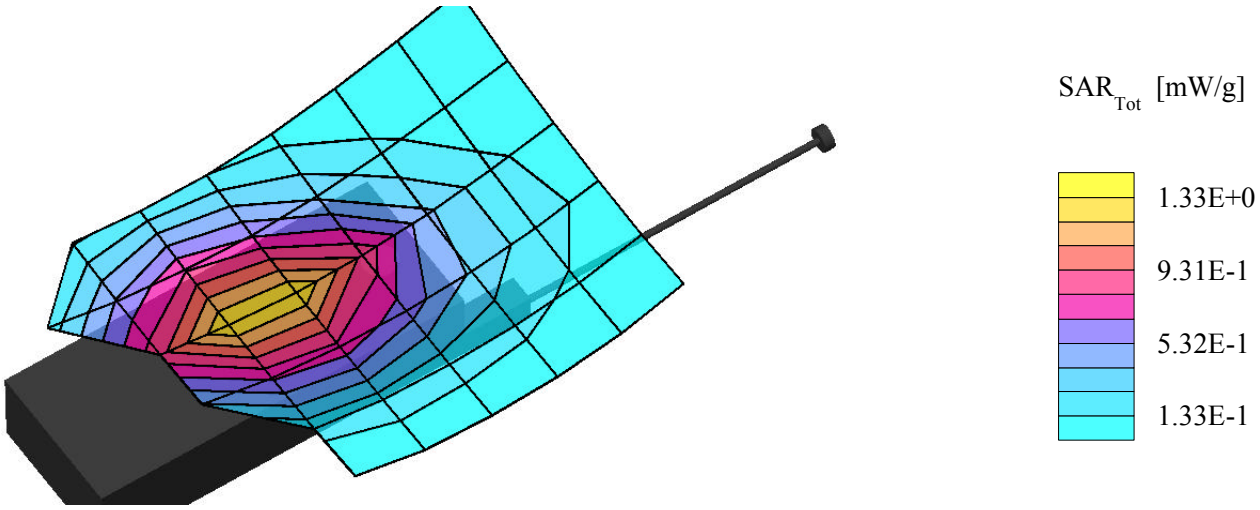
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna In
Channel 799 [848.97MHz]
Conducted Power 25.3dBm
Date Tested: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Brain 835 MHz: σ = 0.80 mho/m ε_r = 44.2 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.44 mW/g, SAR (10g): 1.00 mW/g

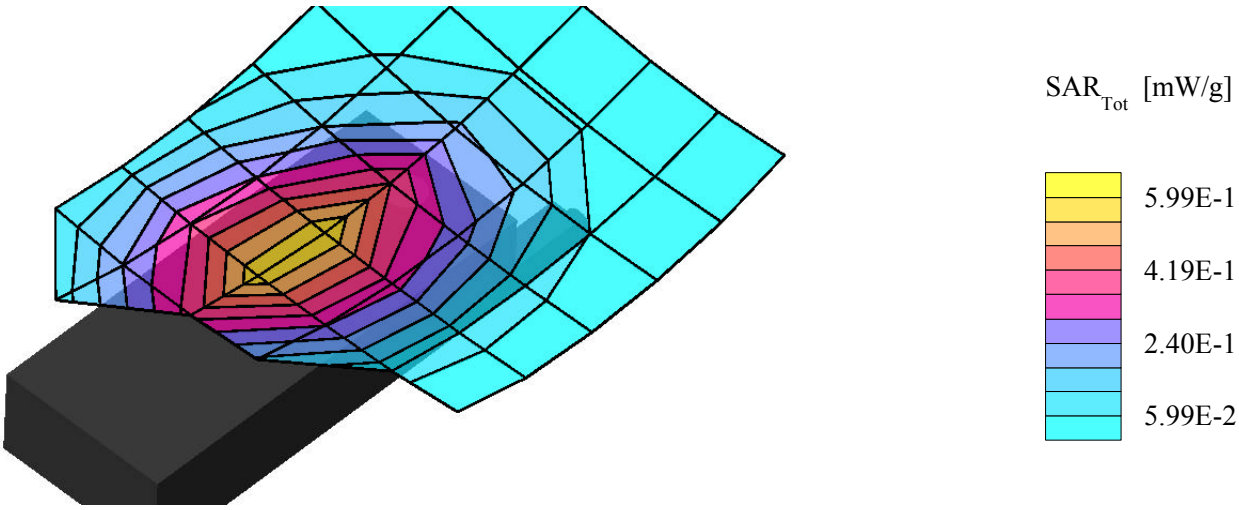
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 799 [848.97MHz]
Conducted Power 25.3dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.603 mW/g, SAR (10g): 0.419 mW/g

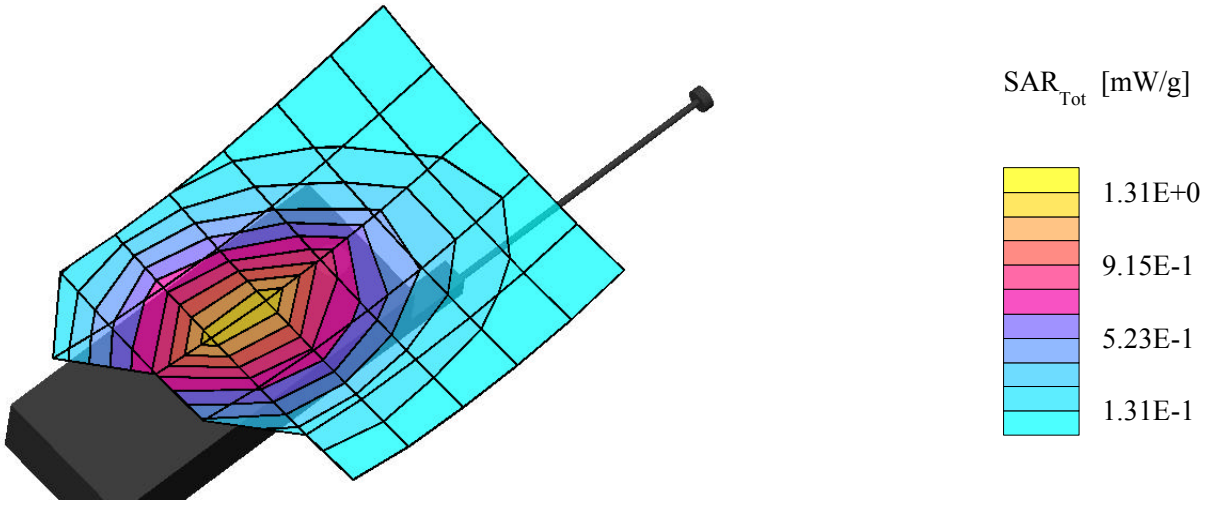
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna In
Channel 1013 [824.70MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.30 mW/g, SAR (10g): 0.907 mW/g

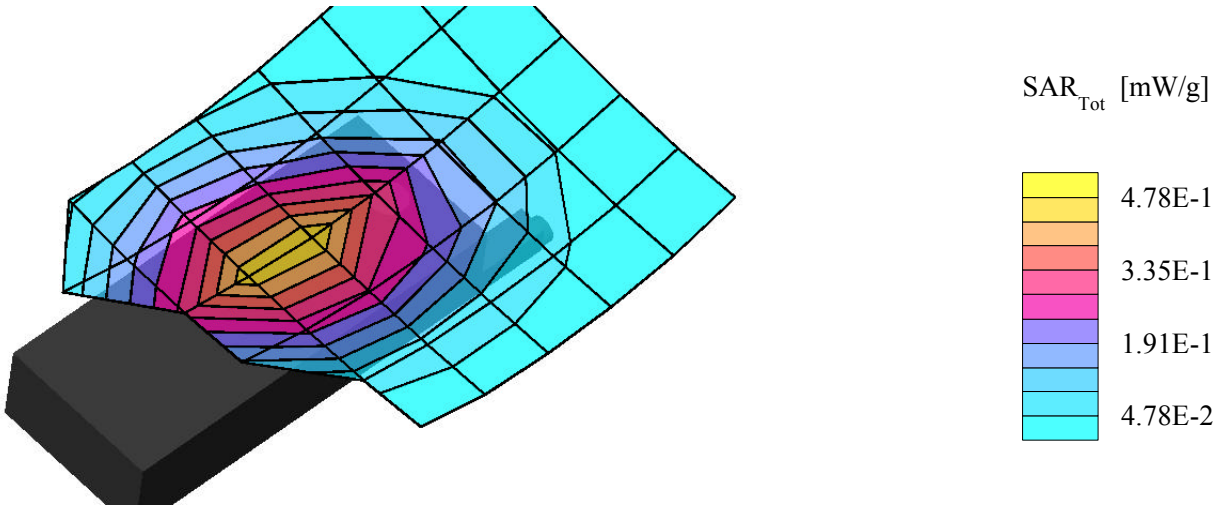
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 1013 [824.70MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.470 mW/g, SAR (10g): 0.329 mW/g

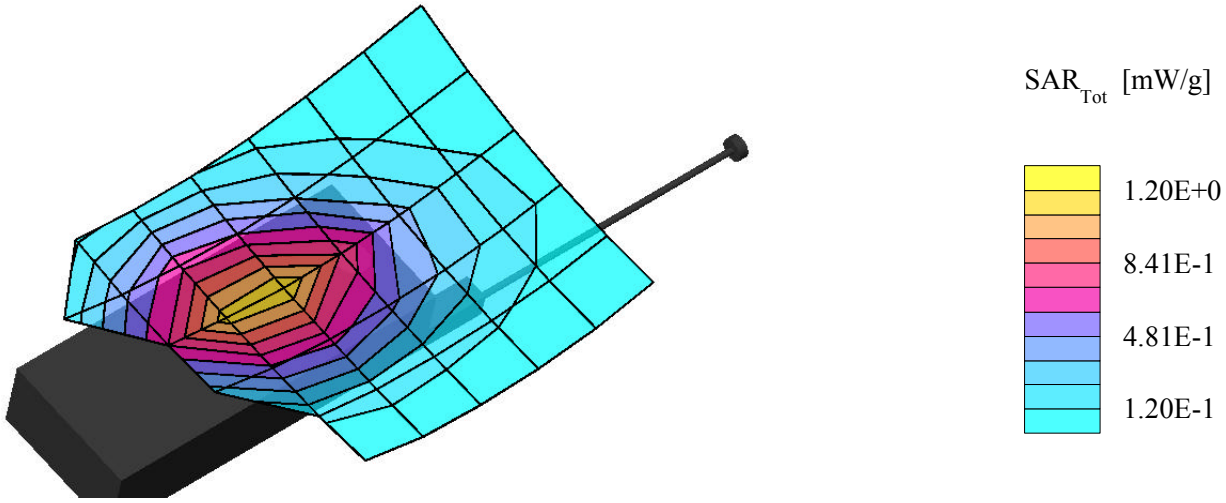
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna In
Channel 363 [835.89MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.19 mW/g, SAR (10g): 0.828 mW/g

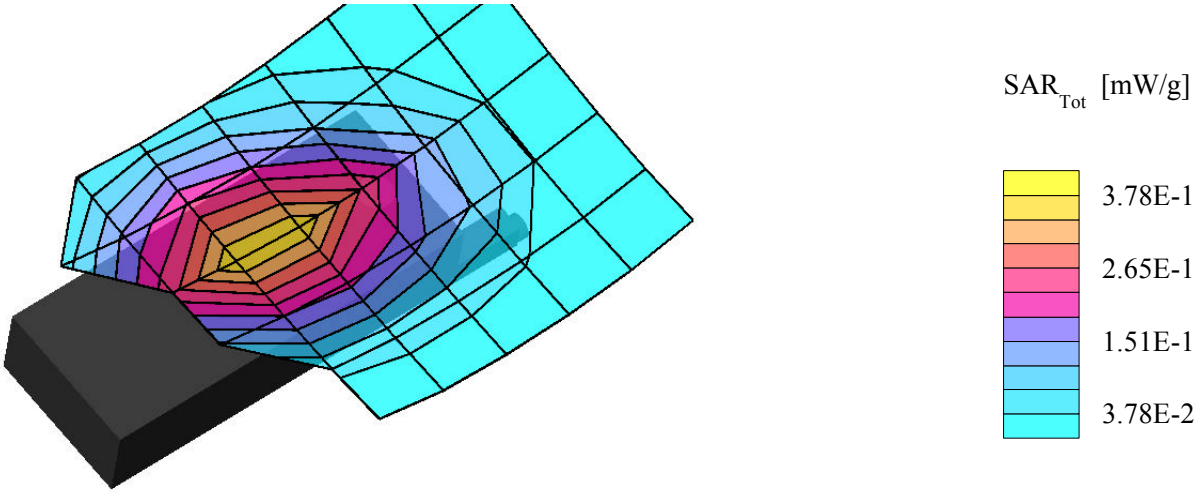
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 363 [835.89MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.373 mW/g, SAR (10g): 0.261 mW/g

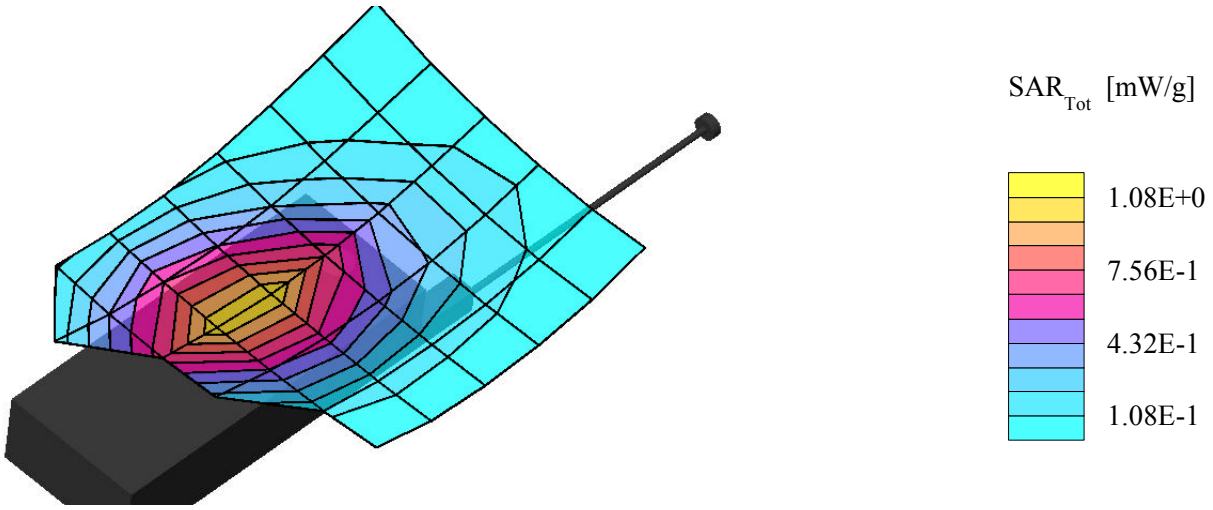
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna In
Channel 777 [848.31MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000

Generic Twin Phantom; Left Hand Section; Position: (80°,65°);
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/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.09 mW/g, SAR (10g): 0.761 mW/g

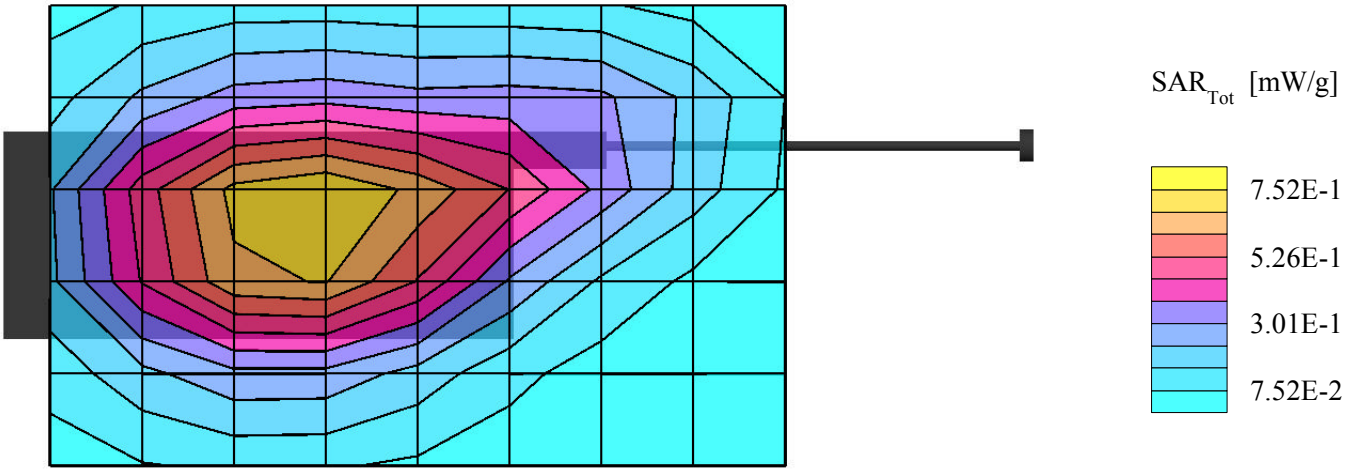
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 777 [848.31MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.739 mW/g, SAR (10g): 0.507 mW/g

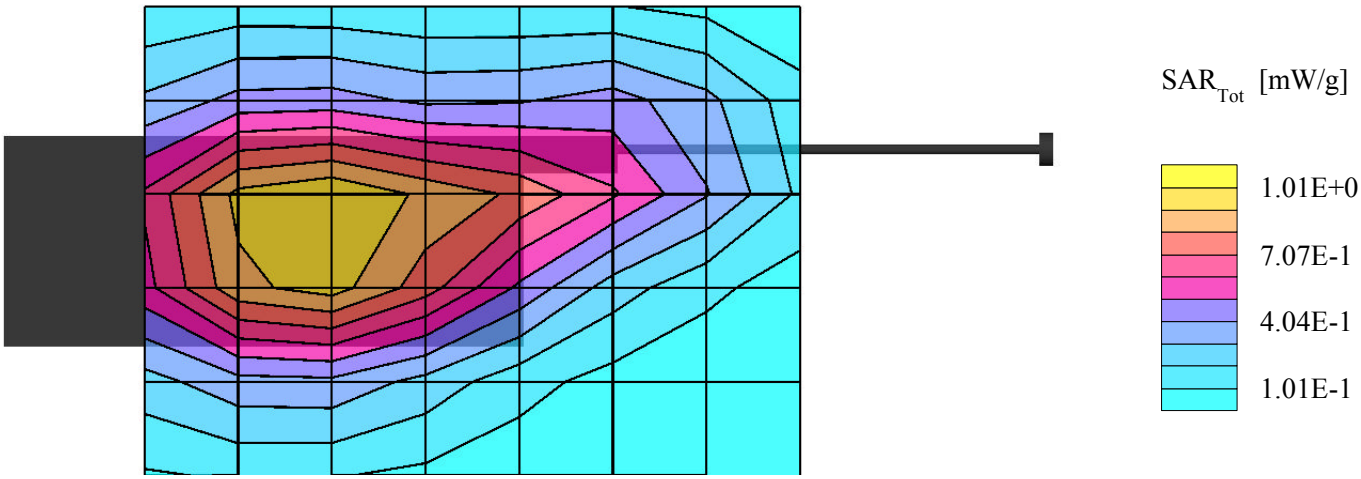
Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 991 [824.04MHz]
Conducted Power 24.1dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 1.02 mW/g, SAR (10g): 0.727 mW/g

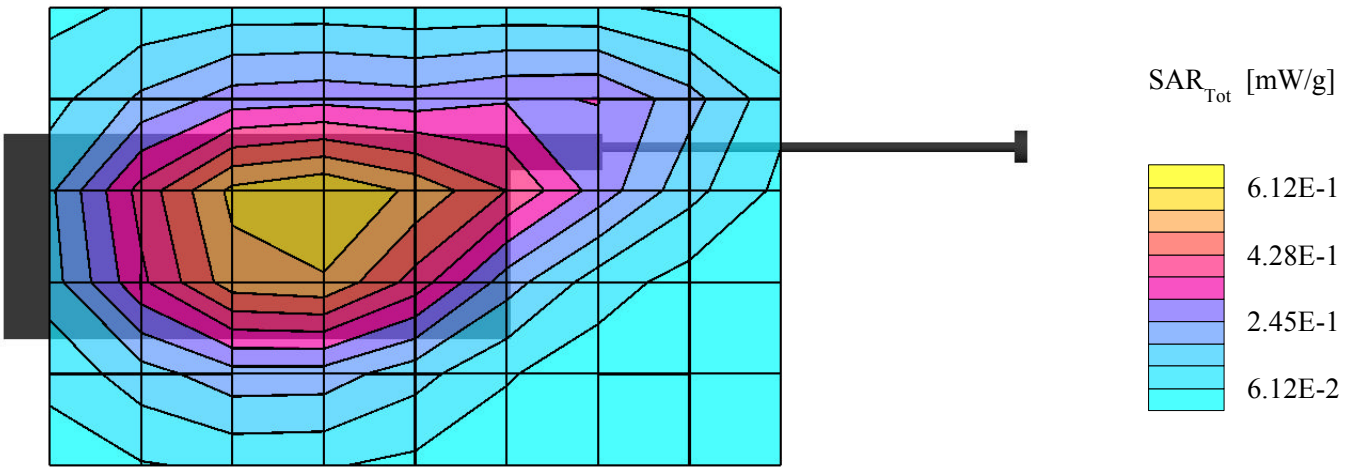
Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 383 [836.49MHz]
Conducted Power 25.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.612 mW/g, SAR (10g): 0.415 mW/g

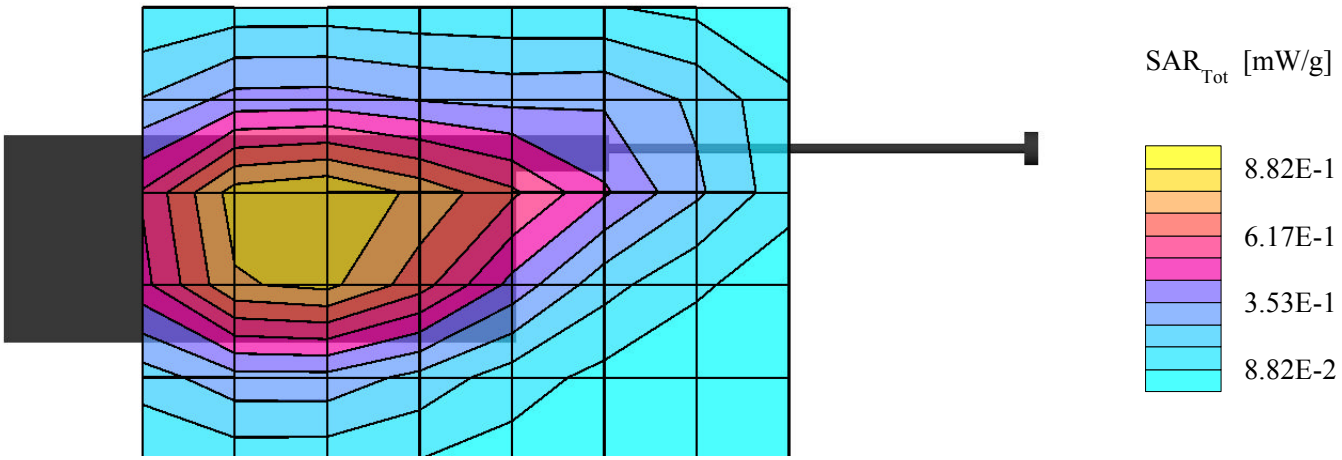
Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
Unmodulated Carrier - Antenna Out
Channel 799 [848.97MHz]
Conducted Power 25.3dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.895 mW/g, SAR (10g): 0.638 mW/g

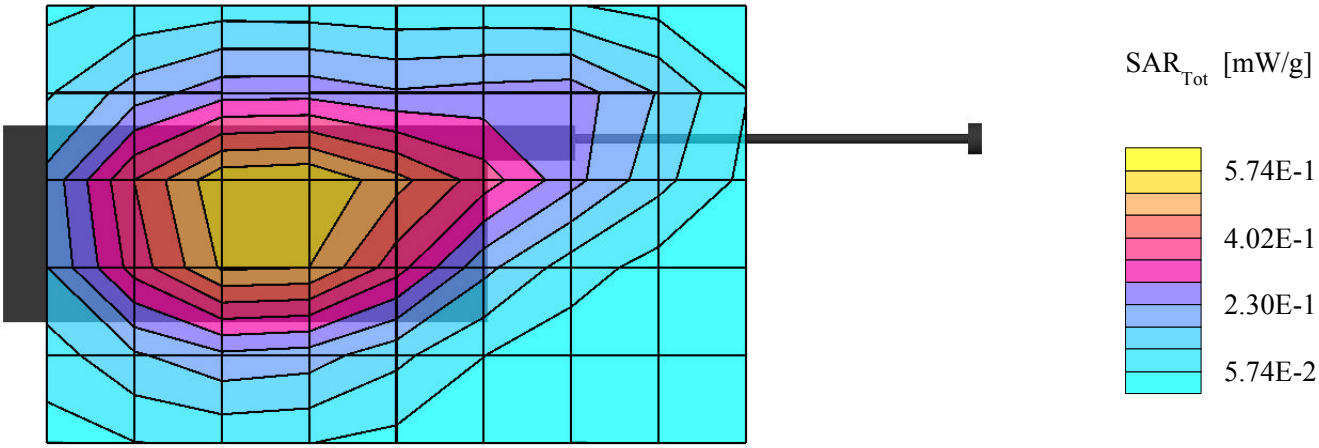
Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 1013 [824.70MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.584 mW/g, SAR (10g): 0.401 mW/g

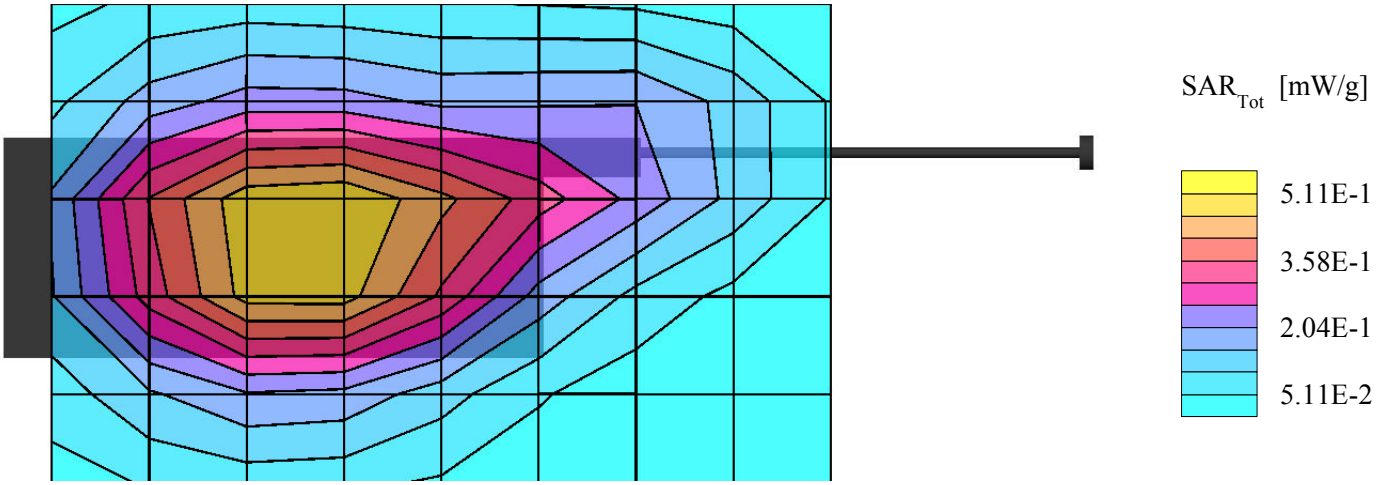
Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 363 [835.89MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000



HANWHA FCC ID: OCCHWC-3000 (Body SAR)

Generic Twin Phantom; Flat Section; Position: (270°,270°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Muscle 835 MHz: σ = 0.95 mho/m ε_r = 56.1 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 0.540 mW/g, SAR (10g): 0.366 mW/g

Separation Distance 1.0cm
Hanwha Dual-Mode Model HWC-3000
CDMA Mode - Antenna Out
Channel 777 [848.31MHz]
Conducted Power 24.0dBm
Test Date: Sept 20, 2000

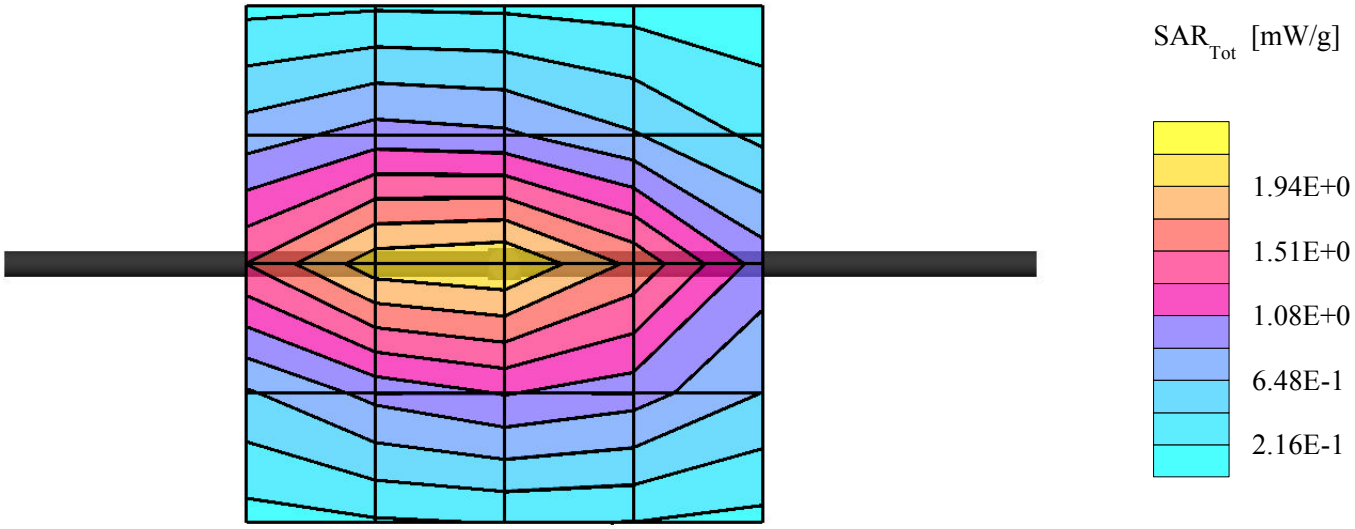


APPENDIX "B" – DIPOLE VALIDATION

Dipole 835 MHz

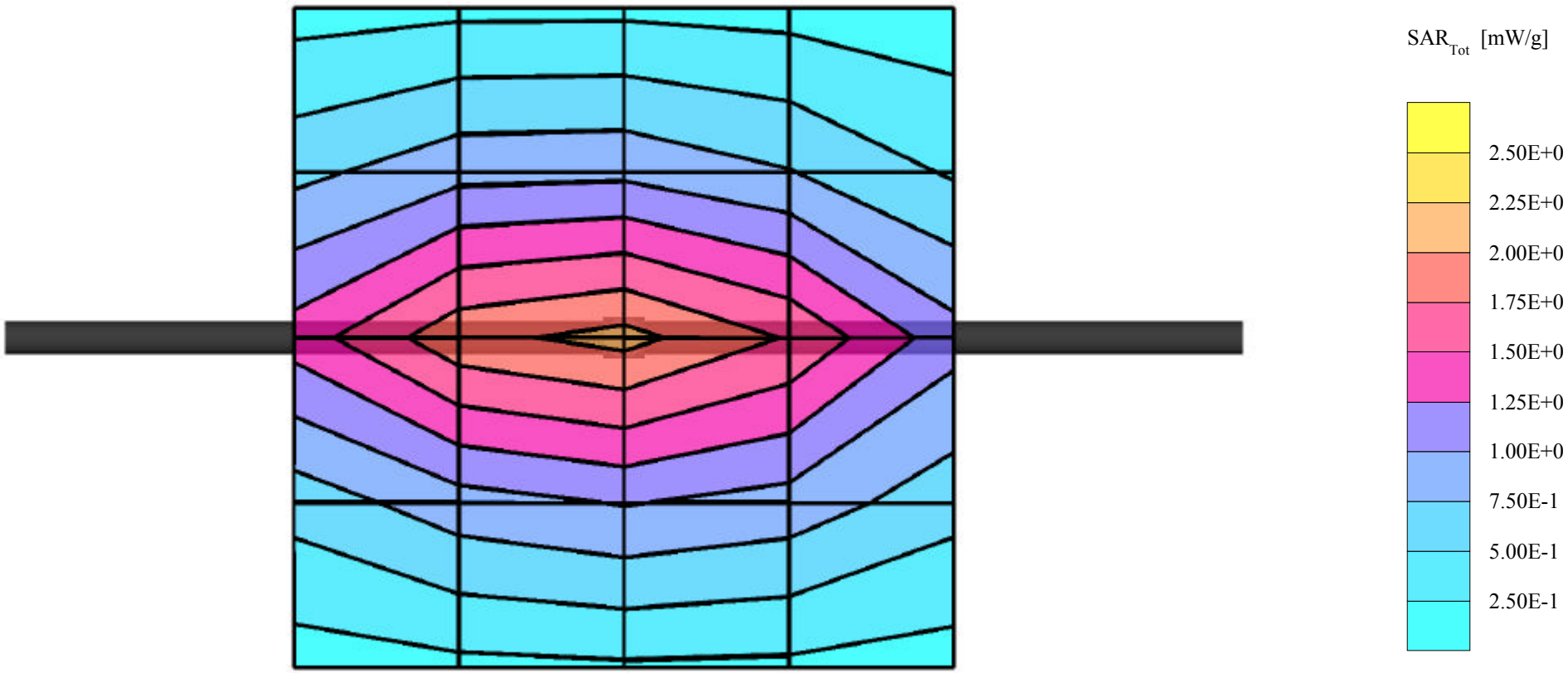
Generic Twin Phantom; Flat Section; Position: (90°,90°);
Probe: ET3DV6 - SN1387; ConvF(6.43,6.43,6.43); Crest factor: 1.0;
Brain 835 MHz: σ = 0.80 mho/m ε_r = 44.2 ρ = 1.00 g/cm^3
Coarse: Dx = 20.0, Dy = 20.0, Dz = 10.0
Cube 5x5x7
SAR (1g): 2.01 mW/g, SAR (10g): 1.34 mW/g

Validation Date: Sept. 20, 2000



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: σ = 0.80 mho/m ε_r = 44.2 ρ = 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**

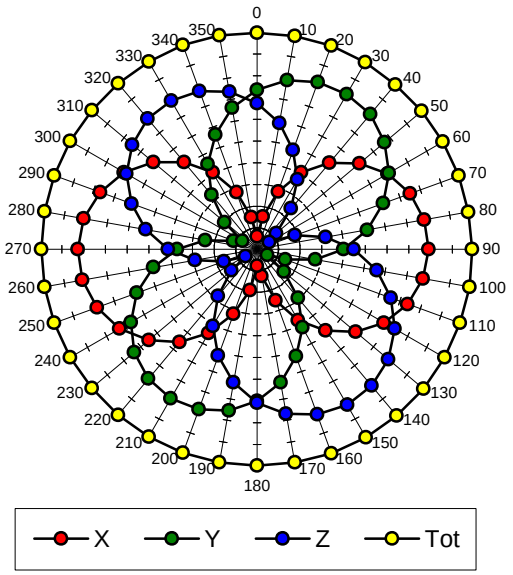
ConvF X	**5.50**	± 7% (k=2)	Boundary effect:	
ConvF Y	**5.50**	± 7% (k=2)	Alpha	**0.81**
ConvF Z	**5.50**	± 7% (k=2)	Depth	**1.70**

Sensor Offset

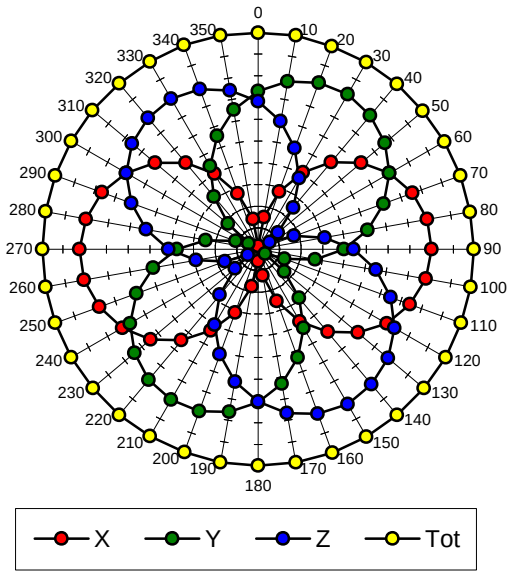
Probe Tip to Sensor Center	**2.7**	mm
Optical Surface Detection	**1.6 ± 0.2**	mm

Receiving Pattern (f), q = 0°

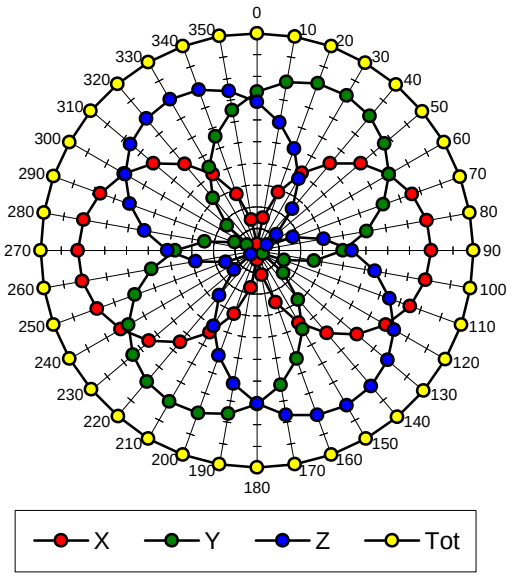
f = 30 MHz, TEM cell ifi110



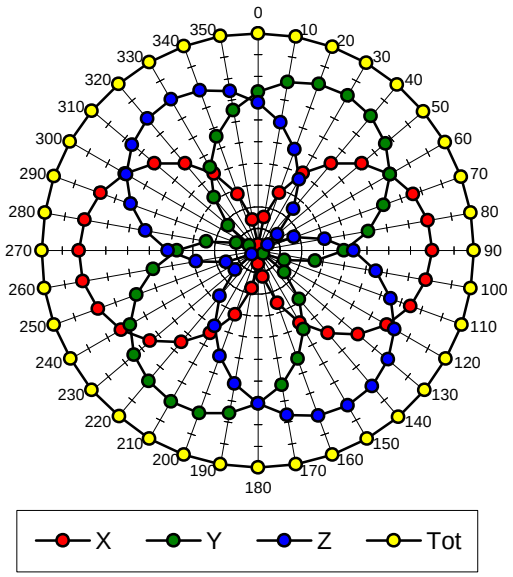
f = 100 MHz, TEM cell ifi110



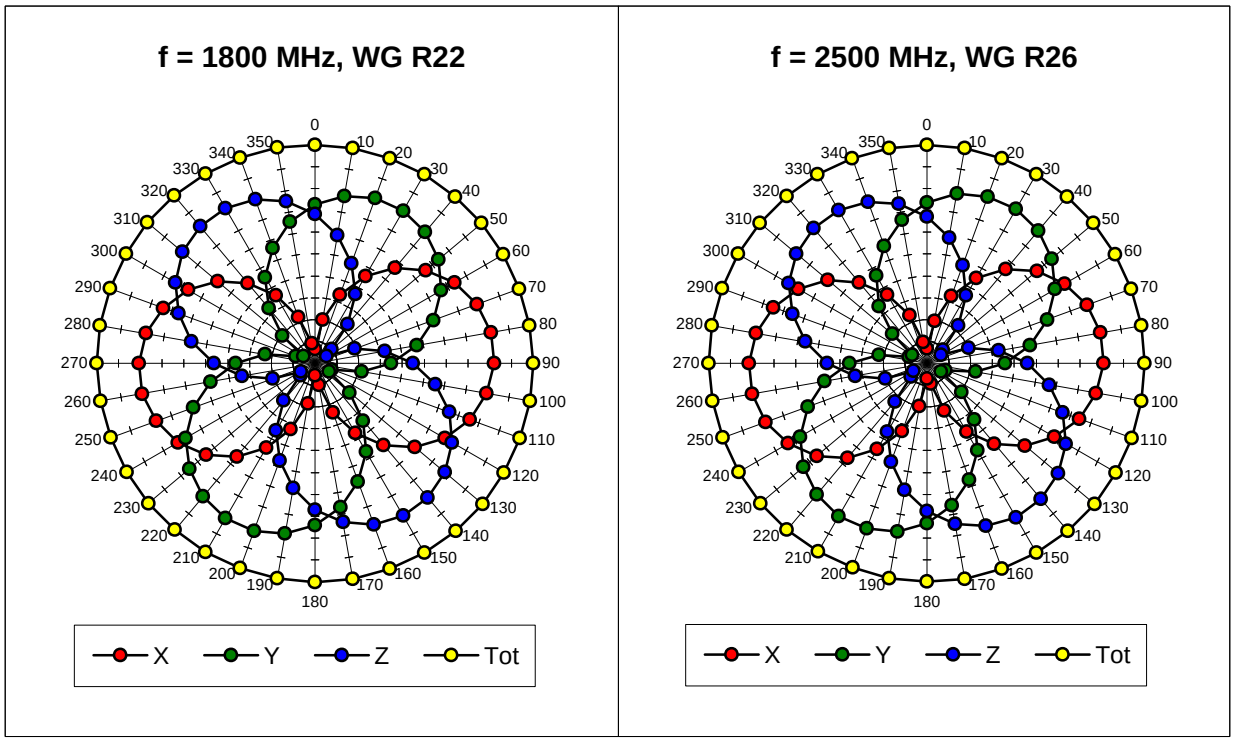
f = 300 MHz, TEM cell ifi110



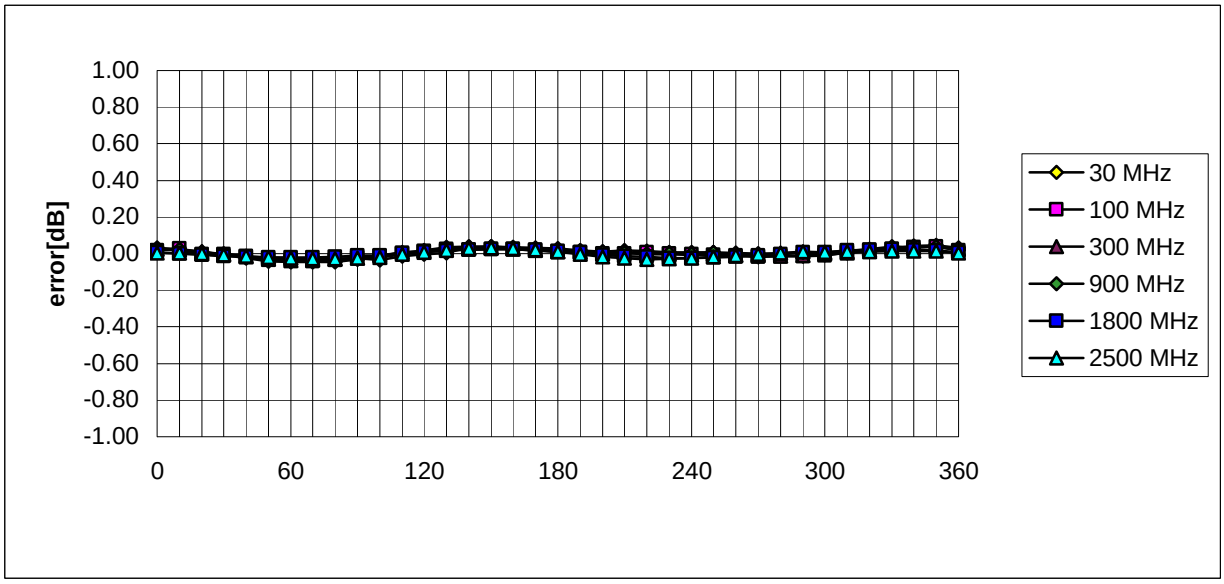
f = 900 MHz, TEM cell ifi110



ET3DV6 SN:1387

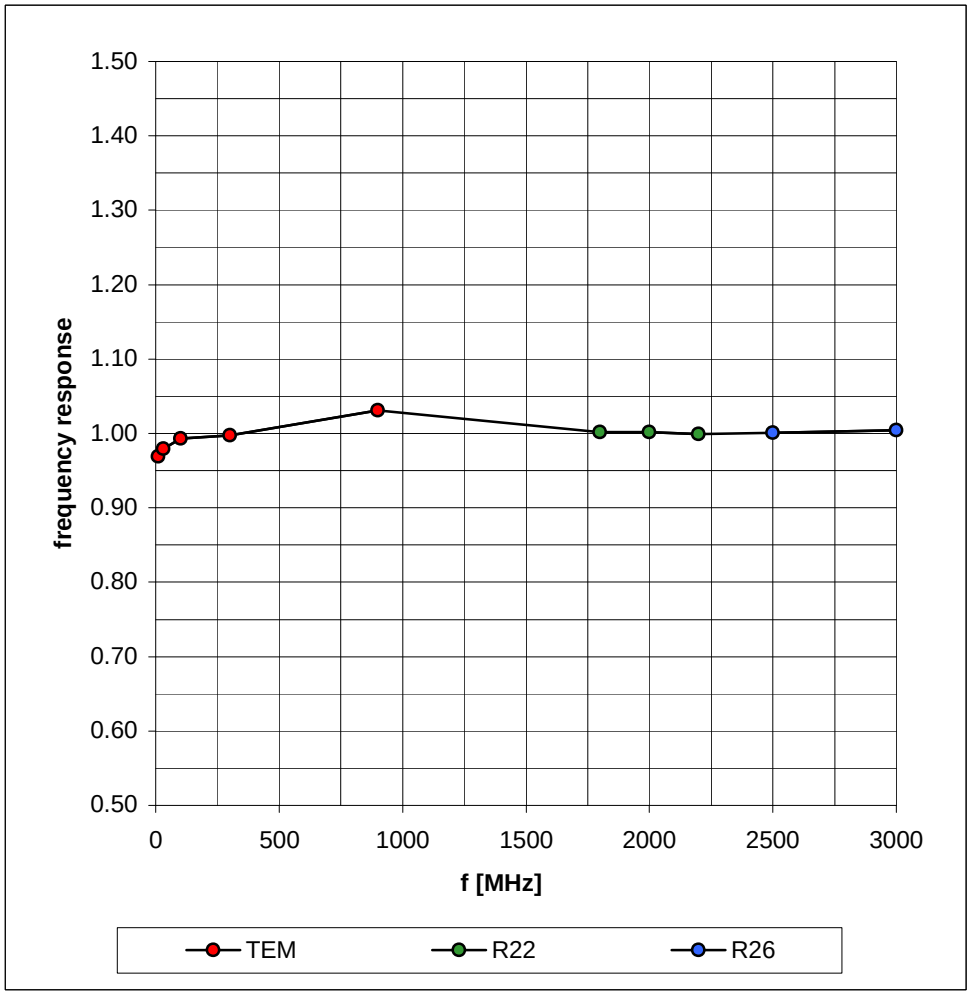


Isotropy Error (f), q = 0°



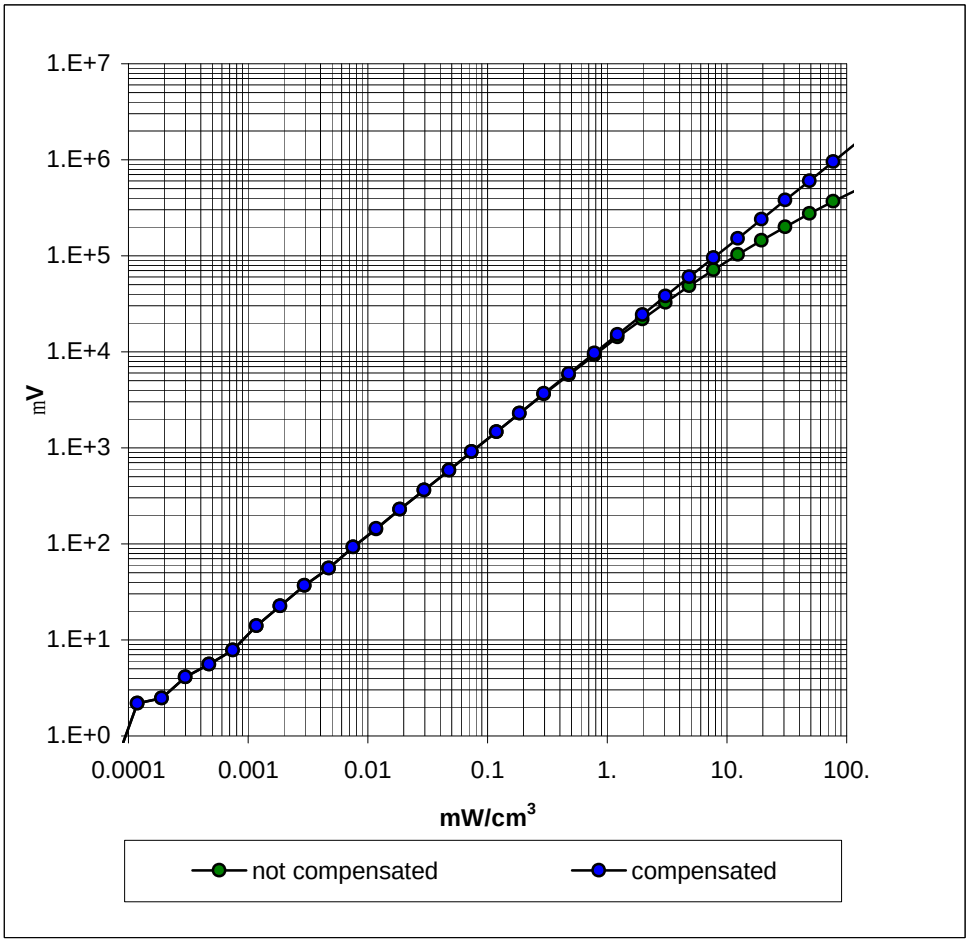
Frequency Response of E-Field

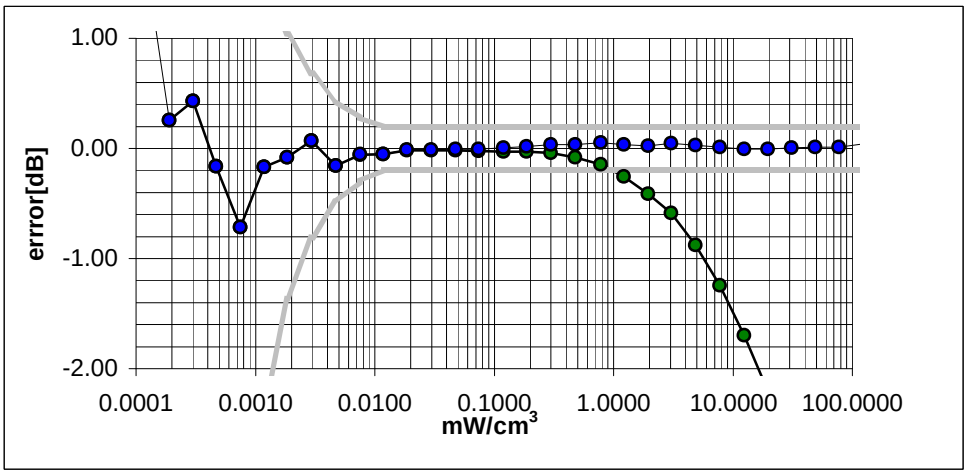
(TEM-Cell:ifi110, Waveguide R22, R26)



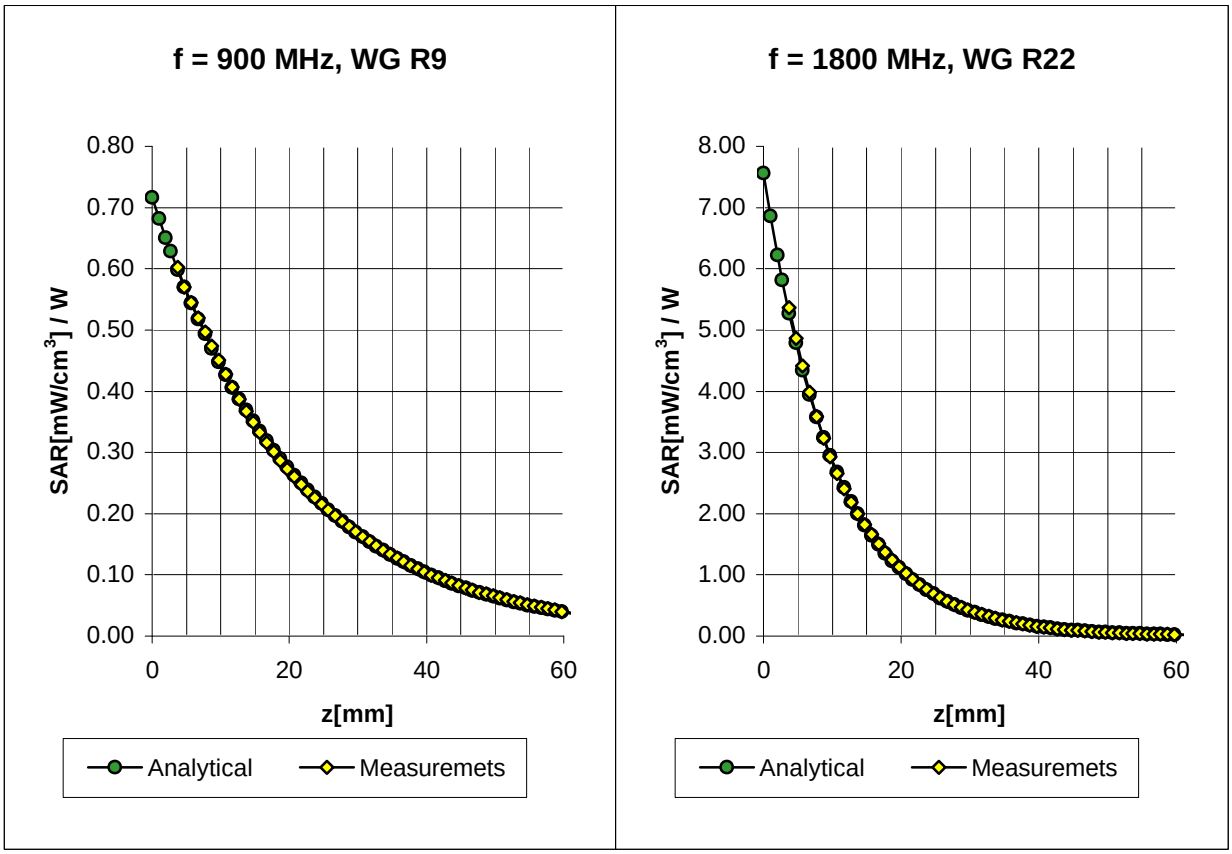
Dynamic Range f(SAR_{brain})

(TEM-Cell:ifi110)



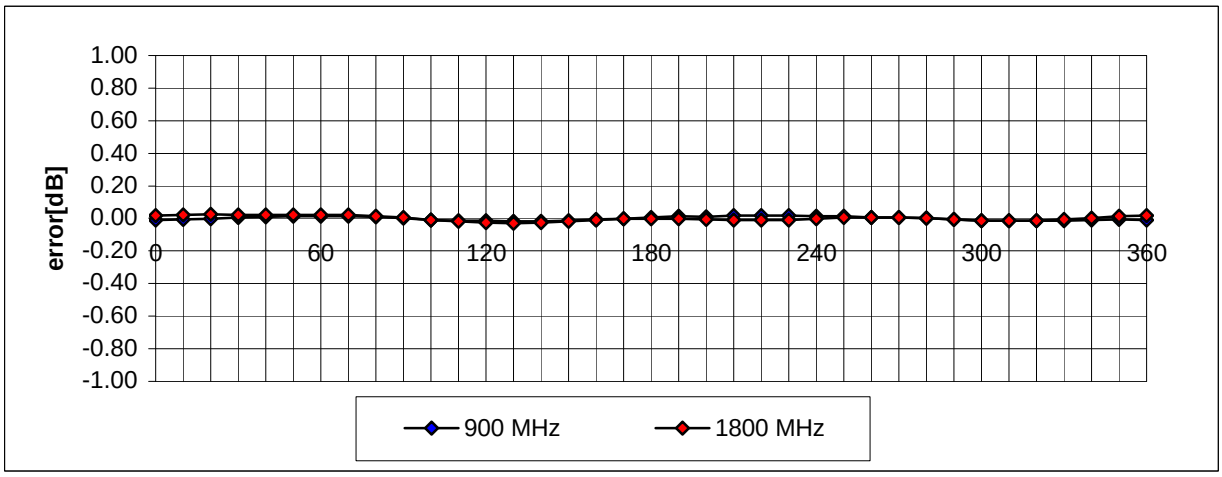


Conversion Factor Assessment



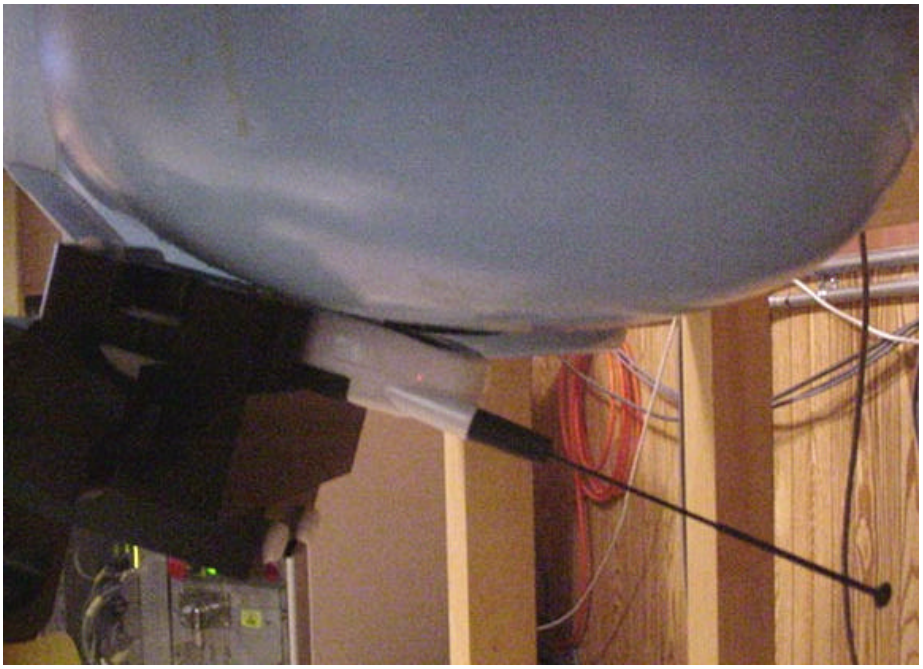
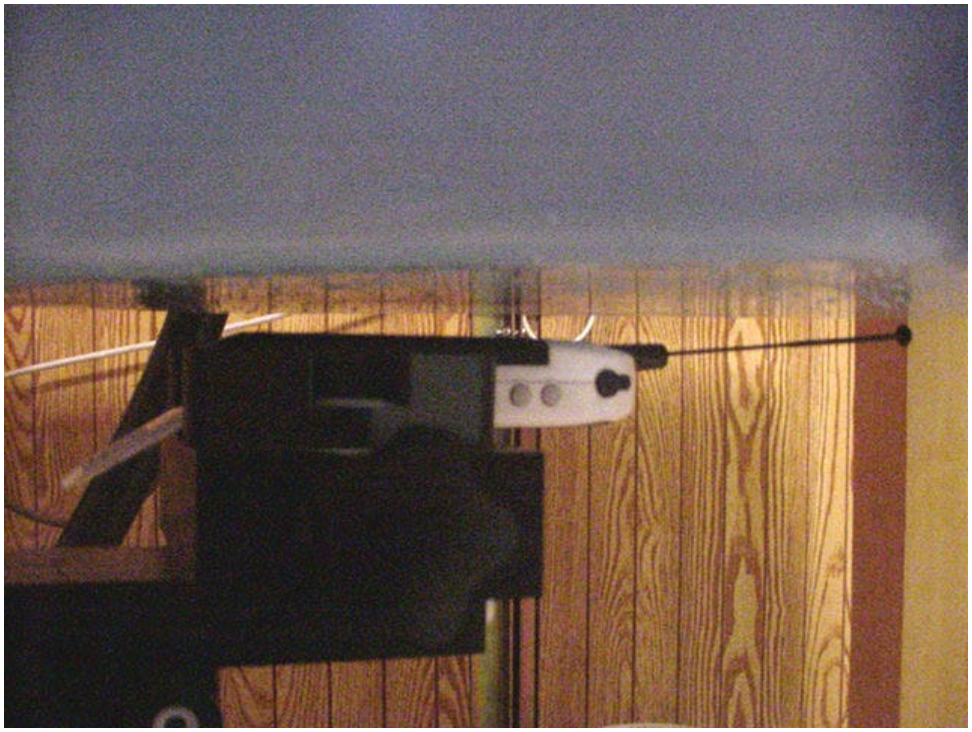
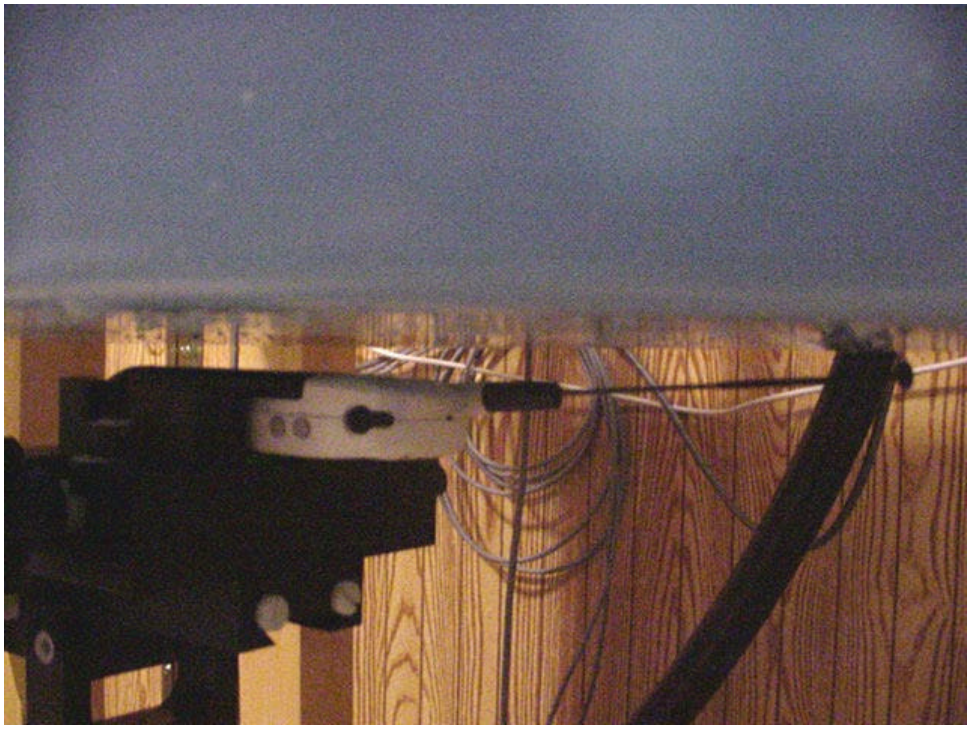
Receiving Pattern (f)

(in brain tissue, z = 5 mm)



APPENDIX "D" – SAR TEST SETUP PHOTOGRAPHS

HEAD SAR TEST PHOTOGRAPHS



BODY SAR TEST PHOTOGRAPHS