


MOTOROLA

Class II Permissive Change Exhibit 11: SAR Test Report IHDT56ER1

Date of test: 12 – 16 July, 2004

Date of Report: 5 August, 2004

Laboratory:

Motorola Personal Communications Sector Product Safety & Compliance Laboratory
600 N. US Highway 45
Room: MW113
Libertyville, Illinois 60048

Test Responsible:

Albert Patapack
Senior Staff Engineer

Accreditation:

This laboratory is accredited to ISO/IEC 17025-1999 to perform the following tests:



Tests:

Electromagnetic Specific Absorption Rate

Procedures:

ANSI/IEEE C95.1-1992, 1999

(SAR) IEEE C95.3-1991

IEEE P1528 (*DRAFT*)

FCC OET Bulletin 65 (*including Supplements A, B, C*)

Australian Communications Authority Radio

Communications (Electromagnetic Radiation – Human

Exposure) Standard 1999

CENELEC EN 50361 (2001)

Simulated Tissue Preparation

APP-0247

RF Power Measurement

DOI-0876, 0900, 0902, 0904, 0915

On the following products or types of products:

Wireless Communications Devices (Examples): Two Way Radios; Portable Phones (including Cellular,

Licensed Non-Broadcast and PCS); Low Frequency Readers; and Pagers

A2LA certificate #1651-01

Statement of Compliance:

Motorola declares under its sole responsibility that portable cellular telephone FCC ID IHDT56ER1 to which this declaration relates, is in conformity with the appropriate General Population/Uncontrolled RF exposure standards, recommendations and guidelines (FCC 47 CFR §2.1093). It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices. Any deviations from these standards, guidelines and recommended practices are noted below:

(none)

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This test report shall not be reproduced except in full, without written approval of the laboratory.

The results and statements contained herein relate only to the items tested. The names of individuals involved may be mentioned only in connection with the statements or results from this report.

Motorola encourages all feedback, both positive and negative, on this test report.

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1. Introduction

The Motorola Personal Communications Sector Product Safety Laboratory has performed measurements of the maximum potential exposure to the user of portable cellular phone (FCC ID IHDT56ER1). The Specific Absorption Rate (SAR) of this product was measured. The portable cellular phone was tested in accordance with FCC OET Bulletin 65 Supplement C 01-01.

2. Description of the Device Under Test

a. Antenna description

Type	External	
Location	Upper Right Corner	
Dimensions	Length	20mm
	Width	10mm
Configuration	Helix	

b. Device description

FCC ID Number	IHDT56ER1							
Serial number(s)	S50UN02293 & S50UN02294							
Mode(s) of Operation	GSM 850	GSM 900	GSM 1800	GSM 1900	GPRS 850	GPRS 900	GPRS 1800	GPRS 1900
Modulation Mode(s)	GSM	GSM	GSM	GSM	GSM	GSM	GSM	GSM
Maximum Output Power Setting	32.30 dBm	32.00 dBm	30.00 dBm	30.00 dBm	32.30 dBm	32.00 dBm	30.00 dBm	30.00 dBm
Duty Cycle	1:8	1:8	1:8	1:8	2:8	2:8	2:8	2:8
Transmitting Frequency Rang(s)	824.2- 848.8 MHz	880.2- 914.8 MHz	1710.2- 1784.8 MHz	1850.2 – 1909.8 Mhz	824.2- 848.8 MHz	880.2- 914.8 MHz	1710.2- 1784.8 MHz	1850.2 – 1909.8 MHz
Production Unit or Identical Prototype (47 CFR §2.908)	Identical Prototype							
Device Category	Portable							
RF Exposure Limits	General Population / Uncontrolled							

3. Test Equipment Used

3.1 Dosimetric System

The Motorola Personal Communications Sector Product Safety & Compliance Laboratory utilizes a Dosimetric Assessment System (Dasy3™ v3.1d) manufactured by Schmid & Partner Engineering AG (SPEAG™), of Zurich Switzerland. All the SAR measurements are taken within a shielded enclosure. The overall RSS uncertainty of the measurement system is $\pm 11.7\%$ ($K=1$) with an expanded uncertainty of $\pm 23.0\%$ ($K=2$). The measurement uncertainty budget is given in Appendix 6. Per IEEE 1528, this uncertainty budget is applicable to the SAR range of 0.4 W/kg to 10 W/kg. The list of calibrated equipment used for the measurements is shown below.

Description	Serial Number	Cal Due Date
DASY3 DAE V1	376	12/22/2004
	437	04/16/2004
E-Field Probe ET3DV6	1391	11/24/2004
	1398	02/16/2005
Dipole Validation Kit, D1800V2	251TR	04/02/2004
	273TR	04/02/2004
S.A.M. Phantom used for 1900MHz	TP-1159	
	TP-1235	

3.2 Additional Equipment

Description	Serial Number	Cal Due Date
Signal Generator HP8648C	3847A04845	11/05/2004
	3847A04850	02/02/2005
Power Meter E4419B	US39250622	01/08/2005
	GB39511084	04/05/2005
Power Sensor #1 - E9301A	US39210933	07/21/2005
	US39210931	08/05/2004
Power Sensor #2 - E9301A	US39210934	07/21/2005
	US39210932	08/05/2004
Network Analyzer HP8753ES	US99360070	10/29/2004
Dielectric Probe Kit HP85070B	US99360070	N/A

4. Electrical parameters of the tissue simulating liquid

Prior to conducting SAR measurements, the relative permittivity, ϵ_r , and the conductivity, σ , of the tissue simulating liquids were measured with the HP85070 Dielectric Probe Kit. These values, along with the temperature of the tissue simulate are shown in the table below. The recommended limits for maximum permittivity and minimum conductivity are also shown. These come from the Federal Communication Commission, OET Bulletin 65 Supplement C 01-01. It is seen that the measured parameters are satisfactory for compliance testing.

f (MHz)	Tissue type	Limits / Measured	Dielectric Parameters		
			ϵ_r	σ (S/m)	Temp (°C)
1900	Body	Measured, 07/12/2004	53.3	1.59	19.0
		Measured, 07/16/2004	52.8	1.59	19.0
		Recommended Limits	53.3 $\pm 5\%$	1.52 $\pm 5\%$	18-25

The list of ingredients and the percent composition used for the tissue simulates are indicated in the table below.

	800MHz Head	800MHz Body	1900MHz Head	1900MHz Body
Ingredient				
Sugar	57.0	44.9	--	30.80
DGBE	--	--	47.0	--
Water	40.45	53.06	52.8	68.91
Salt	1.45	0.94	0.2	0.29
HEC	1.0	1.0	--	--
Bact.	0.1	0.1	--	--

5. System Accuracy Verification

A system accuracy verification of the DASY3 was performed using the measurement equipment listed in Section 3.1. The daily system accuracy verification occurs within center section of the SAM phantom.

A SAR measurement was performed to see if the measured SAR was within +/- 10% from the target SAR indicated on the dipole certification sheet. These tests were done at 900MHz and/or 1800MHz. These frequencies are within 100MHz of the mid-band frequency of the test device. This is within the allowable window given in Supplement C 01-01 *Appendix D System Verification* section item #5. The test was conducted on the same days as the measurement of the DUT. Recommended limits for maximum permittivity, minimum conductivity are shown in the table below. These come from the Federal Communication Commission, OET Bulletin 65 Supplement C 01-01. The obtained results from the system accuracy verification are displayed in the table below. The distributions of SAR compare well with those of the reference measurements (see Appendix 1). The tissue stimulant depth was verified to be 15.0cm $\pm$ 0.5cm. Z-axis scans showing the SAR penetration are also included in Appendix 1. SAR values are normalized to 1W forward power delivered to the dipole.

f (MHz)	Description	SAR (W/kg), 1gram	Dielectric Parameters		Ambient Temp (°C)	Tissue Temp (°C)
			ϵ_r	s (S/m)		
1800	Measured, 07/12/2004	40.65	39.2	1.37	20.0	19.1
	Measured, 07/16/2004	39.95	39.4	1.37	20.0	19.3
	Recommended Limits	40.7	40.0 $\pm$ 5%	1.4 $\pm$ 5%	18-25	18-25

The following probe conversion factors were used on the E-Field probe(s) used for the system accuracy verification measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ET3DV6	1391	1800	5.3	2 of 10
	1398	1800	5.04	7 of 8

6. Test Results

The test sample was operated in a test mode that allows control of the transmitter without the need to place actual phone calls. For the purposes of this test the unit is commanded to test mode and manually set to the proper channel, transmitter power level and transmit mode of operation. The phone was tested in the configurations stipulated in OET Bulletin 65 Supplement C 01-01. Motorola also followed the requirements in Supplement. C / Appendix D: SAR Measurement Procedures, section titled “*Devices Operating Next To A Person’s Ear*”. These directions state “The device should be tested on the left and right side of the head phantom in the “Cheek/Touch” and “Ear/Tilt” positions. When applicable, each configuration should be tested with the antenna in its fully extended and fully retracted positions. These test configurations should be tested at the high, middle and low frequency channels of each operating mode; for example, AMPS, CDMA, and TDMA. If the SAR measured at the middle channel for each test configuration (left, right, Cheek/Touch, Tile/Ear, extended and retracted) is at least 2.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).”

The DASY v3.1d SAR measurement system specified in section 3.1 was utilized within the intended operations as set by the SPEAG™ setup. The phone was positioned into the measurement configurations using the positioner supplied with the DASY 3.1d SAR measurement system. The measured dielectric constant of the material used for the positioner is less than 2.9 and the loss tangent is less than 0.02 ($\pm 30\%$) at 850MHz. The default settings for the “coarse” and “cube” scans were chosen and use for measurements. The grid spacing of the course scan was set to 15cm as shown in the SAR plots included in appendix 2. Please refer to the DASY manual for additional information on SAR scanning procedures and algorithms used.

The Cellular Phone (FCC ID IHDT56ER1) has the AANN4285A as the only available battery option. This battery was used to do all of the SAR testing. The phone was placed in the SAR measurement system with a fully charged battery.

6.1 Body Worn Test Results

The SAR results shown in tables 1 and 2 are the maximum SAR values averaged over 1 gram of phantom tissue. Also shown are the measured conducted output powers, the temperature of the test facility during the test, the temperature of the tissue simulate after the test, the measured drift and the extrapolated SAR. The exact method of extrapolation is $\text{New SAR} = \text{Old SAR} * 10^{(-\text{drift}/10)}$. The SAR reported at the end of the measurement process by the DASY™ measurement system can be scaled up by the measured drift to determine the SAR at the beginning of the measurement process. This is the most conservative SAR because it corresponds to the average output power at the beginning of the SAR test. This extrapolation has been done because when the DUT is operating properly it may exhibit a slump in radiated power and SAR over time. This is verified by measuring the SAR drift after the test. The test conditions indicated as bold numbers in the following table are included in Appendix 3. All other test conditions measured lower SAR values than those included in Appendix 3.

A “flat” phantom was for the body-worn tests. This “flat” phantom is made out of 1” thick natural High Density Polyethylene with a thickness at the bottom equal to 2.0mm. It measures 52.7cm(long) x 26.7cm(wide) x 21.2cm(tall). The measured dielectric constant of the material used is less than 2.3 and the loss tangent is less than 0.0046 all the way up to 2.184GHz.

The tissue stimulant depth was verified to be 15.0cm $\pm$ 0.5cm. The same device holder described in section 6 was used for positioning the phone. The functional accessories were divided into two categories, the ones with metal components and the ones with non-metal components. For non-metallic component accessories’, testing was performed on the accessory that displayed the closest proximity to the flat phantom. Each metallic component accessory, if any, was checked for uniqueness of metal component so that each is tested with the device. If multiple accessories shared an identical metal component, only the accessory that dictates the closest spacing to the body was tested. The cellular phone was tested with a headset connected to the device for all body-worn SAR measurements.

There is one new Body-Worn Accessory available for this phone that utilizes two belt clips:

A Leather Case: Model # VLV2203 / SYN1072A with Belt Clip Model # SYN8631A

A Leather Case: Model # VLV2203 / SYN1072A with Belt Clip Model # SYN8763A

Note that, since all of the 850Mhz band body worn SAR values as well as the 1900Mhz SAR values with belt clip #SYN8631A were less than or equal to that previously reported, the values included in tables 1 and 2 are for reference only. This data has been included to show that the SAR values did not significantly increase from that previously reported for these test conditions. As such, no SAR distribution plots for these body worn configurations have been included in Appendix 2 of this document. The 850Mhz band and 1900Mhz band SAR distribution plots for body worn configuration that were included in Appendix 3 of the original filing report should still be considered to apply.

The following probe conversion factors were used on the E-Field probe(s) used for the body worn measurements:

Description	Serial Number	f (MHz)	Conversion Factor	Cal Cert pg #
E-Field Probe ET3DV6	1391	1800	4.9	8 of 10
	1398	1800	4.5	7 of 8

f (MHz)	Description	Conducted Output Power (dBm)	Body Worn Leather Case: Model # VLV2203 / SYN1072A							
			Belt Clip Model # SYN8631A				Belt Clip Model # SYN8763A			
			Measured (W/kg)	Drift (dB)	Extrapolate d (W/kg)	Simulate Temp (°C)	Measured (W/kg)	Drift (dB)	Extrapolate d (W/kg)	Simulate Temp (°C)
Digital 850MHz	Channel 128	32.28								
	Channel 190	32.25	0.23	-0.08	0.23	20.0	0.113	-0.06	0.11	20.0
	Channel 251	32.25								
Digital 1900MHz	Channel 512	29.96								
	Channel 661	29.98	0.137	0.00	0.14	19.0	0.563	-0.05	0.57	19.0
	Channel 810	29.97								

Table 1: SAR measurement results for the portable cellular telephone FCC ID IHDT56ER1 at highest possible output power. Measured against the body.

f (MHz)	Description	Conducted Output Power (dBm)	GPRS Class 10 Body Worn Leather Case: Model # VLV2203 / SYN1072A							
			Belt Clip Model # SYN8631A				Belt Clip Model # SYN8763A			
			Measured (W/kg)	Drift (dB)	Extrapolate d (W/kg)	Simulate Temp (°C)	Measured (W/kg)	Drift (dB)	Extrapolate d (W/kg)	Simulate Temp (°C)
Digital 850MHz	Channel 128	32.28								
	Channel 190	32.25	0.561	-0.06	0.57	20.0	0.363	-0.04	0.37	20.0
	Channel 251	32.25								
Digital 1900MHz	Channel 512	29.96					0.815	-0.13	0.84	19.0
	Channel 661	29.98	0.204	0.04	0.20	19.0	0.743	-0.02	0.75	19.0
	Channel 810	29.97					0.636	0.02	0.64	19.0

Table 2: SAR measurement results for the portable cellular telephone FCC ID IHDT56ER1 at highest possible output power. Measured against the body.

Appendix 1

SAR distribution comparison for the system accuracy verification

Dipole 1800 MHz

1800 MHz System Performance Check / Dipole Sn# 251TR

PM1 Power = 200mW

Sim.Temp@meas=19.2C Sim.Temp@SPC = 19.1C Room Temp @ SPC = 20C

R3 TP1159 SAM Expanded (Rev. 2)-9Jan03 Phantom; Flat Section; Position: (90°,90°); Frequency: 1800 MHz

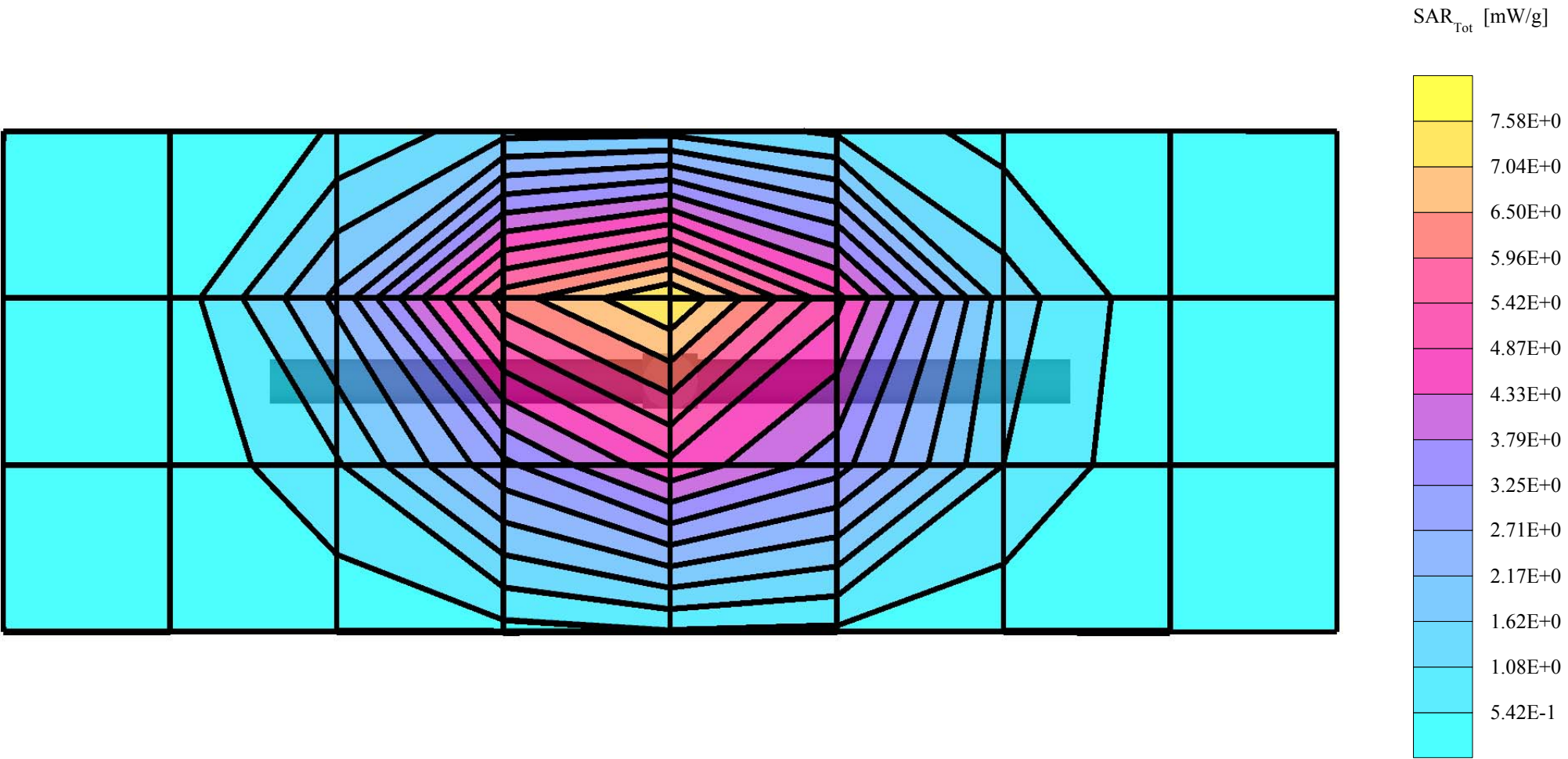
Probe: ET3DV6 - SN1398 - Validation4; ConvF(5.04,5.04,5.04); Crest factor: 1.0; 1800 MHz VALIDATION: $\sigma = 1.37 \text{ mho/m}$ $\epsilon_r = 39.2$ $\rho = 1.00 \text{ g/cm}^3$

Cubes (2): SAR (1g): 8.13 mW/g $\pm 0.02 \text{ dB}$, SAR (10g): 4.29 mW/g $\pm 0.00 \text{ dB}$, (Worst-case extrapolation)

Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0

Penetration depth: 8.7 (8.3, 9.4) [mm]

Powerdrift: -0.03 dB



Dipole 1800 MHz

1800 MHz System Performance Check / Dipole Sn# 251TR

PM1 Power = 200mW

Sim.Temp@meas=19.2C Sim.Temp@SPC = 19.1C Room Temp @ SPC = 20C

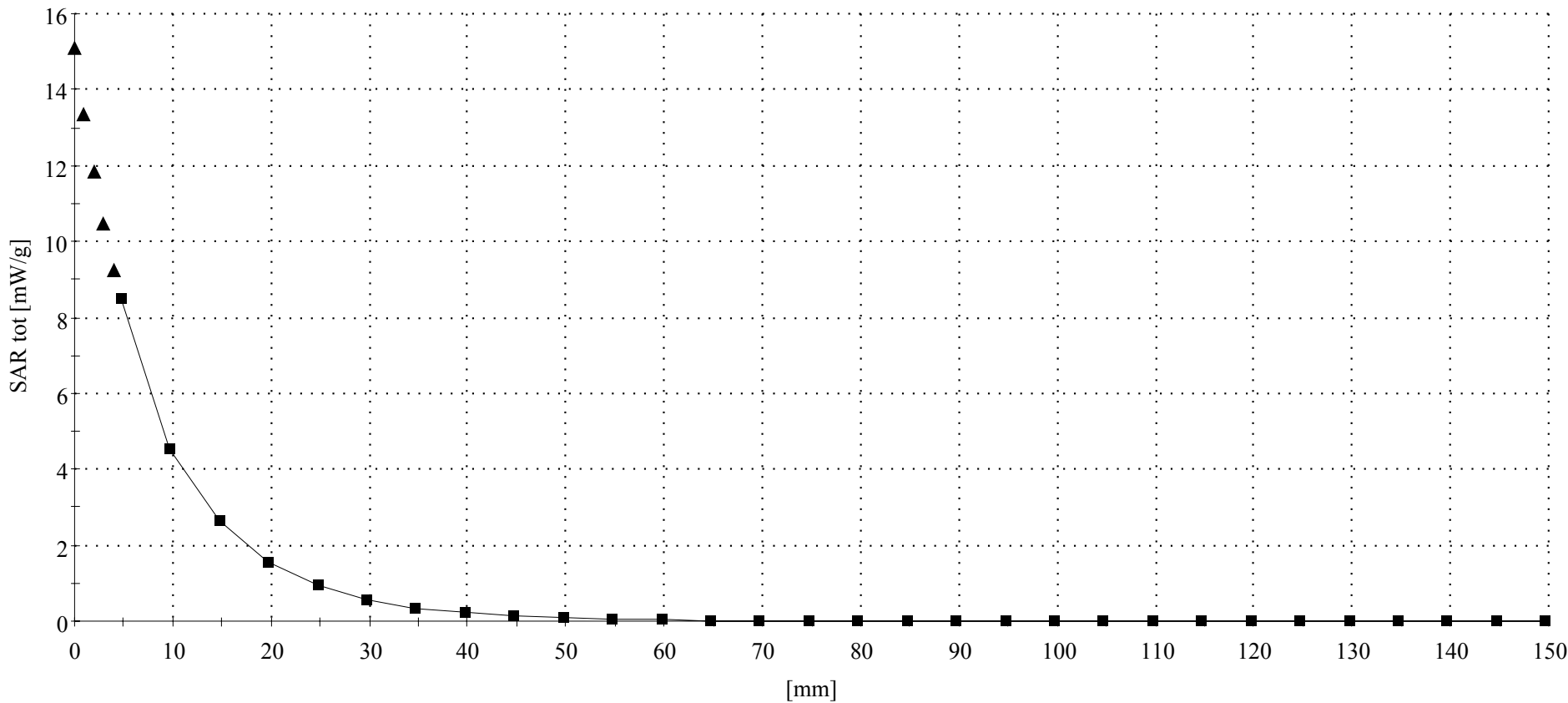
R3 TP1159 SAM Expanded (Rev. 2)-9Jan03 Phantom; Section; Position: ; Frequency: 1800 MHz

Probe: ET3DV6 - SN1398 - Validation4; ConvF(5.04,5.04,5.04); Crest factor: 1.0; 1800 MHz VALIDATION: $\sigma = 1.37 \text{ mho/m}$ $\epsilon_r = 39.2$ $\rho = 1.00 \text{ g/cm}^3$

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Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Penetration depth: 8.4 (8.0, 9.2) [mm]



Dipole 1800 MHz

1800 MHz System Performance Check / Dipole Sn# 273tr

PM1 Power = 200mW

Sim.Temp@meas=19.3°C Sim.Temp@SPC = 19.3C Room Temp @ SPC = 20°C

R2 Amy Twin Phantom Rev.3 Phantom; section 1 Section; Position: (90°,90°); Frequency: 1800 MHz

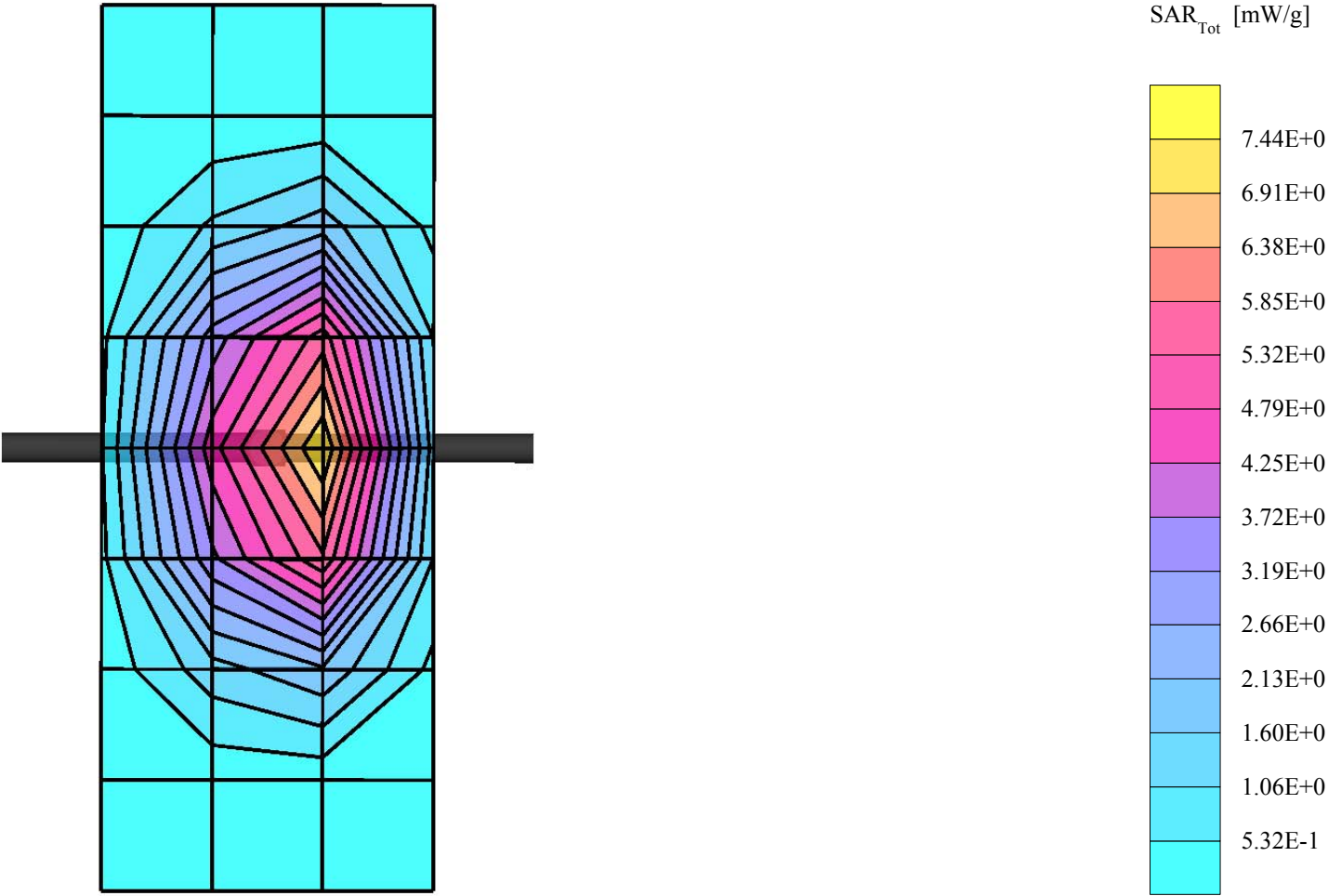
Probe: ET3DV6 - SN1391 - Validation.4; ConvF(5.30,5.30,5.30); Crest factor: 1.0; 1800 MHz VALIDATION: $\sigma = 1.37 \text{ mho/m}$ $\epsilon_r = 39.4$ $\rho = 1.00 \text{ g/cm}^3$

Cubes (2): SAR (1g): 7.99 mW/g $\pm 0.04 \text{ dB}$, SAR (10g): 4.26 mW/g $\pm 0.03 \text{ dB}$, (Worst-case extrapolation)

Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0

Penetration depth: 8.5 (8.2, 9.3) [mm]

Powerdrift: 0.04 dB



Dipole 1800 MHz

1800 MHz System Performance Check / Dipole Sn# 273tr

PM1 Power = 200mW

Sim.Temp@meas=19.3°C Sim.Temp@SPC = 19.3C Room Temp @ SPC = 20°C

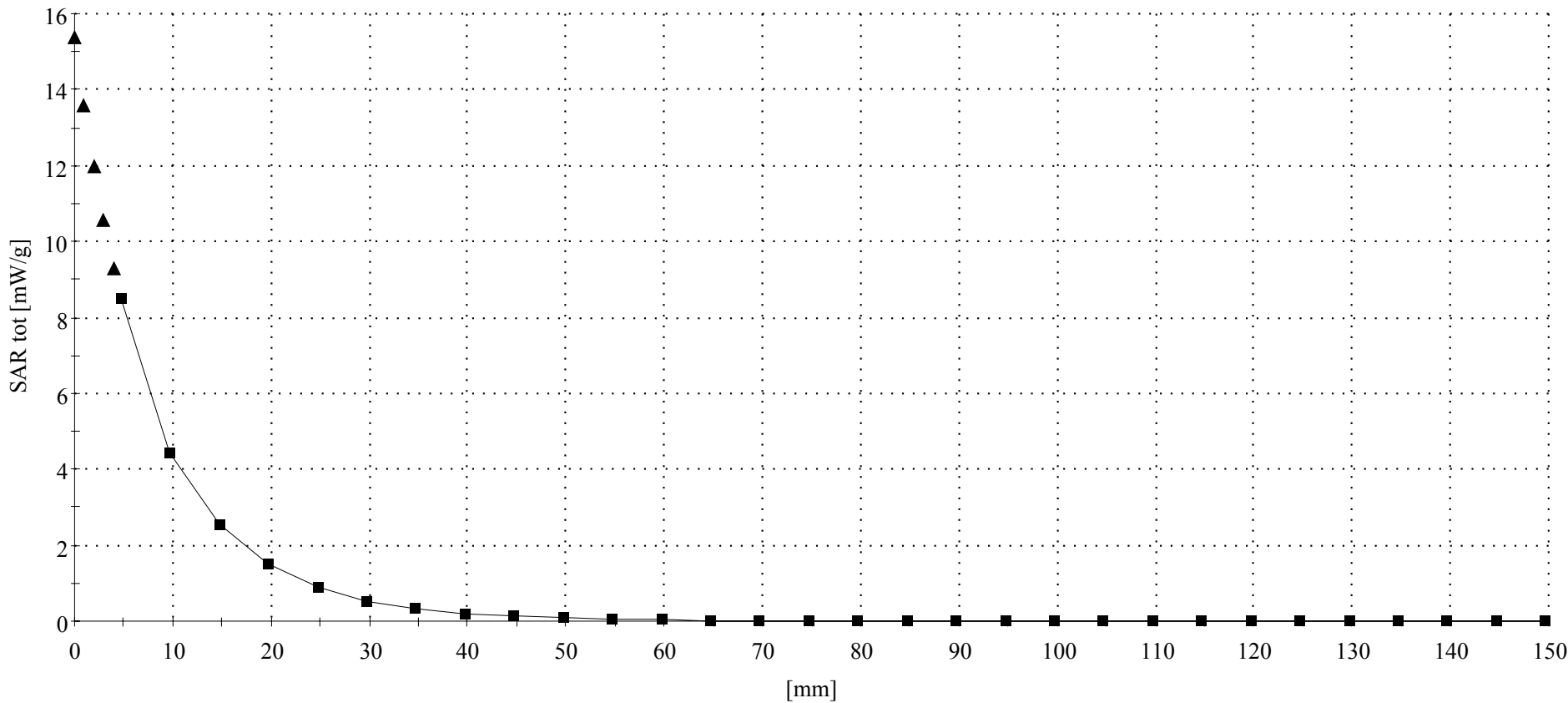
R2 Amy Twin Phantom Rev.3 Phantom; Section; Position: ; Frequency: 1800 MHz

Probe: ET3DV6 - SN1391 - Validation.4; ConvF(5.30,5.30,5.30); Crest factor: 1.0; 1800 MHz VALIDATION: $\sigma = 1.37$ mho/m $\epsilon_r = 39.4$ $\rho = 1.00$ g/cm³

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Z-Axis: Dx = 0.0, Dy = 0.0, Dz = 5.0

Penetration depth: 8.1 (7.7, 9.0) [mm]



Appendix 2

SAR distribution plots for Body Worn Configuration

Note that, since all of the 850Mhz band body worn SAR values as well as the 1900Mhz SAR values with belt clip #SYN8631A were less than or equal to that previously reported, the values included in tables 2 and 3 are for reference only. This data has been included to show that the SAR values did not significantly increase from that previously reported for these test conditions. As such, no SAR distribution plots for these body worn configurations have been included in Appendix 3 of this document. The 850Mhz band and 1900Mhz band SAR distribution plots for body worn configuration that were included in Appendix 3 of the original filing report should still be considered to apply.

s/n: 2294

Ch# 661 / Pwr Step: 0

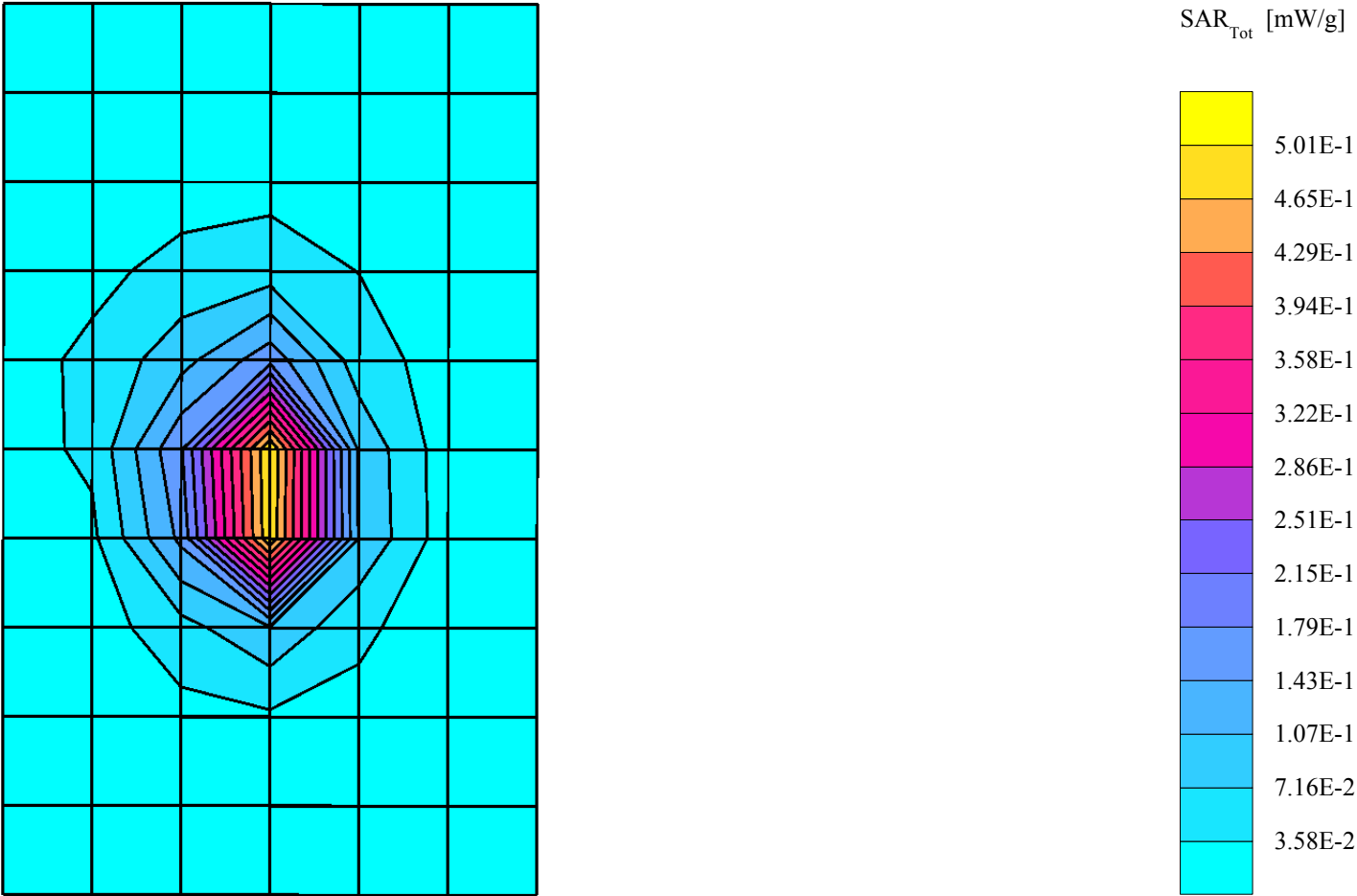
Antenna Position: FIXED

Type of Modulation: GSM

Battery Model #: AANN4285A

Accessory Model #: Half Leather Case VLV2203/SYN1072A & SYN8763A CLIP

R2 Amy Twin Phantom Rev.3 Phantom; section 1 Section; Position: (0°,0°); Frequency: 1880 MHz
Probe: ET3DV6 - SN1391 - FCC Body.2; ConvF(4.90,4.90,4.90); Crest factor: 8.0; 1880 MHz Head & Body: $\sigma = 1.59 \text{ mho/m}$ $\epsilon_r = 52.8$ $\rho = 1.00 \text{ g/cm}^3$
Cube 7x7x7: SAR (1g): 0.563 mW/g, SAR (10g): 0.265 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Penetration depth: 7.9 (7.5, 8.8) [mm]
Powerdrift: -0.05 dB



s/n: 2294

Ch# 512 / Pwr Step: 0

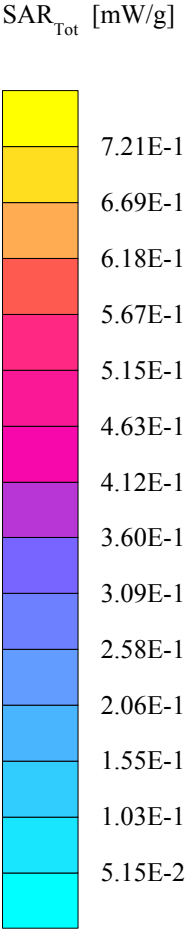
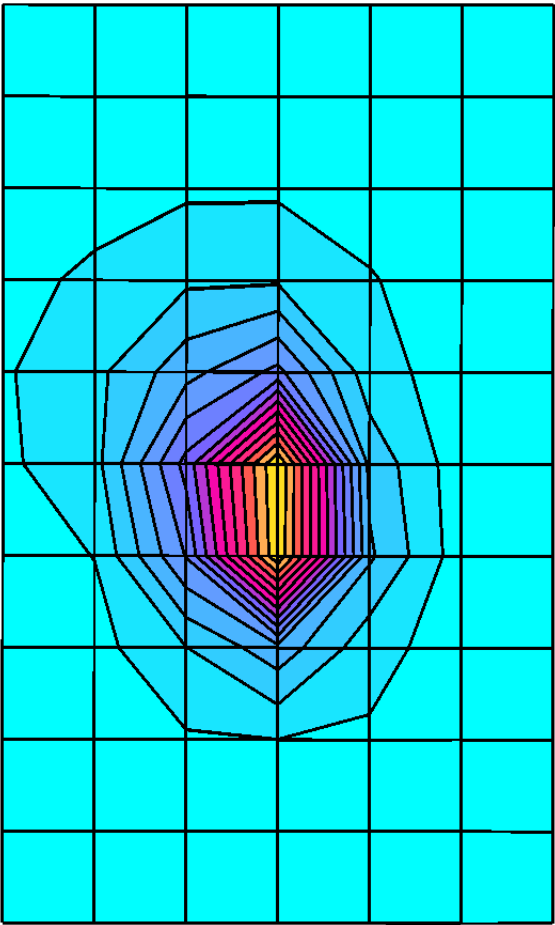
Antenna Position: FXD

Type of Modulation: GPRS

Battery Model #: 4285

Accessory Model #: Leather Case VLV2203/SYN1072A & SYN8763A clip

R3: Amy Twin Phantom Rev.4 (22Aug02) Phantom; section 1 Section; Position: (0°,0°); Frequency: 1850 MHz
Probe: ET3DV6 - SN1398 - FCC Body2; ConvF(4.50,4.50,4.50); Crest factor: 4.0; 1880 MHz Head & Body: $\sigma = 1.59$ mho/m $\epsilon_r = 53.3$ $\rho = 1.00$ g/cm³
Cube 7x7x7: SAR (1g): 0.815 mW/g, SAR (10g): 0.395 mW/g, (Worst-case extrapolation)
Coarse: Dx = 15.0, Dy = 15.0, Dz = 10.0
Penetration depth: 8.0 (7.6, 8.8) [mm]
Powerdrift: -0.13 dB



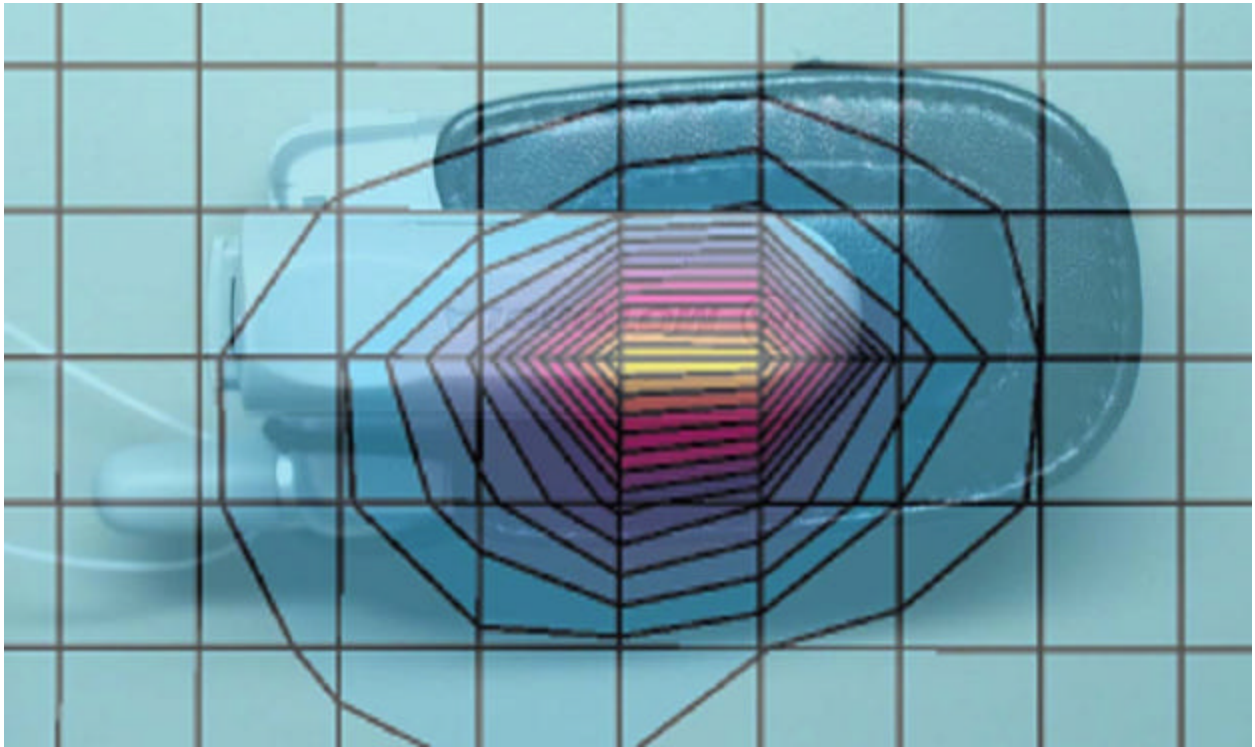


Figure 1. Typical 1900MHz Body-Worn Contour Overlaid on Phone with Antenna Fixed

Appendix 3
Probe Calibration Certificate

Client

Motorola (MRO)

CALIBRATION CERTIFICATE

Object(s)

ET3DV6 - SN: 1391

Calibration procedure(s)

QA CAL-01 v2
Calibration procedure for dosimetric E-field probes

Calibration date:

November 24, 2003

Condition of the calibrated item

In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

Calibrated by:

Name

Nico Vetterli

Function

Technician

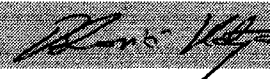
Signature



Approved by:

Katja Pokovic

Laboratory Director



Date issued: November 25, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1391

Manufactured:	October 1, 1999
Last calibration:	November 20, 2002
Recalibrated:	November 24, 2003

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1391

Sensitivity in Free Space

NormX	1.86 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.72 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.73 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression

DCP X	92	mV
DCP Y	92	mV
DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid

Head **900 MHz** $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\% \text{ mho/m}$

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha 0.53
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth 2.20

Head **1800 MHz** $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\% \text{ mho/m}$

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha 0.58
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth 2.43

Boundary Effect

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

Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	11.1	6.1
SAR _{be} [%] With Correction Algorithm	0.3	0.5

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

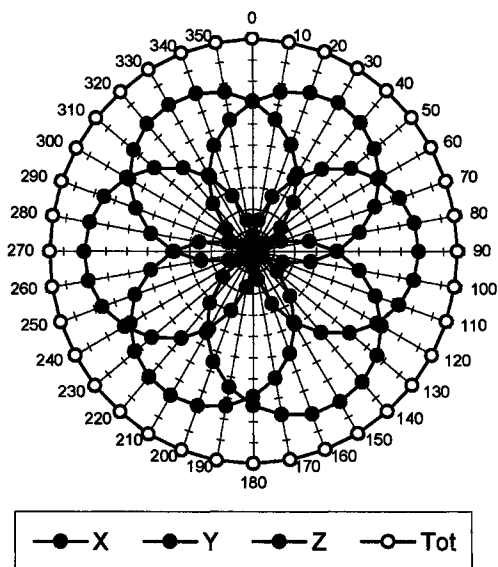
Probe Tip to Boundary	1 mm	2 mm
SAR _{be} [%] Without Correction Algorithm	14.4	9.2
SAR _{be} [%] With Correction Algorithm	0.1	0.0

Sensor Offset

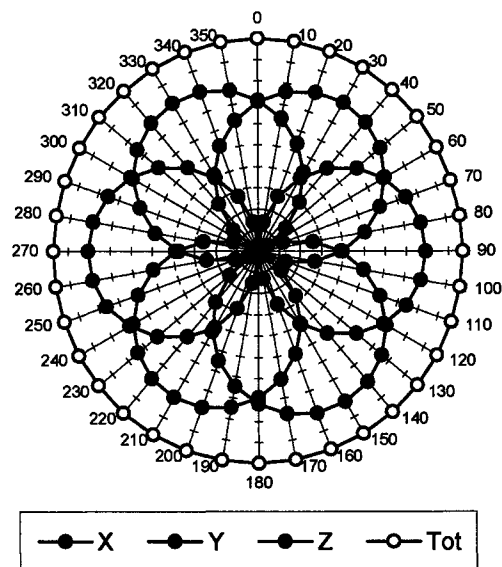
Probe Tip to Sensor Center	2.7	mm
Optical Surface Detection	1.1 $\pm$ 0.2	mm

Receiving Pattern (ϕ , $\theta = 0^\circ$)

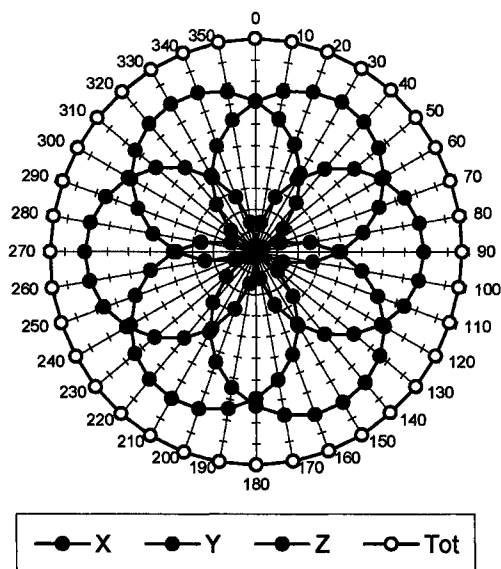
f = 30 MHz, TEM cell ifi110



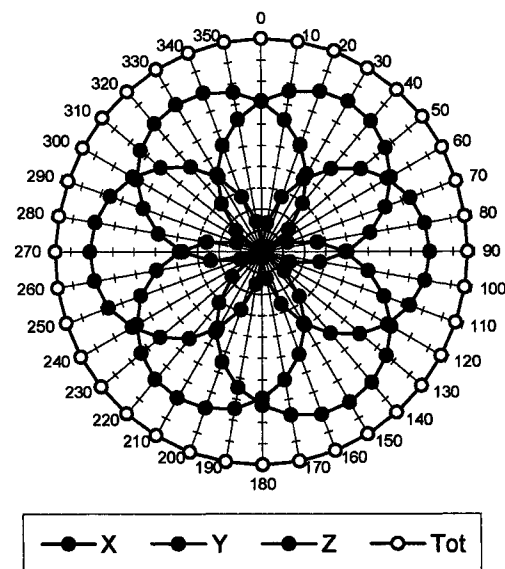
f = 100 MHz, TEM cell ifi110

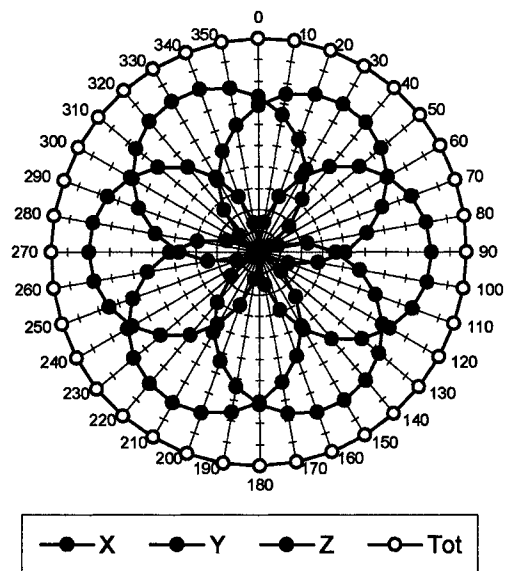
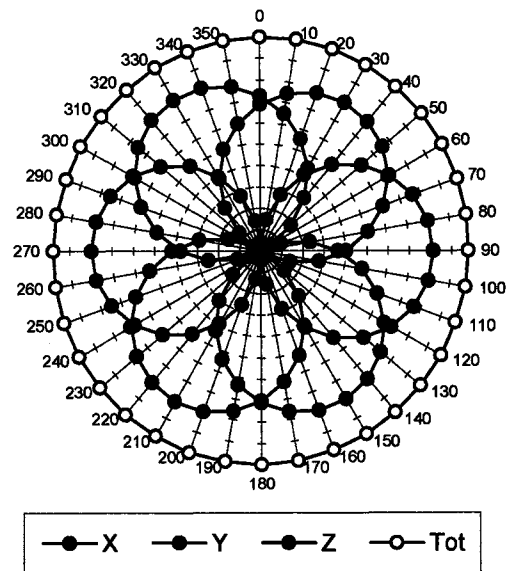


f = 300 MHz, TEM cell ifi110

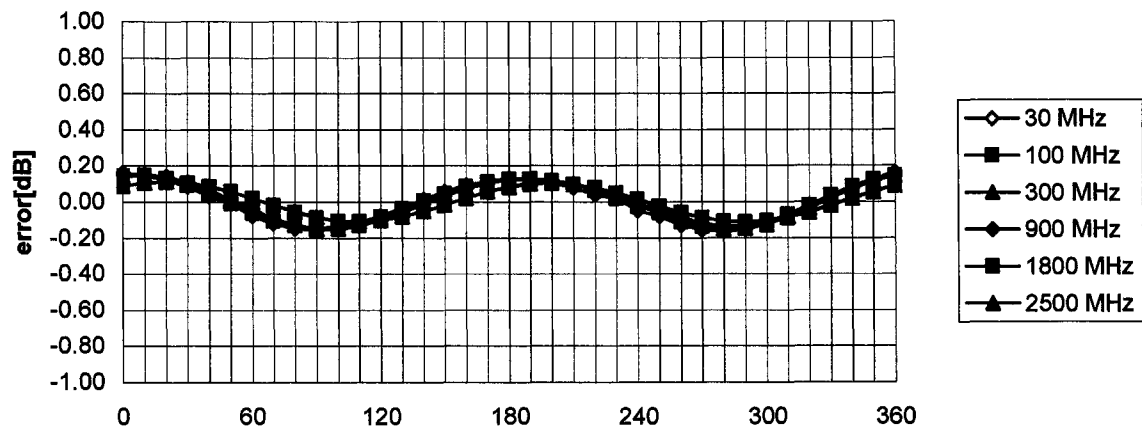


f = 900 MHz, TEM cell ifi110



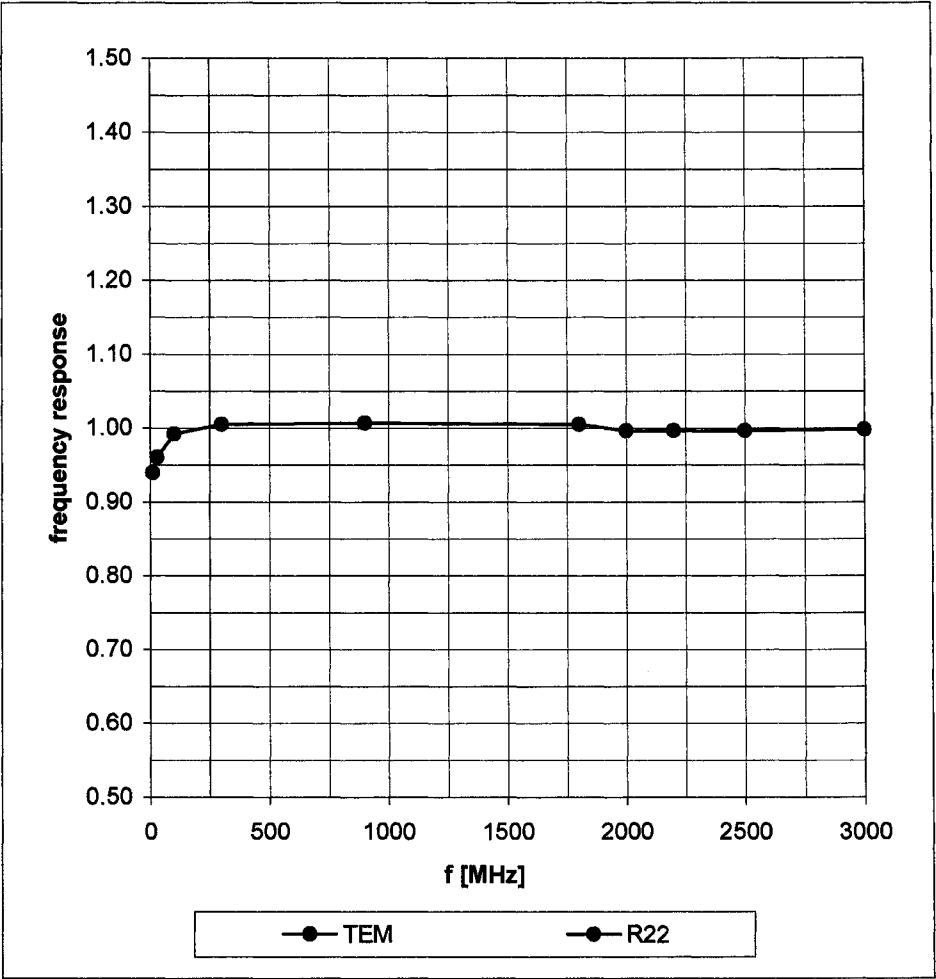
f = 1800 MHz, WG R22**f = 2500 MHz, WG R22**

Isotropy Error (ϕ), $\theta = 0^\circ$

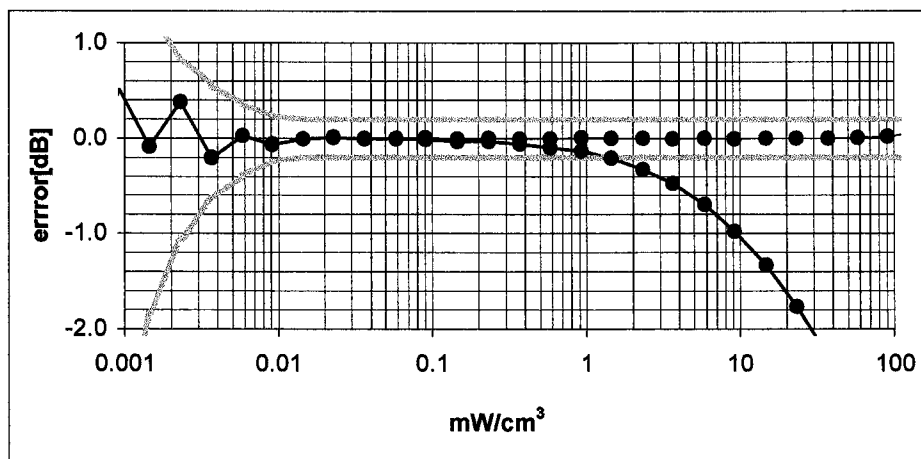
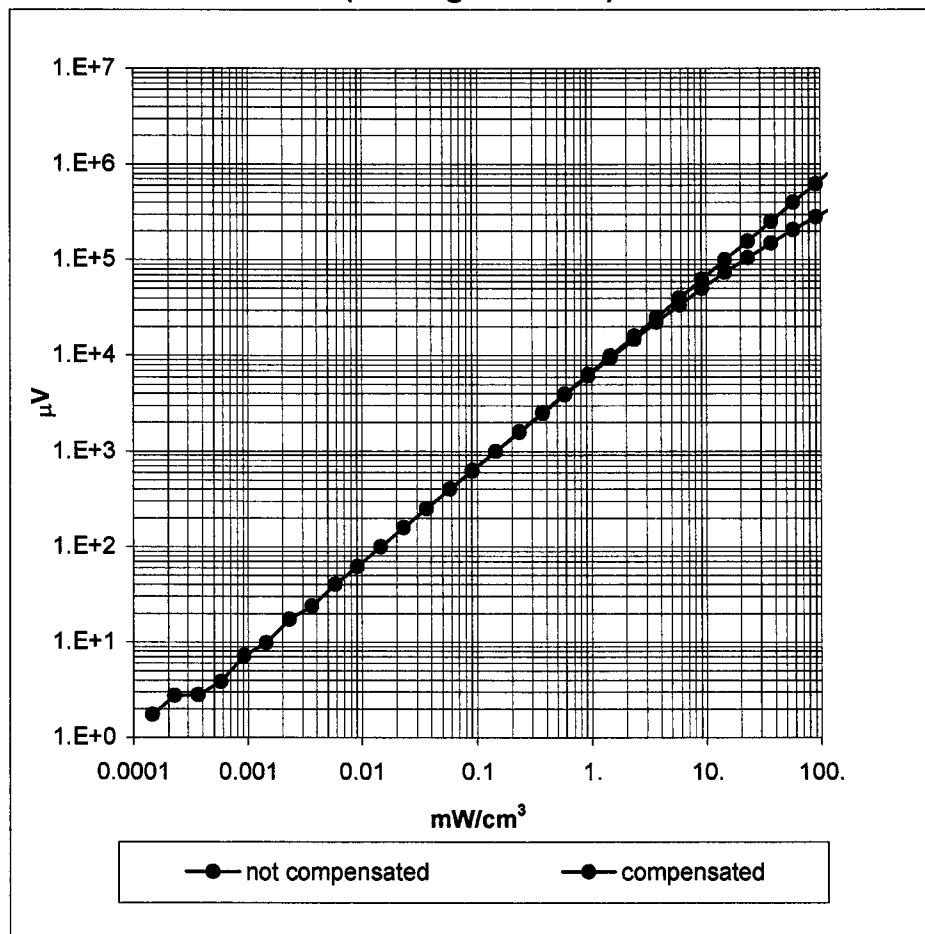


Frequency Response of E-Field

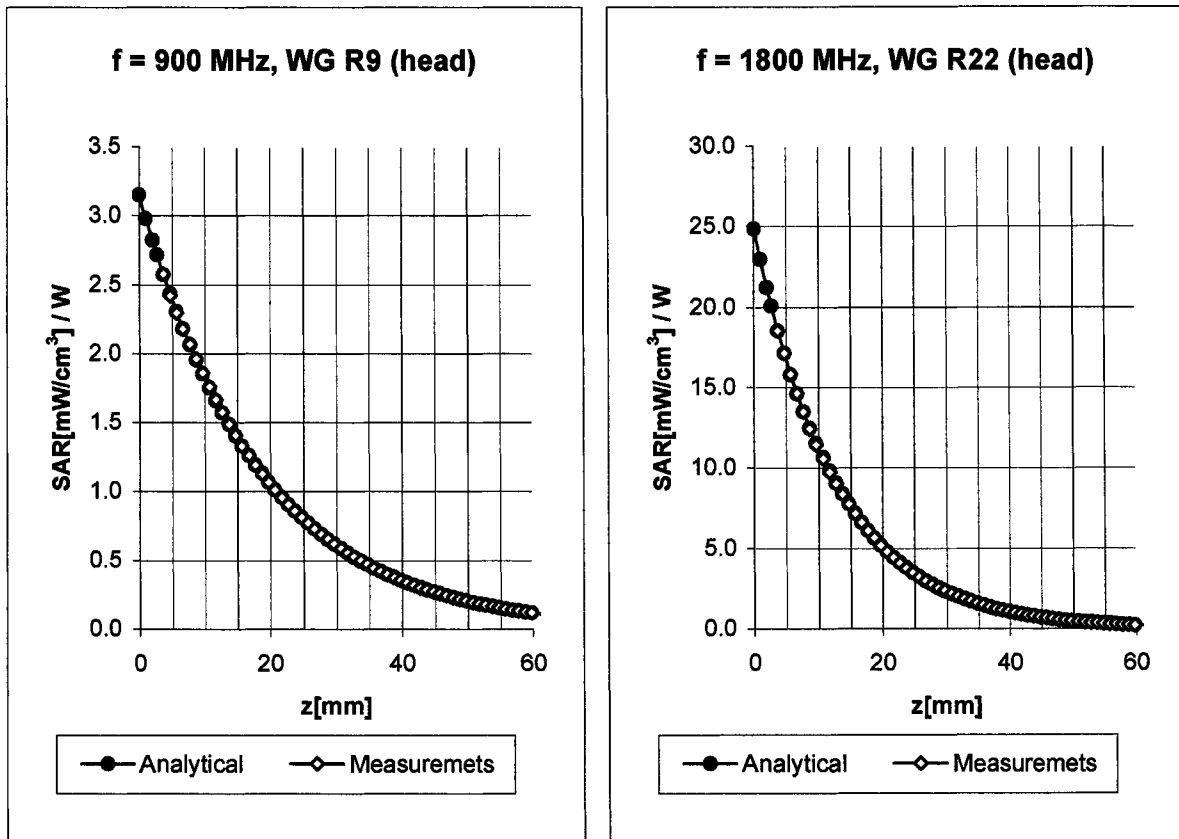
(TEM-Cell:ifi110, Waveguide R22)



Dynamic Range f(SARhead) (Waveguide R22)



Conversion Factor Assessment



Head 900 MHz $\epsilon_r = 41.5 \pm 5\%$ $\sigma = 0.97 \pm 5\%$ mho/m

Valid for f=800-1000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

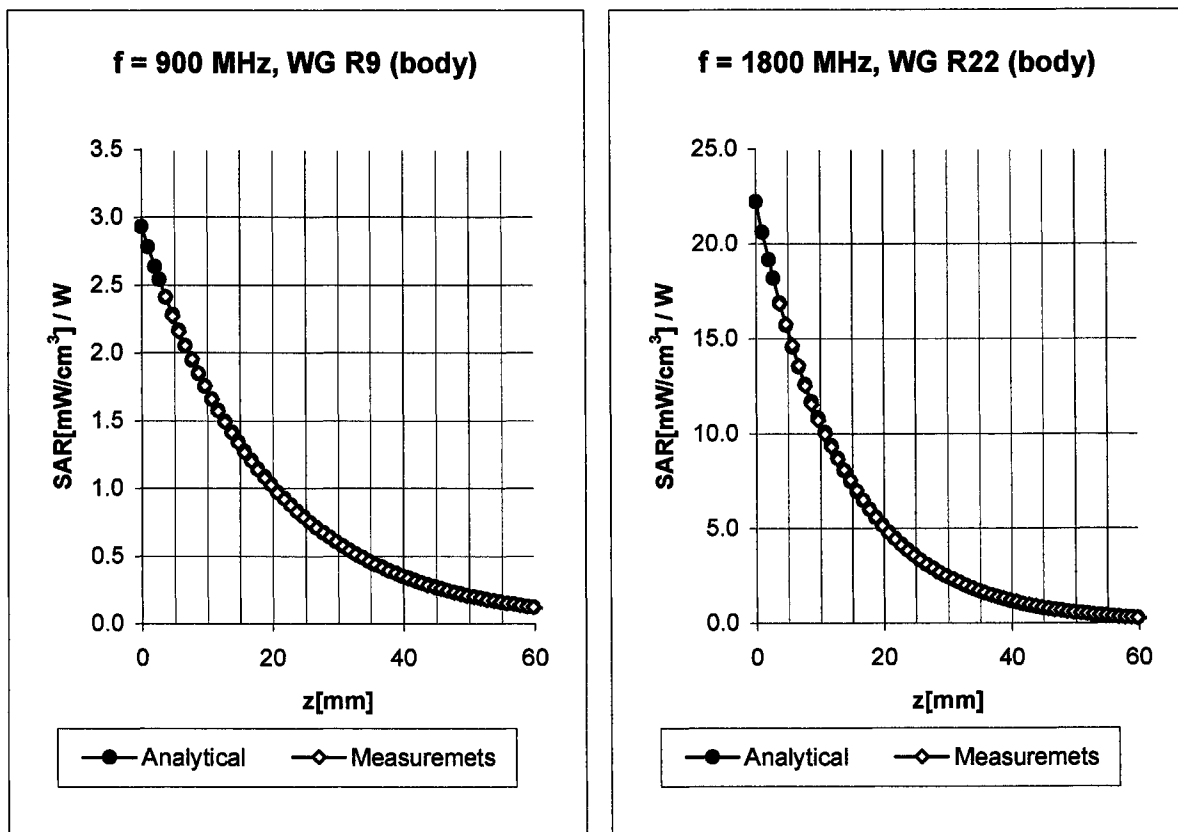
ConvF X	6.5 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	6.5 $\pm 9.5\%$ (k=2)	Alpha 0.53
ConvF Z	6.5 $\pm 9.5\%$ (k=2)	Depth 2.20

Head 1800 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1710-1910 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.3 $\pm 9.5\%$ (k=2)	Boundary effect:
ConvF Y	5.3 $\pm 9.5\%$ (k=2)	Alpha 0.58
ConvF Z	5.3 $\pm 9.5\%$ (k=2)	Depth 2.43

Conversion Factor Assessment



Body **900 MHz** $\epsilon_r = 55.0 \pm 5\%$ $\sigma = 1.05 \pm 5\% \text{ mho/m}$

Valid for f=800-1000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

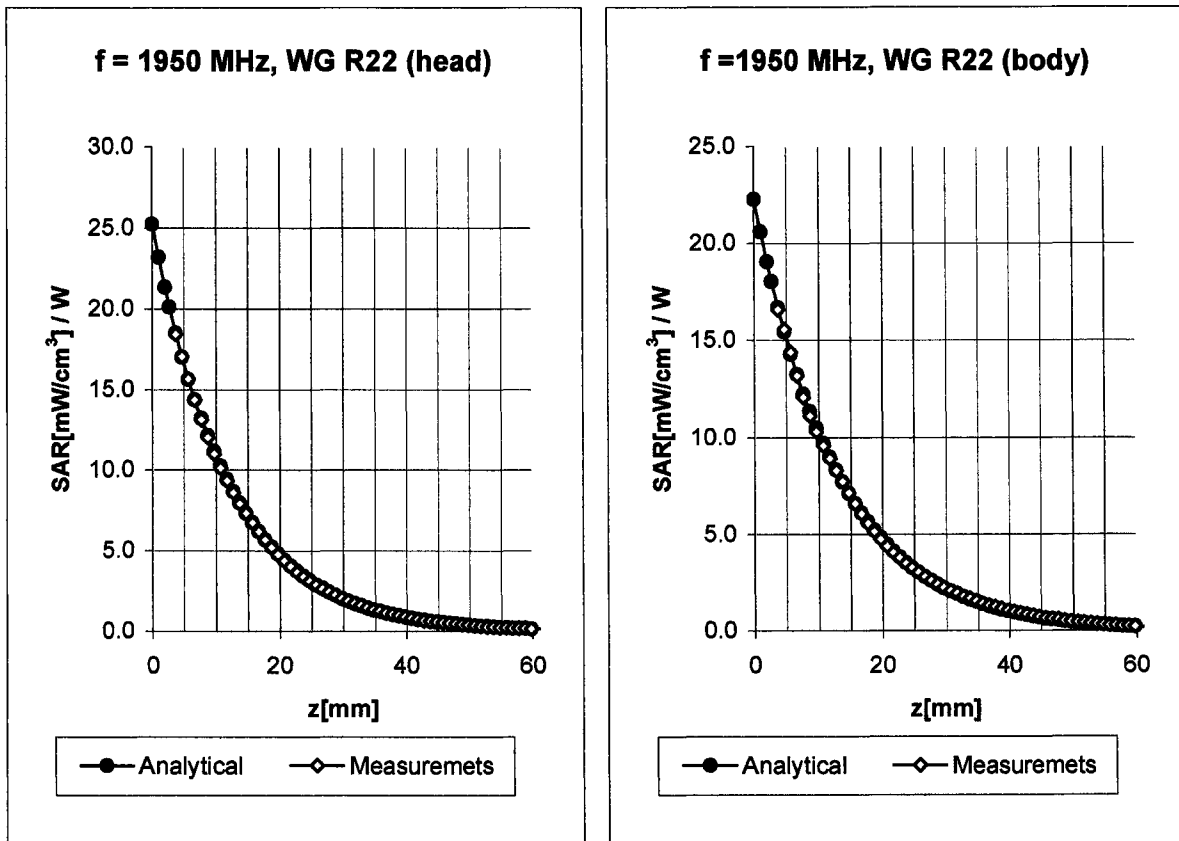
ConvF X	6.2 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	6.2 $\pm 9.5\%$ (k=2)	Alpha	0.51
ConvF Z	6.2 $\pm 9.5\%$ (k=2)	Depth	2.36

Body **1800 MHz** $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\% \text{ mho/m}$

Valid for f=1710-1910 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.9 $\pm 9.5\%$ (k=2)	Boundary effect:	
ConvF Y	4.9 $\pm 9.5\%$ (k=2)	Alpha	0.71
ConvF Z	4.9 $\pm 9.5\%$ (k=2)	Depth	2.35

Conversion Factor Assessment



Head 1950 MHz $\epsilon_r = 40.0 \pm 5\%$ $\sigma = 1.40 \pm 5\%$ mho/m

Valid for f=1900-2000 MHz with Head Tissue Simulating Liquid according to EN 50361, P1528-200X

ConvF X	5.1 $\pm$ 8.9% (k=2)	Boundary effect:
ConvF Y	5.1 $\pm$ 8.9% (k=2)	Alpha 0.66
ConvF Z	5.1 $\pm$ 8.9% (k=2)	Depth 2.29

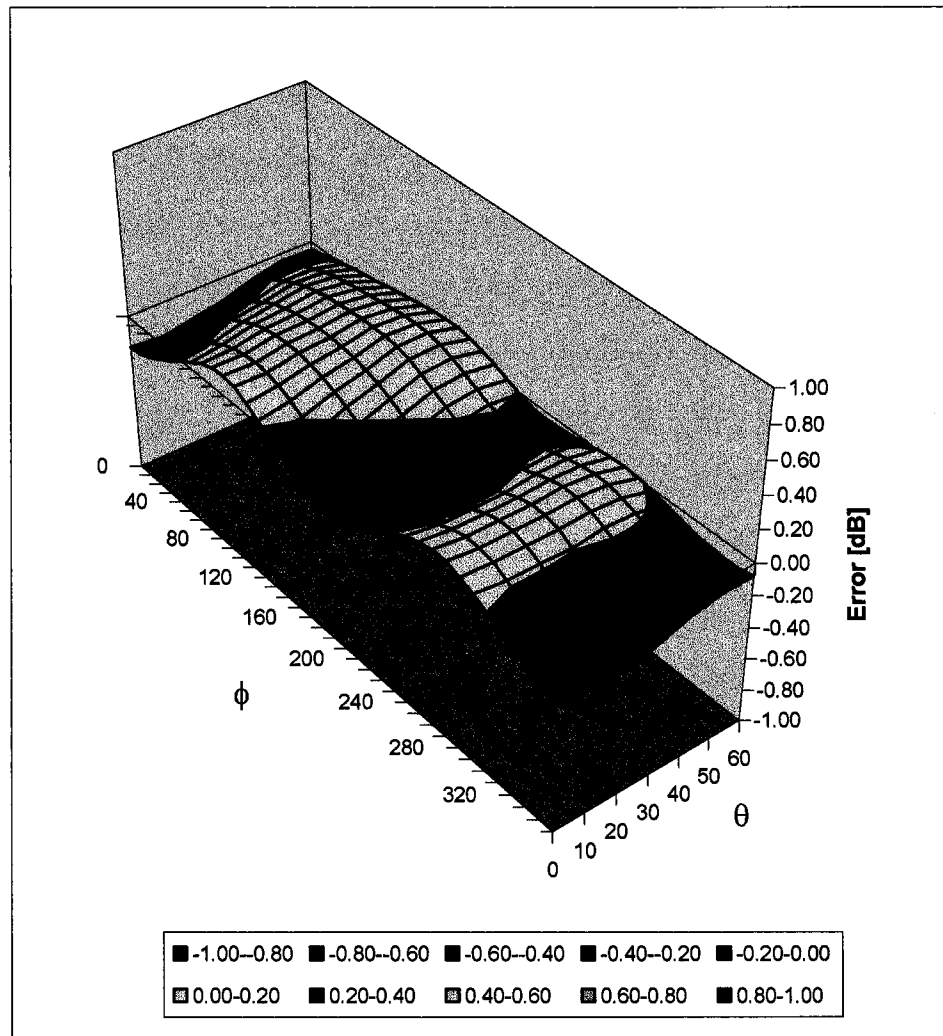
Body 1950 MHz $\epsilon_r = 53.3 \pm 5\%$ $\sigma = 1.52 \pm 5\%$ mho/m

Valid for f=1900-2000 MHz with Body Tissue Simulating Liquid according to OET 65 Suppl. C

ConvF X	4.7 $\pm$ 8.9% (k=2)	Boundary effect:
ConvF Y	4.7 $\pm$ 8.9% (k=2)	Alpha 0.91
ConvF Z	4.7 $\pm$ 8.9% (k=2)	Depth 2.00

Deviation from Isotropy in HSL

Error ($\theta\phi$), $f = 900$ MHz



Client **Motorola Korea (PCS)**

CALIBRATION CERTIFICATE

Object(s) **ET3DV6 - SN 1398**

Calibration procedure(s) **QA CAL-01.v2**
Calibration procedure for dosimetric E-field probes

Calibration date: **February 16, 2004**

Condition of the calibrated item **In Tolerance (according to the specific calibration document)**

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

Model Type	ID #	Cal Date (Calibrated by, Certificate No.)	Scheduled Calibration
Power meter EPM E4419B	GB41293874	2-Apr-03 (METAS, No 252-0250)	Apr-04
Power sensor E4412A	MY41495277	2-Apr-03 (METAS, No 252-0250)	Apr-04
Reference 20 dB Attenuator	SN: 5086 (20b)	3-Apr-03 (METAS, No. 251-0340)	Apr-04
Fluke Process Calibrator Type 702	SN: 6295803	8-Sep-03 (Sintrel SCS No. E-030020)	Sep-04
Power sensor HP 8481A	MY41092180	18-Sep-02 (SPEAG, in house check Oct-03)	In house check: Oct 05
RF generator HP 8684C	US3642U01700	4-Aug-99 (SPEAG, in house check Aug-02)	In house check: Aug-05
Network Analyzer HP 8753E	US37390585	18-Oct-01 (SPEAG, in house check Oct-03)	In house check: Oct 05

	Name	Function	Signature
Calibrated by:	Katja Pokovic	Laboratory Director	

Approved by:	Niels Kuster	Quality Manager
--------------	---------------------	------------------------

Date issued: February 16, 2004

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

Probe ET3DV6

SN:1398

Manufactured:	October 24, 1999
Last calibrated:	February 28, 2003
Recalibrated:	February 16, 2004

Calibrated for DASY Systems

(Note: non-compatible with DASY2 system!)

DASY - Parameters of Probe: ET3DV6 SN:1398

Sensitivity in Free Space

NormX	1.49 $\mu\text{V}/(\text{V}/\text{m})^2$
NormY	1.63 $\mu\text{V}/(\text{V}/\text{m})^2$
NormZ	1.57 $\mu\text{V}/(\text{V}/\text{m})^2$

Diode Compression^A

DCP X	92	mV
DCP Y	92	mV
DCP Z	92	mV

Sensitivity in Tissue Simulating Liquid (Conversion Factors)

Please see Page 7.

Boundary Effect

Head 900 MHz Typical SAR gradient: 5 % per mm

Sensor Cener to Phantom Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	7.6	3.7
SAR _{be} [%]	With Correction Algorithm	0.0	0.1

Head 1800 MHz Typical SAR gradient: 10 % per mm

Sensor to Surface Distance		3.7 mm	4.7 mm
SAR _{be} [%]	Without Correction Algorithm	12.6	8.4
SAR _{be} [%]	With Correction Algorithm	0.1	0.2

Sensor Offset

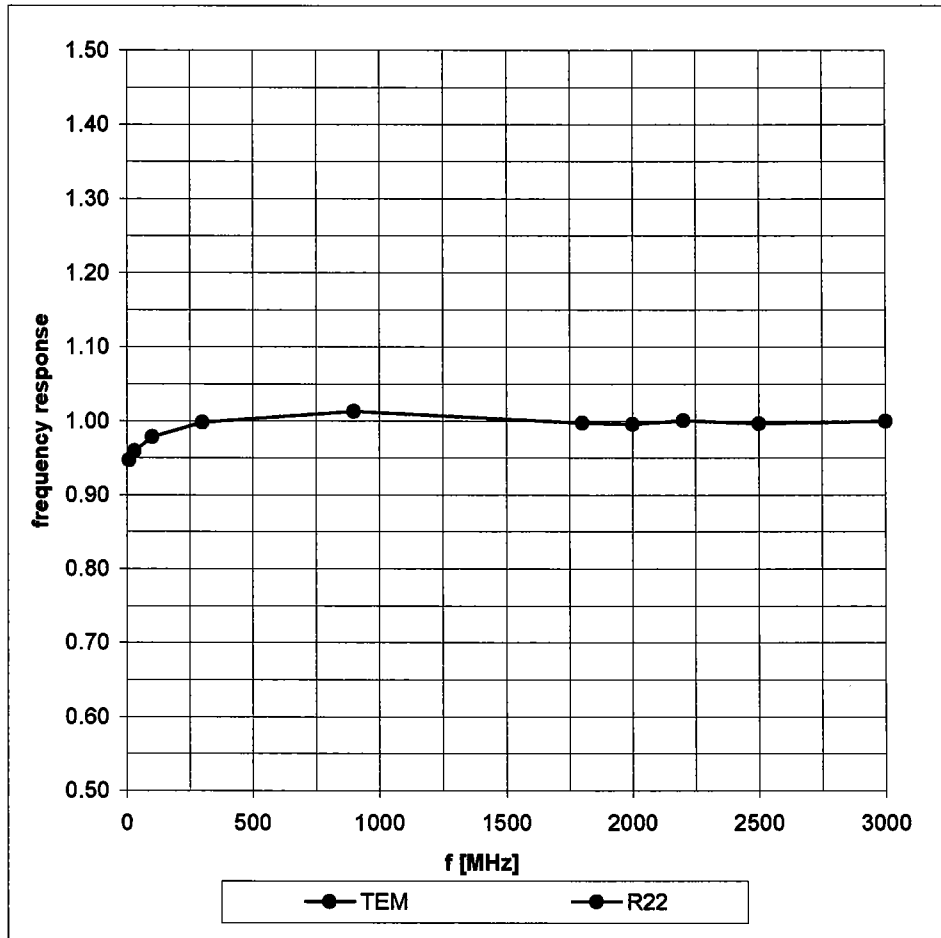
Probe Tip to Sensor Center	2.7 mm
Optical Surface Detection	in tolerance

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

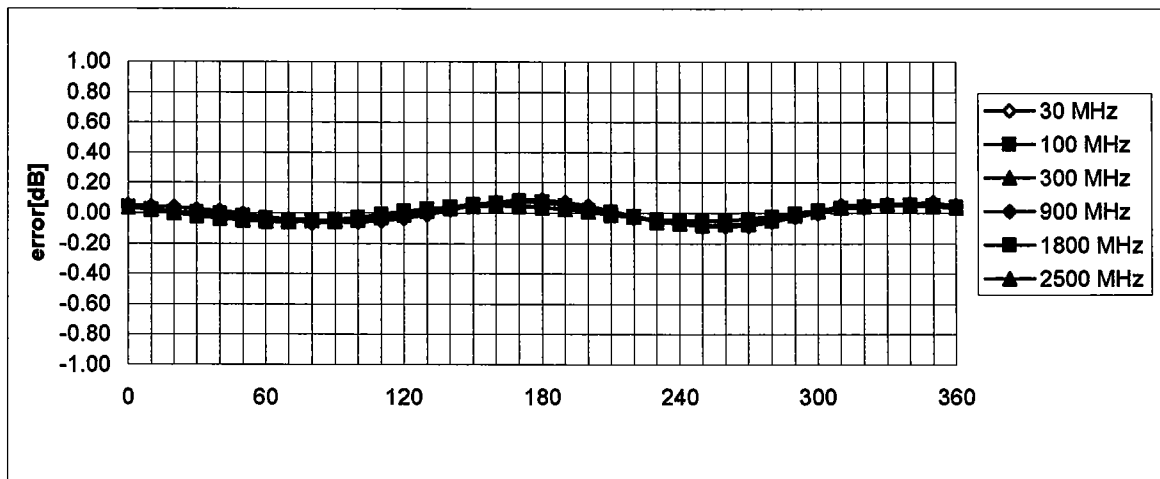
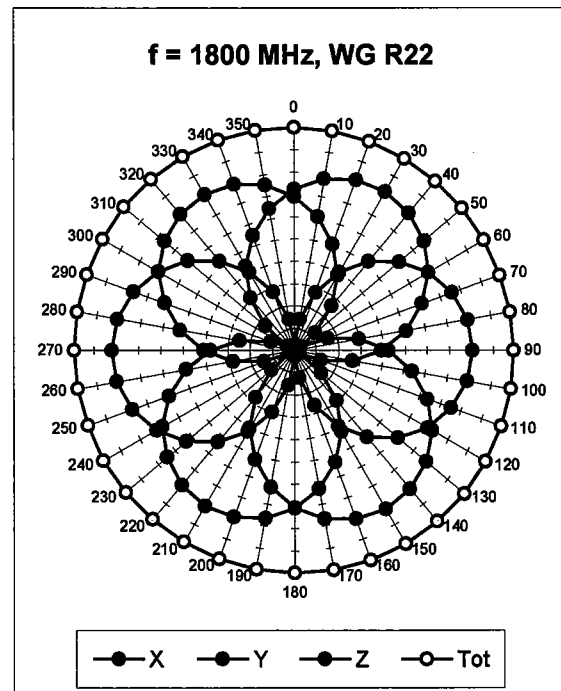
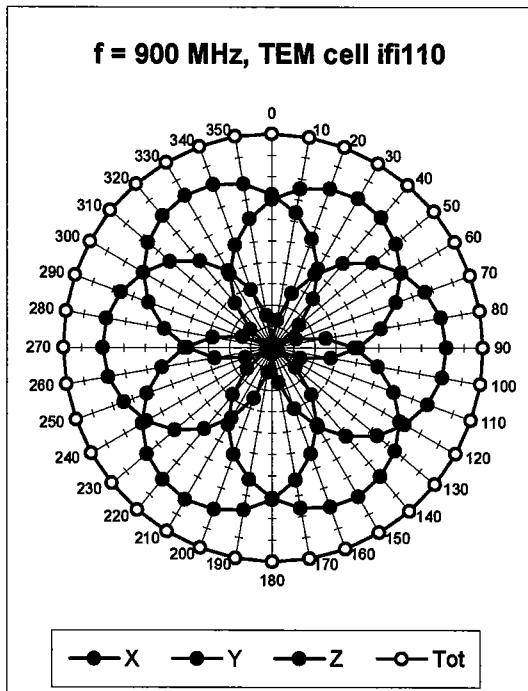
^A numerical linearization parameter: uncertainty not required

Frequency Response of E-Field

(TEM-Cell:ifi110, Waveguide R22)

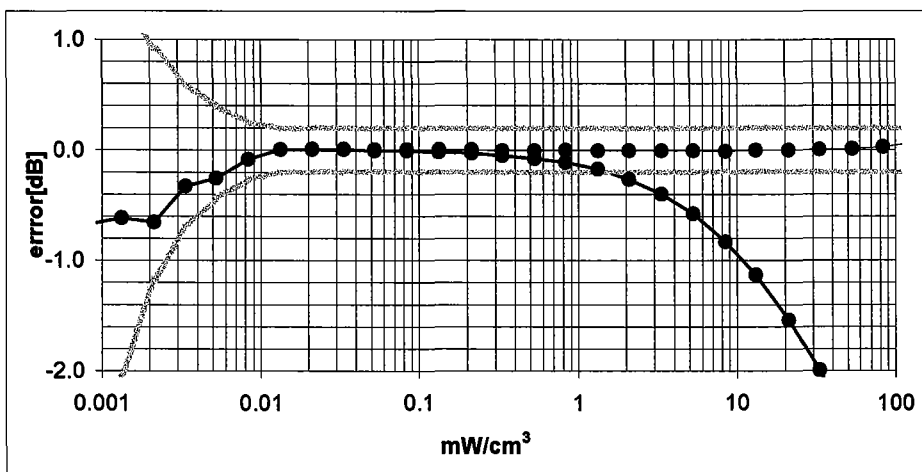
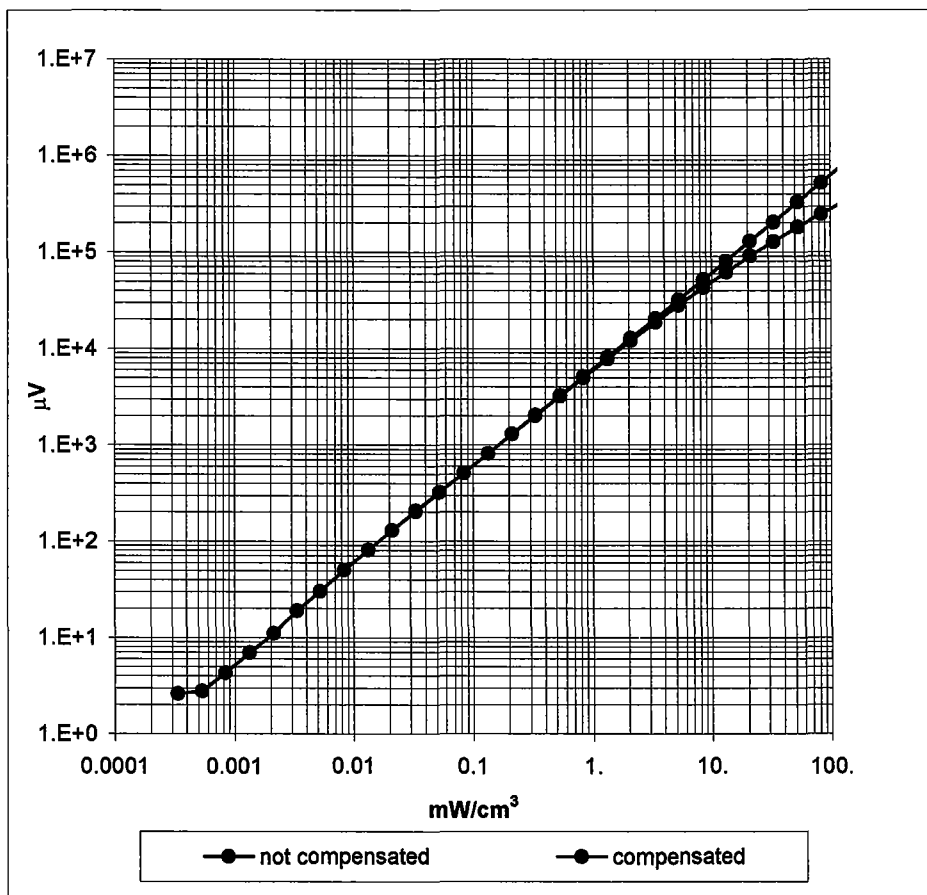


Receiving Pattern (ϕ) , $\theta = 0^\circ$



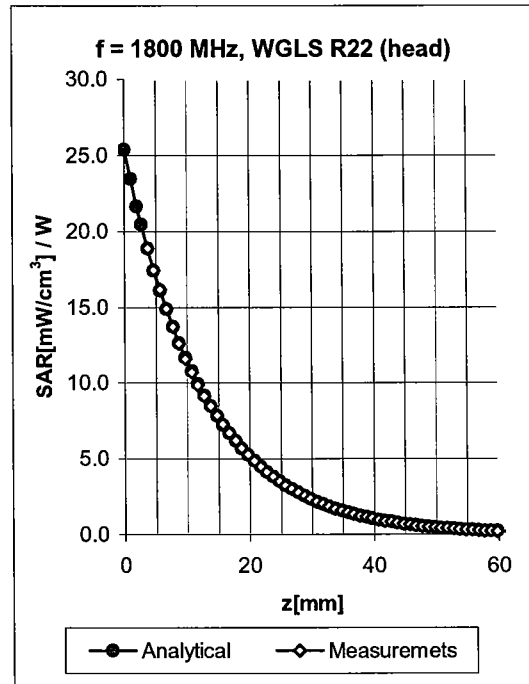
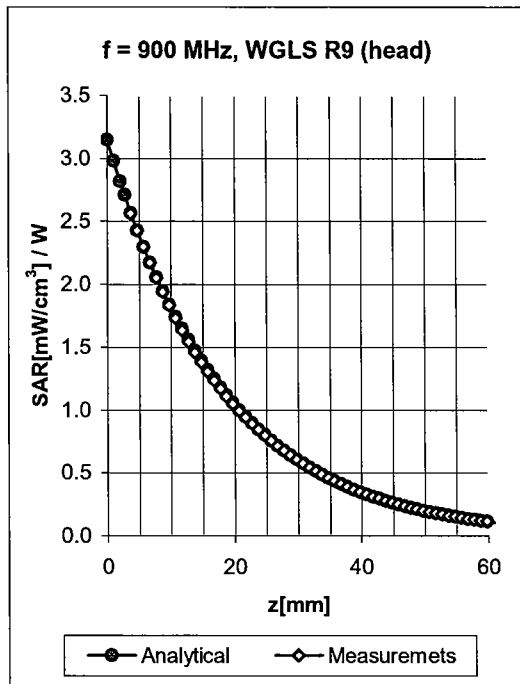
Axial Isotropy Error < ± 0.2 dB

Dynamic Range f(SAR_{head}) (Waveguide R22)



Probe Linearity < ± 0.2 dB

Conversion Factor Assessment

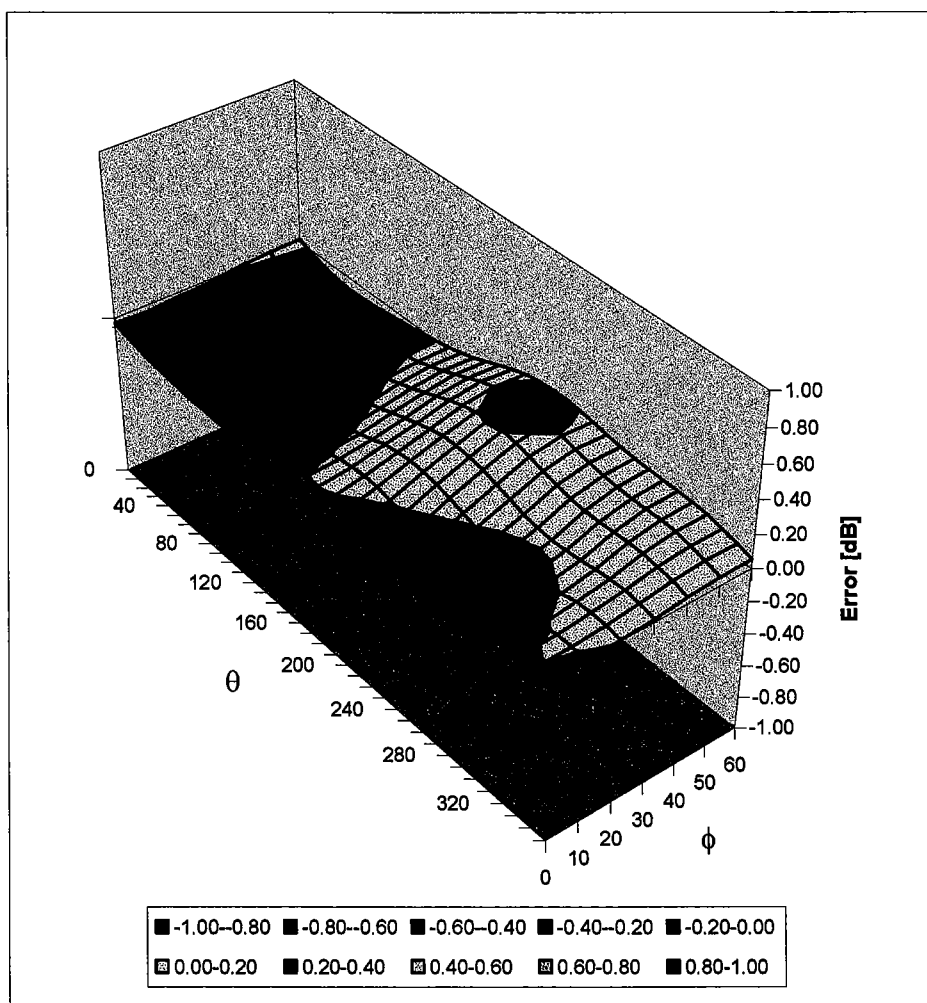


f [MHz]	Validity [MHz] ^B	Tissue	Permittivity	Conductivity	Alpha	Depth	ConvF Uncertainty
900	800-1000	Head	41.5 ± 5%	0.97 ± 5%	1.00	1.39	6.29 ± 9.5% (k=2)
1800	1710-1910	Head	40.0 ± 5%	1.40 ± 5%	0.50	2.48	5.04 ± 9.5% (k=2)
1950	1900-2000	Head	40.0 ± 5%	1.40 ± 5%	0.47	2.71	4.82 ± 9.5% (k=2)
900	800-1000	Body	55.0 ± 5%	1.05 ± 5%	0.43	2.31	5.88 ± 9.5% (k=2)
1800	1710-1910	Body	53.3 ± 5%	1.52 ± 5%	0.58	2.67	4.50 ± 9.5% (k=2)
1950	1900-2000	Body	53.3 ± 5%	1.52 ± 5%	0.68	2.39	4.29 ± 9.5% (k=2)

^B The stated uncertainty of calibration was assessed according to P1528.

Deviation from Isotropy in HSL

Error (θ, ϕ), $f = 900$ MHz



Spherical Isotropy Error $< \pm 0.4$ dB

Appendix 4

Dipole Characterization Certificate

Certification of System Performance Check Targets

Based on APP-0396

-Historical Data-

	835MHz	900MHz	1800MHz	1900MHz	
IEEE1528 Target: Advanced Extrapolation	9.5	10.8	38.1	39.7	(W/kg)
Measurement Uncertainty (k=1):	9.0%	9.0%	9.0%	9.0%	
Measurement Period:	1-July-03 to 1-Apr-04	1-July-03 to 1-Apr-04	1-July-03 to 1-Apr-04	1-July-03 to 1-Apr-04	
# of tests performed:	214	1148	1135	62	
Grand Average: Worst Case Extrapolation	10.0	11.4	40.7	42.0	(W/kg)
% Delta (Average - IEEE1528 Target)	5.3%	5.6%	6.8%	5.8%	
Is % Delta <= Measurement Uncertainty?	Yes	Yes	Yes	Yes	
Accept/Reject <u>Average</u> as new system performance check target?	ACCEPT	ACCEPT	ACCEPT	ACCEPT	
	Applicable 835MHz Dipole Serial Numbers:	Applicable 900MHz Dipole Serial Numbers:	Applicable 1800MHz Dipole Serial Numbers:	Applicable 1900MHz Dipole Serial Numbers:	
	420(TR), 421(TR)	77, 78	246(TR), 250(TR)	514(TR), 518(TR)	
	422(TR), 423(TR)	79, 80	251(TR), 258(TR)	519(TR), 520(TR)	
	424(TR), 425(TR)	91, 92	259(TR), 262(TR)	523(TR), 524(TR)	
	431(TR), 432(TR)	93, 94	263(TR), 271(TR)	526(TR), 527(TR)	
	433(TR), 434(TR)	95, 96	272(TR), 273(TR)	528(TR), 529(TR)	
	436(TR)	97, 55	276(TR), 277(TR)	530(TR), 533(TR)	
			279(TR), 280(TR)		
			281(TR), 282(TR)		
			283(TR), 284(TR)		

-New System Performance Check Targets- per APP-0396
(based on analysis of historical data)

Frequency	SAR Target (W/kg)	Permittivity	Conductivity (S/m)
835MHz	10.0	41.5 ± 5%	0.90 ± 5%
900MHz	11.4	41.5 ± 5%	0.97 ± 5%
1800MHz	40.7	40.0 ± 5%	1.40 ± 5%
1900MHz	42.0	40.0 ± 5%	1.40 ± 5%

=====

-Approvals-

Submitted by:

Marge Kaunas

 Date:

2-Apr-04

Signed:

Marge Kaunas

Comments:

Spreadsheet detailing all historical measurements available upon request.

Approved by:

Mark Douglas

 Date:

2-Apr-04

Signed:

Mark Douglas

Comments:

Targets and associated simulant properties are derived from the IEEE 1528 standard.

=====

Appendix 5

Measurement Uncertainty Budget

Uncertainty Budget for Device Under Test									
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e = f(d,k)</i>	<i>f</i>	<i>g</i>	<i>h = c x f / e</i>	<i>i = c x g / e</i>	<i>k</i>
Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (± %)	10 g <i>u_i</i> (± %)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	9.5	N	2.00	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	0.707	0.707	1.9	1.9	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0.707	0.707	3.9	3.9	∞
Boundary Effect	E.2.3	5.8	R	1.73	1	1	3.3	3.3	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1.0	N	1.00	1	1	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1	1	0.5	0.5	∞
Integration Time	E.2.8	1.3	R	1.73	1	1	0.8	0.8	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.3	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	1.1	R	1.73	1	1	0.6	0.6	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	3.9	R	1.73	1	1	2.3	2.3	∞
Test sample Related									
Test Sample Positioning	E.4.2	3.6	N	1.00	1	1	3.6	3.6	29
Device Holder Uncertainty	E.4.1	2.8	N	1.00	1	1	2.8	2.8	8
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1	1	2.9	2.9	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	10.0	R	1.73	0.64	0.43	3.7	2.5	∞
Liquid Permittivity - deviation from target values	E.3.2	10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity - measurement uncertainty	E.3.3	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Combined Standard Uncertainty			RSS				11.72	11.09	1363
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> = 2				22.98	21.75	

Uncertainty Budget for System Performance Check (dipole & flat phantom)

<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i> = <i>f</i> (<i>d</i> , <i>k</i>)	<i>f</i>	<i>g</i>	<i>h</i> = <i>c</i> × <i>f</i> / <i>e</i>	<i>i</i> = <i>c</i> × <i>g</i> / <i>e</i>	<i>k</i>
Uncertainty Component	Sec.	Tol. (± %)	Prob. Dist.	Div.	<i>c_i</i> (1 g)	<i>c_i</i> (10 g)	1 g <i>u_i</i> (± %)	10 g <i>u_i</i> (± %)	<i>v_i</i>
Measurement System									
Probe Calibration	E.2.1	9.5	N	2.00	1	1	4.8	4.8	∞
Axial Isotropy	E.2.2	4.7	R	1.73	1	1	2.7	2.7	∞
Spherical Isotropy	E.2.2	9.6	R	1.73	0	0	0.0	0.0	∞
Boundary Effect	E.2.3	5.8	R	1.73	1	1	3.3	3.3	∞
Linearity	E.2.4	4.7	R	1.73	1	1	2.7	2.7	∞
System Detection Limits	E.2.5	1.0	R	1.73	1	1	0.6	0.6	∞
Readout Electronics	E.2.6	1.0	N	1.00	1	1	1.0	1.0	∞
Response Time	E.2.7	0.0	R	1.73	1	1	0.0	0.0	∞
Integration Time	E.2.8	0.0	R	1.73	1	1	0.0	0.0	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1	1	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.3	R	1.73	1	1	0.2	0.2	∞
Probe Positioning with respect to Phantom Shell	E.6.3	1.1	R	1.73	1	1	0.6	0.6	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E.5	3.9	R	1.73	1	1	2.3	2.3	∞
Dipole									
Dipole Axis to Liquid Distance	8, E.4.2	1.0	R	1.73	1	1	0.6	0.6	∞
Input Power and SAR Drift Measurement	8, 6.6.2	4.7	R	1.73	1	1	2.7	2.7	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (shape and thickness tolerances)	E.3.1	4.0	R	1.73	1	1	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	10.0	R	1.73	0.64	0.43	3.7	2.5	∞
Liquid Permittivity - deviation from target values	E.3.2	10.0	R	1.73	0.6	0.49	3.5	2.8	∞
Liquid Permittivity - measurement uncertainty	E.3.3	5.0	R	1.73	0.6	0.49	1.7	1.4	∞
Combined Standard Uncertainty			RSS				10.16	9.43	99999
Expanded Uncertainty (95% CONFIDENCE LEVEL)			<i>k</i> =2				19.92	18.48	

Appendix 6

Photographs of the device under test



Figure 2. Front of Phone



Figure 3. Front of Phone with Flip Open



Figure 4. Back of Phone

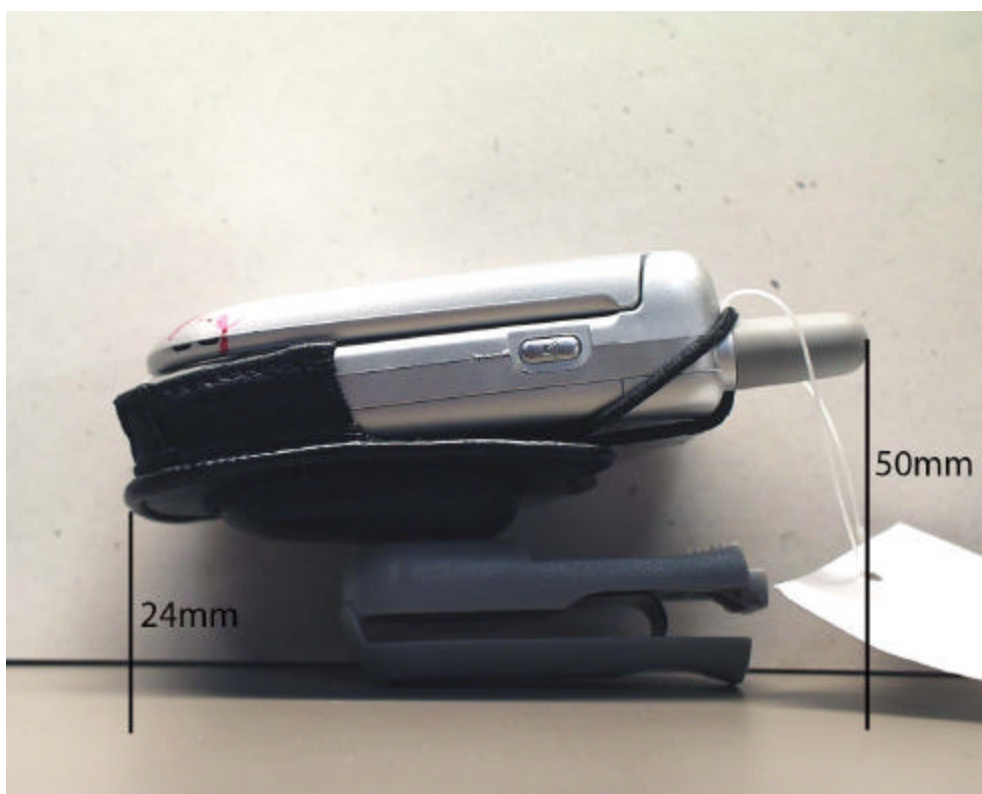


Figure 5. Side of Phone

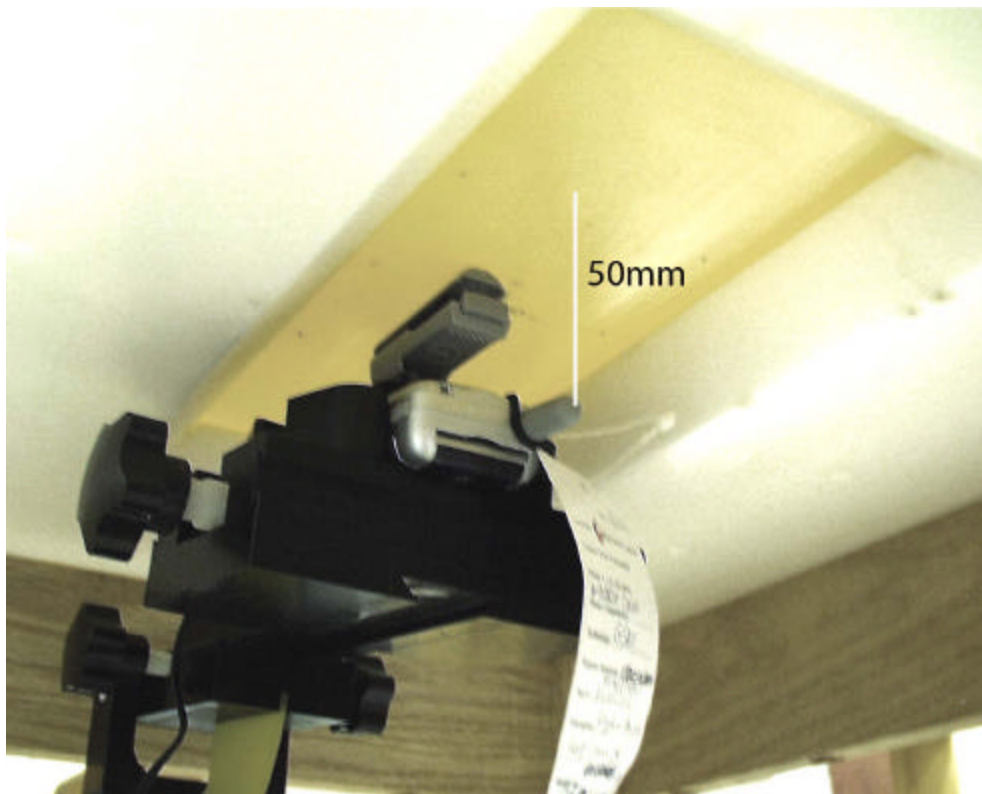


Figure 6. Phone under the Flat Phantom