Certification Report on

Specific Absorption Rate (SAR)
Experimental Analysis

VTECH ENGINEERING CANADA

Cordless Telephone Base
VTech 5831

Test Date: May 2002

VCTB-VT5831 BASE-3899

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Experimental Analysis SAR Report

Subject: **Specific Absorption Rate (SAR) Hand and Body Report**

FCC ID: EW780 – 5198 – 00

Product: Cordless Telephone (Base)

Model: VTech 5831

Client: VTECH ENGINEERING CANADA

Address: 200-7671 Alderbridge Way
Richmond, BC
V6X 1Z9

Project #: VTCB – VT5831 BASE – 3899

Prepared by: APREL Laboratories
51 Spectrum Way
Nepean, Ontario
K2R 1E6

Telecommunications Approval Board - Spectrum Sciences Institute
SAR Certified
APREL Laboratories
Vtech5831

Approved by ______________ Date: June 3rd 2002.
Stuart Nicol
Director Product Development, Dosimetric R&D

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Released by ______________ Date: June 3/02
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CERTIFICATE OF COMPLIANCE (SAR EVALUATION)

Applicant name and address	Date and Location of Testing
VTECH ENGINEERING CANADA 200-7671 Alderbridge Way Richmond, BC V6X 1Z9 CANADA.	Date of Test: May 2002 Project No. :VCTB-VT5831 BASE-3899 Test Location: APREL Laboratories, Nepean, ON CANADA

FCC ID: EW780-5198-00

APPLICANT: VTECH ENGINEERING CANADA

Product:	**Cordless Telephone (Base)**
Model:	**VTech 5831**
Serial No.:	**BS01**
EUT Type:	**ETB-Part 15 Cordless Telephone Base Transceiver**
Frequency Range:	**5744.736 - 5825.952 MHz**
Max. Power Output:	**0.918 watts/29.6 dBm (EIRP)**
Max. SAR Value:	**1.22 W/kg Direct Contact (Hand) SAR**
	1.18 W/kg Body (Partial) SAR at a separation of 15 mm
FCC Rule Parts:	**2.1093, FCC/OET Bulletin 65 Supplement C(2001)**
Application Type:	**Certification**

This application has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-200X (March, 2002).

I attest to the accuracy of the data. All measurements reported were carried out under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the compliance of these measurements and vouch for the qualifications of the persons taking them. This relates only to the sample tested.

Jayanta (Jay) Sarkar
Technical Director, Standards & Certification

FCC ID: EW780-5198-00
Applicant: VTech Engineering Canada
Equipment: VTech Cordless Telephone (Base)
Model: VTech 5831
Standard: FCC 96 –326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation

ENGINEERING SUMMARY

This report contains the results of the engineering evaluation performed on the VTech 5831 Cordless Telephone (Base). The measurements were carried out in accordance with FCC 96-326. The VTech 5831 Cordless Telephone (Base) was evaluated for compliance to FCC RF exposure requirements at **maximum power level** of 29.6dBm (0.918W) EIRP while operating with a 33% duty cycle.

The VTech 5831 Cordless Telephone (Base) is a Base unit with an outer antenna. The VTech 5831 Cordless Telephone has no body worn applications.

The VTech 5831 Cordless Telephone (Base) was evaluated for both body exposure and direct contact SAR (extremities) at low, middle and high channels for the frequency range 5744.736MHz to 5825.952MHz, with keyboard side up, top side up, left side up. The maximum 10 g SAR (1.22W/kg) was found for the peak RF output power of channel #00 (5744.736MHz) with the top side of the device facing up (Graph 1).

At a separation distance of 15.0 mm from the top side of the device the maximum 1 g SAR was found to be 1.18W/kg. The operational manual will contain a warning stating that bystanders and parts of the user's body other than extremities, must be at least 20.0mm away from the device and its antenna.

Evaluation data and graphs are presented in this report. All measurements conducted and documented in this report were performed while the DUI was used in wireless mode.

Based on the measured results and on how the device will be marketed and used, it is certified that the product meets the requirements as set forth in the above specifications, for the RF exposure environment.

The results presented in this report relate only to the sample evaluated.

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1. INTRODUCTION

Tests were conducted to determine the Specific Absorption Rate (SAR) for a sample VTech 5831 Cordless Telephone (Base). These tests were conducted at APREL Laboratories facility located at 51 Spectrum Way, Nepean, Ontario, Canada. A view of the SAR measurement setup can be seen in Appendix A Figure 1. This report describes the results obtained.

2. APPLICABLE DOCUMENTS

The following documents are applicable to the work performed:

1) FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation

2) ANSI/IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

3) ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

4) OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radio Frequency Electromagnetic Fields".

5) IEEE P-1528 Draft "Recommended Practice for Determining the Peak Spatial Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communication Devices: Experimental Techniques."

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3. DEVICE UNDER INVESTIGATION

- Vtech Cordless Telephone model no: VT 5831, received in May, 2002.

The VTech 5831 Cordless Telephone (Base) shall be called DUI (**D**evice **U**nder **I**nvestigation) in the following test report.

Table 1: Measured Transmitted Power

Frequency	Channel	E.I.R.P.
5825.952	High	0.918W

DUI: VTech 5831 Cordless Telephone (Base)

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4. TEST EQUIPMENT

- APREL Triangular Dosimetric Probe Model E-010, s/n 163
- ALIDX-500 Dosimetric SAR Measurement System
- APREL flat Phantom F1, Part # P-V-G8 (overall shell thickness 2mm)
- APREL 5800MHz Dipole
- APREL RF Amplifier
- Hewlett Packard Signal Generator Asset
- R&S Power Meter
- Hewlett Packard Dual Directional Coupler

Table 2: Instrumentation

Instrument	Calibration Due	Asset Number/Serial Number
E-010 Probe	May 2003	163
ALIDX-500	August 2002	N/A
APREL Flat Phantom	N/A	APL-001
APREL UniPhantom	N/A	APL-085
APREL 5800MHz Dipole	12 December 2003	N/A
APREL RF Amplifier	N/A	301467
HP-Signal Generator	12 November 2002	301463
R&S Power Meter	September 2002	301451
R&S Power Sensor	September 2002	301461
HP Directional Coupler	10 October 2002	100251

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5. SET UP

5.1 ALIDX-500 Measurement System

The image below shows the laboratory along with the ALIDX-500 Measurement system.

The ALIDX-500 Dosimetric SAR Measurement System was developed jointly with APREL Laboratories and IDX Robotics for use within wireless development and the compliance environment. The system consists of a six axis articulated arm, and controller for precise probe positioning (0.05 mm repeatability). Custom software has been developed to enable communications between the robot controller software and the host operating system.

An amplifier is located on the articulated arm, which is isolated from the custom designed end effector and robot arm. The end effector provides the mechanical touch detection functionality and probe connection interface. The amplifier is functionally validated within the manufacturers site and calibrated at NCL Calibration Laboratories. A Data Acquisition Card (DAC) is used to collect the signal as detected by the isotropic e-field probe. The DAC manufacturer calibrates the DAC to NIST standards. A formal validation is executed using all mechanical and electronic components to prove conformity of the measurement platform as a whole.

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The ALIDX-500 has been designed to measure devices within the compliance environment to meet all recognized standards. The system also conforms to standards, which are currently being developed by the scientific and manufacturing community.

The course scan resolution is defined by the operator and reflects the requirements of the standard to which the device is being tested. Precise measurements are made within the predefined course scan area and the values are logged.

The user predefines the sample rate for which the measurements are made so as to ensure that the full duty-cycle of a pulse modulation device is covered during the sample. The following algorithm is an example of the function used by the system for linearisation of the output for the probe.

$$V_i = U_i + U_i^{\ 2} \cdot \frac{cf}{dcp_i}$$

The APREL E-Field probe is evaluated to establish the diode compression point.

A complex algorithm is then used to calculate the values within the measured points down to a resolution of 1mm. The data from this process is then used to provide the co-ordinates from which the cube scan is created for the determination of the 1 g and 10 g averages.

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Cube scan averaging consists of a number of complex algorithms, which are used to calculate the one, and ten gram averages. The basis for the cube scan process is centered on the location where the maximum measured SAR value was found. When a secondary peak value is found which is within 60% of the initial peak value, the system will report this back to the operator who can then asses the need for further analysis of both the peak values prior to the one and ten-gram cube scan averaging process. The algorithm consists of 3D cubic Spline, and Lagrange extrapolation to the surface, which form the matrix for calculating the measurement output for the one and ten gram average values. The resolution for the physical scan integral is user defined with a final calculated resolution down to 1mm.

In-depth analysis for the differential of the physical scanning resolution for the cube scan analysis has been carried out, to identify the optimum setting for the probe positioning steps, and this has been determined at 8mm increments on the X, & Y planes. The reduction of the physical step increment increased the time taken for analysis but did not provide a better uncertainty or return on measured values.

Prior to the measurement process the operator can insert the parameters for which the physical measurements are made, defining the X, Y, and Z probe movement integrals. For the FCC compliance process both OET 65 “Supplement C” and the IEEE draft standard “P-1528” were used to define the measurement parameters used during the assessment of the device.

The final output from the system provides data for the area scan measurements, physical and splined (1mm resolution) cube scan with physical and calculated values (1mm resolution).

The overall uncertainty for the methodology and algorithms the ALIDX500 used during the SAR calculation was evaluated using the data from IEEE P-1528 f3 algorithm:

$$f_3(x, y, z) = A \frac{a^2}{\frac{a^2}{4} + x'^2 + y'^2} \cdot \left(e^{-\frac{2z}{a}} + \frac{a^2}{2(a + 2z)^2} \right)$$

The probe used during the measurement process has been assessed to provide values for diode compression. These values are calculated during the probe calibration exercise and are used in the mathematical calculations for the assessment of SAR.

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5.2 Validation

A full system validation was run prior to the SAR testing. The methodology used for the system validation was taken from IEEE P-1528 section 7 (where applicable). Further details of the tissue used during the system validation is provided in section 6.3 Simulated Tissue. The results from the system validation are provided in Annex A Measurement Results.

The image below shows the setup used for the system validation.

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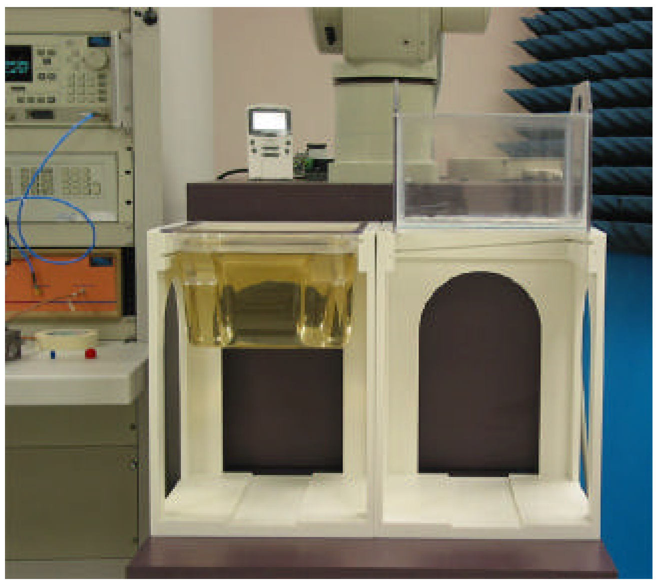
5.3 Body & Bystander Analysis

Measurements were made on the device using the APREL Universal Phantom, on the low, mid, and high channel of the device. The device was assed for the keyboard up and keyboard down permutations. The separation distance used was 0 mm for the conservative SAR assessment. A secondary assessment was executed on the device at the position and frequency for the conservative value at a distance of 15 mm from the phantom. The results from this exercise are presented in section 6 test results.

The image below shows part of the setup used for body measurements.



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5.4 Simulated Tissue

The recipes used to make the simulated tissue were developed by APREL Laboratories using the epsilon and sigma as presented in OET Supplement C. Upon request further information shall be presented.

The density used to determine SAR from the measurements was the recommended 1.0 kg/m^3 found in Appendix C of "Supplement C OET Bulletin 65, Edition 01-01".

Dielectric parameters of the simulated tissue material were determined using an Anritsu 37347A Vector Network Analyzer, a Hewlett Packard 809B Slotted Line Carriage, and an APREL SLP-001 Slotted Line Probe.

Table 3: Properties of the Tissue

BODY Tissue	APREL	Target Value	D (%)
Dielectric constant, ε_r	35.23	35.3	-0.2
Conductivity, σ [S/m]	6.5	5.27	+23.3
Tissue Conversion Factor,	2.5	-	-

Table 4: Tissue Calibration Instrumentation

Instrument	Calibration Due	Asset Number/Serial Number
Anritsu VNA	7 August 2002	Z0107643 TEMP
HP Slotted Line	NA	100195
APREL Slotted Line Probe	December 2002	APL-SLP-001

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5.5 Methodology

1. The test methodology utilized in the certification of the DUI complies with the requirements of FCC 96-326 and ANSI/IEEE C95.3-1992.

2. The E-field is measured with a small isotropic probe (output voltage proportional to E^2).

$$SAR = \frac{\sigma \left|\mathbf{E}\right|^2}{\rho}$$

3. The probe is moved precisely from one point to the next using the robot (10 mm increments for wide area scanning and 8 mm increments for zoom scanning in the X, Y directions) and (5.0 mm increments for the final depth profile measurement in the Z direction).

4. The probe travels in the homogeneous liquid simulating human tissue (body).

   Section 5.4 contains information about the properties of the simulated tissue used for these measurements.

5. The liquid is contained in a manikin simulating a portion of the human body with an overall shell thickness of 2 mm.

6. The DUI is positioned with the surface under investigation against the phantom with no separation distance for conservative analysis.

7. All tests were performed with the highest power available from the sample DUI under transmit conditions.

More detailed descriptions of the test method are given in Section 6 where appropriate.

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6. TEST RESULTS

6.1. TRANSMITTER CHARACTERISTICS

The device has been developed to operate with both AC and Battery operation. The Battery operation is a backup function, which comes into operation if the AC power fails. The device was analyzed with the AC cord attached, and the position, and frequency, for which the conservative SAR was measured was then re-assessed using the battery supply. The maximum SAR was measured while the device was transmitting while attached to the AC supply. The values recorded in table 5 represent the assessed drift while attached to the AC supply.

Note

The power measurement is not conducted and only relative to a true pin on pin conducted measurement. The spectrum analyzer provides the technician with the functionality of viewing the actual received Tx Signal from the DUI. This allows the engineer to monitor any drift in power during the test process, and as a result assess the delta if any.

Table 5: Relative power measurement before and after the scanning

Type of Exposure	Scan Type	Power Readings (dBm)		ΔP_{TX} (dB)	Battery #
		Before scanning	After scanning		
Hand Exposure	Coarse	-33.00	-33.00	0	1
	Fine	-33.00	-33.00	0	1
Body Exposure	Coarse	-33.00	-33.00	0	1
	Fine - body	-33.00	-33.00	0	1

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6.2. SAR MEASUREMENTS

1) RF exposure is expressed as a Specific Absorption Rate (SAR). SAR is calculated from the E-field, measured in a grid of test points. SAR is expressed as RF power per kilogram of mass, averaged in 10 grams of tissue for the extremities and 1 gram of tissue elsewhere. The equation below is a representation of how SAR can theoretically equate.

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dV}\right)$$

2) The DUI was put into test mode for the SAR measurements via testing software supplied by the manufacturer running on the DUI to control the channel and operating TX mode.

3) Table 6 provides the details in tabular form of the full measurement analysis, which was performed on the DUI. Appendix A provides contour plots of the SAR measurements on the DUI. Graph 1 provides the worst-case conservative SAR plot for channel #00 (5744.736MHz) with top side up. The actual device is presented as an overlay superimposed onto the contour plot of the DUI.

4) Wide area scans were performed for the low, middle and high channels of the DUI. The DUI was operating at 4 slots Tx mode with maximum output power and a duty cycle of 33%. The DUI was placed up against the phantom during the test process. The phantom shell thickness is 2 mm overall.

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6.3. DIRECT CONTACT SAR

All subsequent testing for the direct contact SAR (user's hand exposure) was performed on three channels (low: 5744.736MHz, middle: 5785.344 MHz, high: 5825.952MHz) at four positions - with the keyboard and the top side as well as left and right side of the DUI facing up against the phantom. The highest 10 g averaged SAR was measured on the low channel with the top side facing up. The results are presented in Table 6 below.

1) The device had an initial area scan executed to establish the location of the maximum peak SAR. A calculated resolution of 1 mm was used to determine the location for the peak SAR.
2) The device was then explored on a refined 32 mm grid (Cube, Fine Scan) in three dimensions (X, Y & Z) measuring at 8 mm integrals X & Y and 5 mm integrals in the Z plane so as to create a physical measured point matrix. The system then runs a series of complex algorithms, which completes the matrix of calculated and measured values equivalent to a 1 mm resolution in the X, & Y planes.
3) The software runs a series of Lagrange functions to provide the data for the Z plane, which is inserted into the matrix.
4) To complete the calculated matrix (1 mm resolution) a fourth-order polynomial extrapolation is used to compute the surface values and the 1 and 10-gram averages are then calculated.
5) Where two (or more) peaks with similar values are measured the location of the peaks is recorded. A refined grid is then created to asses each peak location individually, and the maximum value from the assesment is used to record conservative SAR for this report. The highest conservative SAR value averaged over 10 grams for the direct contact exposure (user's hand exposure) analysis was found to be 1.22W/kg (Table 6).

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6.4. BODY EXPOSURE

All subsequent testing for the direct contact SAR (user's hand exposure) was performed on three channels (low: 5744.736MHz, middle: 5785.344 MHz, high: 5825.952MHz) at four positions - with the keyboard and the top side as well as left and right side of the DUI facing up against the phantom. The highest 1 g averaged SAR was measured on the low channel with the top side facing up. The results are presented in **Table 6** below.

1) The device had an initial area scan executed to establish the location of the maximum peak SAR. A calculated resolution of 1mm was used to determine the location for the peak SAR.
2) The device was then explored on a refined 32 mm grid (Cube, Fine Scan) in three dimensions (X, Y & Z) measuring at 8 mm integrals X & Y and 5 mm integrals in the Z plane so as to create a physical measured point matrix. The system then runs a series of complex algorithms, which completes the matrix of calculated and measured values equivalent to a 1 mm resolution in the X, & Y planes.
3) The software runs a series of Lagrange functions to provide the data for the Z plane, which is inserted into the matrix.
4) To complete the calculated matrix (1 mm resolution) a fourth order polynomial is used to extrapolate the surface values and the 1 and 10-gram averages are then calculated.
5) Where two (or more) peaks with similar values are measured the location of the peaks is recorded. A refined grid is then created to asses each peak location individually, and the maximum value from the assesment is used to record conservative SAR for this report.
6) The maximum conservative SAR value averaged over 1 gram for the body analysis was found to be 3.23 W/kg from the top side of the device`. At a separation distance of 15.0 mm from the top side of the device the highest 1 g SAR was found to be 1.18W/kg The operational manual for the DUI will contain a warning stating that bystanders and parts of the user's body other than extremities, must be at least 15.0 mm away from the top side of the device.

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Table 6: Testing results - 1 g and 10 g SAR values for VTech VT 5831 Cordless Telephone (Base) measured at the highest power (0.918W EIRP)

Type of Test	DUI position	Channel			Measured SAR (W/kg)		
		L/M/H	Channel #	Freq (MHz)	Peak SAR	1g SAR Limit: 1.6W/Kg	10g SAR Limit: 4.0W/Kg
Course Scan	Keyboard up	Low	00	5744.736	1.83		
	Keyboard down	Low	00	5744.736	0.29		
	Left side up	Low	00	5744.736	1.24		
	Right side up	Low	00	5744.736	0.27		
	Top side up	Low	00	5744.736	3.73		
Body/Hand Exposure	Top side Up	Low	00	5744.736	8.64	3.23	1.22
	Top side Up	Middle	47	5785.344	6.90	2.55	0.96
	Top side up	High	94	5825.952	6.34	2.41	0.90
	Top side Up ***	Low	00	5744.736	2.78	1.18	0.58
	Top side Up ***	Middle	47	5785.344	2.84	1.14	0.52
	Top side up ***	High	94	5825.952	2.31	0.98	0.50
	Keyboard up	Low	00	5744.736	5.79	2.38	1.00
	Keyboard up	Middle	47	5785.344	5.40	2.09	0.84
	Keyboard up	High	94	5825.952	4.47	1.80	0.76
	Keyboard up ***	Low	00	5744.736	2.54	0.95	0.42
	Keyboard up ***	Middle	47	5785.344	2.91	0.84	0.35
	Keyboard up ***	High	94	5825.952	1.83	0.66	0.34
	Left side up	Low	00	5744.736	3.42	1.31	0.58
	Left side up	Middle	47	5785.344	3.14	1.27	0.54
	Left side up	High	94	5825.952	3.38	1.23	0.51

*** Test was performed on 15mm separation distance.

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7. CONCLUSIONS

The maximum Specific Absorption Rate (SAR) averaged over 10 grams, determined at low channel (ch#00, f_{TX}=5744.736 MHz) of the Vtech VT5831 Cordless Telephone (Base) , is 1.22 W/kg (direct contact SAR for the exposed extremities – hands, wrists, feet and ankles). The overall margin of uncertainty for this measurement is **±18.0% (**Appendix D). The SAR limit given in the FCC 96-326 Safety Guideline is 4 W/kg for direct contact exposure for the general population.

The maximum Specific Absorption Rate (SAR) averaged over 1 gram, determined at low channel (ch#00, f_{TX}=5744.736 MHz) of the Vtech VT5831 Cordless Telephone (Base) at 15 mm separation distance is 1.18W/kg. The overall margin of uncertainty for this measurement is **±18.0%** (Appendix D). The SAR limit given in the FCC 96-326 Safety Guideline is 1.6 W/kg for body exposure for the general population.

Considering the above, this unit as tested, and as it will be marketed and used, is found to be compliant with the FCC 96-326 requirement.

Tested by: ______________ Date: May, 2002

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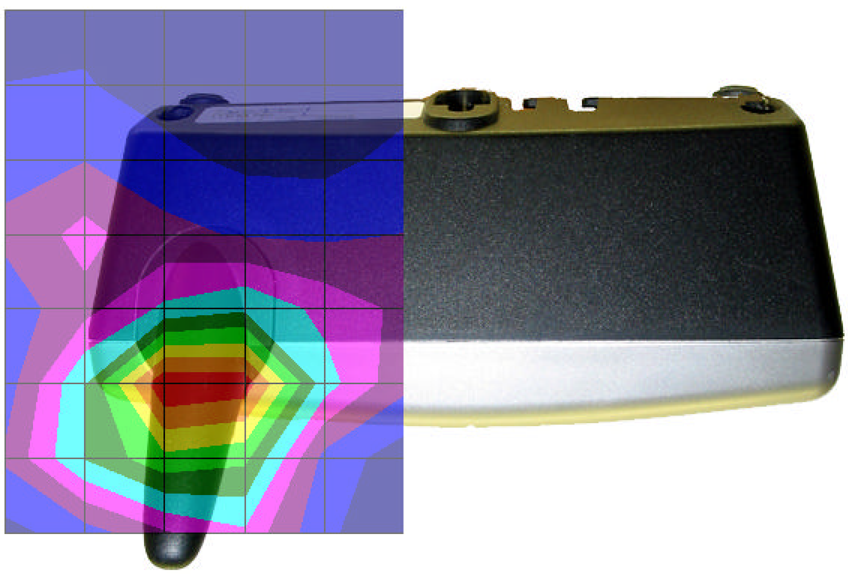
Appendix A: GRAPHIC PLOTS FROM SAR MEASUREMENTS

GRAPH 1
TOP SIDE UP
Distance 0 mm
Frequency: 5744.736 MHz



SAR DATA REPORT:
VTECH V5831 BASE, SCAN 20 – LOW CHANNEL 5744.736MHZ, TOP UP

Area Scan - Max Local SAR Value at x=4.0 y=-11.0 = 2.27 W/kg
Zoom Scan - Max Local SAR Value at x=5.0 y=-11.0 z=0.0 = 8.64 W/kg
Max 1g SAR at x=6.0 y=-11.0 z=0.0 = 3.23 W/kg
Max 10g SAR at x=5.0 y=-12.0 z=0.0 = 1.22 W/kg

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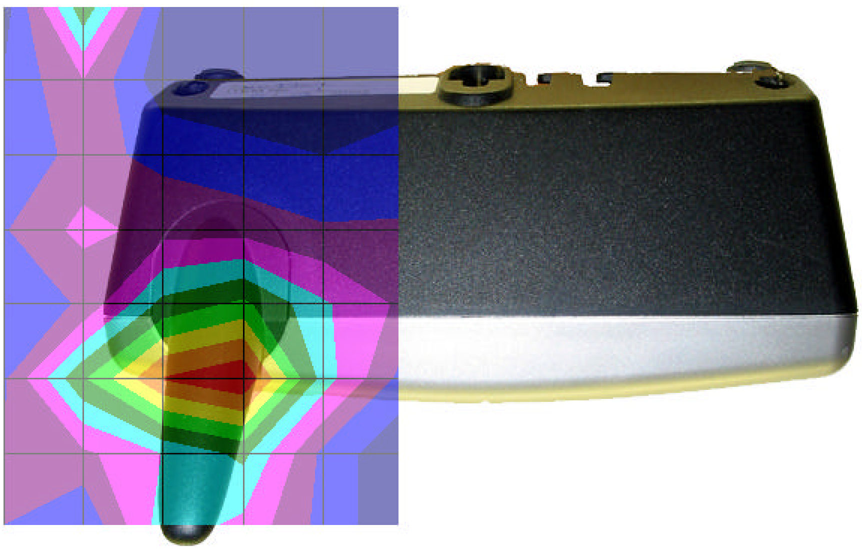
GRAPH 2
TOP SIDE UP
Distance 0 mm
Frequency: 5785.344 MHz



SAR DATA REPORT:
VTECH V5831 BASE, SCAN 21 – MIDDLE CHANNEL 5785.344MHZ, TOP UP

Area Scan - Max Local SAR Value at x=7.0 y=-9.0 = 1.83 W/kg
Zoom Scan - Max Local SAR Value at x=7.0 y=-9.0 z=0.0 = 6.90 W/kg
Max 1g SAR at x=8.0 y=-8.0 z=0.0 = 2.55 W/kg
Max 10g SAR at x=7.0 y=-8.0 z=0.0 = 0.96 W/kg

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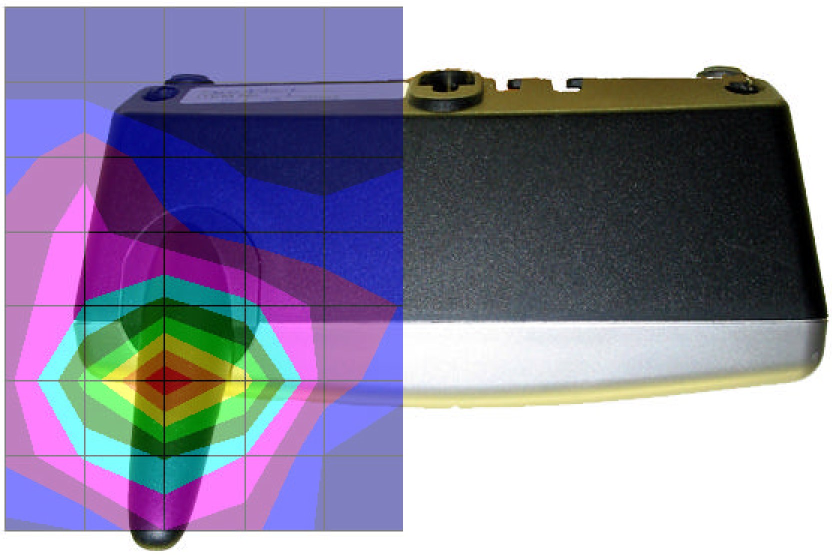
GRAPH 3
TOP SIDE UP
Distance 0 mm
Frequency: 5825.952 MHz



SAR DATA REPORT:
VTECH V5831 BASE, SCAN 22 – HIGH CHANNEL 5825.952MHZ, TOP UP

Area Scan - Max Local SAR Value at x=1.0 y=-10.0 = 1.75 W/kg
Zoom Scan - Max Local SAR Value at x=2.0 y=-10.0 z=0.0 = 6.34 W/kg
Max 1g SAR at x=2.0 y=-9.0 z=0.0 = 2.41 W/kg
Max 10g SAR at x=1.0 y=-10.0 z=0.0 = 0.90 W/kg

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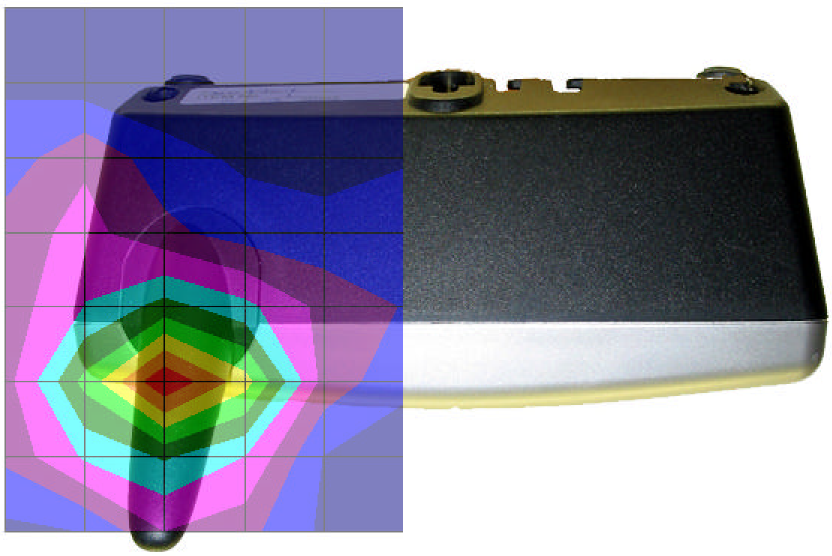
GRAPH 4

TOP SIDE UP

Distance 15 mm

Frequency: 5744.736 MHz



SAR DATA REPORT:

VTECH V5831 BASE, SCAN 23 – LOW CHANNEL 5744.736MHZ, TOP UP, 15MM SEPARATION

AREA SCAN - MAX LOCAL SAR VALUE AT X=1.0 Y=-10.0 = 0.86 W/KG SEPARATION

ZOOM SCAN - MAX LOCAL SAR VALUE AT X=6.0 Y=-9.0 Z=0.0 = 2.78 W/KG

MAX 1G SAR AT X=5.0 Y=-9.0 Z=0.0 = 1.18 W/KG

MAX 10G SAR AT X=4.0 Y=-9.0 Z=0.0 = 0.58 W/KG

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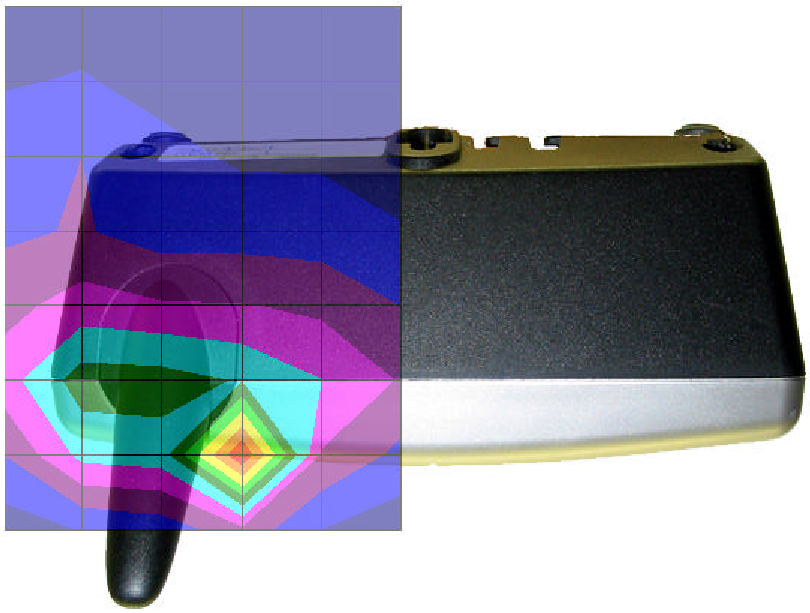
GRAPH 5
TOP SIDE UP
Distance 15 mm
Frequency: 5785.344 MHz



SAR DATA REPORT:
VTECH V5831 BASE, SCAN 24 – MIDDLE CHANNEL 5785.344MHZ, TOP UP, 15MM SEPARATION

AREA SCAN - MAX LOCAL SAR VALUE AT X=10.0 Y=-20.0 = 1.30 W/KG
ZOOM SCAN - MAX LOCAL SAR VALUE AT X=-6.0 Y=-13.0 Z=0.0 = 2.84 W/KG
MAX 1G SAR AT X=-1.0 Y=-13.0 Z=0.0 = 1.14 W/KG
MAX 10G SAR AT X=5.0 Y=-15.0 Z=0.0 = 0.52 W/KG

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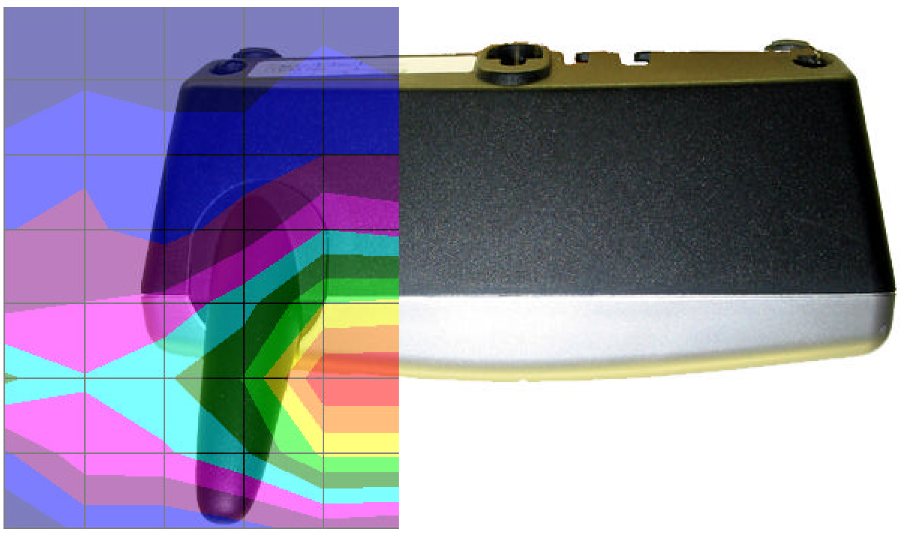
GRAPH 6
TOP SIDE UP
Distance 15 mm
Frequency: 5825.952 MHz



SAR DATA REPORT:
VTECH V5831 BASE, SCAN 25 – HIGH CHANNEL 5825.952MHZ, TOP UP, 15MM SEPARATION

Area Scan - Max Local SAR Value at x=24.0 y=-10.0 = 0.72 W/kg
Zoom Scan - Max Local SAR Value at x=30.0 y=-10.0 z=0.0 = 2.31 W/kg
Max 1g SAR at x=28.0 y=-10.0 z=0.0 = 0.98 W/kg
Max 10g SAR at x=26.0 y=-10.0 z=0.0 = 0.50 W/kg

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GRAPH 7
KEYBOARD UP
Distance 0 mm
Frequency: 5744.736 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 29 – LOW CHANNEL 5744.736MHZ, KEYBOARD UP

Area Scan - Max Local SAR Value at x=1.0 y=1.0 = 1.72 W/kg
Zoom Scan - Max Local SAR Value at x=0.0 y=4.0 z=0.0 = 5.79 W/kg
Max 1g SAR at x=1.0 y=3.0 z=0.0 = 2.38 W/kg
Max 10g SAR at x=2.0 y=2.0 z=0.0 = 1.00 W/kg

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GRAPH 8
KEYBOARD UP
Distance 0 mm
Frequency: 5785.344 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 30 – MIDDLE CHANNEL 5785.344MHZ, KEYBOARD UP

Area Scan - Max Local SAR Value at x=-3.0 y=7.0 = 1.38 W/kg
Zoom Scan - Max Local SAR Value at x=-3.0 y=10.0 z=0.0 = 5.40 W/kg
Max 1g SAR at x=-3.0 y=8.0 z=0.0 = 2.09 W/kg
Max 10g SAR at x=-3.0 y=7.0 z=0.0 = 0.84 W/kg

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Graph 9
KEYBOARD UP
Distance 0 mm
Frequency: 5825.952 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 31 – HIGH CHANNEL 5825.952MHZ, KEYBOARD UP

Area Scan - Max Local SAR Value at x=-1.0 y=8.0 = 1.25 W/kg
Zoom Scan - Max Local SAR Value at x=-1.0 y=5.0 z=0.0 = 4.47 W/kg
Max 1g SAR at x=0.0 y=7.0 z=0.0 = 1.80 W/kg
Max 10g SAR at x=0.0 y=7.0 z=0.0 = 0.76 W/kg

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GRAPH 10
KEYBOARD UP
Distance 15 mm
Frequency: 5744.736 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 32 – LOW CHANNEL 5744.736MHZ, KEYBOARD UP, 15MM SEPARATION

Area Scan - Max Local SAR Value at x=-4.0 y=-8.0 = 0.66 W/kg
Zoom Scan - Max Local SAR Value at x=-2.0 y=-8.0 z=0.0 = 2.54 W/kg
Max 1g SAR at x=0.0 y=-7.0 z=0.0 = 0.95 W/kg
Max 10g SAR at x=1.0 y=-8.0 z=0.0 = 0.42 W/kg

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GRAPH 11
KEYBOARD UP
Distance 15 mm
Frequency: 5785.344 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 33 – MIDDLE CHANNEL 5785.344MHZ, KEYBOARD UP, 15MM SEPARATION

Area Scan - Max Local SAR Value at x=2.0 y=-7.0 = 0.57 W/kg
Zoom Scan - Max Local SAR Value at x=-14.0 y=-7.0 z=0.0 = 2.91 W/kg
Max 1g SAR at x=-9.0 y=-5.0 z=0.0 = 0.84 W/kg
Max 10g SAR at x=-3.0 y=-4.0 z=0.0 = 0.35 W/kg

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GRAPH 12
KEYBOARD UP
Distance 0 mm
Frequency: 5825.952 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 34 – HIGH CHANNEL 5825.952MHZ, KEYBOARD UP, 15MM SEPARATION

Area Scan - Max Local SAR Value at x=3.0 y=-3.0 = 0.51 W/kg
Zoom Scan - Max Local SAR Value at x=12.0 y=-11.0 z=0.0 = 1.83 W/kg
Max 1g SAR at x=11.0 y=-8.0 z=0.0 = 0.66 W/kg
Max 10g SAR at x=6.0 y=-5.0 z=0.0 = 0.34 W/kg

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GRAPH 13
LEFT SIDE UP
Distance 0 mm
Frequency: 5744.736 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 35 – LOW CHANNEL 5744.736MHZ, LEFT SIDE UP

Area Scan - Max Local SAR Value at x=21.0 y=10.0 = 0.91 W/kg
Zoom Scan - Max Local SAR Value at x=5.0 y=18.0 z=0.0 = 3.42 W/kg
Max 1g SAR at x=20.0 y=10.0 z=0.0 = 1.31 W/kg
Max 10g SAR at x=18.0 y=9.0 z=0.0 = 0.58 W/kg

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GRAPH 14
LEFT SIDE UP
Distance 0 mm
Frequency: 5785.344 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 36 – MIDDLE CHANNEL 5785.344MHZ, LEFT SIDE UP

AREA SCAN - MAX LOCAL SAR VALUE AT X=20.0 Y=16.0 = 0.86 W/KG
ZOOM SCAN - MAX LOCAL SAR VALUE AT X=18.0 Y=16.0 Z=0.0 = 3.14 W/KG
MAX 1G SAR AT X=20.0 Y=16.0 Z=0.0 = 1.27 W/KG
MAX 10G SAR AT X=20.0 Y=16.0 Z=0.0 = 0.54 W/KG

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GRAPH 15
LEFT SIDE UP
Distance 0 mm
Frequency: 5825.952 MHz

SAR DATA REPORT:
VTECH V5831 BASE, SCAN 37 – HIGH CHANNEL 5825.952MHZ, LEFT SIDE UP

Area Scan - Max Local SAR Value at x=14.0 y=11.0 = 0.75 W/kg
Zoom Scan - Max Local SAR Value at x=14.0 y=11.0 z=0.0 = 3.38 W/kg
Max 1g SAR at x=15.0 y=11.0 z=0.0 = 1.23 W/kg
Max 10g SAR at x=14.0 y=11.0 z=0.0 = 0.51 W/kg

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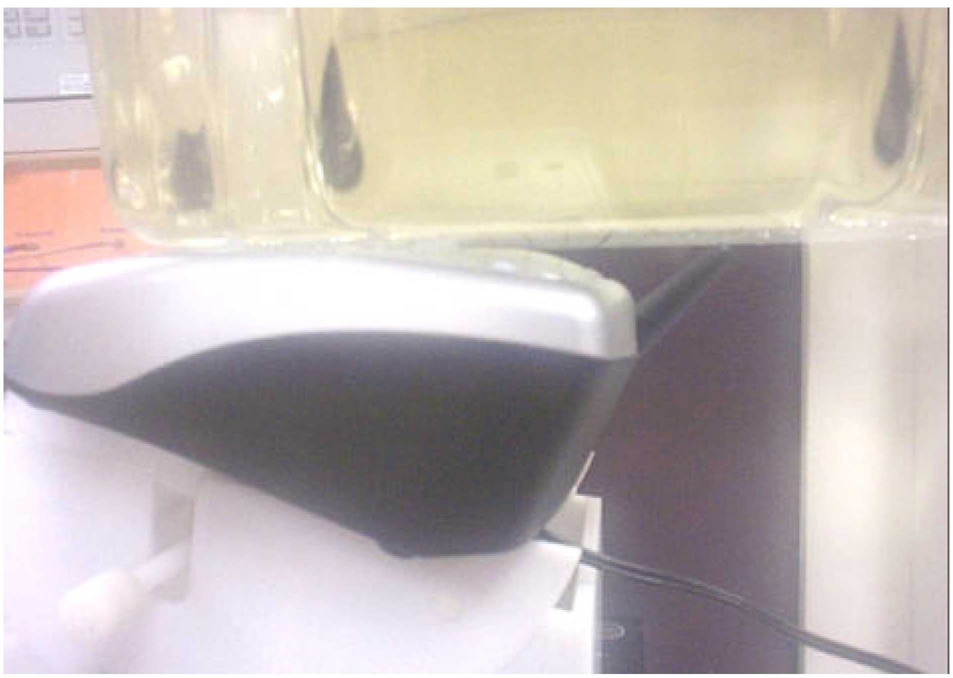
Appendix B: PICTURES OF THE EVALUATION SETUP

PICTURE 1

KEYBOARD UP, Distance 0 mm



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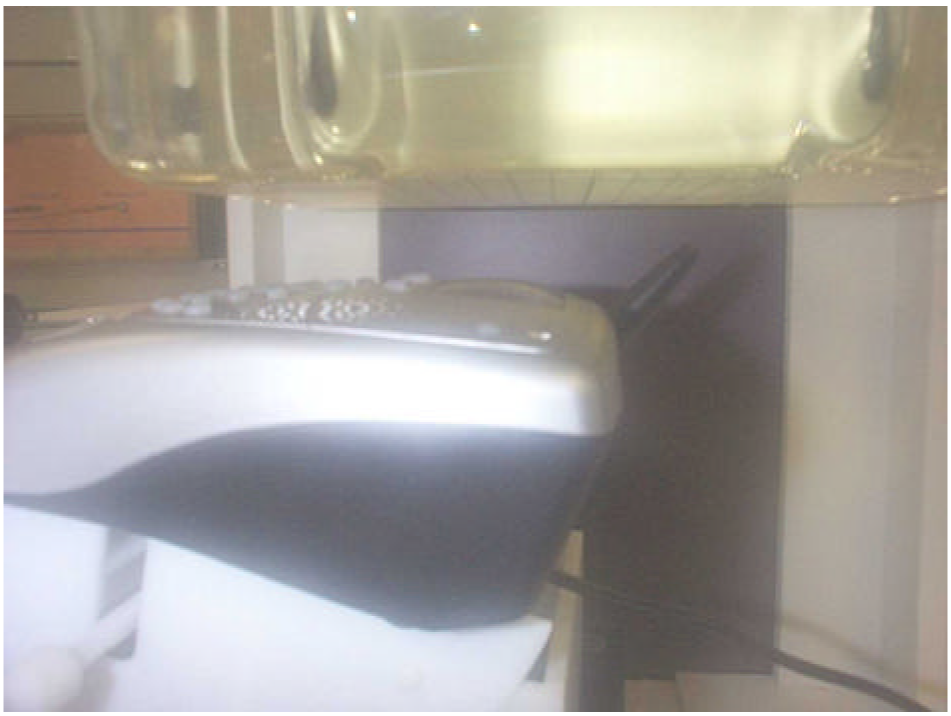
PICTURE 2

KEYBOARD UP, Distance 15 mm



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PICTURE 3

LEFT SIDE UP, Distance 0 mm

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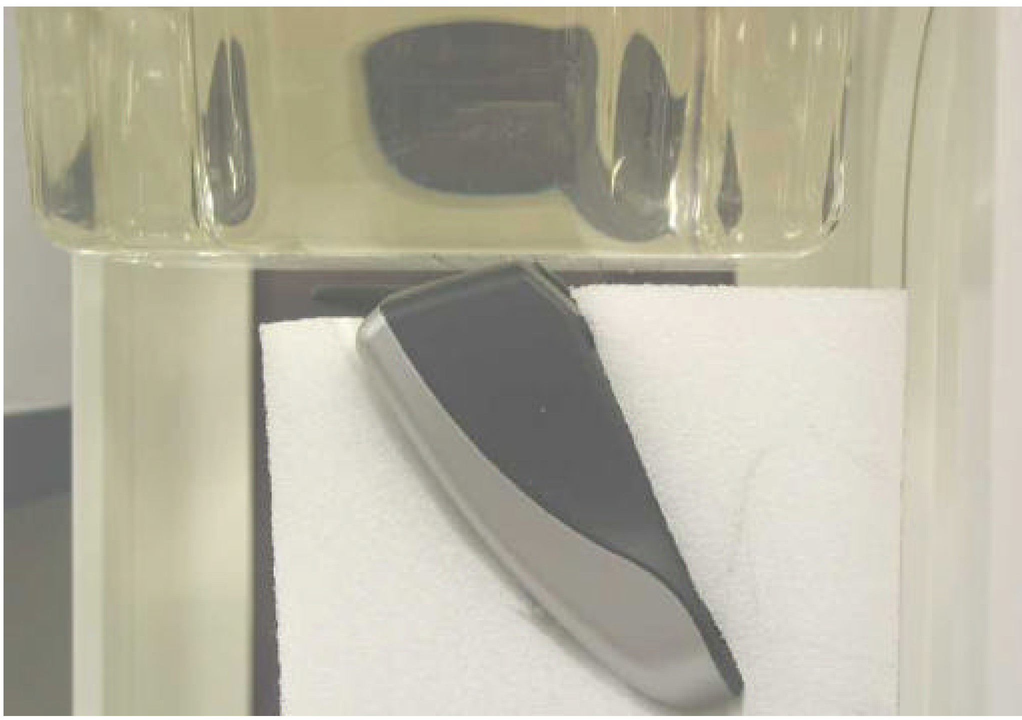
PICTURE 4

TOP SIDE UP, Distance 0 mm



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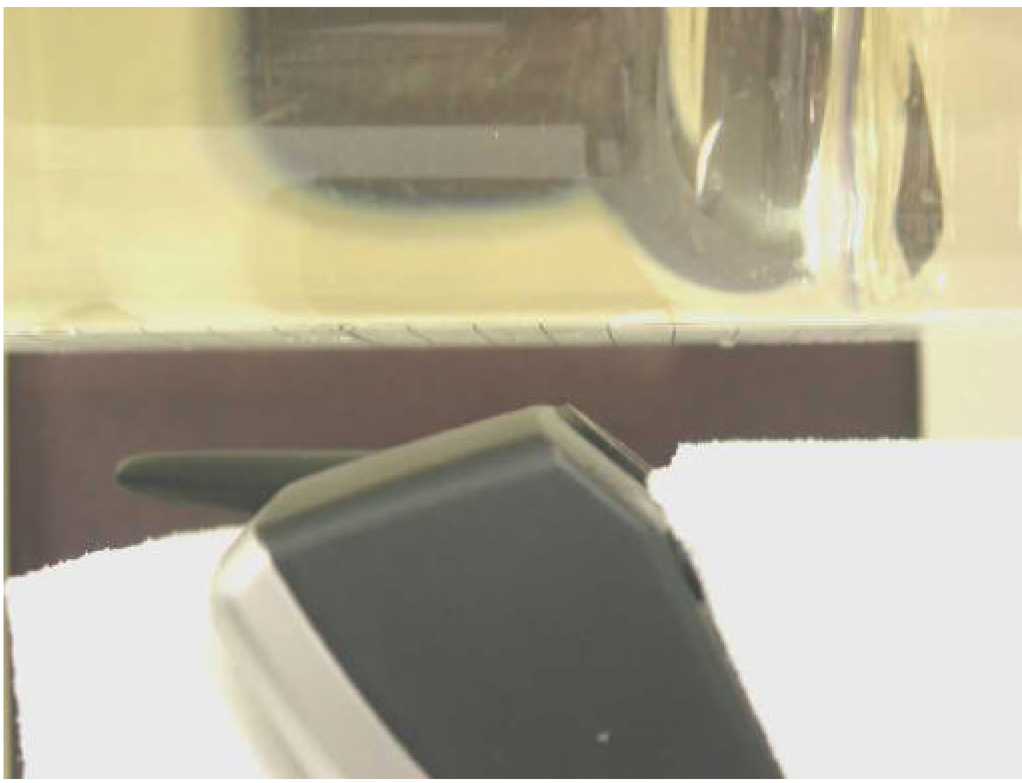
PICTURE 5

TOP SIDE UP, Distance 15 mm



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APPENDIX C: VALIDATION SCAN

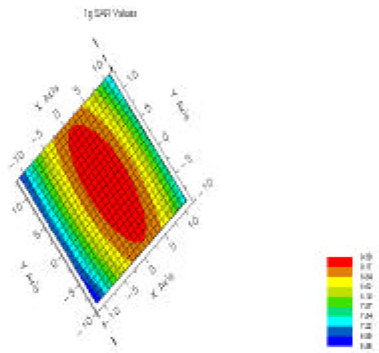

Figure 5. Contour Plot of 1 gram Validation Scan

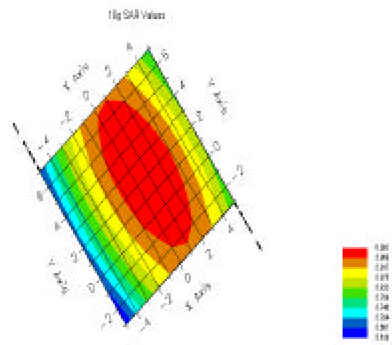

Figure 6. Surface Plot of 1 gram Validation

Frequency: 5800 MHz
Input Power to Dipole: 0.1 W (Normalized to 1W)
Distance from Dipole to Tissue: 10 mm
Tissue Deapth: 15 mm

Measured 1 Gram SAR (W/Kg)	Target 1 Gram SAR (W/Kg)	Delta (%)
131.3	132.3	-0.75

Measured 10 Gram SAR (W/Kg)	Target 10 Gram SAR (W/Kg)	Delta (%)
38.0	38.4	1.1

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Appendix D: UNCERTAINTY BUDGET

Calculated Uncertainties

Type of Uncertainty	Specific to	Uncertainty
Power variation due to battery condition	DUI	0%
Extrapolation due to depth measurement	Setup	3.8%
Conductivity	Setup	1.0%
Permitivity	Setup	2.0%
Probe Calibration	Setup	7.0%
Probe Positioning	Setup	1.0%
Probe Isotropicity	Setup	1.5%
Other Setup Uncertainty (Ambient)	Setup	3.0%
	18.0%	**Expanded Uncertainty K=2**

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Appendix E: Probe Calibration

NCL CALIBRATION LABORATORIES

Calibration File No.: C-P-0249

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the **NCL CALIBRATION LABORATORIES** by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic RF Probe 5.8 GHz

Manufacturer: APREL Laboratories
Model No.: E-010
Serial No.: 163

Calibration Procedure: SSI/DRB-TP-D01-032
Project No: Probe Cal Internal

Calibrated: May 8th 2002
Recalibration required: may 7th 2003
Released on: May 8th 2002

Released By: ____

NCL CALIBRATION LABORATORIES

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NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

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INTRODUCTION

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-010 163.

REFERENCES

SSI/DRB-TP-D01-032 E-Field Probe Calibration Procedure
IEEE P-1528 *DRAFT* "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
SSI-TP-014 Tissue Calibration Procedure

Conditions

Probe 163 was a new probe taken from stock prior to calibration.

Ambient Temperature of the Laboratory: 23 °C +/- 0.5 °C
Temperature of the Tissue: 22 °C +/- 0.5 °C

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CALIBRATION RESULTS SUMMARY

Probe Type: E-Field Probe E-010

Serial Number:	163
Frequency:	5.8 GHz
Sensor Offset:	2.4 mm
Sensor Length:	**2.5 mm**
Tip Enclosure:	**Glass***
Tip Diameter:	**7 mm**
Tip Length:	**40 mm**
Total Length:	**290 mm**

*Resistive to recommended tissue recipes per IEEE-P1528

SENSITIVITY IN AIR

Channel X: 0.58 ìV/(V/m)^2
Channel Y: 0.58 ìV/(V/m)^2
Channel Z: 0.58 ìV/(V/m)^2

Diode Compression Point: 76 mV

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SENSITIVITY IN HEAD TISSUE

Frequency: 5.8 GHz

Epsilon: 35.3(+/-10%)

Sigma: 5.27 S/m (+/-10%)

ConvF

Channel X: 2.5

Channel Y: 2.5

Channel Z: 2.5

Tissue sensitivity values were calculated using a load impedance of 5 MΩ.

Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.6mm.

Spatial Resolution:

The measured probe tip diameter is 7 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

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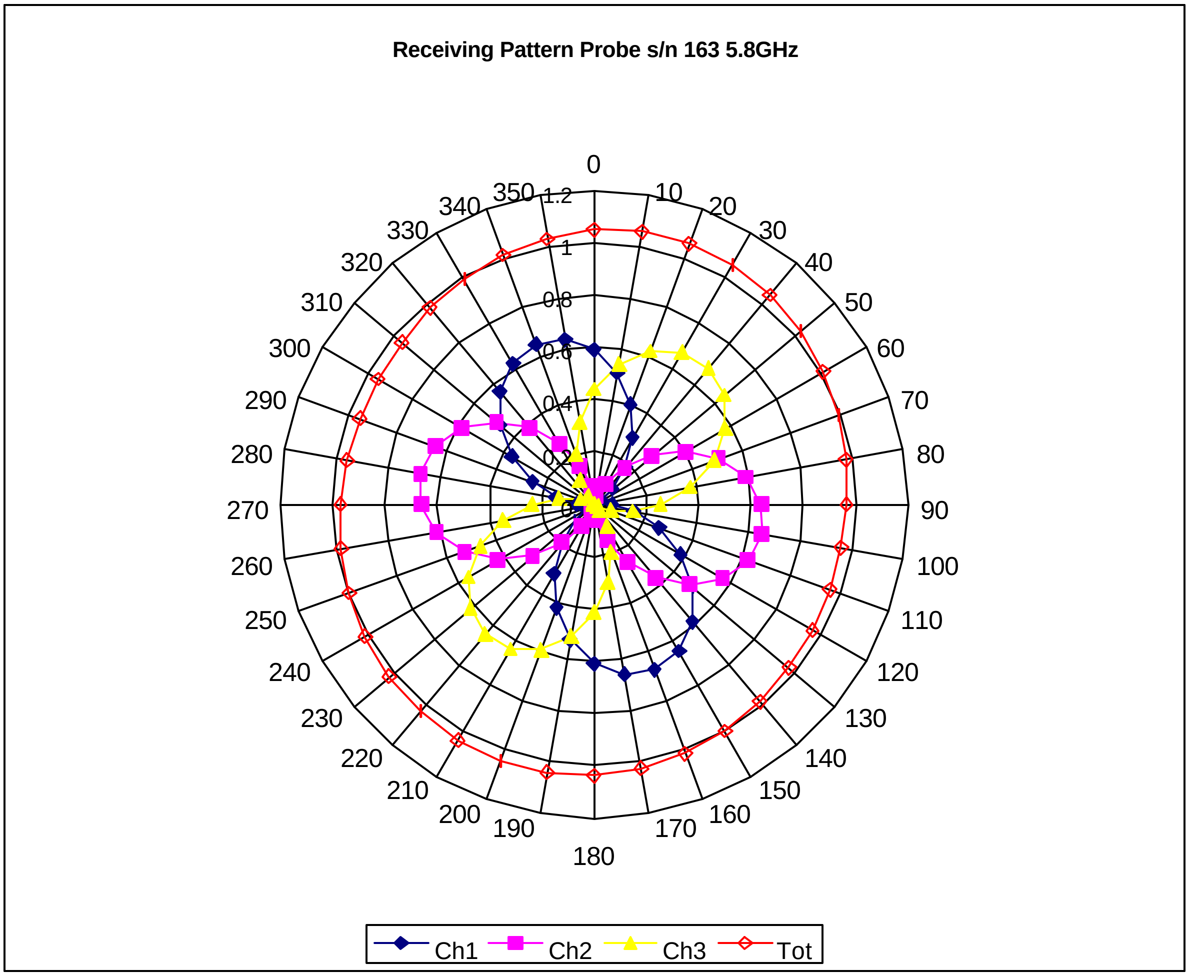
RECEIVING PATTERN 5.8 GHZ (AIR)



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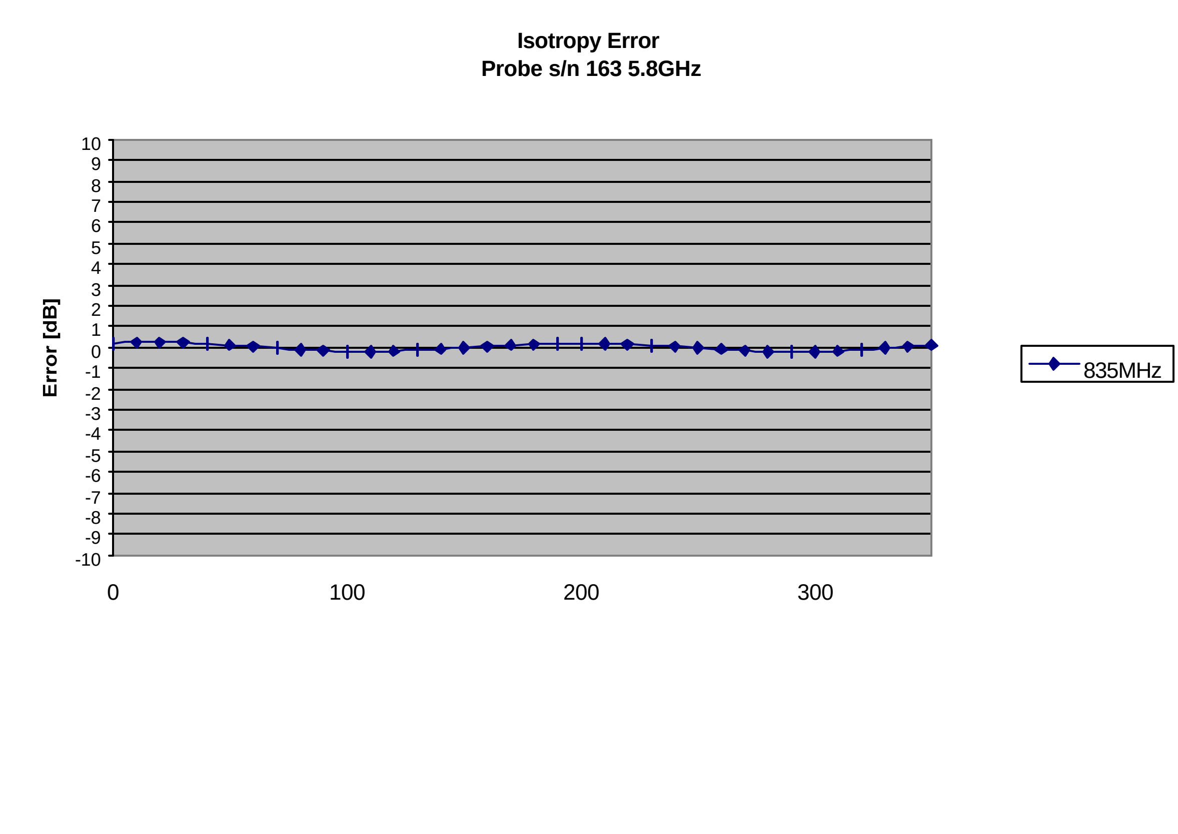
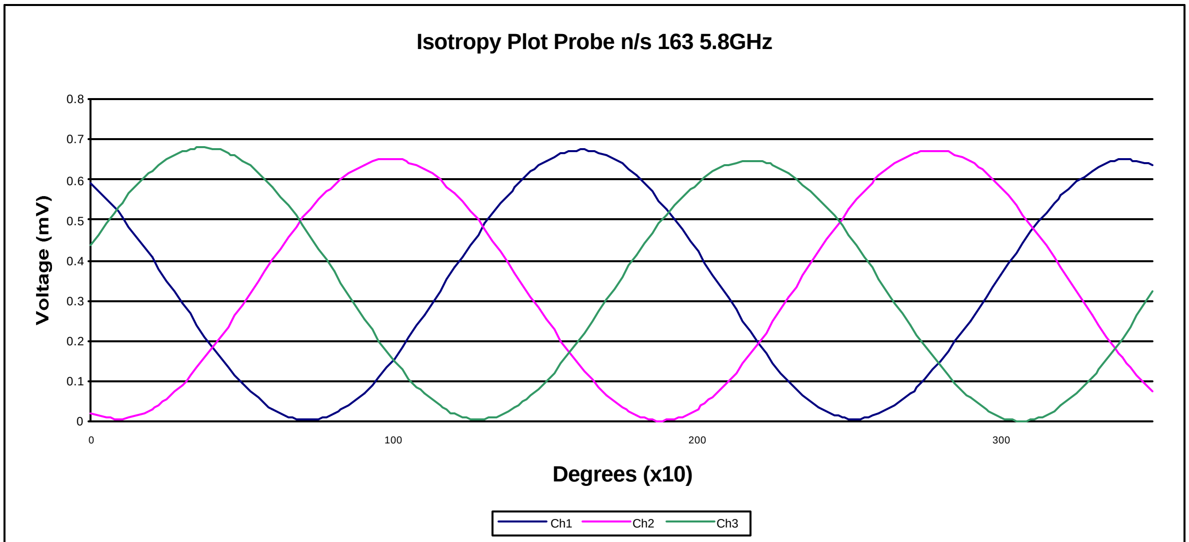
ISOTROPY ERROR 5.8 GHZ (AIR)





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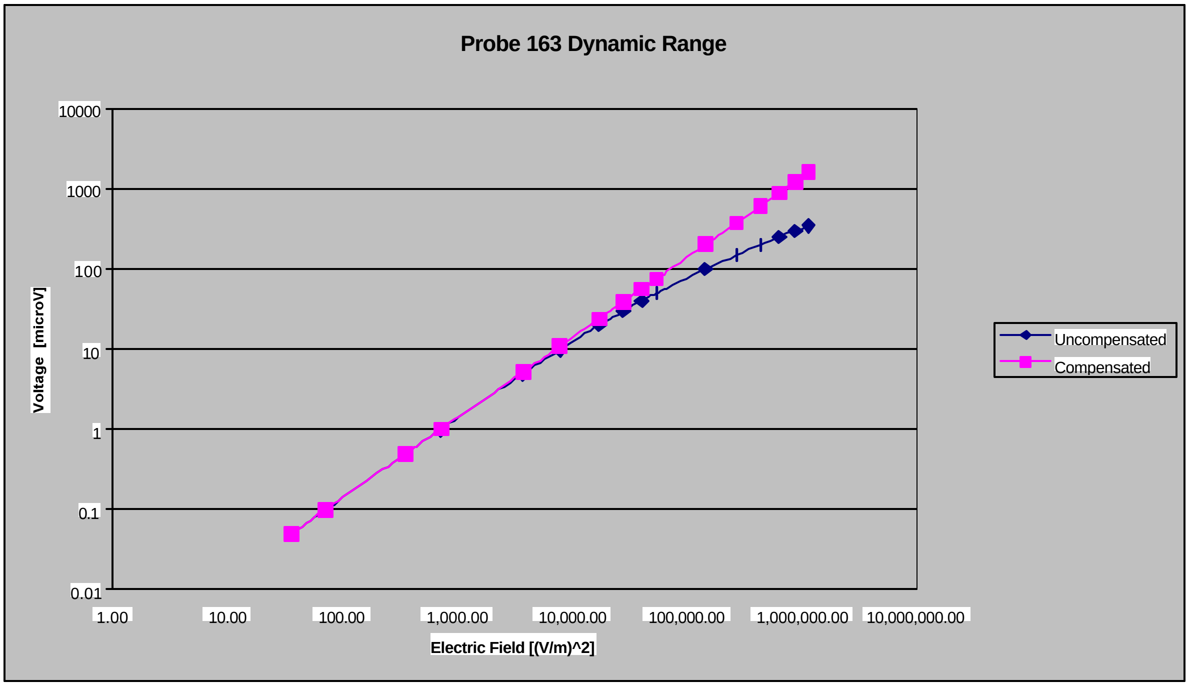
DYNAMIC RANGE



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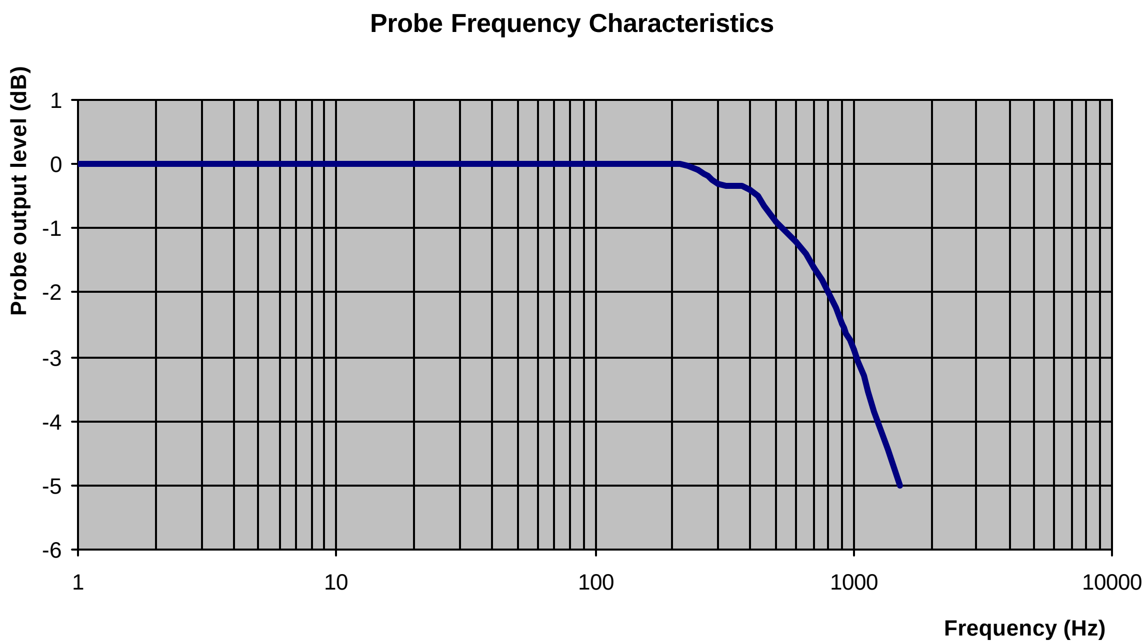
Video Bandwidth



8.

Video Bandwidth at 500 Hz 1 dB
Video Bandwidth at 1.02 KHz: 3 dB

9.

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10. CONVERSION FACTOR UNCERTAINTY ASSESSMENT

Frequency: 5.8 GHz

Epsilon: 35.3 (+/-10%)
Sigma: 5.27 S/m (+/-10%)

ConvF

Channel X: **2.5** **7%(K=2)**

Channel Y: **2.5** **7%(K=2)**

Channel Z: 2.5 7%(K=2)

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 MΩ.

Boundary Effect:

For a distance of 2.6mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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TEST EQUIPMENT

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed in the following table:

Instrument	Manufacturer	Model Number	Asset Number Serial Number	Calibration Due
UniPhantom	APREL		APL-085	-
Universal Frame	APREL		APL-114	-
<1GHz TEM Cell			APL-1GHZ-TEM	Jan 2003
>1GHz-2GHz Tem Cell			APL-2GHZ-TEM	Jan 2003
E-010 Probe			160	March 2003
ALIDX-500	APREL/IDX		-	March 2003
RF Amplifier	APREL		301467	October 2003
Signal Generator	HP		301463	November 2002
Power Meter	R&S		301451	September 2002
Power Sensor	R&S		301461	September 2002
Directional Coupler	HP		100251	October 2002
VNA	Anritsu		Z0107643 *TEMP*	August 2002
Slotted Line	HP		100195	-
Slotted Line Probe	APREL		APL-SLP-001	December 2002
APREL D-835-S1			301463	March 2003
D-900-S1	APREL		301472	March 2003
D-1900-S1	APREL		301459	March 2003
Measuring Amplifier	B&K		100675	Feb 2003
Signal Generator	B&K		100677	Feb 2003

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