

## SAR Data Report Hitachi June26 scan05

Start : 26-June-03 04:03:02 am  
End : 26-June-03 04:09:06 am  
Code Version : 4.12  
Robot Version: 4.08

### Product Data:

Type : Latitude - Hitachi  
Frequency : 2437 MHz  
Antenna Type : Center Fed  
Antenna Posn. : Internal

### Measurement Data:

Phantom Name : APREL-Uni  
Phantom Type : Uniphantom  
Tissue Type : Muscle  
Tissue Dielectric : 50.600  
Tissue Conductivity : 2.010  
Tissue Density : 1.000  
Crest Factor : 1.000  
Robot Name : CRS

### Probe Data:

Probe Name : 163  
Probe Type : E Fld Triangle  
Frequency : 2450 MHz  
Tissue Type : Muscle  
Calibrated Dielectric : 50.600  
Calibrated Conductivity : 2.010  
Probe Offset : 2.500 mm  
Conversion Factor : 5.6  
Diode Compression Pt : 76.0 mV  
Probe Sensitivity : 0.580 0.580 0.580 mV/(mW/cm^2)  
Amplifier Gains : 20.00 20.00 20.00  
Chan. Offset (mV) : -5.45 3.23 -1.24

### Sample:

Rate: 6000 Samples/Sec  
Count: 1000 Samples  
NIDAQ Gain: 5  
Scan Time: 166.7 msec

### Comments:

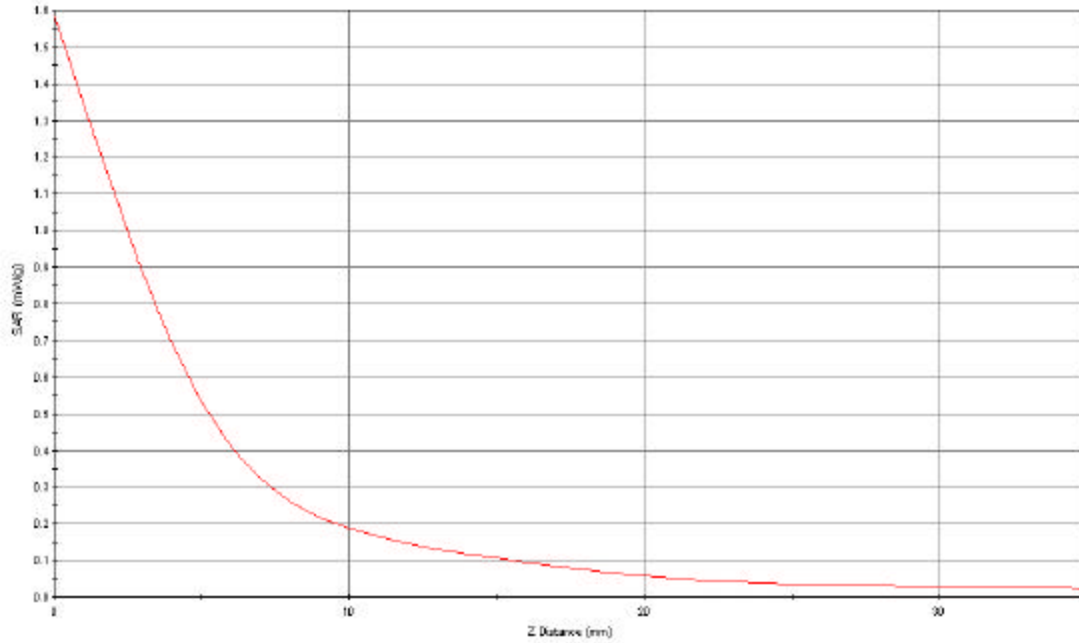
LCD, 0mm

Area Scan - Max Local SAR Value at x=16.0 y=47.0 = 1.25 W/kg  
Zoom Scan - Max Local SAR Value at x=16.0 y=56.0 z=0.0 = 3.06 W/kg  
Max 1g SAR at x=16.0 y=55.0 z=0.0 = 1.32 W/kg  
Max 10g SAR at x=17.0 y=52.0 z=0.0 = 0.83 W/kg



## Z Axis Scan Body SAR 1g

SAR - Z Axis  
at Hotspot x:15.0 y:-70.0



## GRAPH 5

Body SAR (1g)  
Right Hand Side  
Distance 0 mm  
Mid Channel  
Frequency: 2437 MHz  
Duty Cycle 1



Date	Dielectric Constant $\epsilon_r$	Conductivity $\sigma$ [S/m]	Probe Con/F	Tissue Temp ( °C)	1g SAR ( W/kg )	Power Drift
<b>26/06/03</b>	<b>50.6</b>	<b>2.01</b>	<b>5.6</b>	<b>21</b>	<b>0.54</b>	<b>0</b>



## GRAPH 6

Direct Contact SAR (10g)  
Right Hand Side  
Distance 0 mm  
Mid Channel  
Frequency: 2437 MHz  
Duty Cycle 1



Date	Dielectric Constant $\epsilon_r$	Conductivity $\sigma$ [S/m]	Probe Con/F	Tissue Temp ( °C)	10g SAR ( W/kg )	Power Drift
<b>26/06/03</b>	<b>50.6</b>	<b>2.01</b>	<b>5.6</b>	<b>21</b>	<b>0.10</b>	<b>0</b>

## GRAPH 7

Direct Contact SAR (10g)  
Keyboard Down  
Distance 0 mm  
Mid Channel  
Frequency: 2437 MHz  
Duty Cycle 1



Date	Dielectric Constant $\epsilon_r$	Conductivity $\sigma$ [S/m]	Probe Con/F	Tissue Temp ( °C)	10g SAR ( W/kg )	Power Drift
26/06/03	50.6	2.01	5.6	21	0.02	0

## GRAPH 8

Body SAR (1g)  
Keyboard Down  
Distance 0 mm  
Mid Channel  
Frequency: 2437 MHz  
Duty Cycle 1



Date	Dielectric Constant $\epsilon_r$	Conductivity $\sigma$ [S/m]	Probe Con/F	Tissue Temp ( $^{\circ}\text{C}$ )	1g SAR (W/kg)	Power Drift
26/06/03	50.6	2.01	5.6	21	0.04	0

## Appendix B

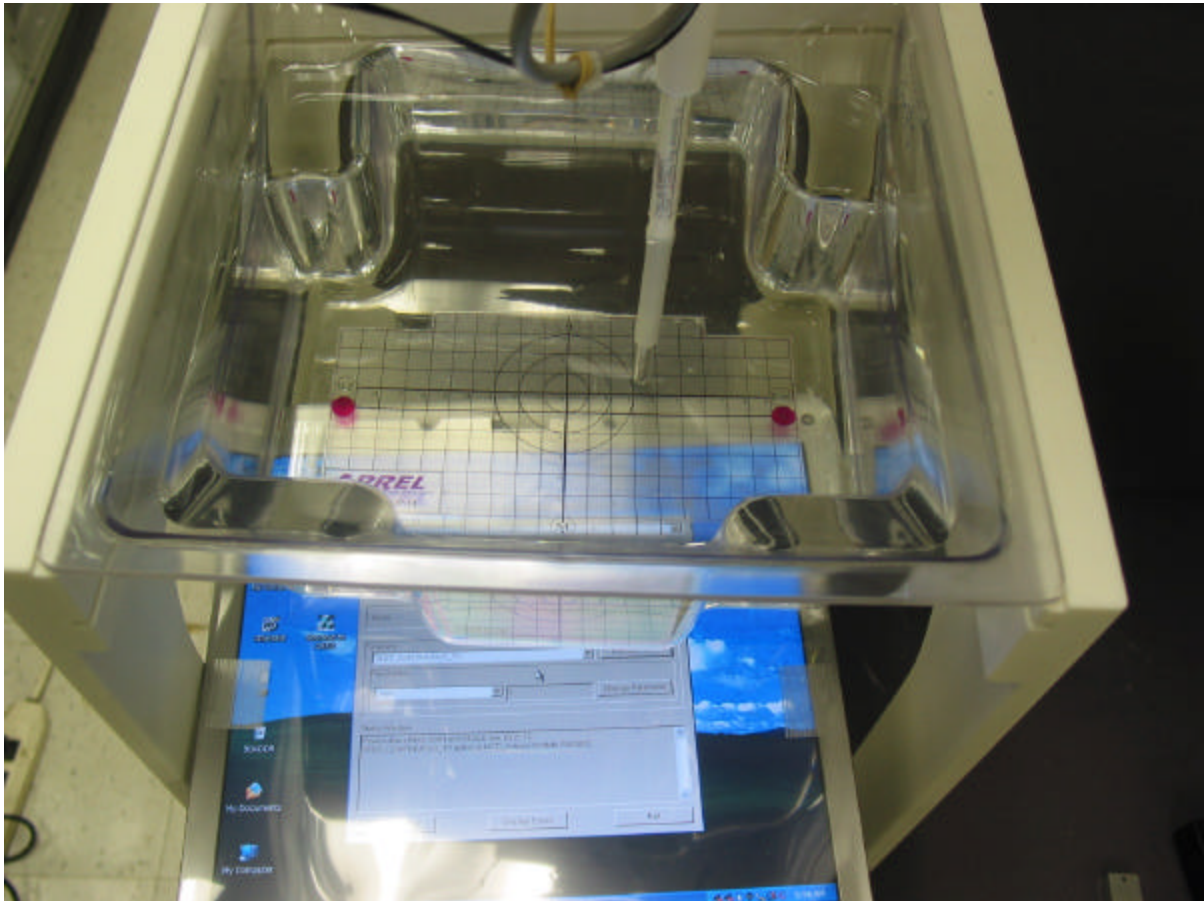
### Setup Pictures





## PICTURE 1

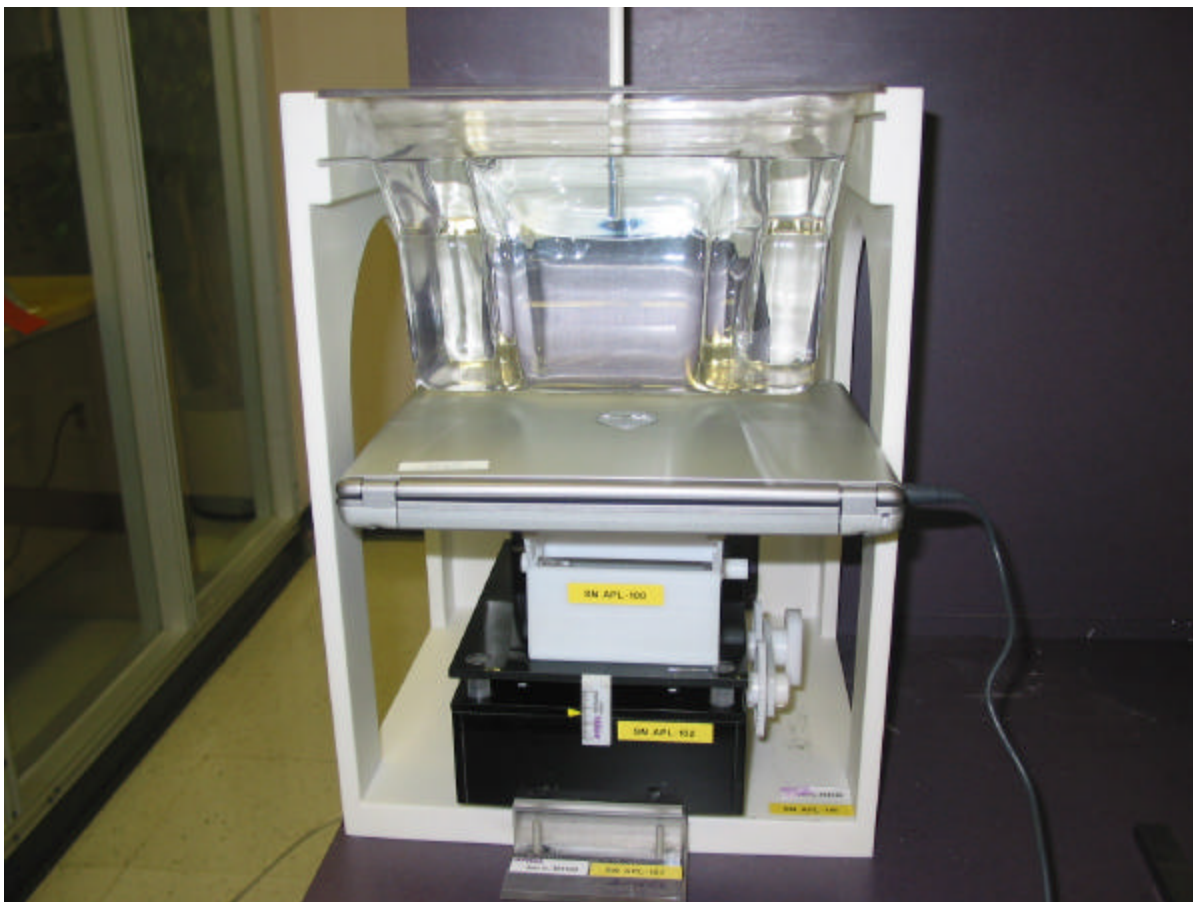
### Hitachi Antenna LCD Open





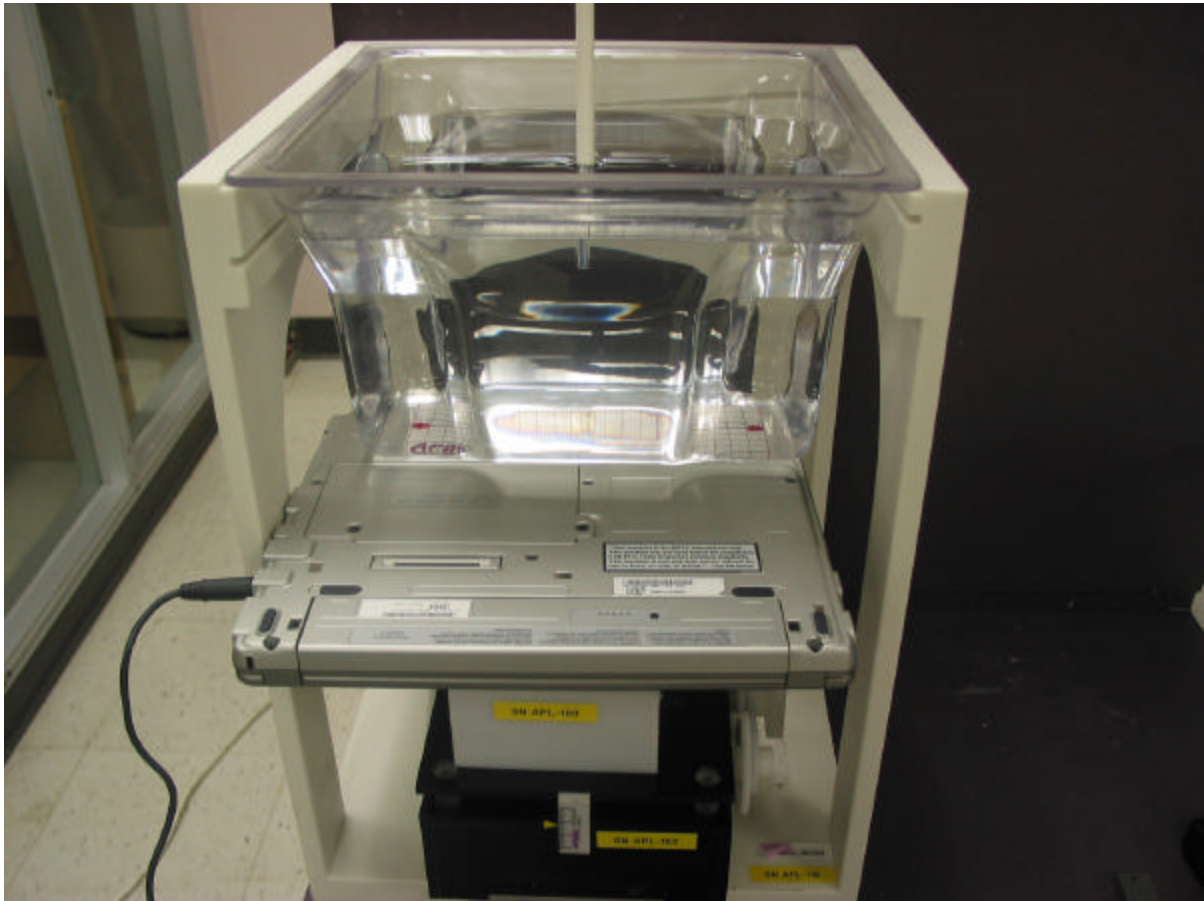
## PICTURE 2

### Hitachi Antenna LCD Closed



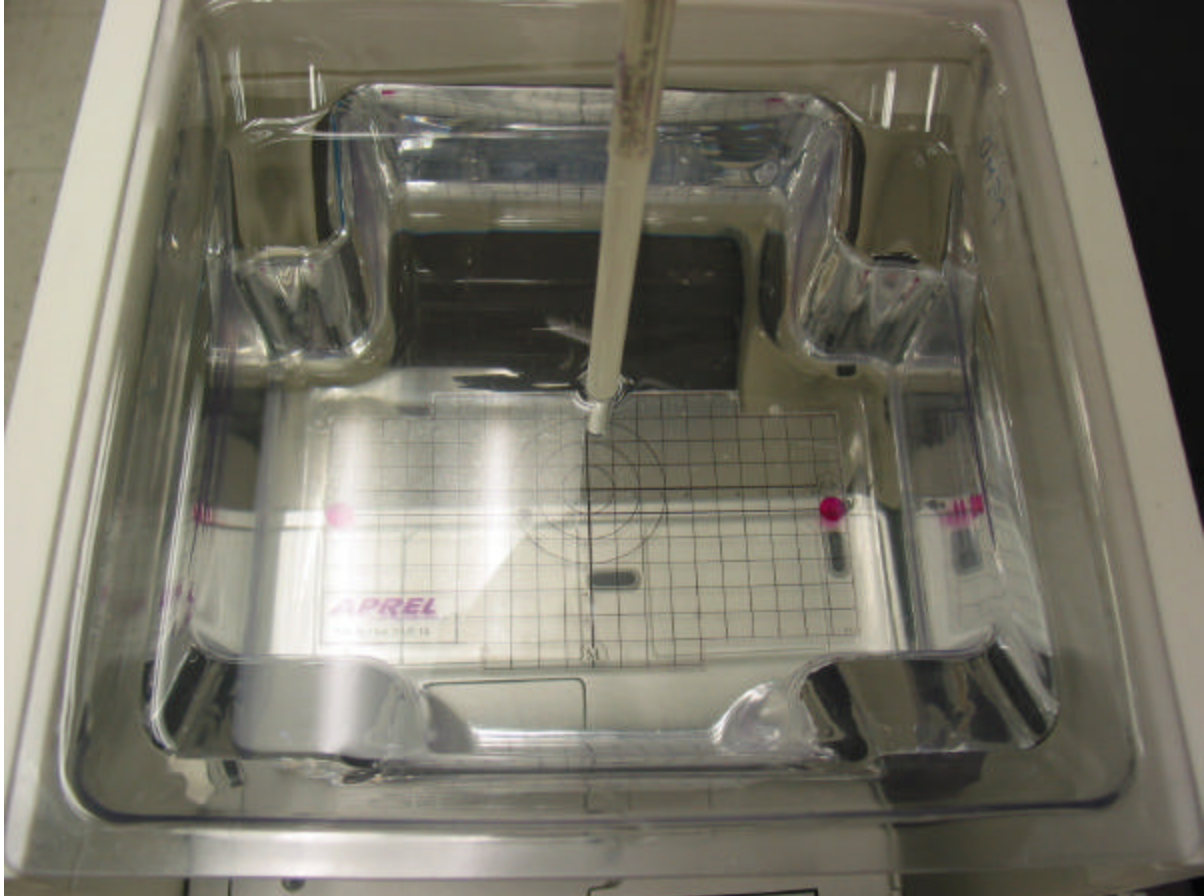
### PICTURE 3

#### Hitachi Antenna Keyboard Down



**PICTURE 4**

**Hitachi Antenna Right Hand Side**

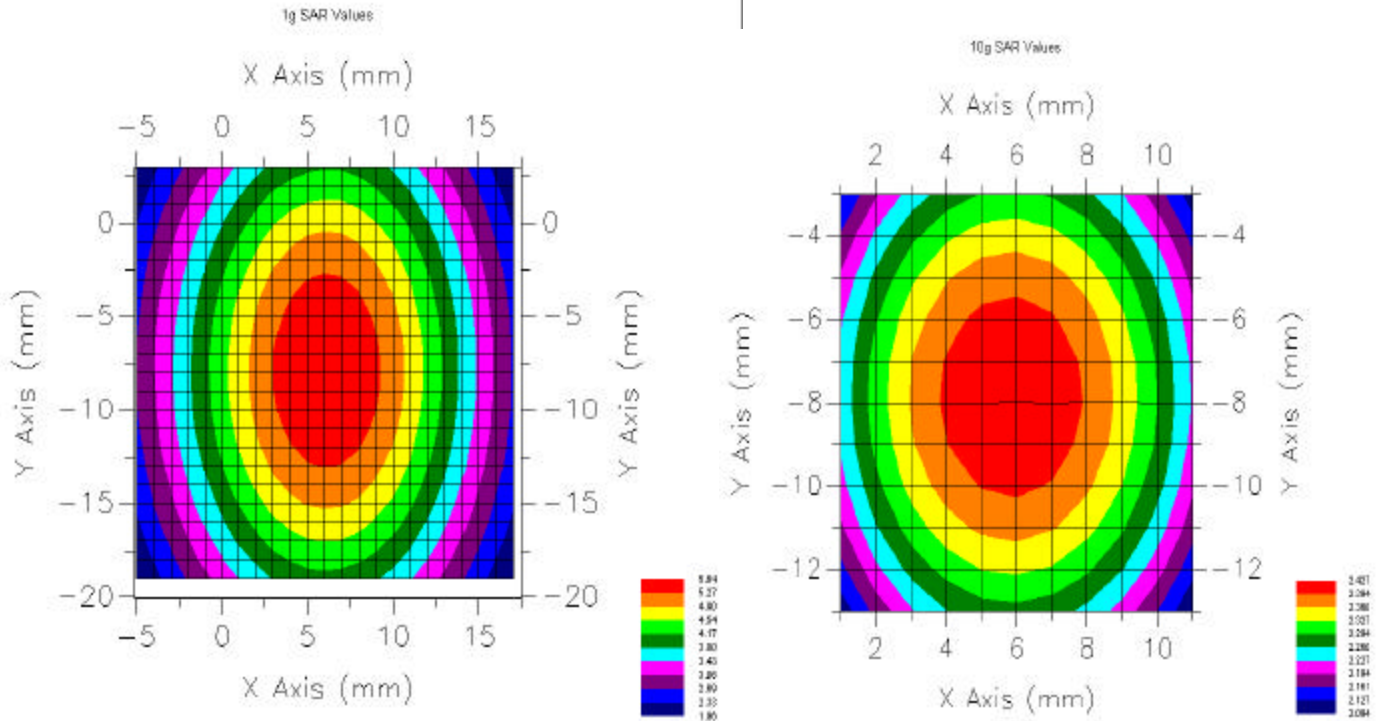


## Appendix C

### Validation Scan Results



## VALIDATION SCAN



Frequency: 2450 MHz  
 Tissue Type: Muscle  
 Epsilon: 50.6  
 Sigma: 2.01  
 Tissue Calibration Date: 26<sup>th</sup> June 2003  
 Conversion Factor: 5.6  
 Input Power to Dipole: 0.1 W (Normalized to 1W)  
 Duty Cycle: 1  
 Distance from Dipole to Tissue: 10 mm  
 Tissue Temperature: 21°C  
 Tissue Depth: 15 cm

Measured 1 Gram SAR (W/Kg)	Target 1 Gram SAR (W/Kg)	Delta (%)
52.9	52.4	+2.0

Measured 10 Gram SAR (W/Kg)	Target 10 Gram SAR (W/Kg)	Delta (%)
24.0	24.0	0





## Appendix d: Uncertainty Budget

Intel Mini PCI Type 3A 802.11b Wireless LAN Adapter model WM3A2100 located inside DELL laptop chassis model number PP04S

Source of Uncertainty	Description (Annex)	Tolerance Value	Probability Distribution	Divisor	$c_i$ (1-g)	$c_i$ (10-g)	Standard Uncertainty (1-g)	Standard Uncertainty (10-g)	$v_i^2$ or $v_{eff}$
<b>Measurement System</b>									
Probe Calibration	E1.1	3.5	normal	1	1	1	3.5	3.5	
Axial Isotropy	E1.2	3.7	rectangular	3	$(1-cp)^{1/2}$	$(1-cp)^{1/2}$	1.5	1.5	
Hemispherical Isotropy	E1.2	10.9	rectangular	3	cp	cp	4.4	4.4	
Boundary Effect	E1.3	1.0	rectangular	3	1	1	0.6	0.6	
Linearity	E1.4	4.7	rectangular	3	1	1	2.7	2.7	
Detection Limit	E1.5	1.0	rectangular	3	1	1	0.6	0.6	
Readout Electronics	E1.6	1.0	normal	1	1	1	1.0	1.0	
Response Time	E1.7	0.8	rectangular	3	1	1	0.5	0.5	
Integration Time	E1.8	1.7	rectangular	3	1	1	1.0	1.0	
RF Ambient Condition	E5.1	3.0	rectangular	3	1	1	1.7	1.7	
Probe Positioner Mech. Restrictions	E5.2	0.4	rectangular	3	1	1	0.2	0.2	
Probe Positioning with respect to Phantom Shell	E5.3	2.9	rectangular	3	1	1	1.7	1.7	
Extrapolation and Integration	E4.2	3.7	rectangular	3	1	1	2.1	2.1	
Test Sample Positioning	E3.1.3	4.0	normal	1	1	1	4.0	4.0	11
Device Holder Uncertainty	E3.1.2	2.0	normal	1	1	1	2.0	2.0	8
Drift of Output Power	Section 5.6.2	0.0	rectangular	3	1	1	0.0	0.0	
<b>Phantom and Setup</b>									
Phantom Uncertainty (shape and thickness tolerance)	E2.1	3.4	rectangular	3	1	1	2.0	2.0	
Liquid Conductivity (target)	E2.2	0.0	rectangular	3	0.7	0.5	0.0	0.0	
Liquid Conductivity (meas.)	E2.2	2.0	rectangular	3	0.7	0.5	0.8	0.6	
Liquid Permittivity (target)	E2.2	5.0	rectangular	3	0.6	0.5	1.7	1.4	
Liquid Permittivity (meas.)	E2.2	2.0	rectangular	3	0.6	0.5	0.7	0.6	
<b>Combined Uncertainty</b>			RSS				9.0	8.9	
<b>Combined Uncertainty (coverage factor = 2)</b>			Normal (k=2)				18.0	17.8	





## Appendix E

### Probe Calibration Certificate



**NCL CALIBRATION LABORATORIES**

Calibration File No.: C-P-0265

**C E R T I F I C A T E   O F   C A L I B R A T I O N**

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 2.45 GHz

Manufacturer: APREL Laboratories

Model No.: E-010

Serial No.: 163

Calibration Procedure: SSI/DRB-TP-D01-032

Project No: Probe Cal Internal

Calibrated: November 5<sup>th</sup> 2002  
Recalibration required: November 4<sup>th</sup> 2003  
Released on: November 5<sup>th</sup> 2002

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

51 SPECTRUM WAY  
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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 is a working released probe.

**Ambient Temperature of the Laboratory:** 22 °C +/- 0.5 °C  
**Temperature of the Tissue:** 21 °C +/- 0.5 °C



## CALIBRATION RESULTS SUMMARY

**Probe Type:** E-Field Probe E-010

**Serial Number:** 163

**Frequency:** 2450 MHz

**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  $\mu\text{V}/(\text{V}/\text{m})^2$

**Channel Y:** 0.58  $\mu\text{V}/(\text{V}/\text{m})^2$

**Channel Z:** 0.58  $\mu\text{V}/(\text{V}/\text{m})^2$

**Diode Compression Point:** 76 mV



## SENSITIVITY IN BODY TISSUE

**Frequency:** 2450 MHz

**Epsilon:** 52.7(+/-5%) **Sigma:** 1.95 S/m (+/-10%)

### ConvF

**Channel X:** 5.6

**Channel Y:** 5.6

**Channel Z:** 5.6

Tissue sensitivity values were calculated using a load impedance of 5 M $\Omega$ .

### Boundary Effect:

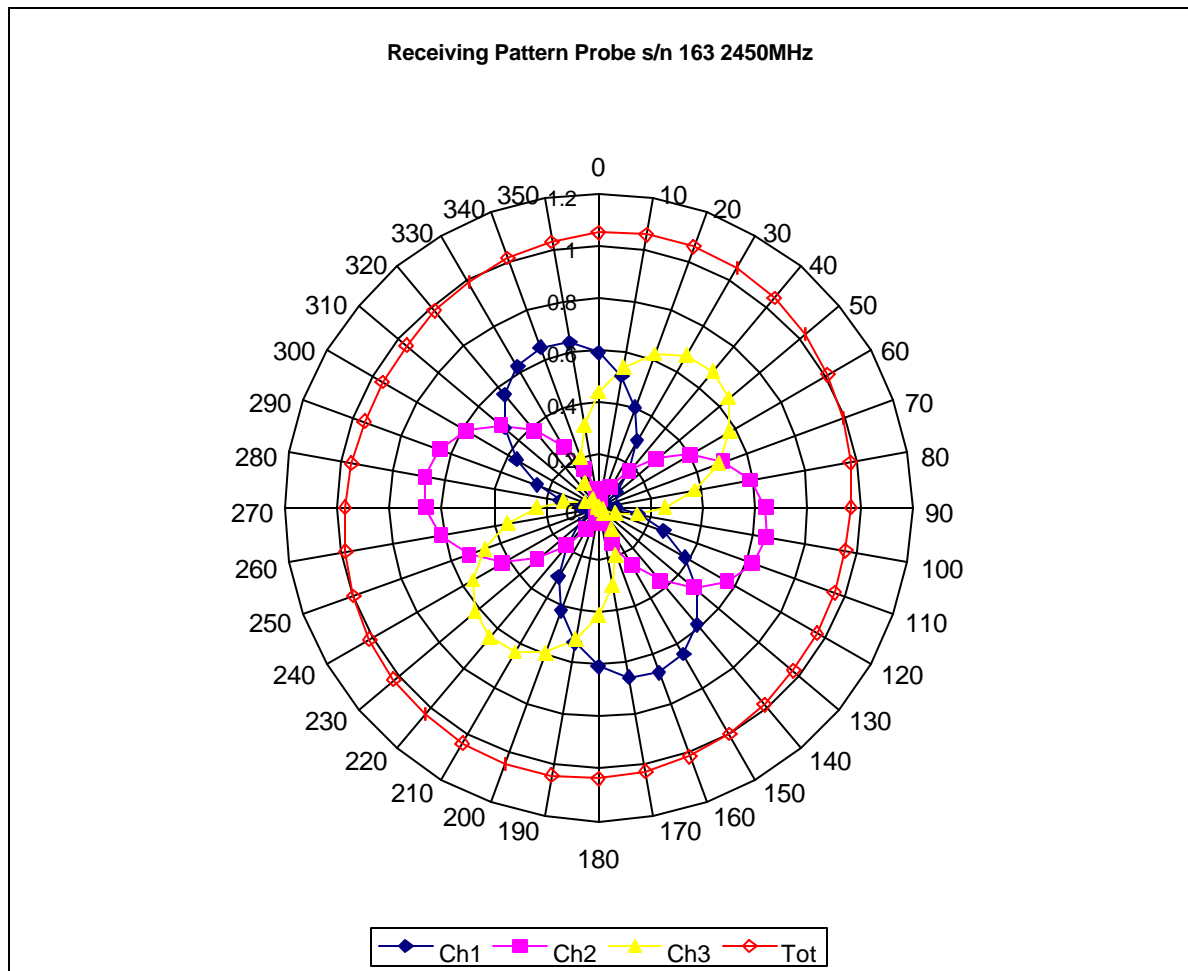
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.6mm.

### 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.

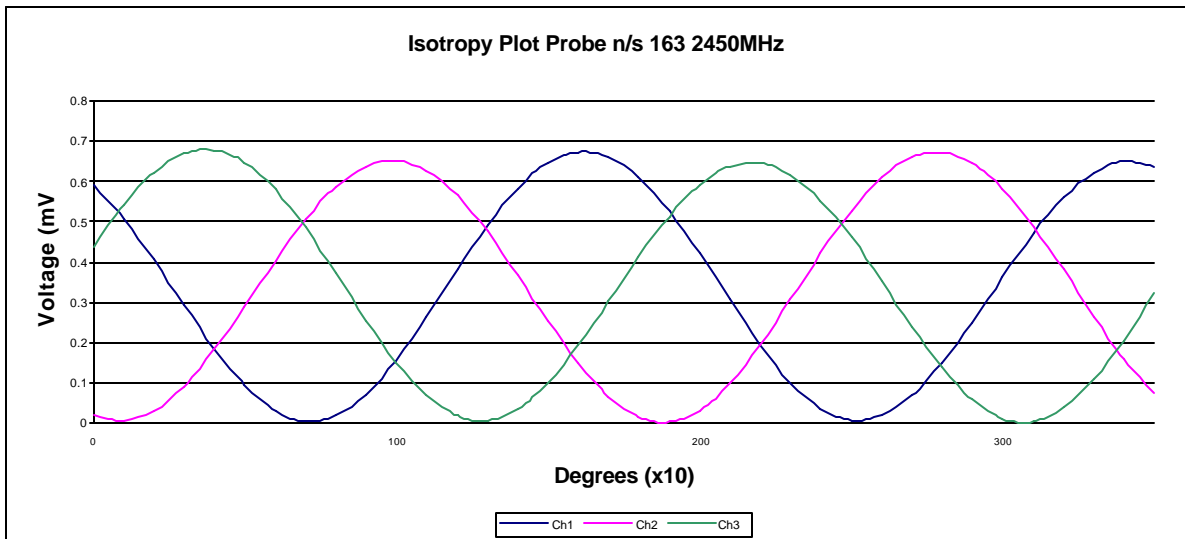
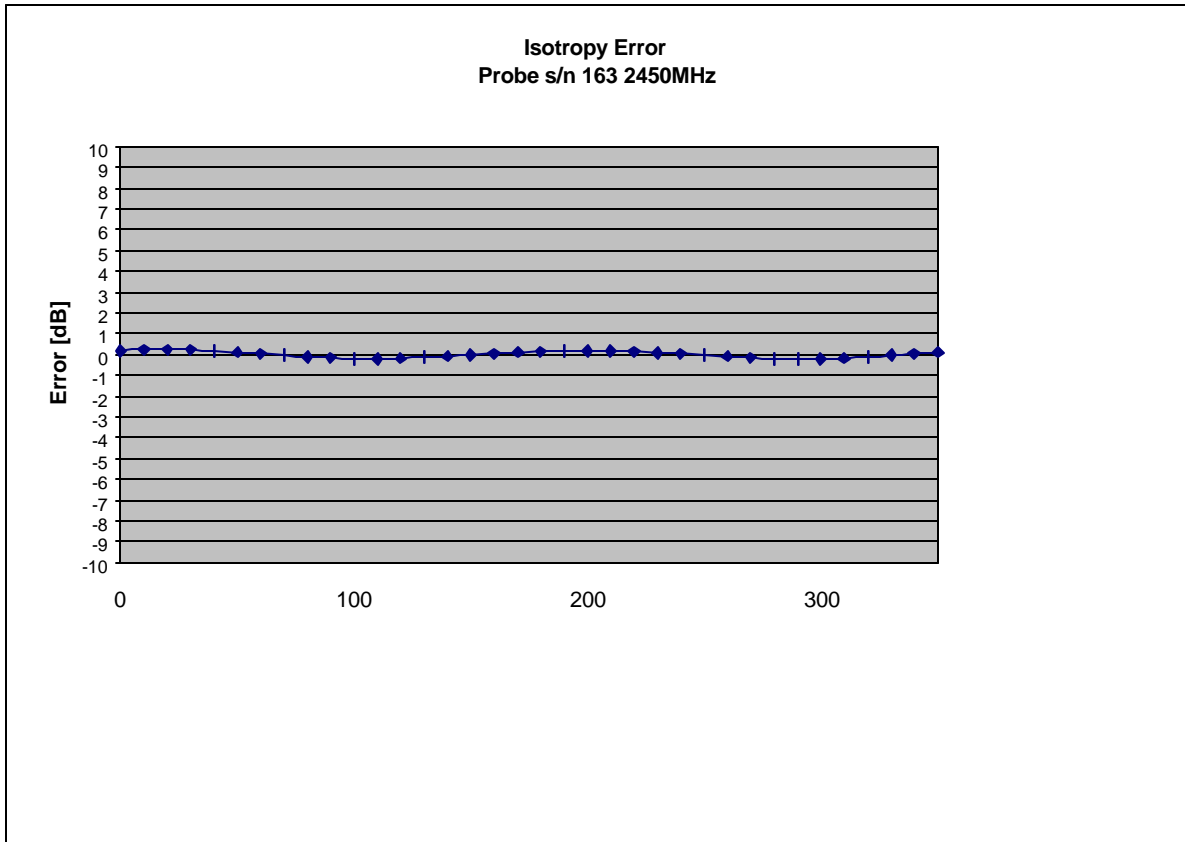


## RECEIVING PATTERN 2450 MHZ (AIR)

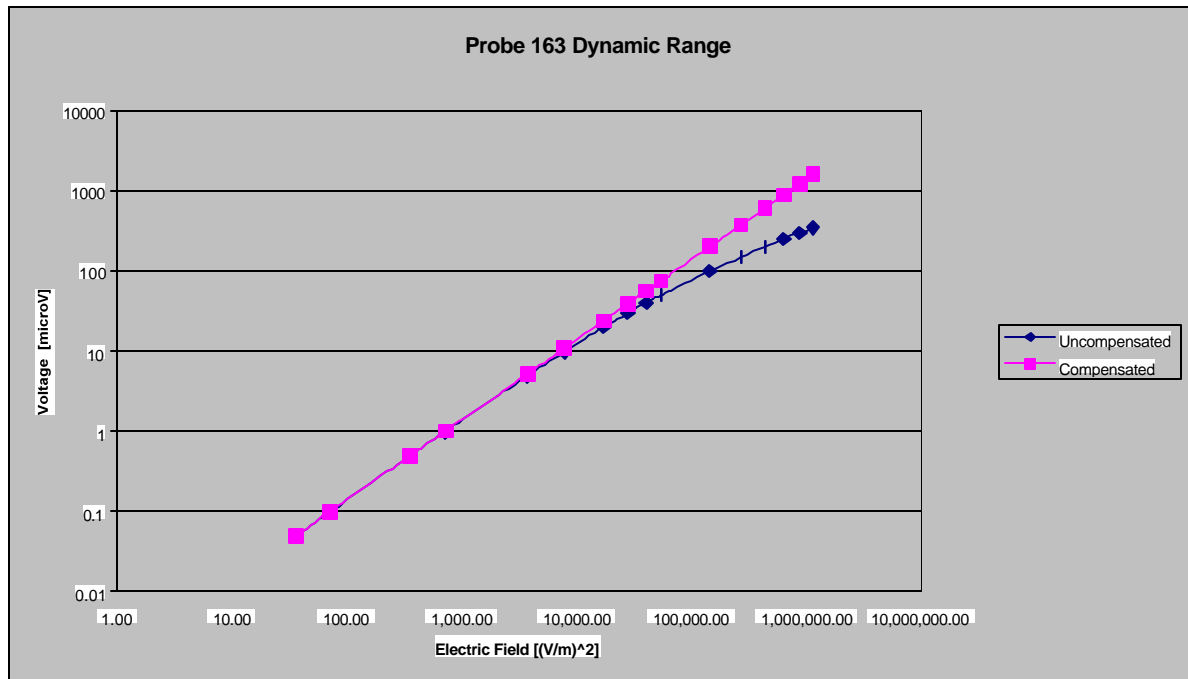




## ISOTROPY ERROR 2450 MHZ (AIR)

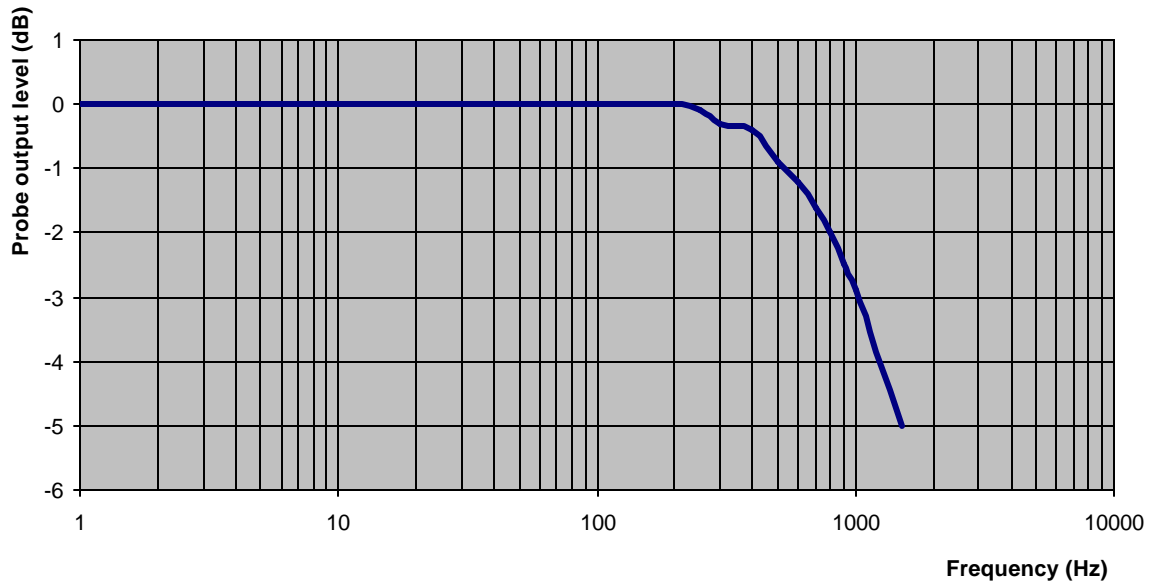


## DYNAMIC RANGE



## Video Bandwidth

Probe Frequency Characteristics



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



## CONVERSION FACTOR UNCERTAINTY ASSESSMENT

**Frequency:** 2450 MHz

**Epsilon:** 52.7 (+/-5%) **Sigma:** 1.95 S/m (+/-10%)

**ConvF**

Channel X: **5.6** **7%(K=2)**

Channel Y: **5.6** **7%(K=2)**

**Channel Z:** 5.6 **7%(K=2)**

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 M $\Omega$ .

Boundary Effect:

FOR A DISTANCE OF 2.6MM THE EVALUATED UNCERTAINTY (INCREASE IN THE PROBE SENSITIVITY) IS LESS THAN 2%.



## TEST EQUIPMENT

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2002



## Appendix F

# Dipole Calibration Certificate





## NCL CALIBRATION LABORATORIES

Calibration File No: DC-0265

Project Number: Internal

# 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.

APREL Validation Dipole

Manufacturer: APREL Laboratories

Part number: D-2450-S-1

Frequency: 2.45 GHz

Serial No: ALCD-10

Customer: APREL

Calibrated: 15 November 2002  
Released on: 14 November 2003

Released By: \_\_\_\_\_

## **NCL** CALIBRATION LABORATORIES

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



## 7. CALIBRATION RESULTS SUMMARY

The following results relate the Calibrated Dipole and should be used as a quick reference for the user.

### *Mechanical Dimensions*

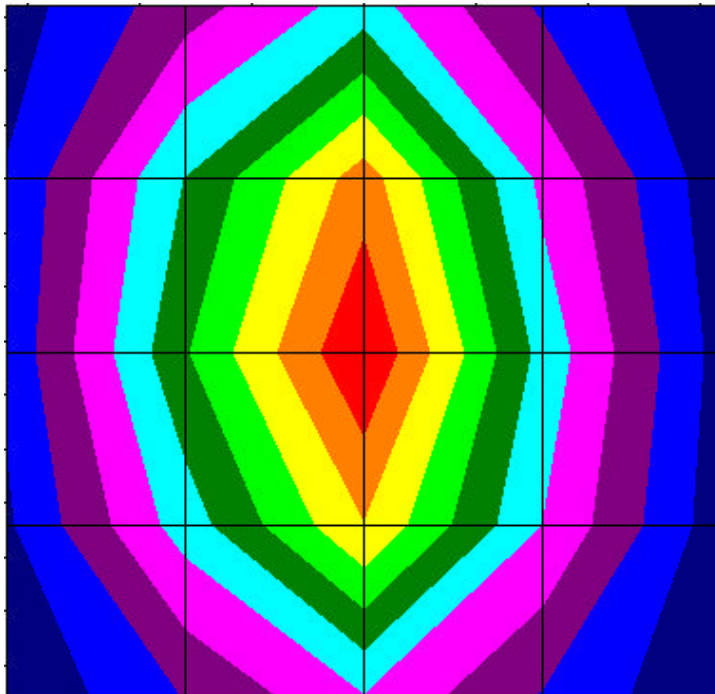
**Length:** 51.7 mm  
**Height:** 30.8 mm

### *Electrical Specification*

**SWR:** 1.181U  
**Return Loss:** -21.4 dB  
**Impedance:** 46.175

### *System Validation Results*

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	52.45	22.91	102.91



## 8. INTRODUCTION

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018. The results contained within this report are for Validation Dipole ALCD-10 at 2.45 GHz. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the IEEE mechanical specification. Step 2 was an Electrical Calibration for the Validation Dipole, where the SWR, Impedance, and the Return loss were assessed. Step 3 involved a System Validation using the ALIDX-500, along with the APREL Reference E-010 130 MHz to 26 GHz E-Field Probe Serial Number 163.

## 9. REFERENCES

SSI-TP-018 Dipole Calibration Procedure

SSI-TP-016 Tissue 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"

Conditions

Dipole ALCD-10 was a new Dipole taken from stock prior to calibration.

**Ambient Temperature of the Laboratory:** 24 °C +/- 0.5 °C

**Temperature of the Tissue:** 20 °C +/- 0.5 °C



## 10. DIPOLE CALIBRATION RESULTS

### *Mechanical Verification*

IEEE Length	IEEE Height	Measured Length	Measured Height
51.5 mm	30.4 mm	51.7 mm	30.8 mm

### *Tissue Validation*

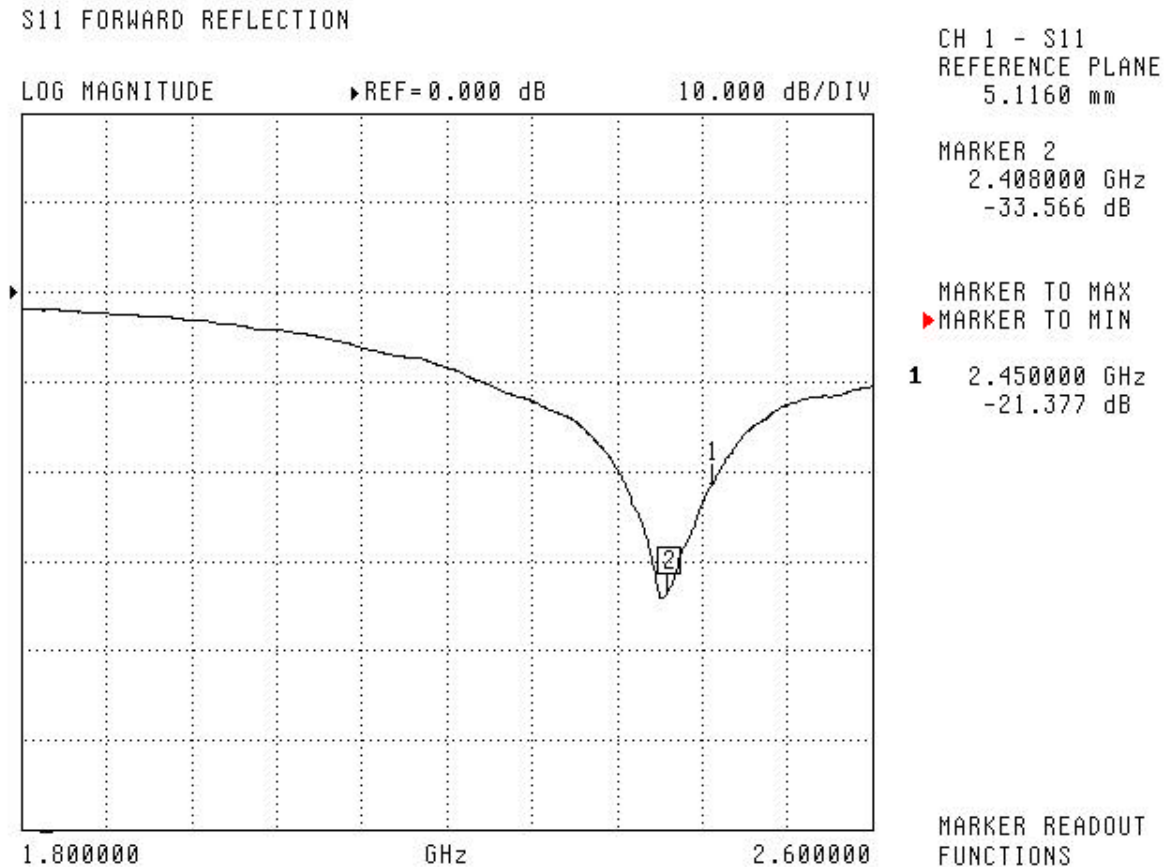
Head Tissue 2450 MHz	Measured
Dielectric constant, $\epsilon_r$	39.2
Conductivity, $\sigma$ [S/m]	1.82
Tissue Conversion Factor,	4.61

## Electrical Calibration

Test	Result	IEEE Value
S11 R/L	-21.4	-21 dB
SWR	1.181U	-
Impedance	46.175 $\Omega$	

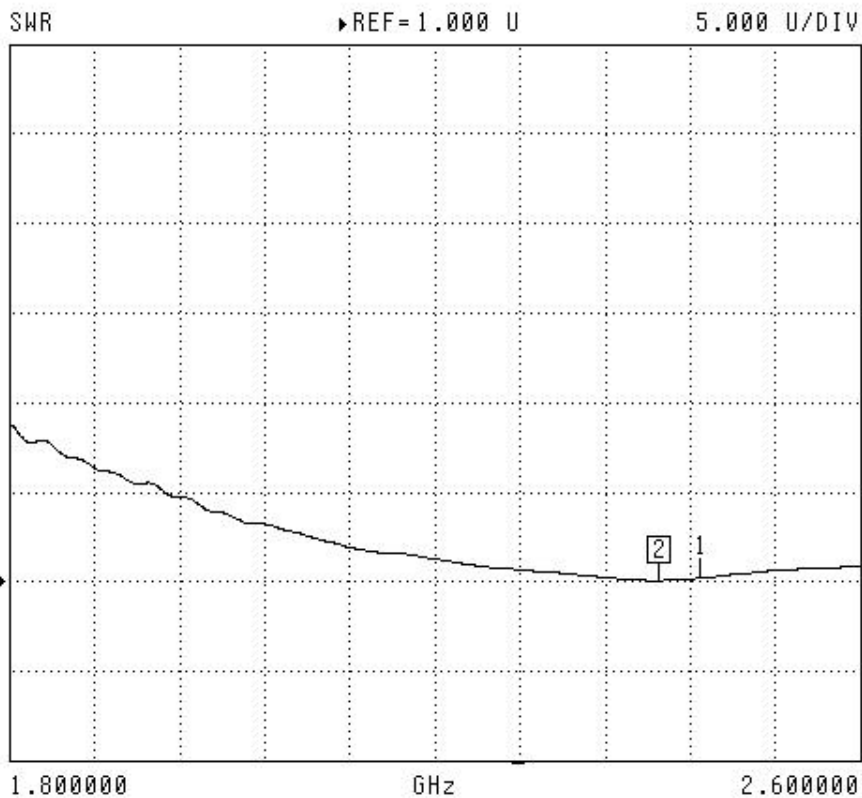
The Following Graphs are the results as displayed on the Vector Network Analyzer.

### S11 Parameter Return Loss



## SWR

S11 FORWARD REFLECTION



CH 1 - S11  
REFERENCE PLANE  
5.1160 mm

MARKER 2  
2.411000 GHz  
1.049 U

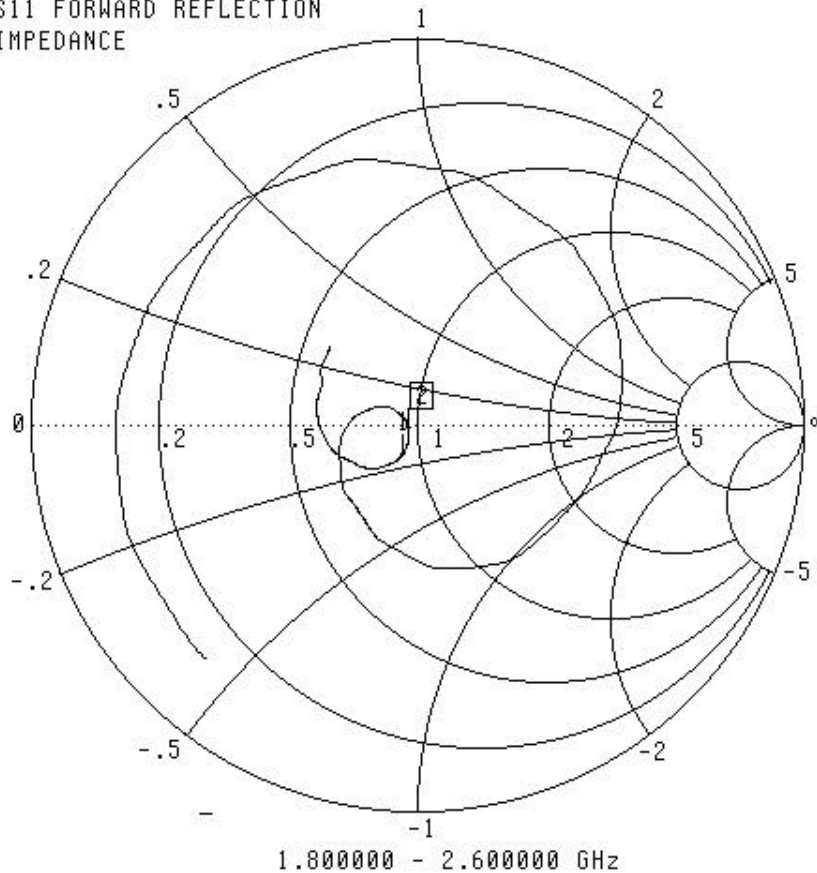
MARKER TO MAX  
▶ MARKER TO MIN

1 2.450000 GHz  
1.181 U

MARKER READOUT  
FUNCTIONS

## Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
REFERENCE PLANE  
5.1160 mm

MARKER 2  
2.411000 GHz  
48.080 Ω  
-1.171 jΩ

MARKER TO MAX  
▶ MARKER TO MIN

**1** 2.450000 GHz  
46.175 Ω  
-7.199 jΩ

MARKER READOUT  
FUNCTIONS

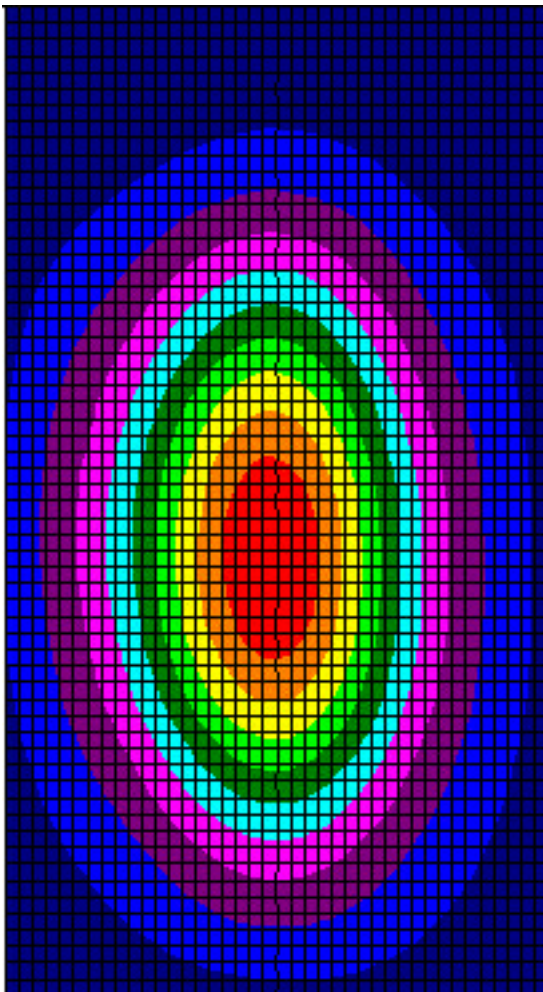




**System Validation Results Using the Electrically Calibrated Dipole**

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	52.45	22.91	102.91

The following Graphic Plot is the splined measurement result for the course scan.





## 11. TEST EQUIPMENT

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2002

