Appendix A
SAR Plots

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SAR Data Report
Start : 31-Dec-2003 11:09:44 AM
End : 31-Dec-2003 11:16:34 AM
Scanning time : 410 secs

Product Data
Device Name : DELL-DELL-P2-WNC
Device Serial No. : PN 5N793
Device Model : DELL-P2-WNC
Device Type : Other
Device Frequency : 2412.00 MHz
Max. Transmit Power : 0.045 W
Drift Time : 60 min(s)
Device Length : 0 mm
Device Width : 0 mm
Device Depth : 0 mm
Device Orientation : Touch
Antenna Type : Internal
Device Power at ERP-Start : 0.04
Device Power At ERP-Finish: 0.04
Device Drift : 0.00

Measurement Data
Phantom Name : APREL-Uni
Phantom Type : Uni-Phantom
Phantom Size : 280 x 280 x 200
Phantom Serial No. : Default
Phantom Location : Center
Phantom Description : test
Tissue Type : Body
Tissue Serial No. : Lab1
Tissue Frequency : 2450.00 MHz
Tissue Calibration Date : 31-Dec-2003
Tissue Dielectric : 50.60 F/m
Tissue Conductivity : 2.03 S/m
Tissue Density : 1000.00 kg/cu. m
Crest Factor : 1.00

Probe Data
Probe Name : APREL Lab Probe
Probe Model : E020
Probe Type : E-Field Triangle
Probe Serial No. : 209
Probe Frequency : 2450.00 MHz
Tissue Type : Body
Calibrated Dielectric : 50.60 F/m
Calibrated Conductivity : 2.03 S/m
Probe Offset : 2.44 mm
Conversion Factor : 4.60
Diode Compression Pt : 98.00 mV
Probe Sensitivity : 0.72 0.72 0.72 μV/(V/sq. m)

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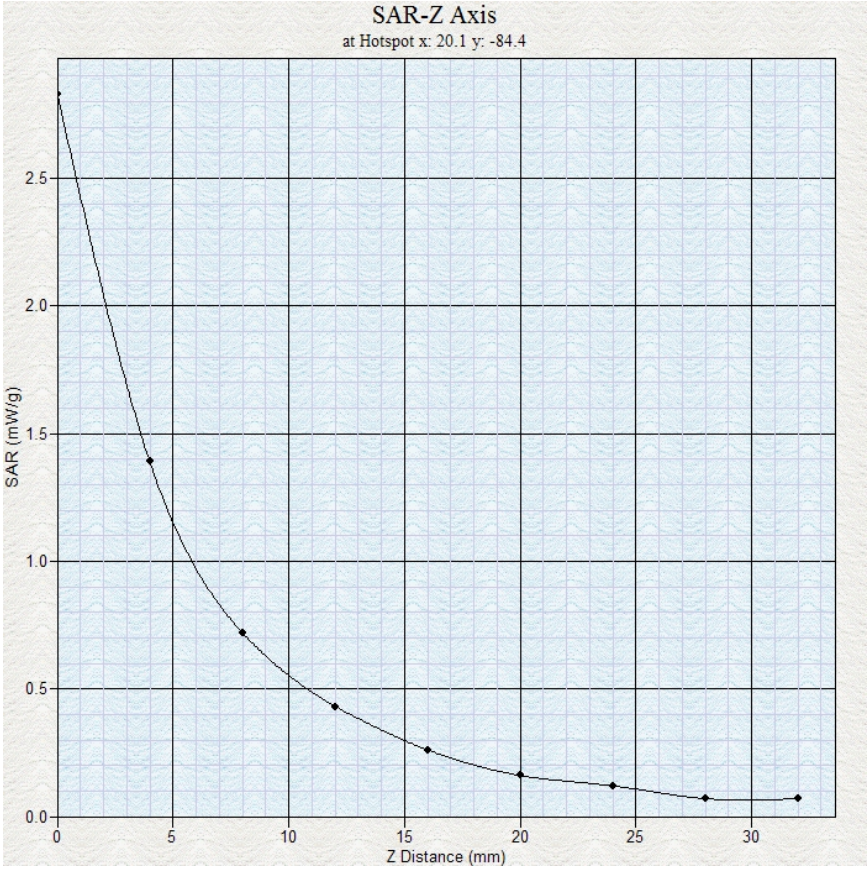
1 gram SAR Value : X = 22.90 Y = -84.30 Z = 3.3 Value = 1.16 W/kg
10 gram SAR Value : X = 22.90 Y = -84.30 Z = 3.3 Value = 0.52 W/kg
Area Scan Peak SAR : 1.21
Zoom Scan Peak SAR : 2.83



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SAR Data Report
Start : 31-Dec-2003 11:20:24 AM
End : 31-Dec-2003 11:27:15 AM
Scanning time : 411 secs

Product Data
Device Name : DELL-DELL-P2-WNC
Device Serial No. : PN 5N793
Device Model : DELL-P2-WNC
Device Type : Other
Device Frequency : 2412.00 MHz
Max. Transmit Power : 0.045 W
Drift Time : 60 min(s)
Device Length : 0 mm
Device Width : 0 mm
Device Depth : 0 mm
Device Orientation : Touch
Antenna Type : Internal
Device Power at ERP-Start : 0.05
Device Power At ERP-Finish: 0.07
Device Drift : 0.02

Measurement Data
Phantom Name : APREL-Uni
Phantom Type : Uni-Phantom
Phantom Size : 280 x 280 x 200
Phantom Serial No. : Default
Phantom Location : Center
Phantom Description : test
Tissue Type : Body
Tissue Serial No. : Lab1
Tissue Frequency : 2450.00 MHz
Tissue Calibration Date : 31-Dec-2003
Tissue Dielectric : 50.60 F/m
Tissue Conductivity : 2.03 S/m
Tissue Density : 1000.00 kg/cu. m
Crest Factor : 1.00

Probe Data
Probe Name : APREL Lab Probe
Probe Model : E020
Probe Type : E-Field Triangle
Probe Serial No. : 209
Probe Frequency : 2450.00 MHz
Tissue Type : Body
Calibrated Dielectric : 50.60 F/m
Calibrated Conductivity : 2.03 S/m
Probe Offset : 2.44 mm
Conversion Factor : 4.60
Diode Compression Pt : 98.00 mV
Probe Sensitivity : 0.72 0.72 0.72 μV/(V/sq. m)

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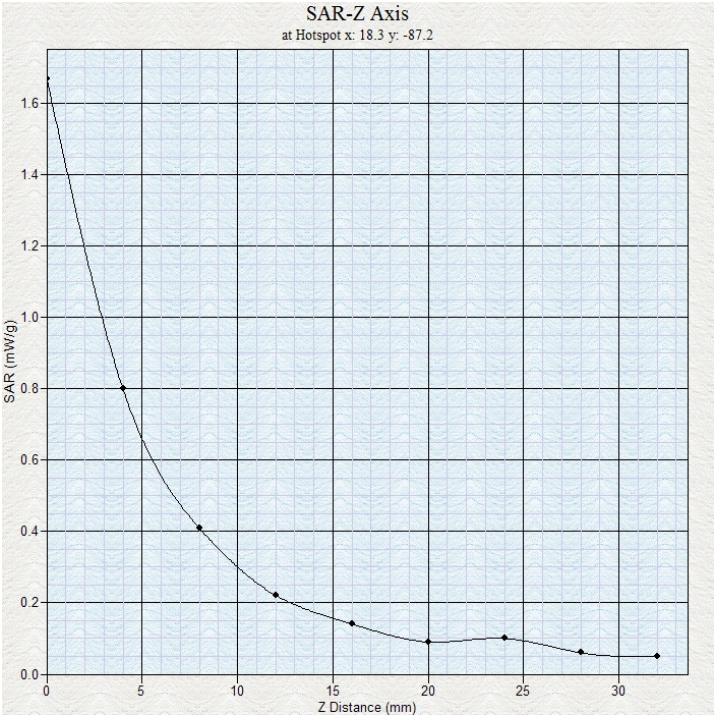
1 gram SAR Value : X = 12.70 Y = -79.50 Z = 2.6 Value = 0.65 W/kg
10 gram SAR Value : X = 12.70 Y = -79.50 Z = 2.6 Value = 0.29 W/kg
Area Scan Peak SAR : 0.73
Zoom Scan Peak SAR : 1.67



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SAR Data Report
Start : 31-Dec-2003 09:34:10 AM
End : 31-Dec-2003 09:41:55 AM
Scanning time : 465 secs

Product Data
Device Name : DELL-DELL-P2-WNC
Device Serial No. : PN 5N793
Device Model : DELL-P2-WNC
Device Type : Other
Device Frequency : 2412.00 MHz
Max. Transmit Power : 0.045 W
Drift Time : 60 min(s)
Device Length : 0 mm
Device Width : 0 mm
Device Depth : 0 mm
Device Orientation : Touch
Antenna Type : Internal
Device Power at ERP-Start : 0.16
Device Power At ERP-Finish: 0.17
Device Drift : 0.01

Measurement Data
Phantom Name : APREL-Uni
Phantom Type : Uni-Phantom
Phantom Size : 280 x 280 x 200
Phantom Serial No. : Default
Phantom Location : Center
Phantom Description : test
Tissue Type : Body
Tissue Serial No. : Lab1
Tissue Frequency : 2450.00 MHz
Tissue Calibration Date : 31-Dec-2003
Tissue Dielectric : 50.60 F/m
Tissue Conductivity : 2.03 S/m
Tissue Density : 1000.00 kg/cu. m
Crest Factor : 1.00

Probe Data
Probe Name : APREL Lab Probe
Probe Model : E020
Probe Type : E-Field Triangle
Probe Serial No. : 209
Probe Frequency : 2450.00 MHz
Tissue Type : Body
Calibrated Dielectric : 50.60 F/m
Calibrated Conductivity : 2.03 S/m
Probe Offset : 2.44 mm
Conversion Factor : 4.60
Diode Compression Pt : 98.00 mV
Probe Sensitivity : 0.72 0.72 0.72 μV/(V/sq. m)

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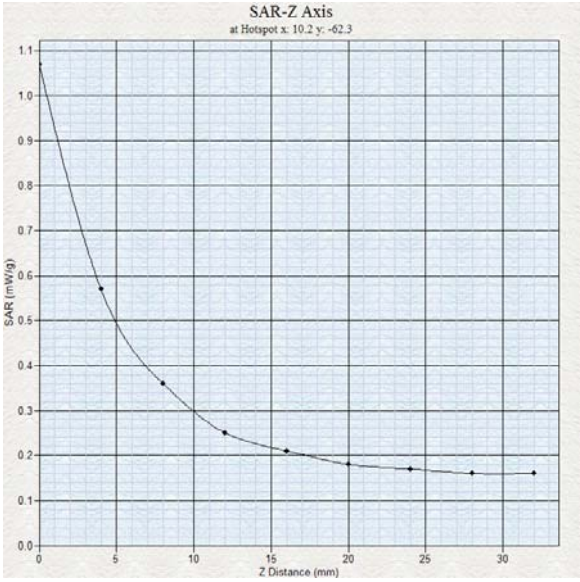
1 gram SAR Value : X = 13.10 Y = -62.20 Z = 2.8 Value = 0.50 W/kg
10 gram SAR Value : X = 13.10 Y = -62.20 Z = 2.8 Value = 0.30 W/kg
Area Scan Peak SAR : 0.73
Zoom Scan Peak SAR : 1.07



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SAR Data Report
Start : 30-Dec-2003 11:28:51 PM
End : 30-Dec-2003 11:36:38 PM
Scanning time : 467 secs

Product Data
Device Name : DELL-P2_WNC
Device Serial No. :
Device Model : DELL-P2-WNC
Device Type : Other
Device Frequency : 2412.00 MHz
Max. Transmit Power : 0.045 W
Drift Time : 60 min(s)
Device Length : 0 mm
Device Width : 0 mm
Device Depth : 0 mm
Device Orientation : Touch
Antenna Type : Internal
Device Power at ERP-Start : 0.20
Device Power At ERP-Finish: 0.18
Device Drift : 0.02

Measurement Data
Phantom Name : APREL-Uni
Phantom Type : Uni-Phantom
Phantom Size : 280 x 280 x 200
Phantom Serial No. : Default
Phantom Location : Center
Phantom Description : test
Tissue Type : Body
Tissue Serial No. : Lab1
Tissue Frequency : 2450.00 MHz
Tissue Calibration Date : 31-Dec-2003
Tissue Dielectric : 50.60 F/m
Tissue Conductivity : 2.03 S/m
Tissue Density : 1000.00 kg/cu. m
Crest Factor : 1.00

Probe Data
Probe Name : APREL Lab Probe
Probe Model : E020
Probe Type : E-Field Triangle
Probe Serial No. : 209
Probe Frequency : 2450.00 MHz
Tissue Type : Body
Calibrated Dielectric : 50.60 F/m
Calibrated Conductivity : 2.03 S/m
Probe Offset : 2.44 mm
Conversion Factor : 4.60
Diode Compression Pt : 98.00 mV
Probe Sensitivity : 0.72 0.72 0.72 μV/(V/sq. m)

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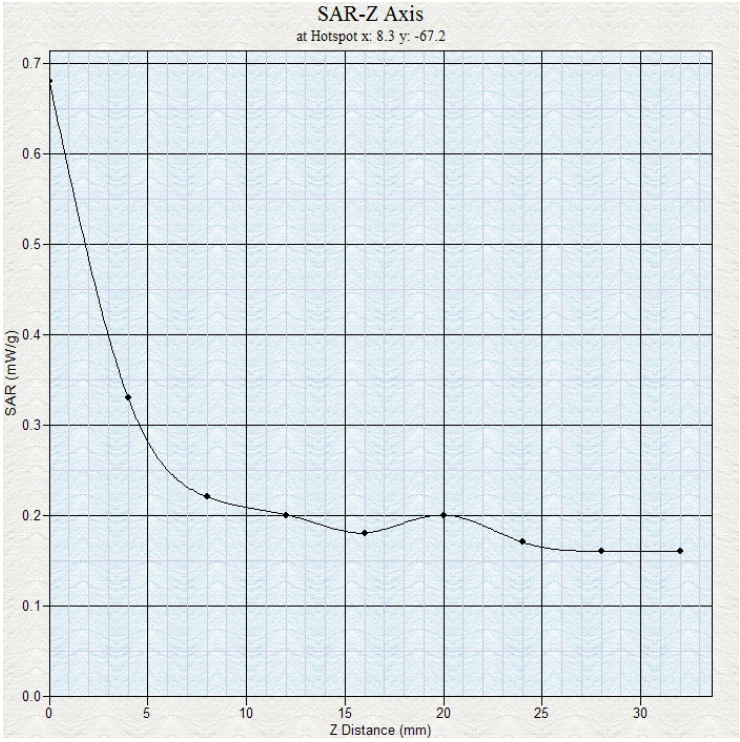
1 gram SAR Value : X = 2.60 Y = -59.60 Z = 2.4 Value = 0.30 W/kg
10 gram SAR Value : X = 2.60 Y = -59.60 Z = 2.4 Value = 0.21 W/kg
Area Scan Peak SAR : 0.28
Zoom Scan Peak SAR : 0.68



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Appendix B
Probe Calibration Certificate

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NCL CALIBRATION LABORATORIES

Calibration File No.: CP-339

Client.: APREL

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 2450 MHz

Manufacturer: APREL Laboratories
Model No.: E-020
Serial No.: 209

BODY Calibration

Calibration Procedure: SSI/DRB-TP-D01-032-E020
Project No: Internal

Calibrated: 3rd November 2003
Released on: 4th November 2003

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: _____

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Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 209.

References

SSI/DRB-TP-D01-032-E020 E-Field Probe Calibration Procedure
IEEE 1528 "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-011 Tissue Calibration Procedure

Conditions

Probe 209 was a new probe taken from stock prior to calibration.

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

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Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	209
Frequency:	2450 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	0.72 $\mu V/(V/m)^2$
Channel Y:	0.72 $\mu V/(V/m)^2$
Channel Z:	0.72 $\mu V/(V/m)^2$

Diode Compression Point:	98 mV

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Sensitivity in Body Tissue

Frequency: 2450 MHz

Epsilon: 50.6 (+/-5%) **Sigma:** 1.98 S/m (+/-10%)

ConvF

Channel X: 4.60

Channel Y: 4.60

Channel Z: 4.60

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq.

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 2.4mm.

Spatial Resolution:

The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

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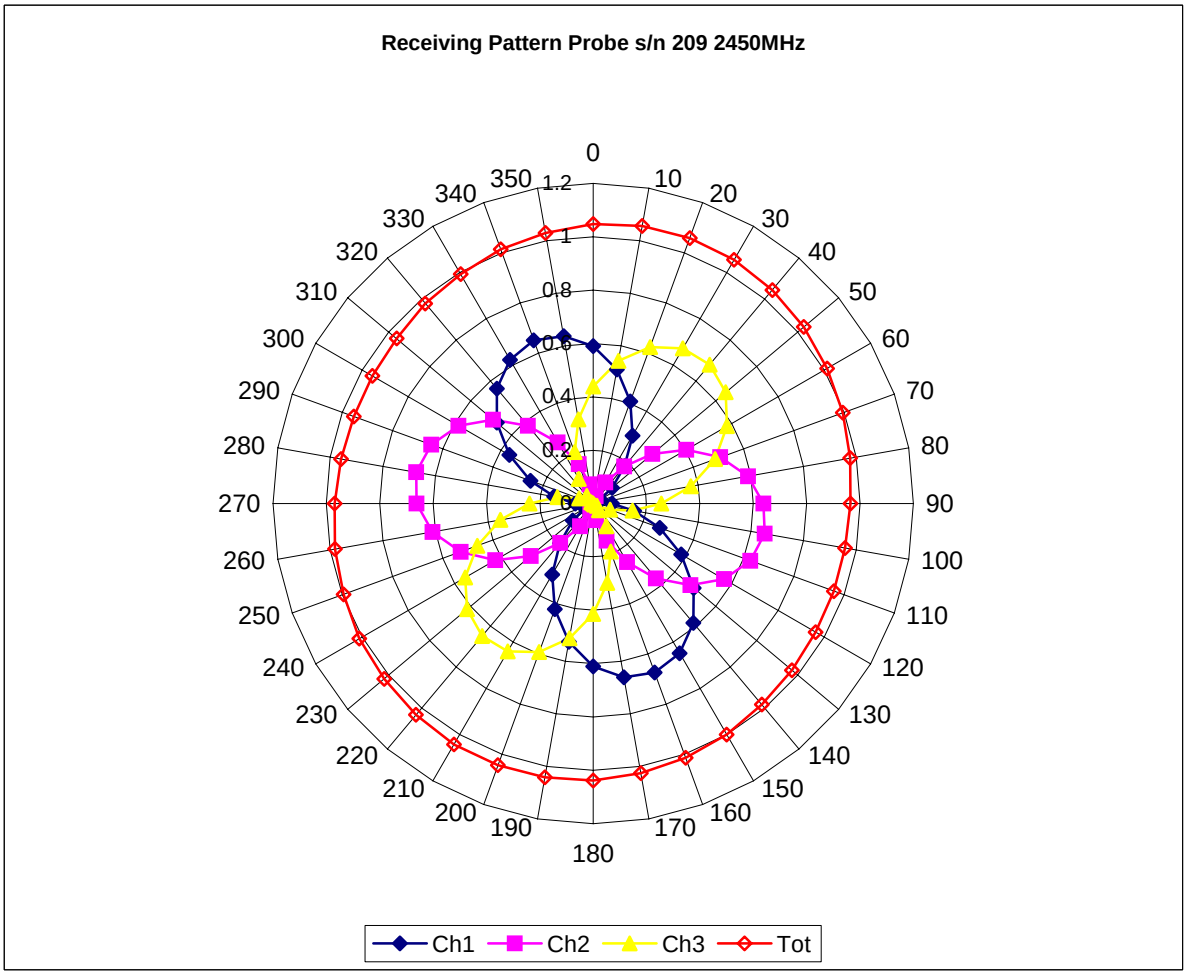
Receiving Pattern 2450 MHz (Air)



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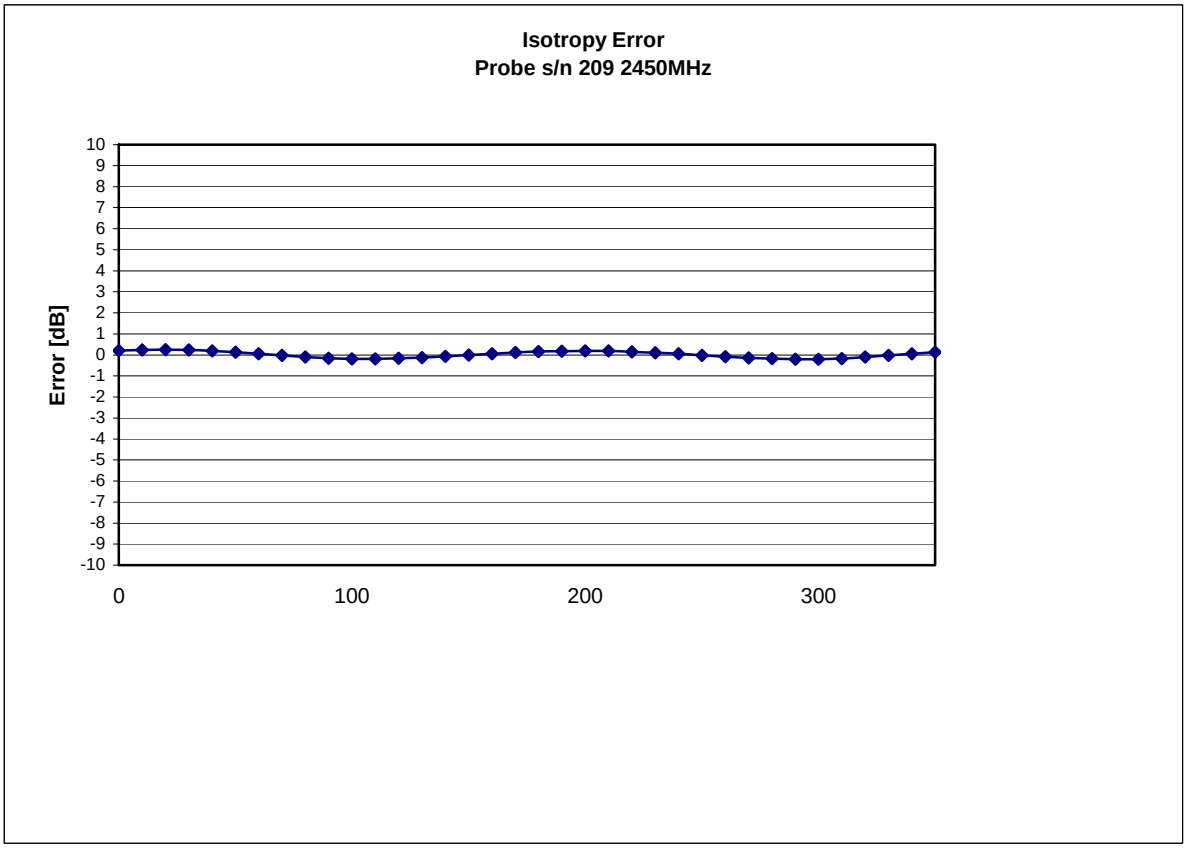
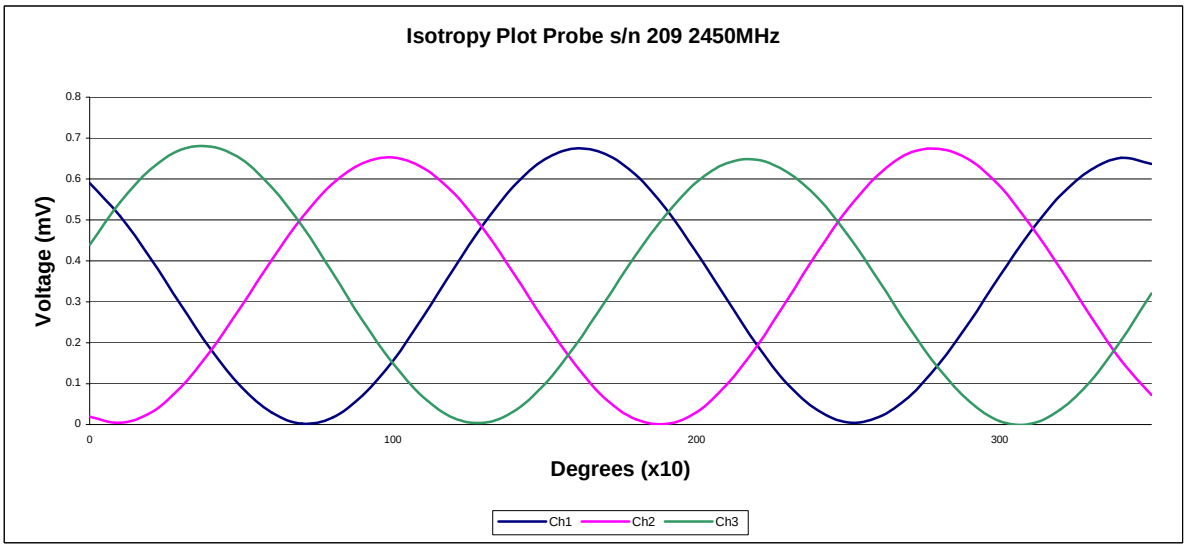
Isotropy Error 2450 MHz (Air)





Isotropicity: 0.10 dB

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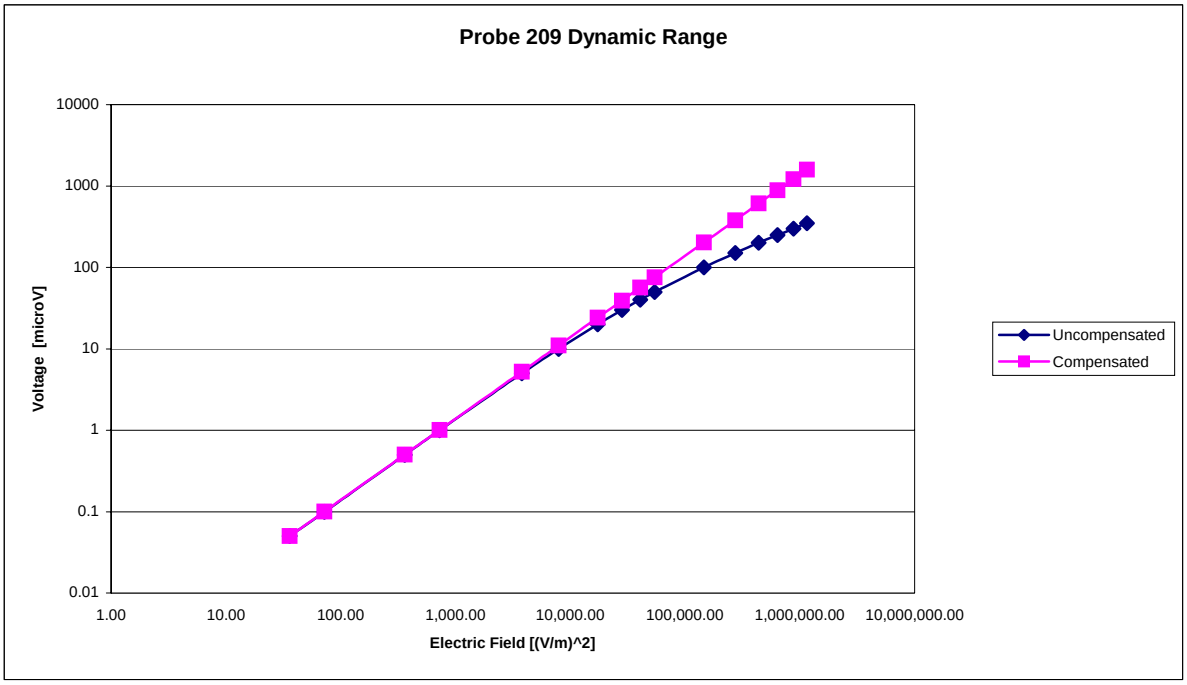
Dynamic Range



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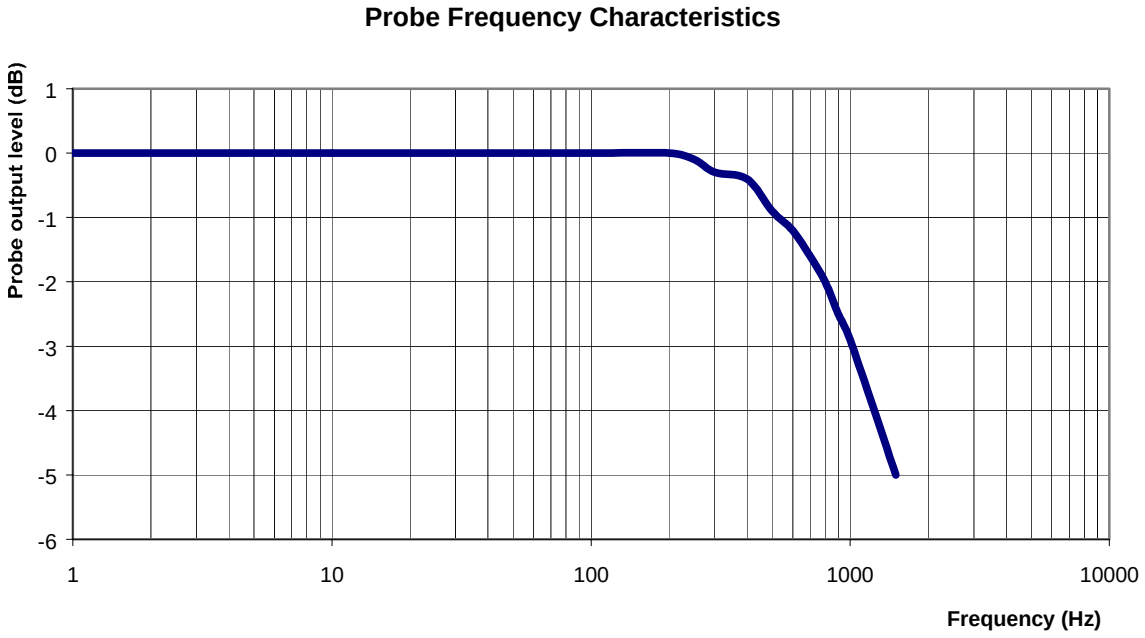
Video Bandwidth



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

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Conversion Factor Uncertainty Assessment

Frequency: 2450MHz

Epsilon: 50.6 (+/-5%) **Sigma:** 1.98 S/m (+/-10%)

ConvF

Channel X: 4.60 7%(K=2)

Channel Y: 4.60 7%(K=2)

Channel Z: 4.60 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 2.4mm 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 and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2003.

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Appendix C
Dipole Calibration Certificate

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NCL CALIBRATION LABORATORIES

Calibration File No: DC-0265
Project Number: Internal

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories
Part number: D-2450-S-1
Frequency: 2.45 GHz
Serial No: ALCD-10

Customer: APREL

Calibrated: 14 November 2003
Released on: 15 November 2003

Released By: _____

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Calibration Results Summary

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

Mechanical Dimensions

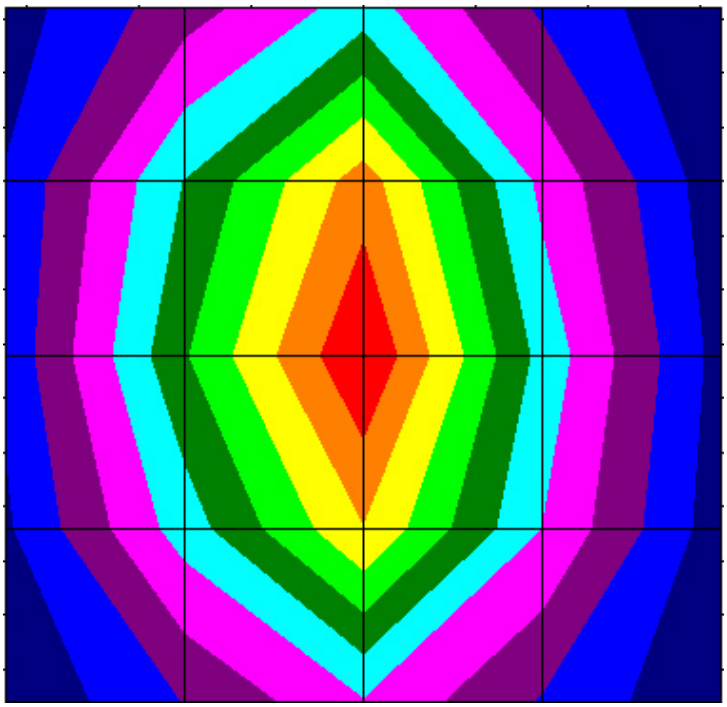
Length: 51.7 mm
Height: 30.8 mm

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



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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.

References

SSI-TP-018 Dipole Calibration Procedure
SSI-TP-016 Tissue Calibration Procedure
IEEE 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

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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, ε_r	39.2
Conductivity, σ [S/m]	1.82
Tissue Conversion Factor,	4.61

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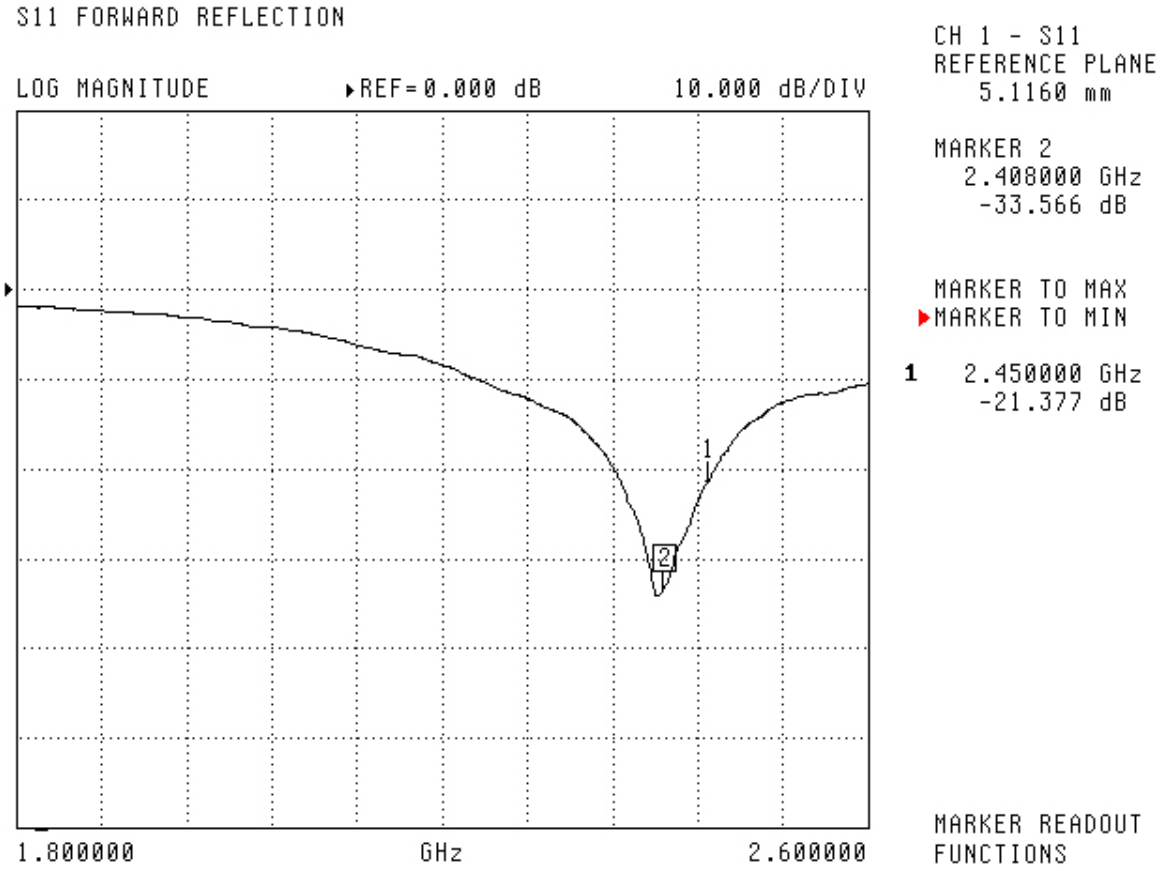
Electrical Calibration

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

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

S11 Parameter Return Loss



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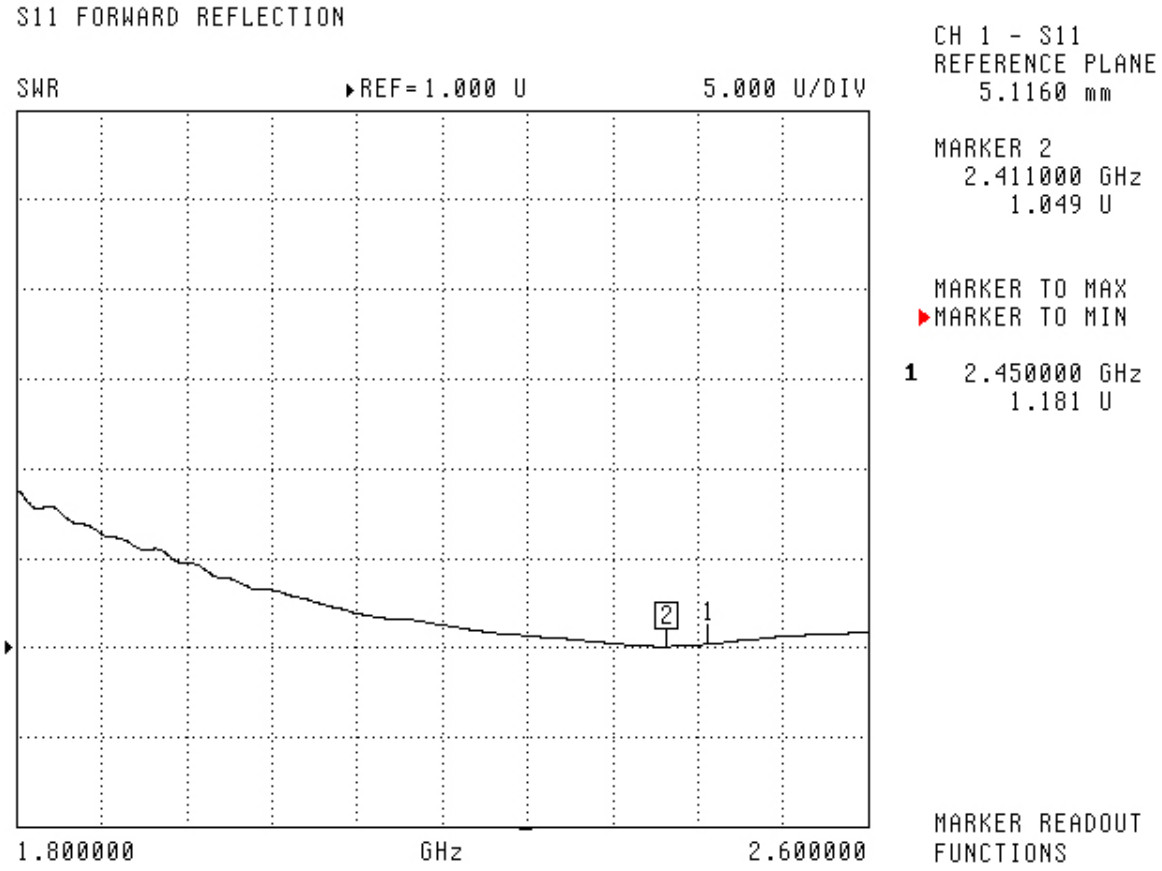
SWR



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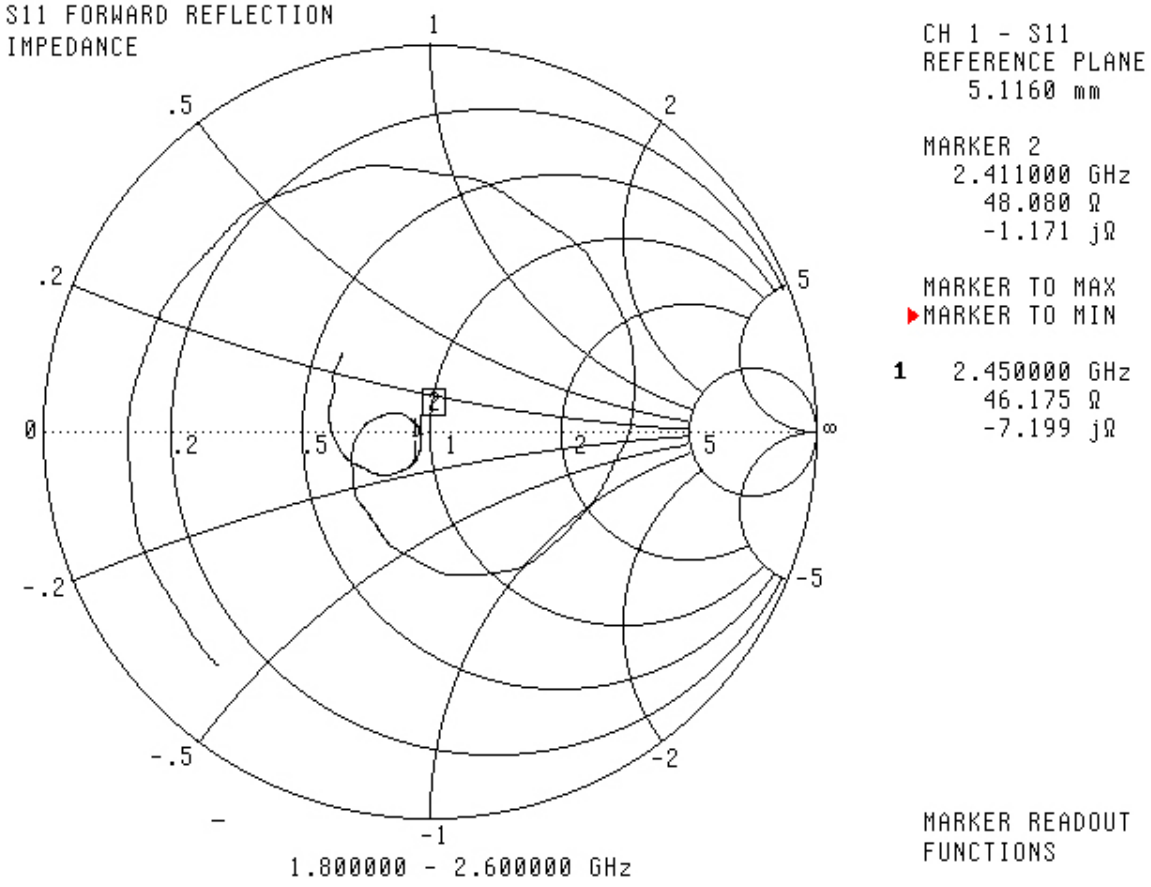
Smith Chart Dipole Impedance



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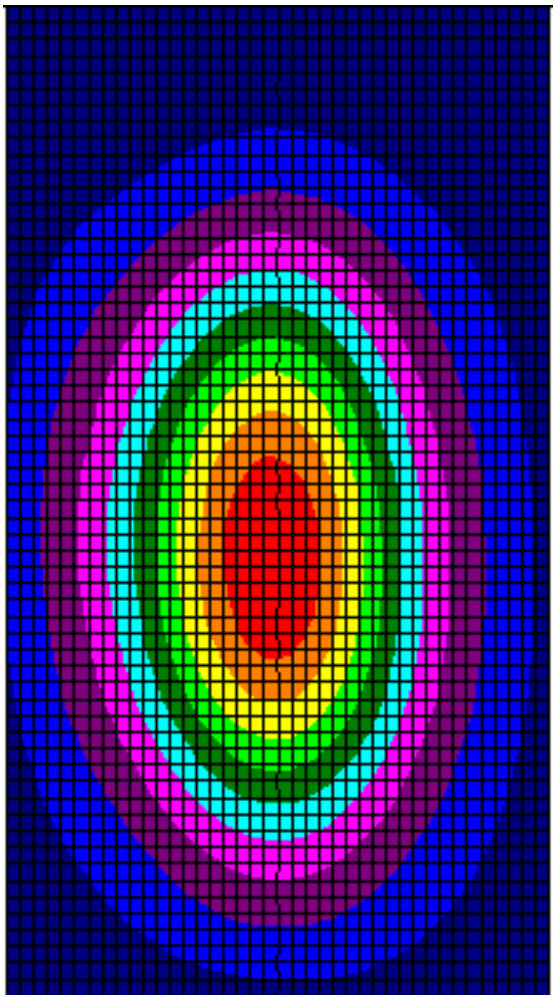
System Validation Results Using the Electrically Calibrated Dipole

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.



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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 2003

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