

Appendix A SAR Plots

Project number: ITLB-Dell-4091
FCC ID: ID:E2K24GBRL

51 Spectrum Way
Nepean, Ontario
Canada K2R 1E6
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Tel: (613) 820-2730
Fax: (613) 820-4161
Info@aprel.com
www.aprel.com

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 $\mu\text{V}/(\text{V}/\text{sq. m})$

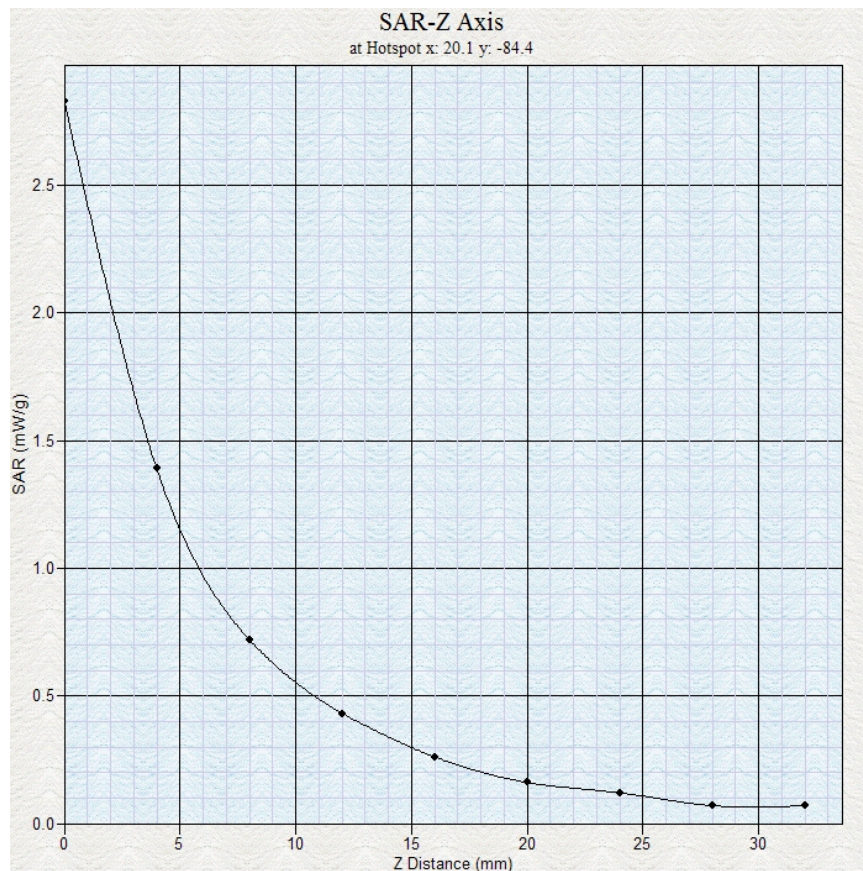
Project number: ITLB-Dell-4091
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1 gram SAR Value : X = 22.90 Y = -84.30 Z = 3.3 Value = 1.16 W/kg
 10 gram SAR Value : X = 22.90 Y = -84.30 Z = 3.3 Value = 0.52 W/kg
 Area Scan Peak SAR : 1.21
 Zoom Scan Peak SAR : 2.83



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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 $\mu\text{V}/(\text{V}/\text{sq. m})$

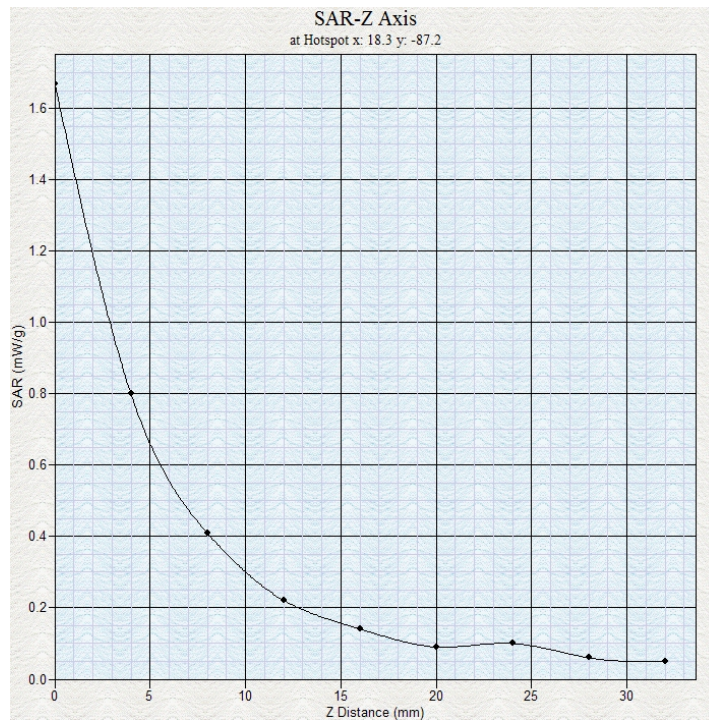
Project number: ITLB-Dell-4091
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1 gram SAR Value : X = 12.70 Y = -79.50 Z = 2.6 Value = 0.65 W/kg
 10 gram SAR Value : X = 12.70 Y = -79.50 Z = 2.6 Value = 0.29 W/kg
 Area Scan Peak SAR : 0.73
 Zoom Scan Peak SAR : 1.67



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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 $\mu\text{V}/(\text{V}/\text{sq. m})$

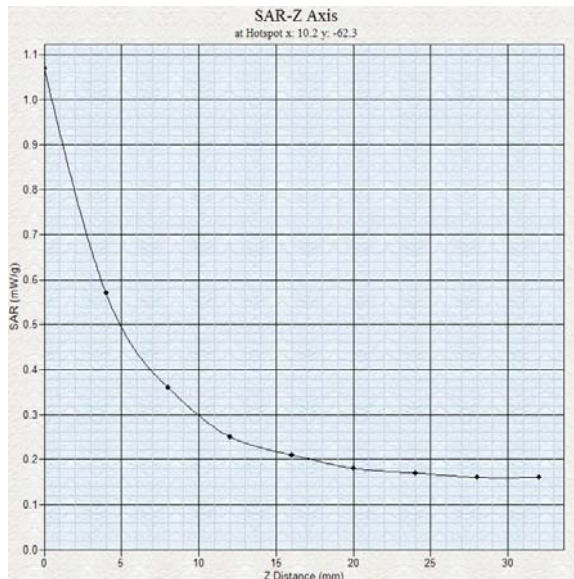
Project number: ITLB-Dell-4091
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1 gram SAR Value : X = 13.10 Y = -62.20 Z = 2.8 Value = 0.50 W/kg
 10 gram SAR Value : X = 13.10 Y = -62.20 Z = 2.8 Value = 0.30 W/kg
 Area Scan Peak SAR : 0.73
 Zoom Scan Peak SAR : 1.07



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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

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Probe Name : APREL Lab Probe
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Probe Offset : 2.44 mm
Conversion Factor : 4.60
Diode Compression Pt : 98.00 mV
Probe Sensitivity : 0.72 0.72 0.72 $\mu\text{V}/(\text{V}/\text{sq. m})$

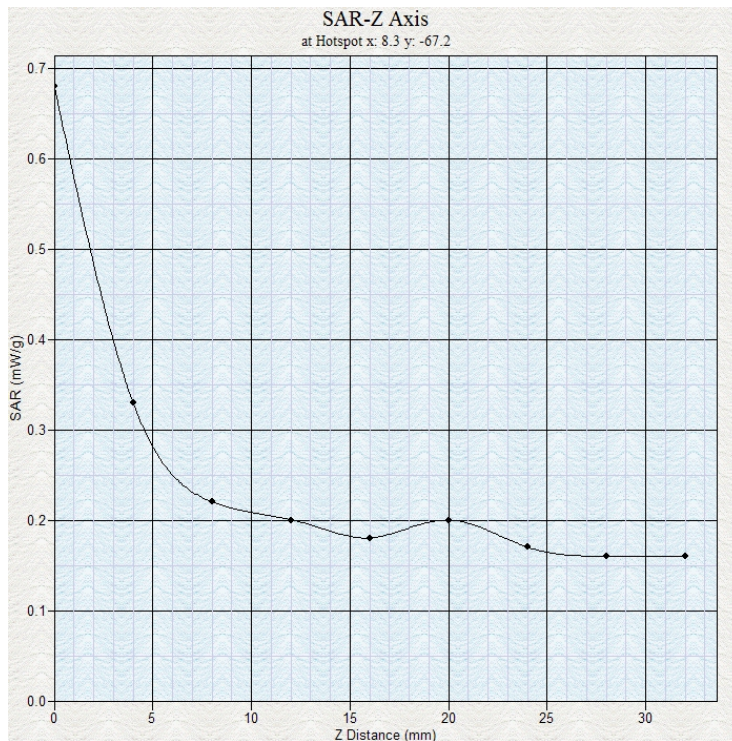
Project number: ITLB-Dell-4091
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1 gram SAR Value : X = 2.60 Y = -59.60 Z = 2.4 Value = 0.30 W/kg
 10 gram SAR Value : X = 2.60 Y = -59.60 Z = 2.4 Value = 0.21 W/kg
 Area Scan Peak SAR : 0.28
 Zoom Scan Peak SAR : 0.68



Project number: ITLB-Dell-4091
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Tel: (613) 820-2730
 Fax: (613) 820-4161
 Info@aprel.com
 www.aprel.com

Appendix B
Probe Calibration Certificate

Project number: ITLB-Dell-4091
FCC ID: ID:E2K24GBRL

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Fax: (613) 820-4161
Info@aprel.com
www.aprel.com

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: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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



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



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 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Y: 0.72 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Z: 0.72 $\mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point: 98 mV



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:

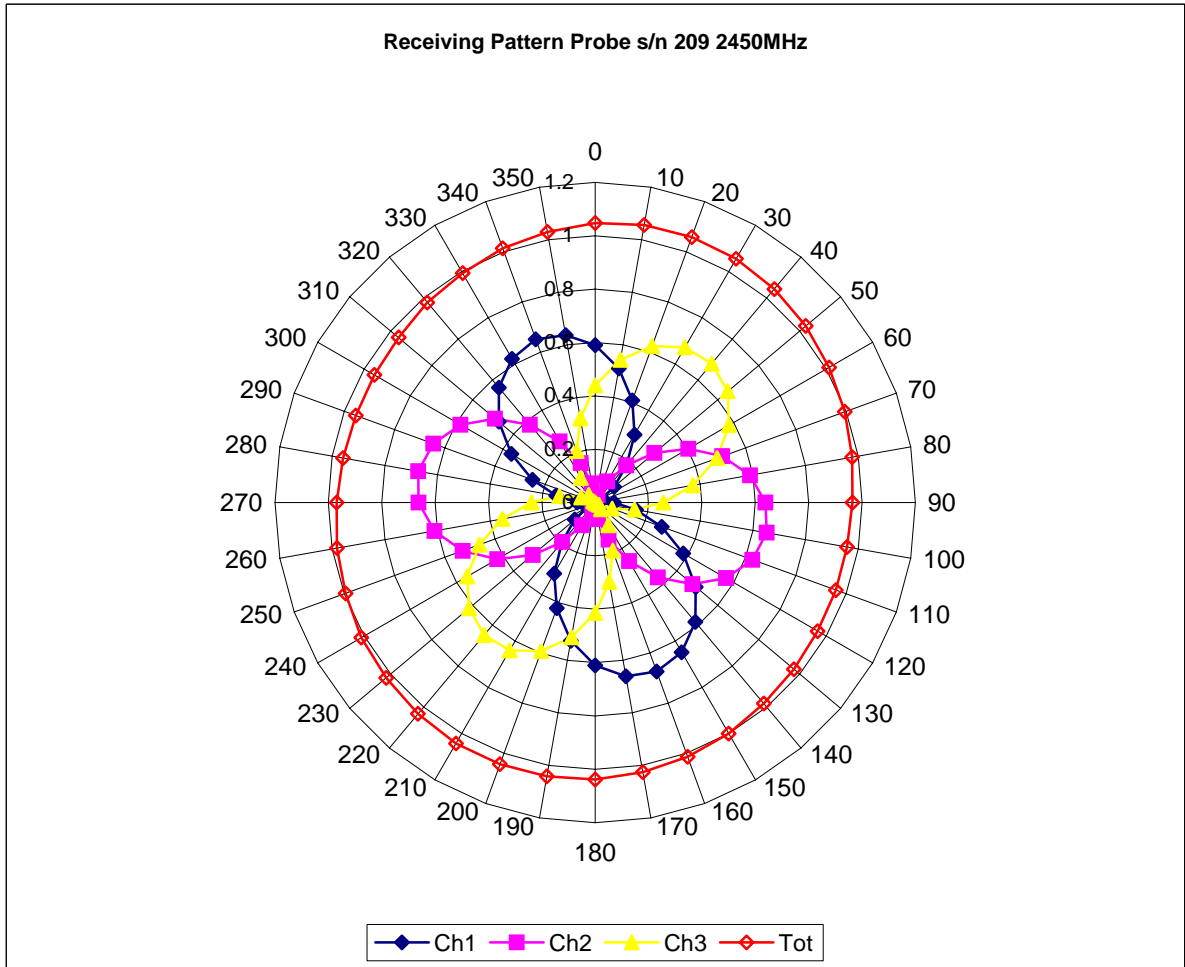
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.4mm.

Spatial Resolution:

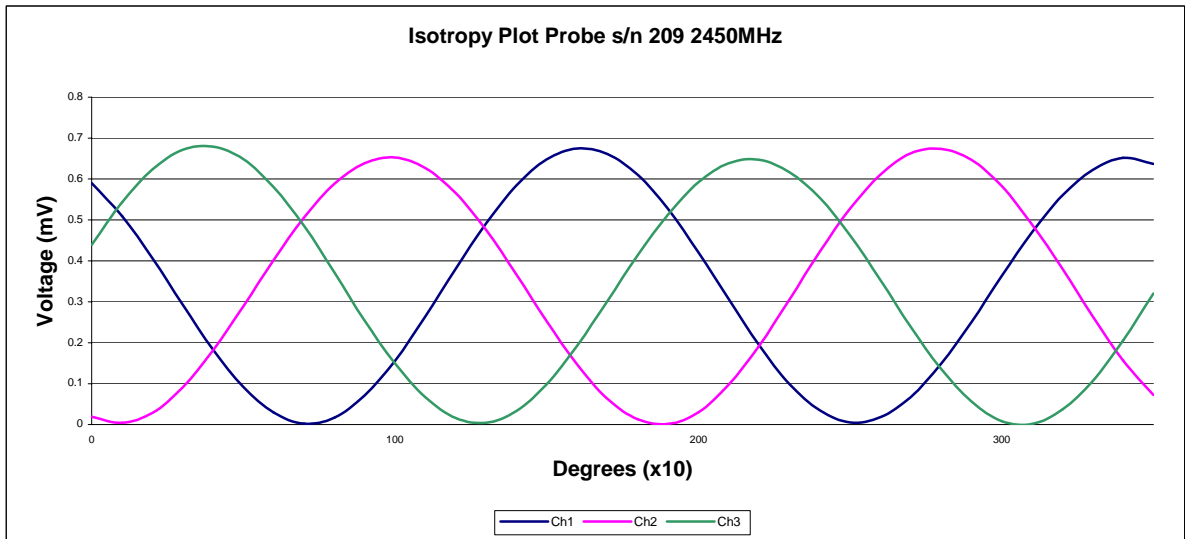
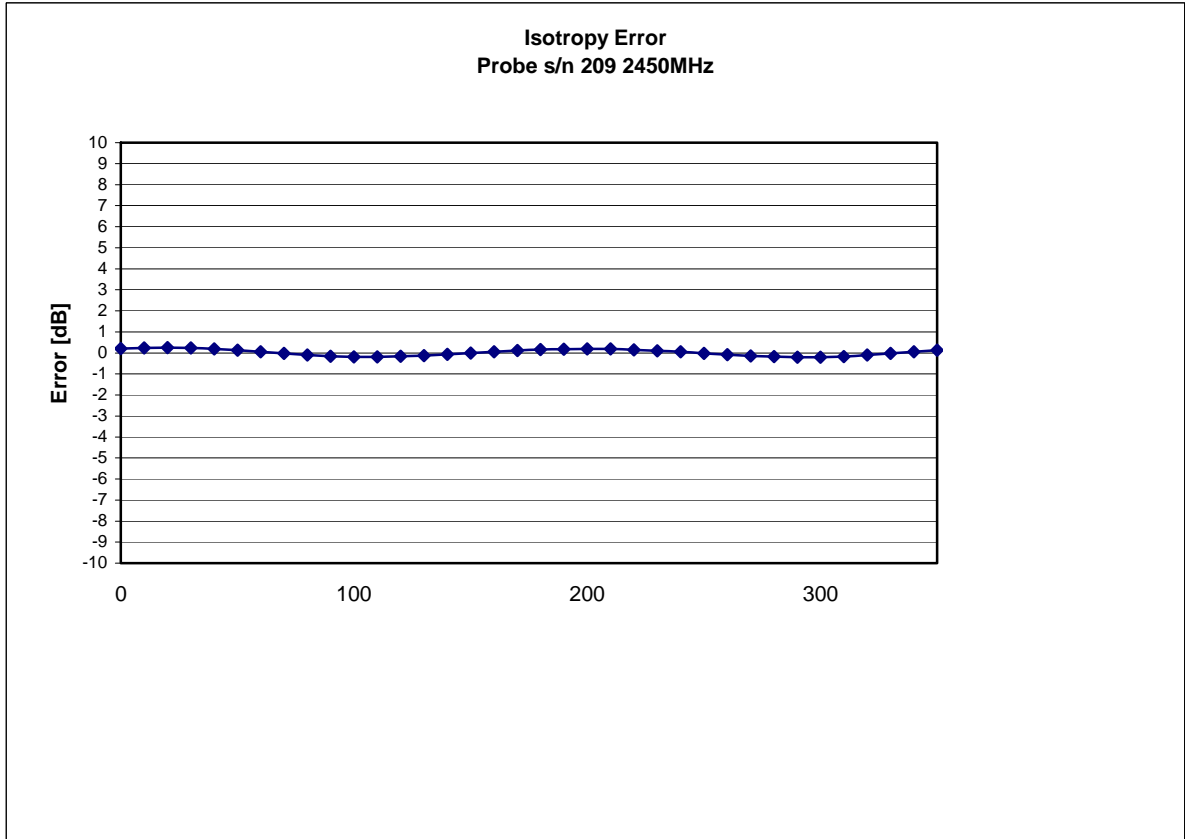
The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.



Receiving Pattern 2450 MHz (Air)



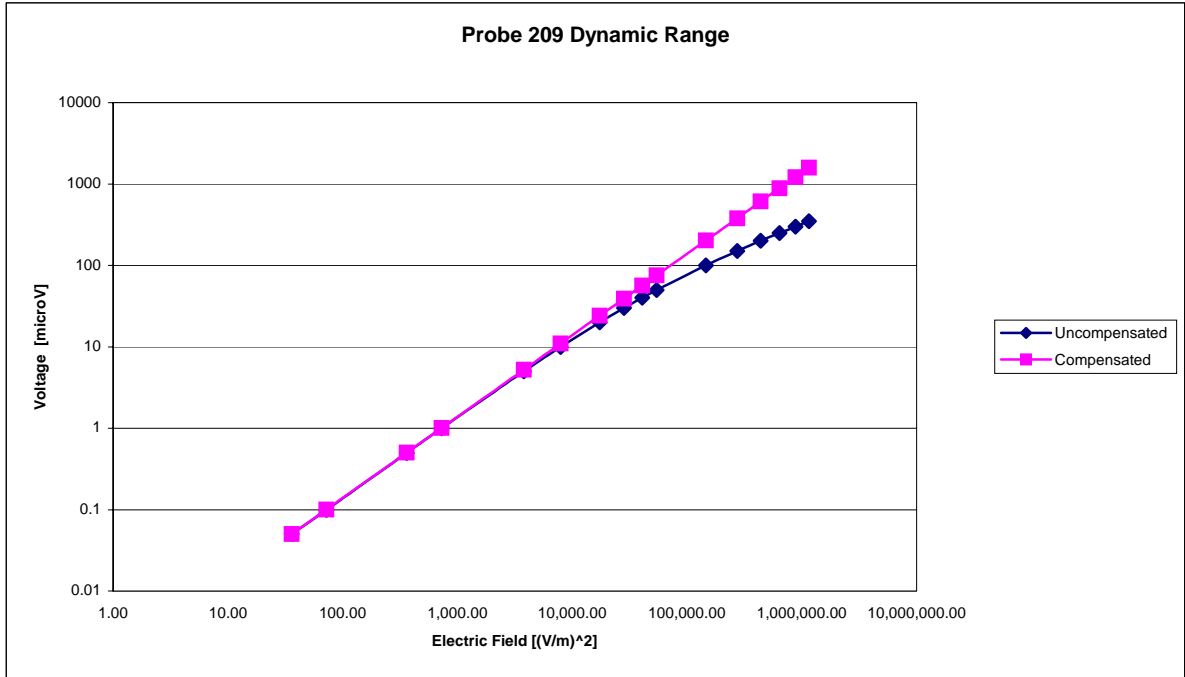
Isotropy Error 2450 MHz (Air)



Isotropicity: 0.10 dB

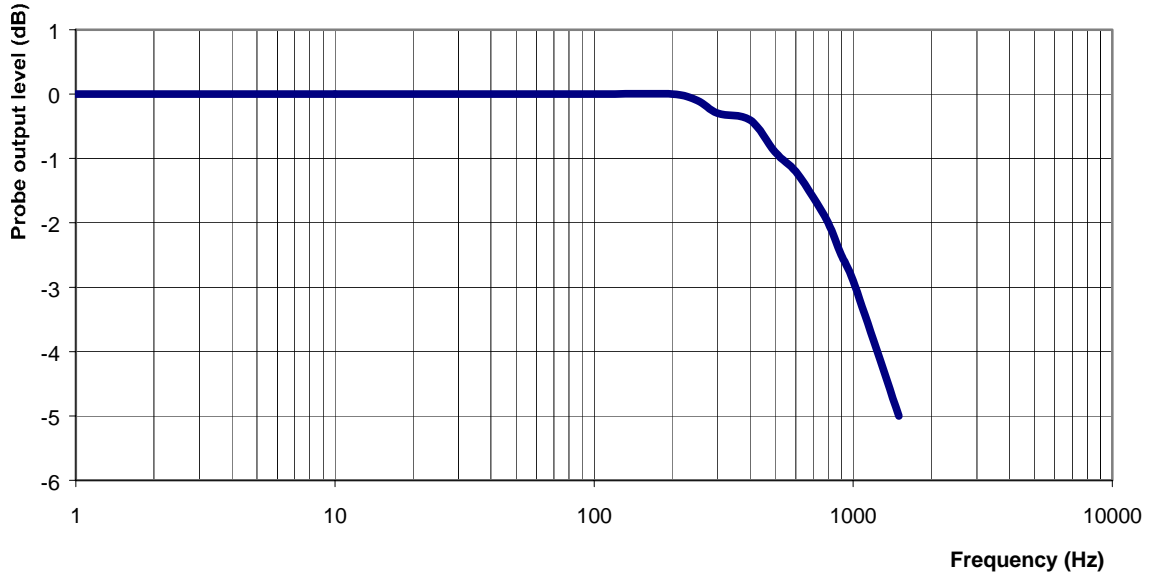


Dynamic Range



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: 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%.



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.



Appendix C
Dipole Calibration Certificate

Project number: ITLB-Dell-4091
FCC ID: ID:E2K24GBRL

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Nepean, Ontario
Canada K2R 1E6
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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: 14 November 2003
Released on: 15 November 2003

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

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



Calibration Results Summary

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

Mechanical Dimensions

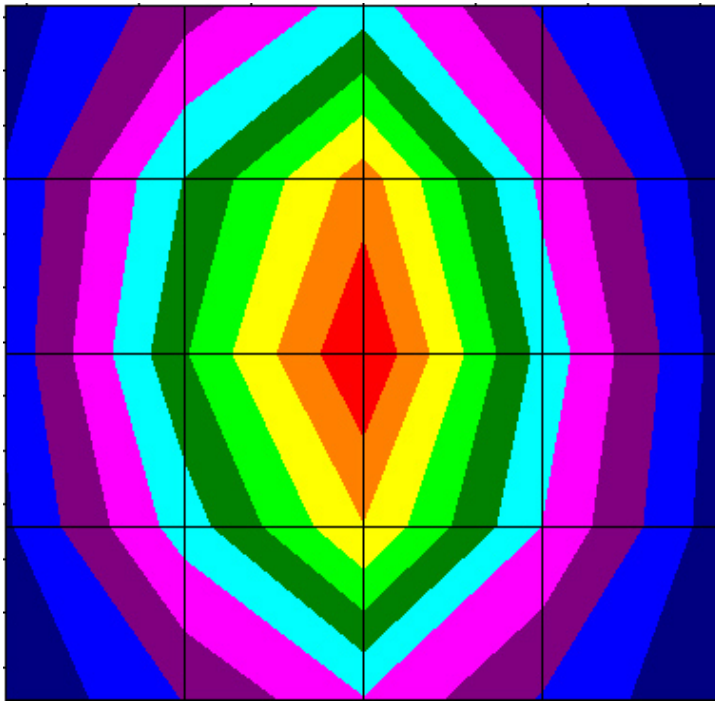
Length: 51.7 mm
Height: 30.8 mm

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



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



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



Electrical Calibration

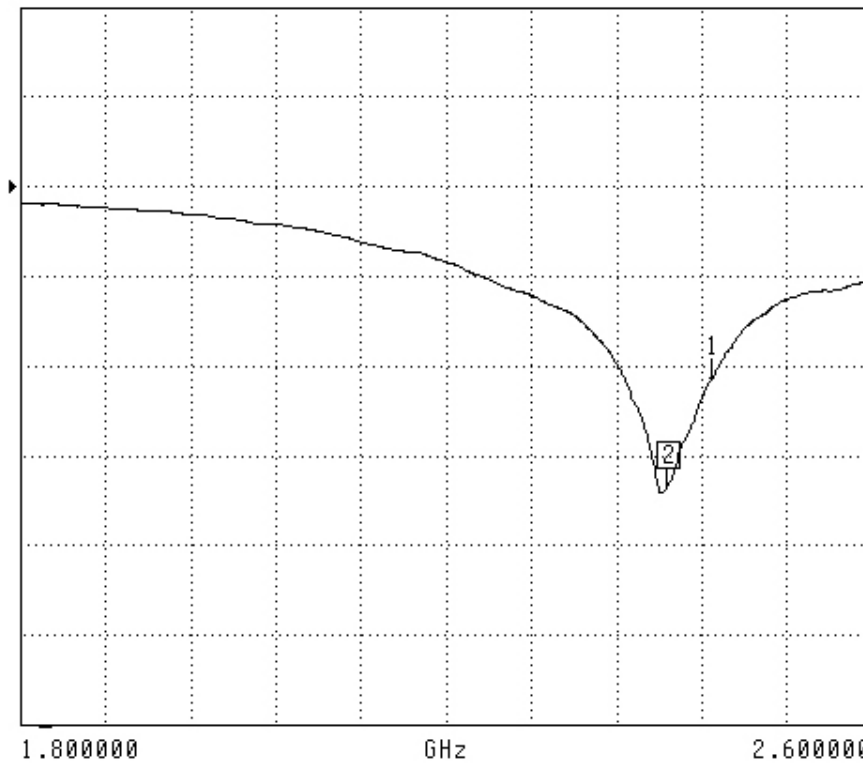
Test	Result	IEEE Value
S11 R/L	-21.4	-21 dB
SWR	1.181U	-
Impedance	46.175 Ω	

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

S11 Parameter Return Loss

S11 FORWARD REFLECTION

LOG MAGNITUDE REF=0.000 dB 10.000 dB/DIV



CH 1 - S11
REFERENCE PLANE
5.1160 mm

MARKER 2
2.408000 GHz
-33.566 dB

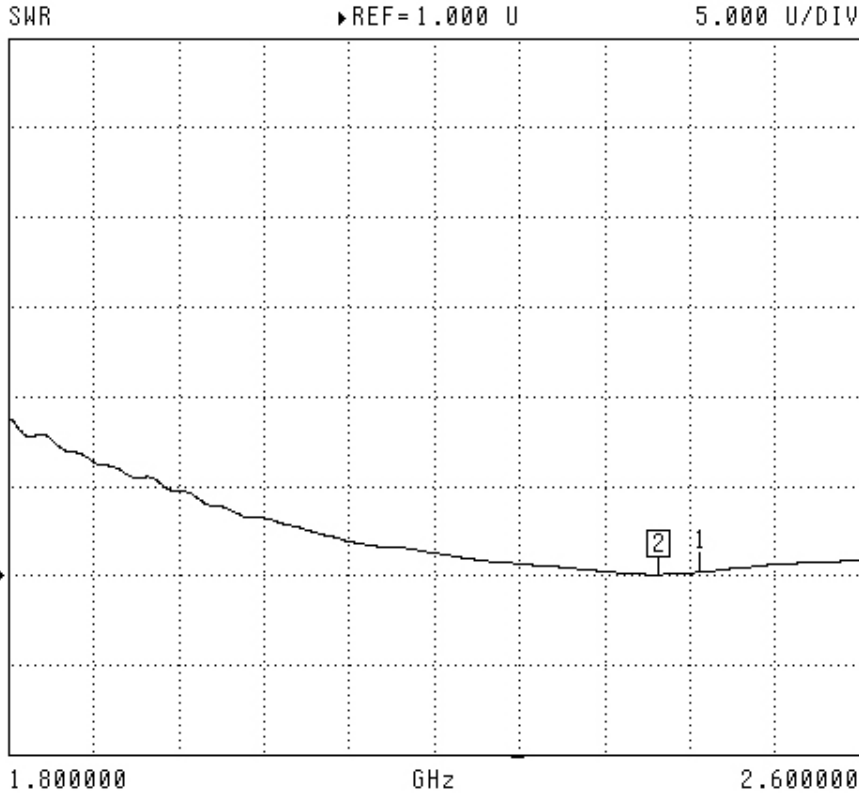
MARKER TO MAX
▶ MARKER TO MIN
1 2.450000 GHz
-21.377 dB

MARKER READOUT
FUNCTIONS



SWR

S11 FORWARD REFLECTION



CH 1 - S11
REFERENCE PLANE
5.1160 mm

MARKER 2
2.411000 GHz
1.049 U

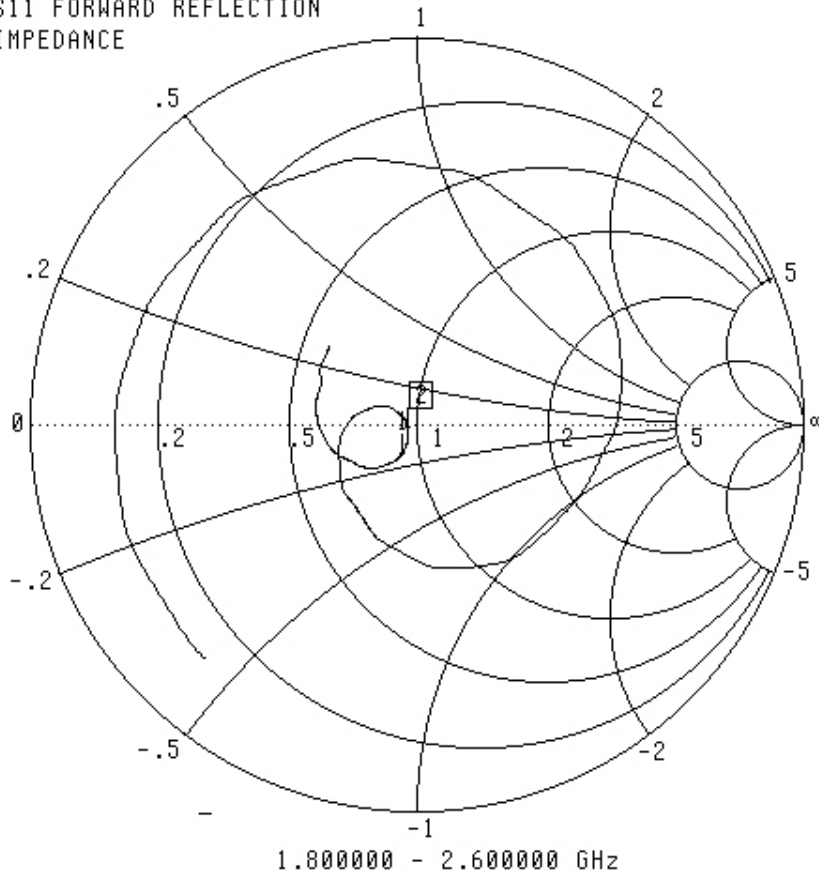
MARKER TO MAX
▶ MARKER TO MIN
1 2.450000 GHz
1.181 U

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

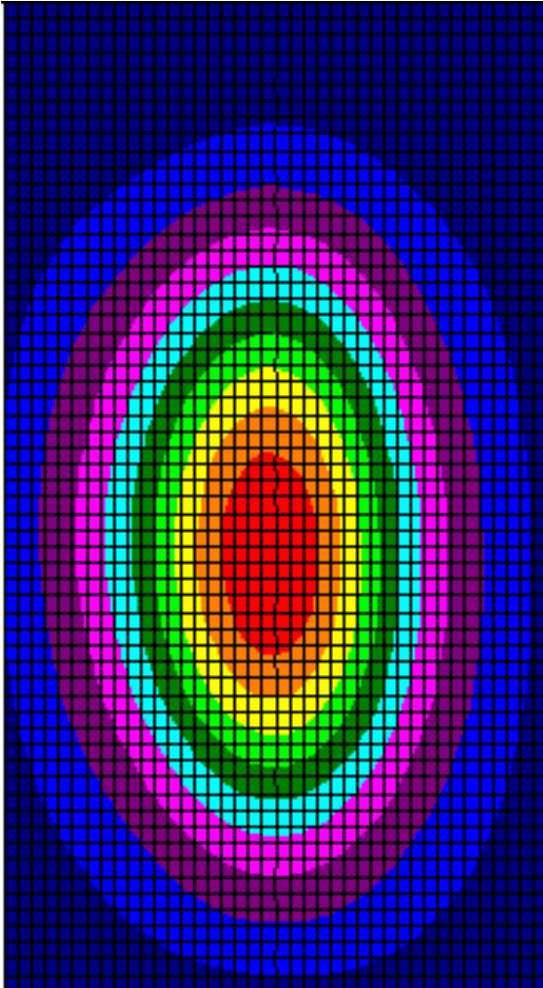
MARKER READOUT
FUNCTIONS



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.



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

