Appendix A

TEST GRAPHIC PLOTS

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

GRAPH 1

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

Date	Dielectric Constant ε_r	Conductivity σ [S/m]	Probe Con/F	Tissue Temp (ºC)	10g SAR (W/kg)	Power Drift
23/05/03	50.4	2.03	6.6	22	1.21	0

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

SAR DATA REPORT

START : 23-MAY-03 10:31:49 PM
END : 23-MAY-03 10:37:27 PM
CODE VERSION : 4.12
ROBOT VERSION: 4.08

PRODUCT DATA:
TYPE : ASUS M3000N NOTEBOOK
FREQUENCY : 2412 MHZ
ANTENNA TYPE : END FED
ANTENNA POSN. : INTERNAL

MEASUREMENT DATA:
PHANTOM NAME : ONKEYBOARD
PHANTOM TYPE : UNIPHANTOM
TISSUE TYPE : MUSCLE
TISSUE DIELECTRIC : 50.400
TISSUE CONDUCTIVITY : 2.030
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 : 50.400
CALIBRATED CONDUCTIVITY : 2.030
PROBE OFFSET : 2.500 MM
CONVERSION FACTOR : 6.600
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) : -5.03 3.39 -0.64

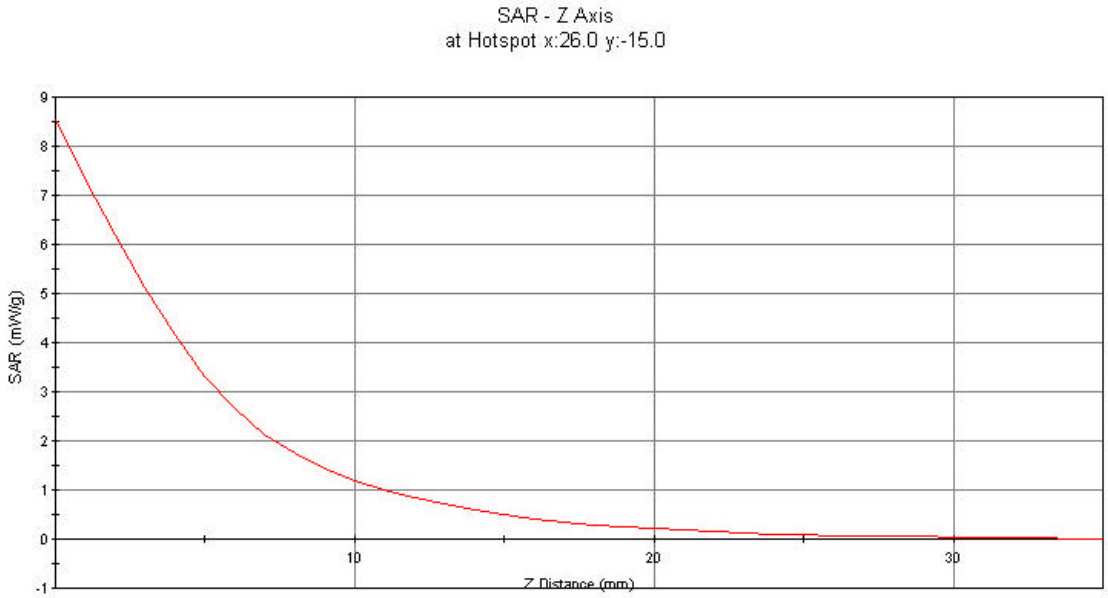
SAMPLE:
RATE: 6000 SAMPLES/SEC
COUNT: 1000 SAMPLES
NIDAQ GAIN: 5
SCAN TIME: 166.7 MSEC

COMMENTS:
KEYBOARD SIDE, OPEN, 0MM

AREA SCAN - MAX LOCAL SAR VALUE AT X=27.0 Y=-16.0 = 3.00 W/KG
ZOOM SCAN - MAX LOCAL SAR VALUE AT X=26.0 Y=-15.0 Z=0.0 = 8.55 W/KG
MAX 1G SAR AT X=27.0 Y=-14.0 Z=0.0 = 3.68 W/KG
MAX 10G SAR AT X=27.0 Y=-14.0 Z=0.0 = 1.21 W/KG

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Z AXIS SCAN DIRECT CONTACT SAR 10G KEYBOARD UP



51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

GRAPH 2

Body SAR (1g)
Keyboard Closed
Distance 0 mm
High Channel
Frequency: 2462 MHz
Duty Cycle 1

Date	Dielectric Constant ε_r	Conductivity σ [S/m]	Probe Con/F	Tissue Temp (ºC)	1g SAR (W/kg)	Power Drift
23/05/03	50.4	2.03	6.6	22	0.11	0

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

SAR DATA REPORT

START : 23-MAY-03 12:42:20 AM
END : 23-MAY-03 12:48:15 AM
CODE VERSION : 4.12
ROBOT VERSION: 4.08

PRODUCT DATA:
TYPE : ASUS M3000N NOTEBOOK
FREQUENCY : 2462 MHZ
TRANSMIT PWR : 0.1 W
ANTENNA TYPE : END FED
ANTENNA POSN. : INTERNAL

MEASUREMENT DATA:
PHANTOM NAME : APREL-UNI
PHANTOM TYPE : UNIPHANTOM
TISSUE TYPE : MUSCLE
TISSUE DIELECTRIC : 50.400
TISSUE CONDUCTIVITY : 2.030
TISSUE DENSITY : 1.000
CREST FACTOR : 1.000
ROBOT NAME : CRS

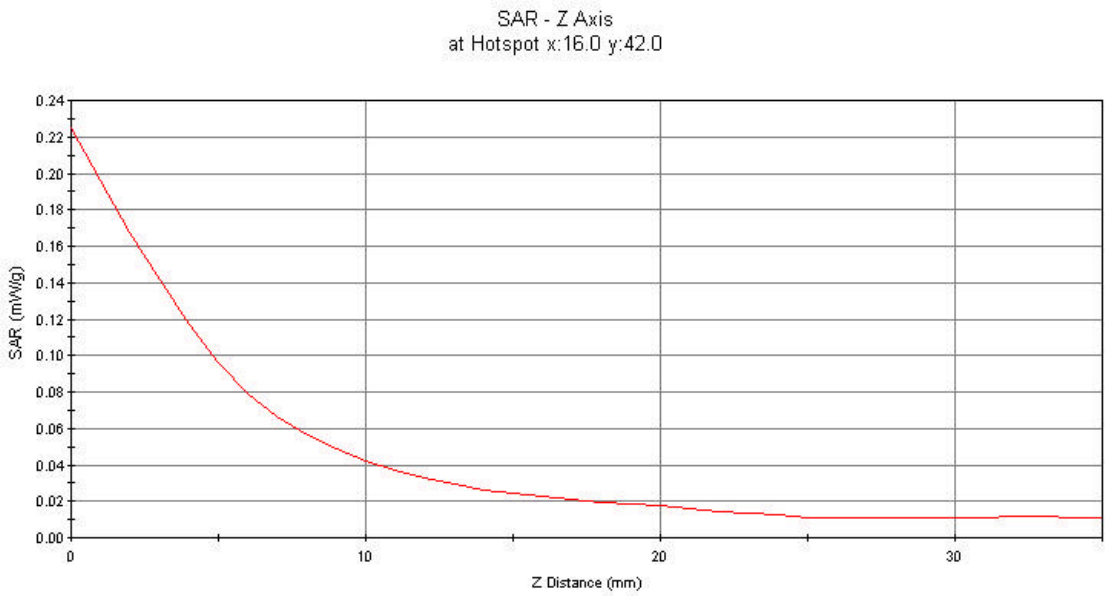
PROBE DATA:
PROBE NAME : 163
PROBE TYPE : E FLD TRIANGLE
FREQUENCY : 2450 MHZ
TISSUE TYPE : MUSCLE
CALIBRATED DIELECTRIC : 50.400
CALIBRATED CONDUCTIVITY : 2.030
PROBE OFFSET : 2.500 MM
CONVERSION FACTOR : 6.600
DIODE COMPRESSION PT : 76.0 MV
PROBE SENSITIVITY : 0.580 0.580 0.580 MV/(MW/CM^2)
AMPLIFIER GAINS : 20.00 20.00 20.00
CHAN. OFFSET (MV) : -6.56 3.29 -0.86

SAMPLE:
RATE: 6000 SAMPLES/SEC
COUNT: 1000 SAMPLES
NIDAQ GAIN: 5
SCAN TIME: 166.7 MSEC

COMMENTS:
FRONT SIDE, CLOSED, 0MM
AREA SCAN - MAX LOCAL SAR VALUE AT X=15.0 Y=43.0 = 0.08 W/KG
ZOOM SCAN - MAX LOCAL SAR VALUE AT X=16.0 Y=42.0 Z=0.0 = 0.23 W/KG
MAX 1G SAR AT X=16.0 Y=43.0 Z=0.0 = 0.11 W/KG
MAX 10G SAR AT X=17.0 Y=45.0 Z=0.0 = 0.05 W/KG

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

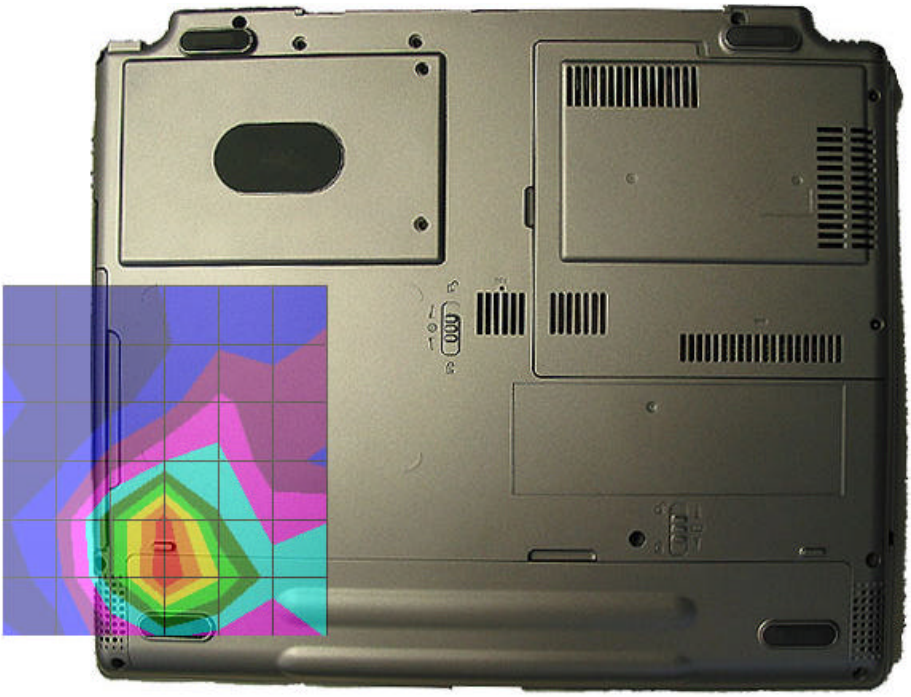
Z AXIS SCAN



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

GRAPH 3

Body SAR (1g)
Keyboard Down
Distance 0 mm
High Channel
Frequency: 2462 MHz
Duty Cycle 1



Date	Dielectric Constant ε_r	Conductivity σ [S/m]	Probe Con/F	Tissue Temp (ºC)	1g SAR (W/kg)	Power Drift
23/05/03	50.4	2.03	6.6	22	0.06	0

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

SAR DATA REPORT

START : 23-MAY-03 02:54:44 AM
END : 23-MAY-03 03:10:30 AM
CODE VERSION : 4.12
ROBOT VERSION: 4.08

PRODUCT DATA:
TYPE : ASUS M3000N NOTEBOOK
FREQUENCY : 2462 MHZ
TRANSMIT PWR : 0.1 W
ANTENNA TYPE : END FED
ANTENNA POSN. : INTERNAL

MEASUREMENT DATA:
PHANTOM NAME : APREL-UNI
PHANTOM TYPE : UNIPHANTOM
TISSUE TYPE : MUSCLE
TISSUE DIELECTRIC : 50.400
TISSUE CONDUCTIVITY : 2.030
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 : 50.400
CALIBRATED CONDUCTIVITY : 2.030
PROBE OFFSET : 2.500 MM
CONVERSION FACTOR : 6.600
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) : -6.56 3.29 -0.86

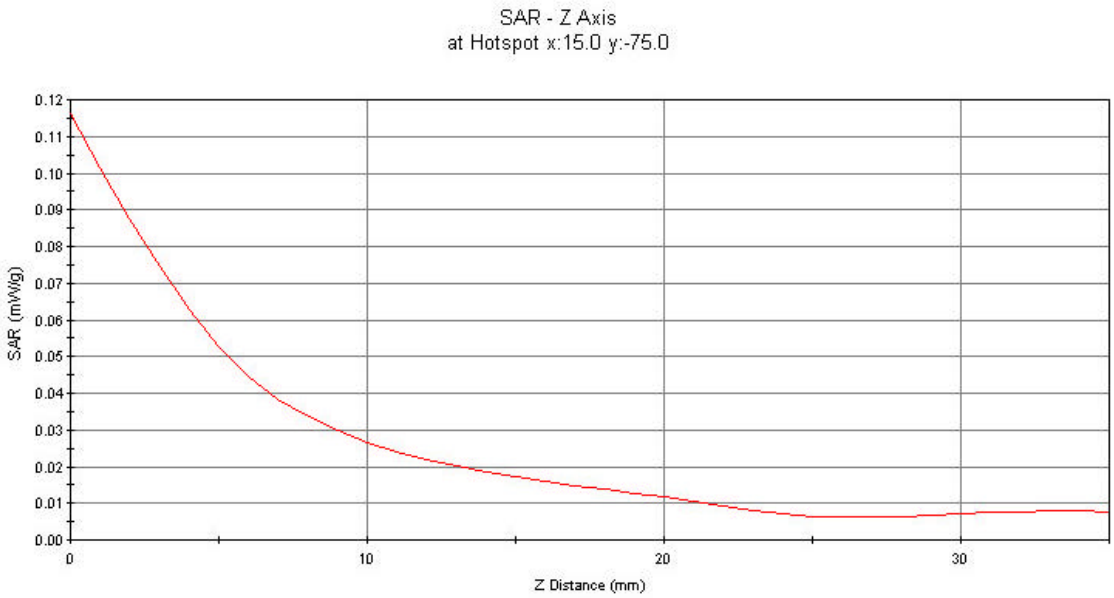
SAMPLE:
RATE: 6000 SAMPLES/SEC
COUNT: 1000 SAMPLES
NIDAQ GAIN: 5
SCAN TIME: 166.7 MSEC

COMMENTS:
BACK SIDE, CLOSED, 0MM

AREA SCAN - MAX LOCAL SAR VALUE AT X=12.0 Y=-76.0 = 0.05 W/KG
ZOOM SCAN - MAX LOCAL SAR VALUE AT X=15.0 Y=-75.0 Z=0.0 = 0.12 W/KG
MAX 1G SAR AT X=14.0 Y=-75.0 Z=0.0 = 0.06 W/KG
MAX 10G SAR AT X=14.0 Y=-75.0 Z=0.0 = 0.03 W/KG

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Z AXIS SCAN



51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

GRAPH 4

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

Date	Dielectric Constant ε_r	Conductivity σ [S/m]	Probe Con/F	Tissue Temp (ºC)	10g SAR (W/kg)	Power Drift
23/05/03	50.4	2.03	6.6	22	0.08	0

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

GRAPH 5

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

Date	Dielectric Constant ε_r	Conductivity σ [S/m]	Probe Con/F	Tissue Temp (ºC)	1g SAR (W/kg)	Power Drift
23/05/03	50.4	2.03	6.6	22	0.17	0

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

SAR Data Report

Start : 23-May-03 12:53:51 am
End : 23-May-03 12:59:27 am
Code Version : 4.12
Robot Version: 4.08

Product Data:
Type : Asus M3000N notebook
Frequency : 2437 MHz
Antenna Type : End Fed
Antenna Posn. : Internal

Measurement Data:
Phantom Name : Laptop_edge
Phantom Type : Uniphantom
Tissue Type : Muscle
Tissue Dielectric : 50.400
Tissue Conductivity : 2.030
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 : 50.400
Calibrated Conductivity : 2.030
Probe Offset : 2.500 mm
Conversion Factor : 6.600
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) : -5.03 3.39 -0.64

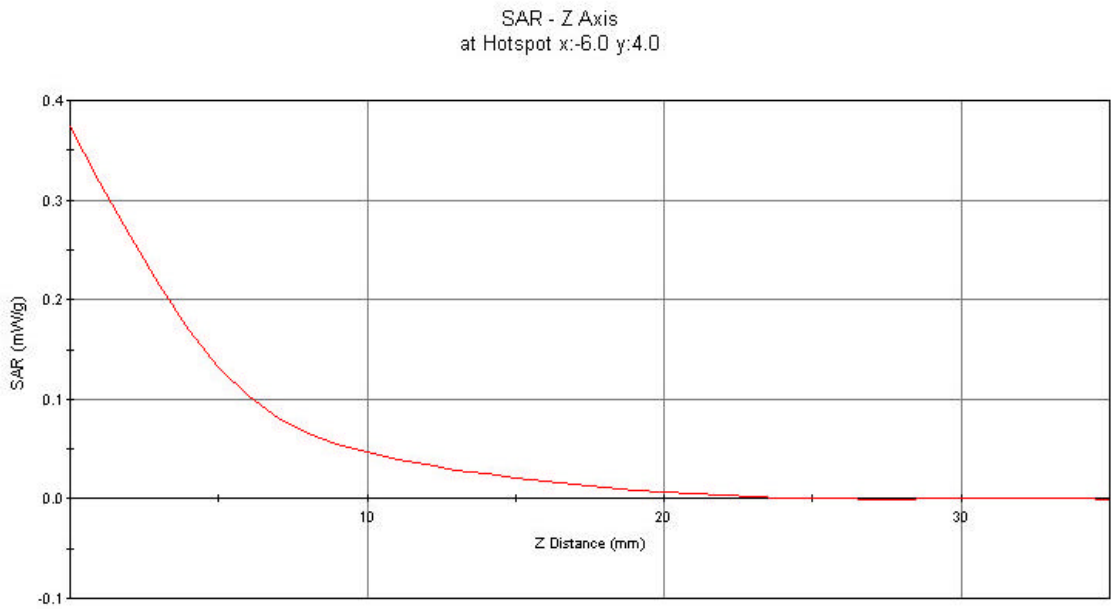
Sample:
Rate: 6000 Samples/Sec
Count: 1000 Samples
NIDAQ Gain: 5
Scan Time: 166.7 msec

Comments:
Keyboard side, Open, 0mm

Area Scan - Max Local SAR Value at x=-12.0 y=7.0 = 0.16 W/kg
Zoom Scan - Max Local SAR Value at x=-6.0 y=4.0 z=0.0 = 0.37 W/kg
Max 1g SAR at x=-10.0 y=4.0 z=0.0 = 0.17 W/kg
Max 10g SAR at x=-12.0 y=5.0 z=0.0 = 0.08 W/kg

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Z Axis Scan



51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com

Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

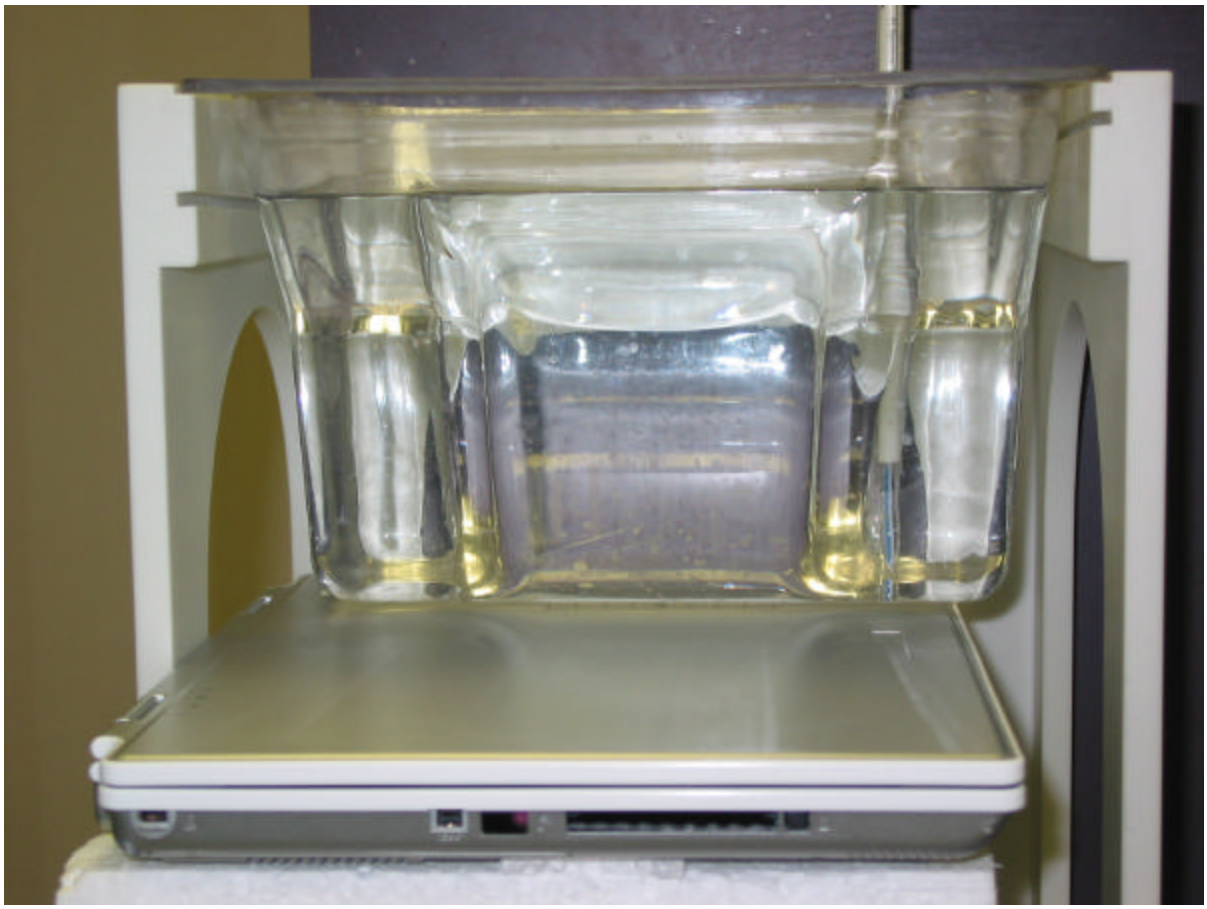
APPENDIX B

SETUP PICTURES

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

PICTURE 1

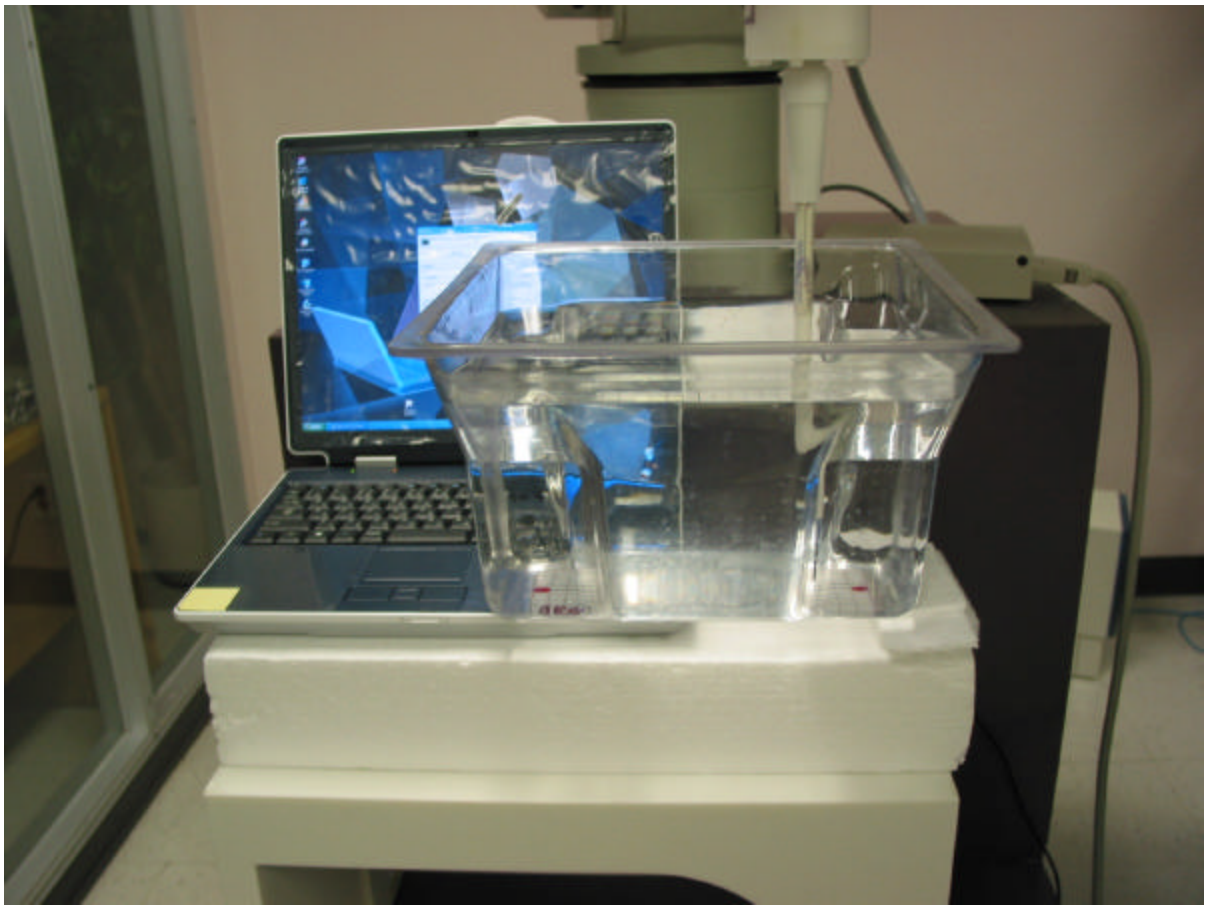
LCD Closed



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

PICTURE 2

Keyboard Up



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

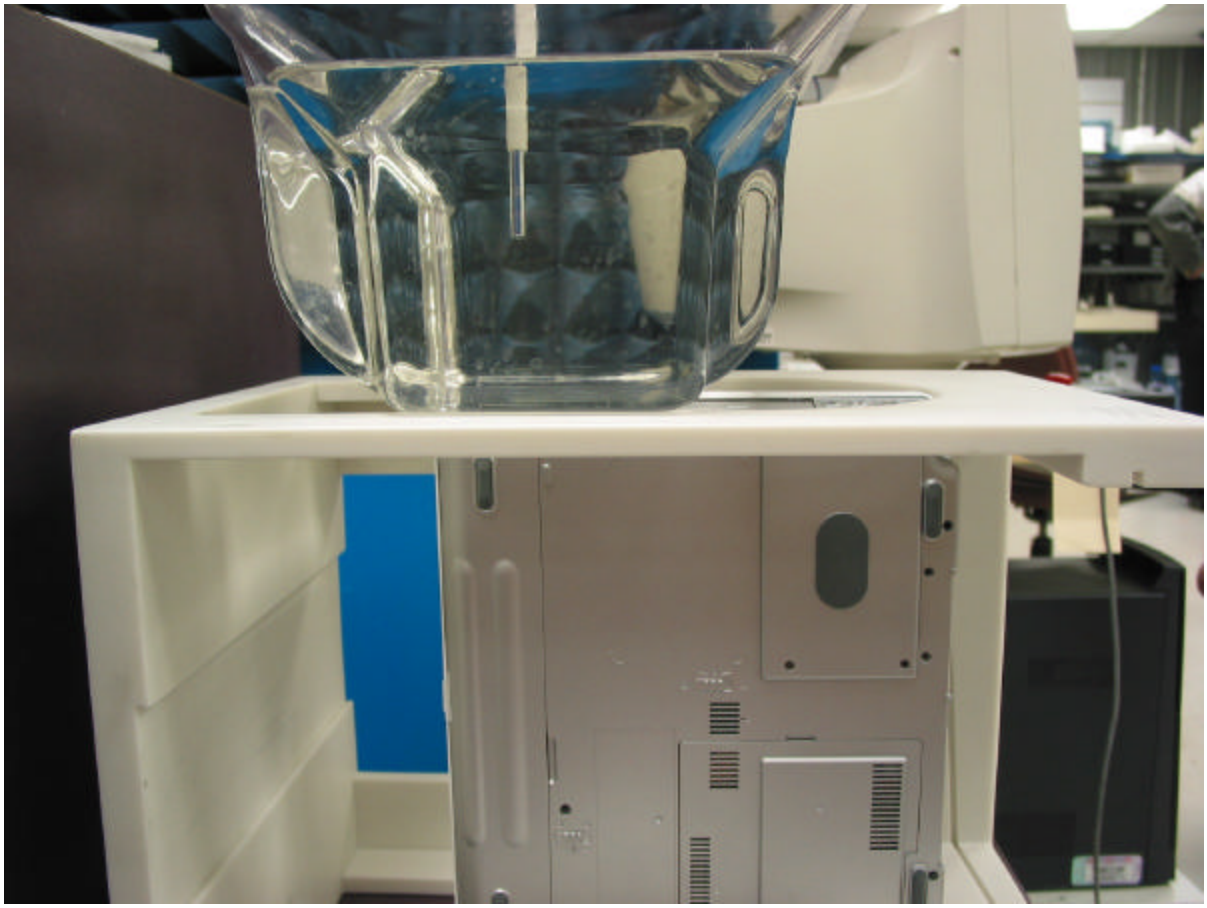
PICTURE 3

Keyboard Down

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

PICTURE 4

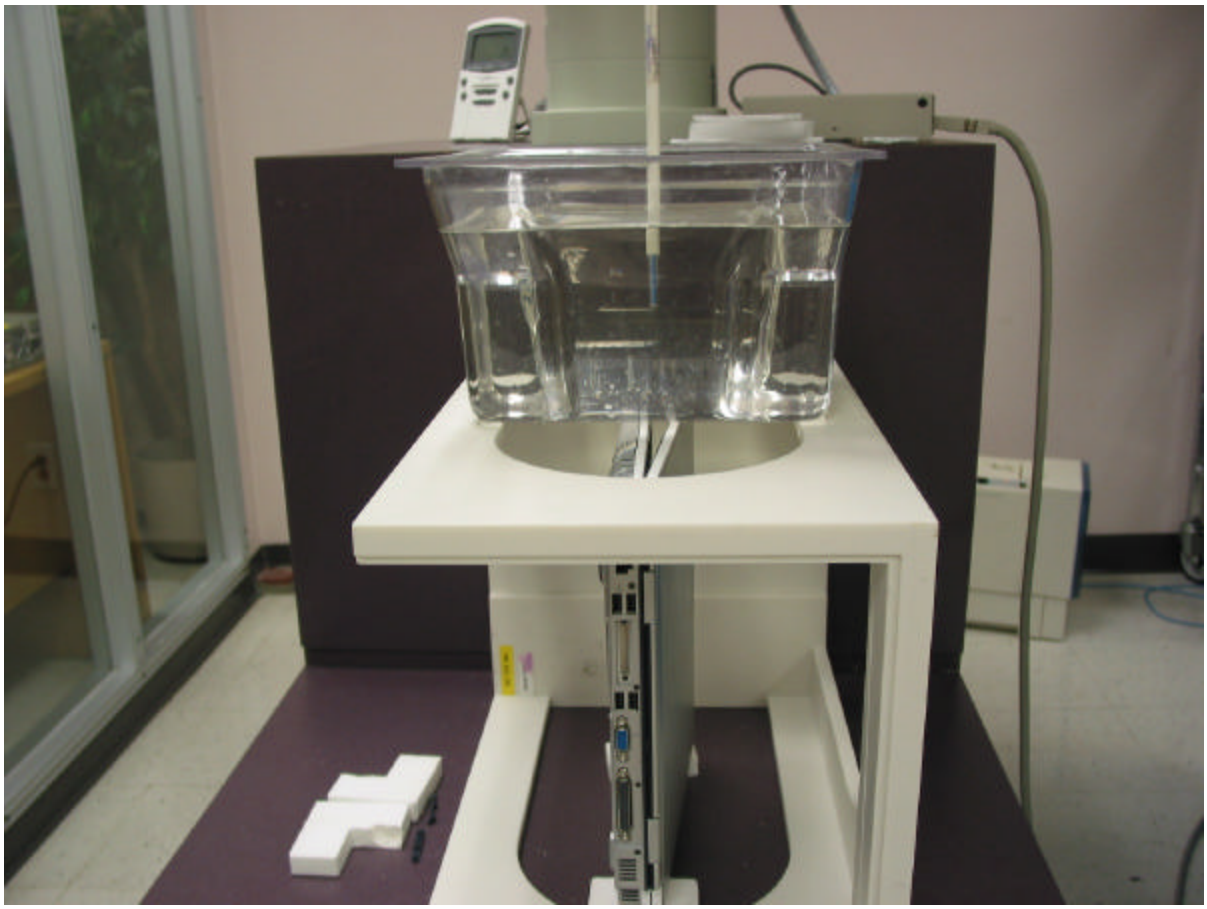
LHS Left Hand Side



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

PICTURE 5

RHS Right Hand Side



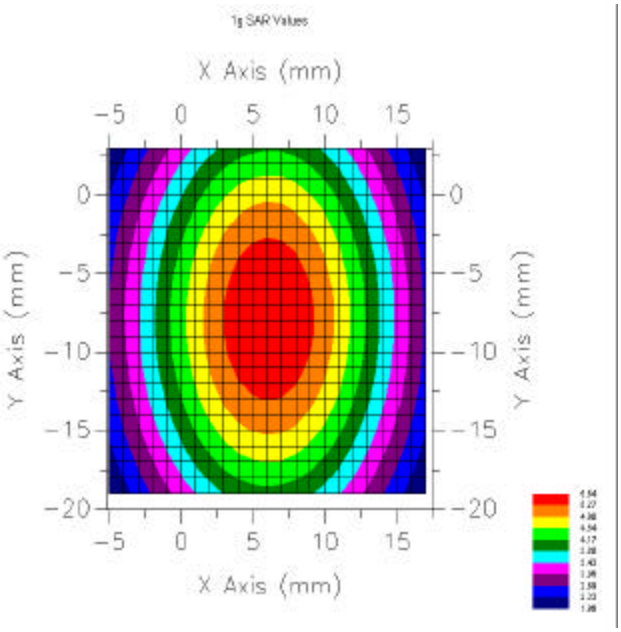
51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

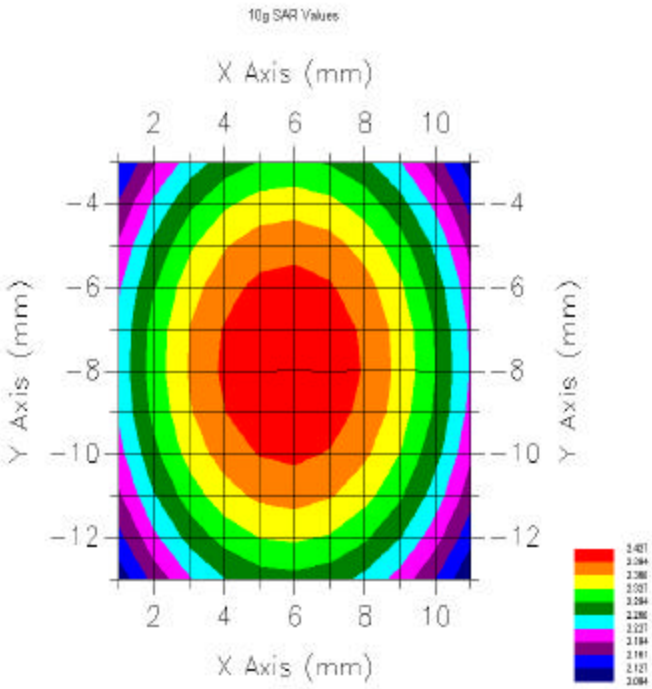
Appendix C

Validation Scan Results

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

VALIDATION SCAN





Date:28th May 2003
Frequency: 2450 MHz
Tissue Type: Muscle
Epsilon: 50.4
Sigma: 2.03
Tissue Calibration Date: 28th May 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 (%)
53.0	52.4	+2.0

Measured 10 Gram SAR (W/Kg)	Target 10 Gram SAR (W/Kg)	Delta (%)
24.3	24.0	+1

51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Appendix d: Uncertainty Budget

Intel Mini PCI Type 3B 802.11a/b Wireless LAN Adapter model WM3B2100A located inside the Asus M3000N notebook

Source of Uncertainty	Description (Annex)	Tolerance Value	Probability Distribution	Divisor	c_i^1 (1-g)	c_i^1 (10-g)	Standard Uncertainty (1-g)	Standard Uncertainty (10-g)	v_i^2 or v_{eff}
Measurement System									
Probe Calibration	E1.1	3.5	normal	1	1	1	3.5	3.5	
Axial Isotropy	E1.2	3.7	rectangular	3	$(1\text{-cp})^{1/2}$	(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	
Phantom and Setup									
Phantom Uncertainty (shape and thickness tolerance)	E2.1	3.4	rectangular	3	1	1	2.0	2.0	
Liquid Conductivity (target)	E2.2	4.0	rectangular	3	0.7	0.5	1.6	1.2	
Liquid Conductivity (meas.)	E2.2	2.0	rectangular	3	0.7	0.5	0.8	0.6	
Liquid Permittivity (target)	E2.2	4.0	rectangular	3	0.6	0.5	1.6	1.2	
Liquid Permittivity (meas.)	E2.2	2.0	rectangular	3	0.6	0.5	0.7	0.6	
Combined Uncertainty			RSS				9.1	9.0	
Combined Uncertainty **(coverage factor = 2)**			Normal (k=2)				18.1	17.8	

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Appendix E

Probe Calibration Certificate

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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 5th 2002
Recalibration required: November 4th 2003
Released on: November 5th 2002

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

© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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 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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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 MΩ.

Boundary Effect:

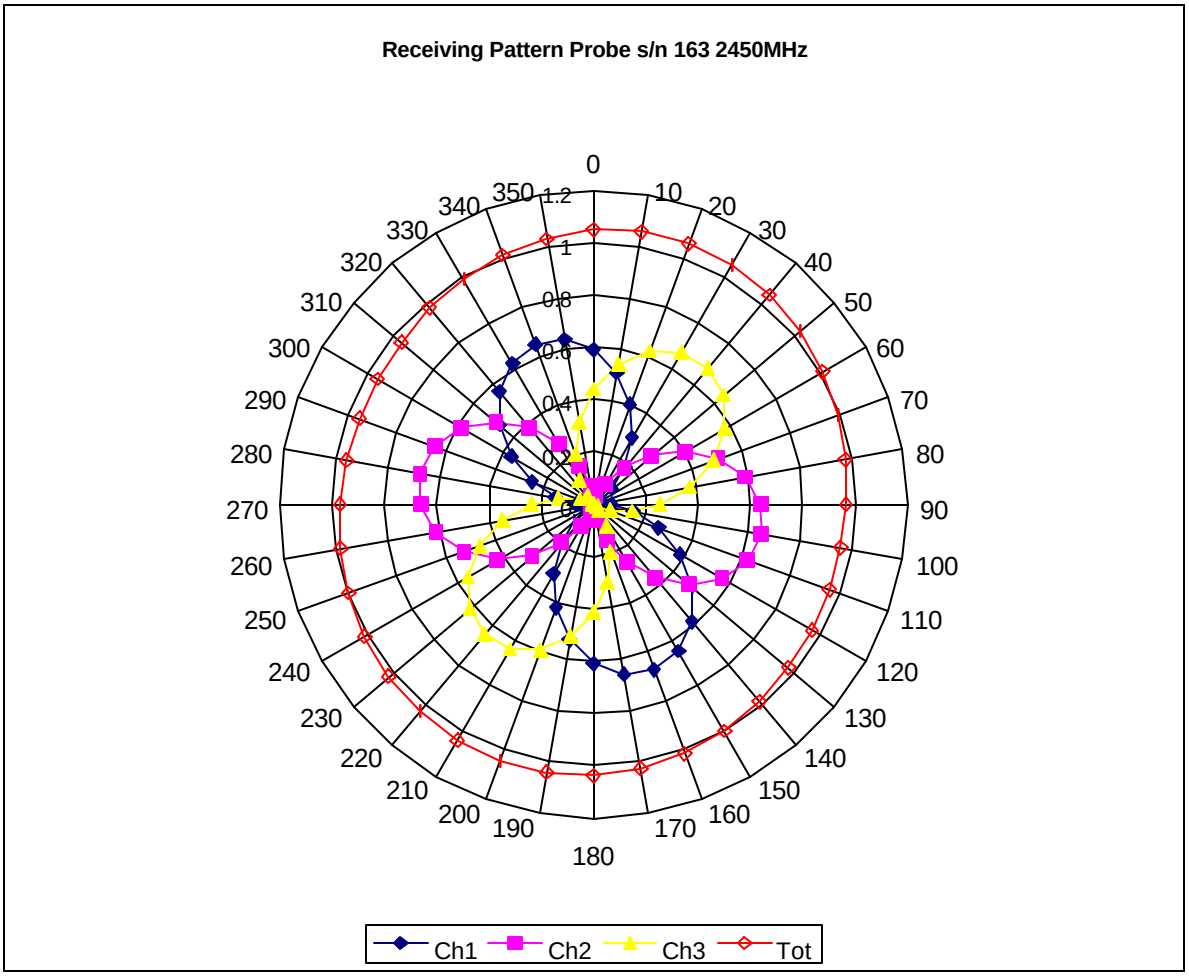
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.6mm.

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.

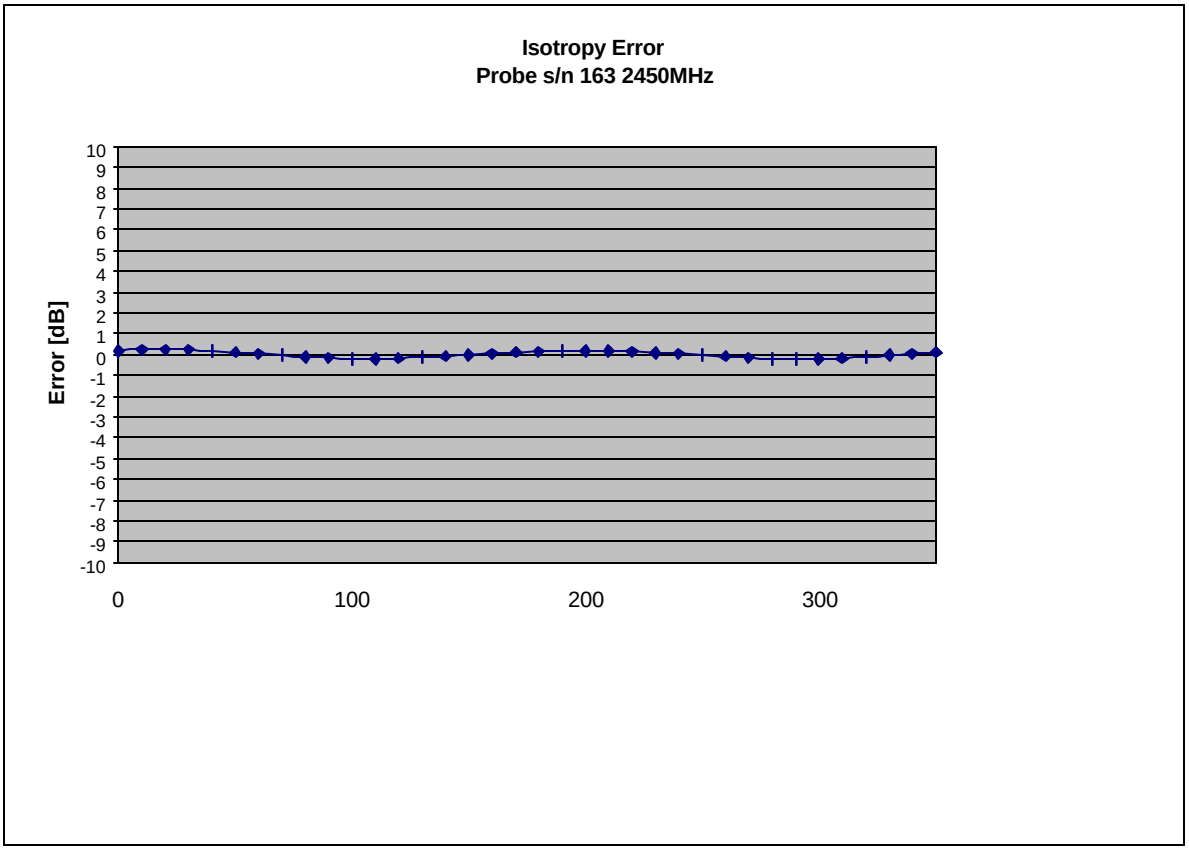
51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

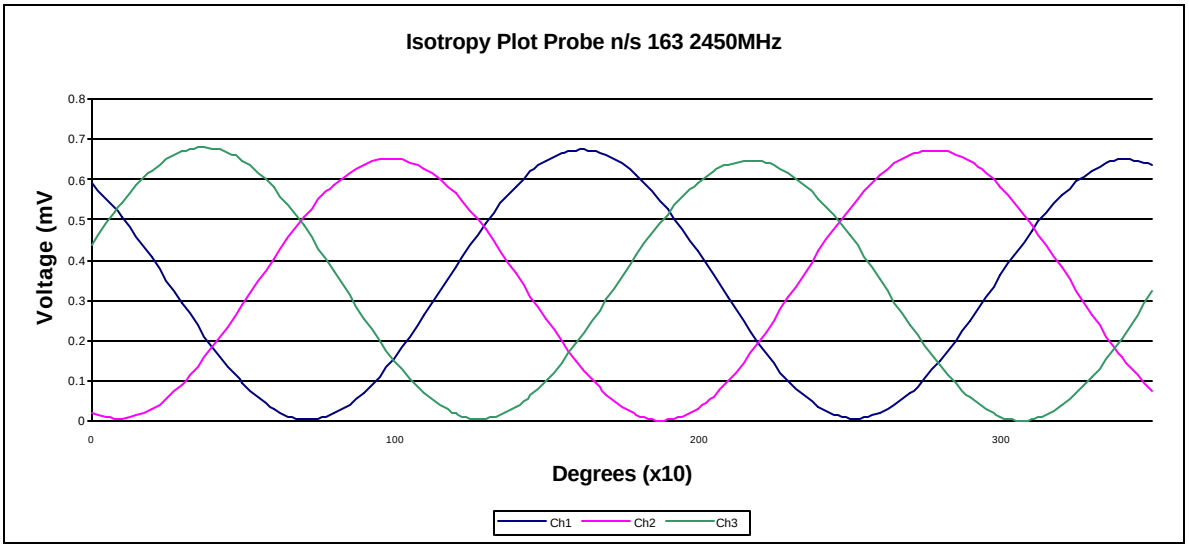
RECEIVING PATTERN 2450 MHZ (AIR)



51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

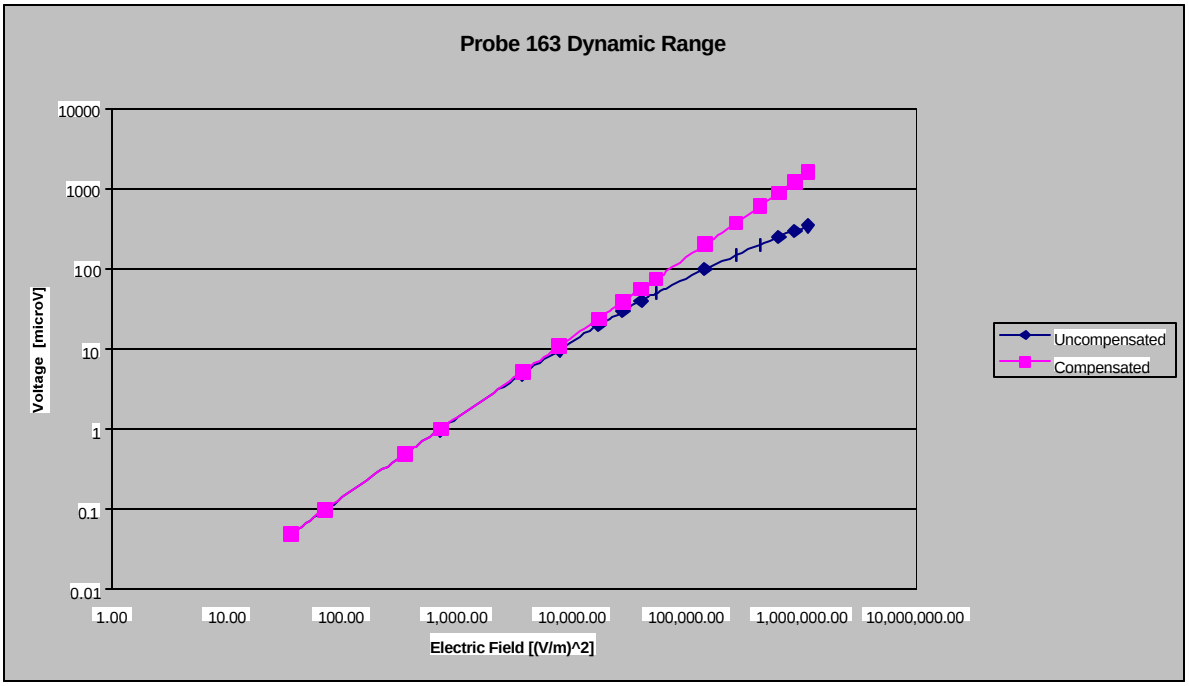
ISOTROPY ERROR 2450 MHZ (AIR)





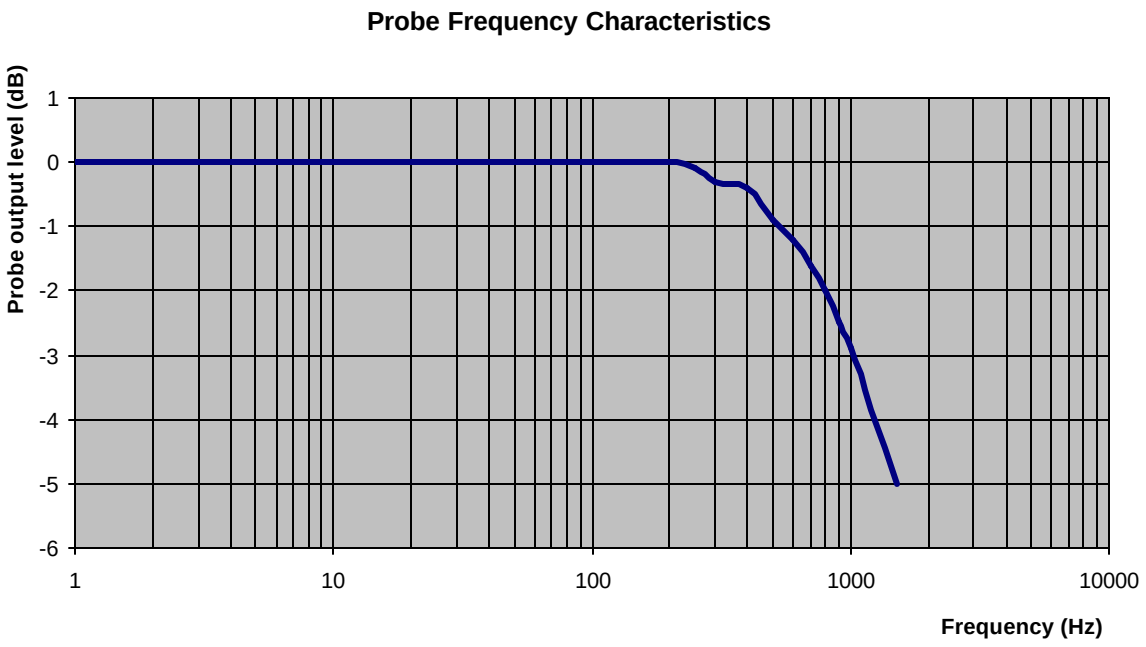
51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

DYNAMIC RANGE



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Video Bandwidth



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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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 MΩ.

Boundary Effect:

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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

Appendix F

Dipole Calibration Certificate

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

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: 15 November 2002
Released on: 14 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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories

7. CALIBRATION RESULTS SUMMARY

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

Mechanical Dimensions

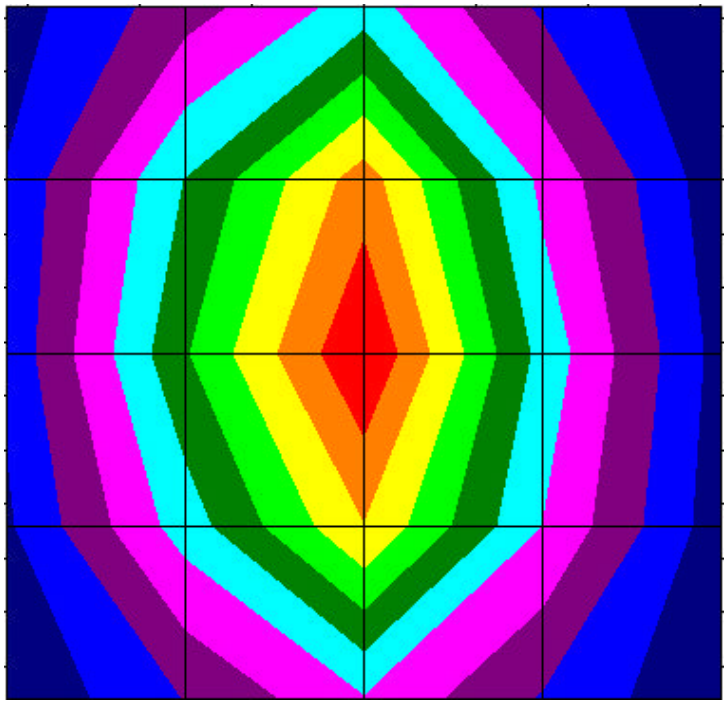
Length: 51.7 mm
Height: 30.8 mm

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



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

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, e_r	39.2
Conductivity, s [S/m]	1.82
Tissue Conversion Factor,	4.61

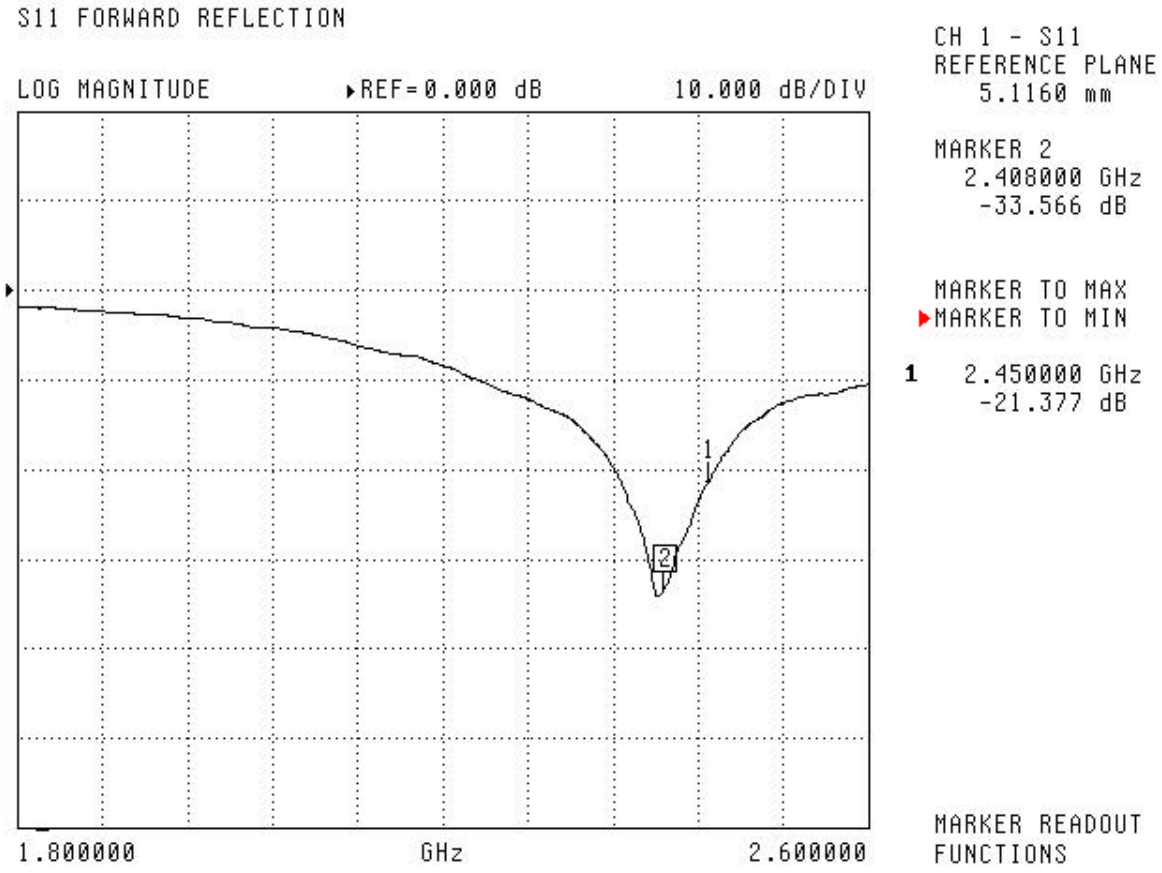
51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

Electrical Calibration

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

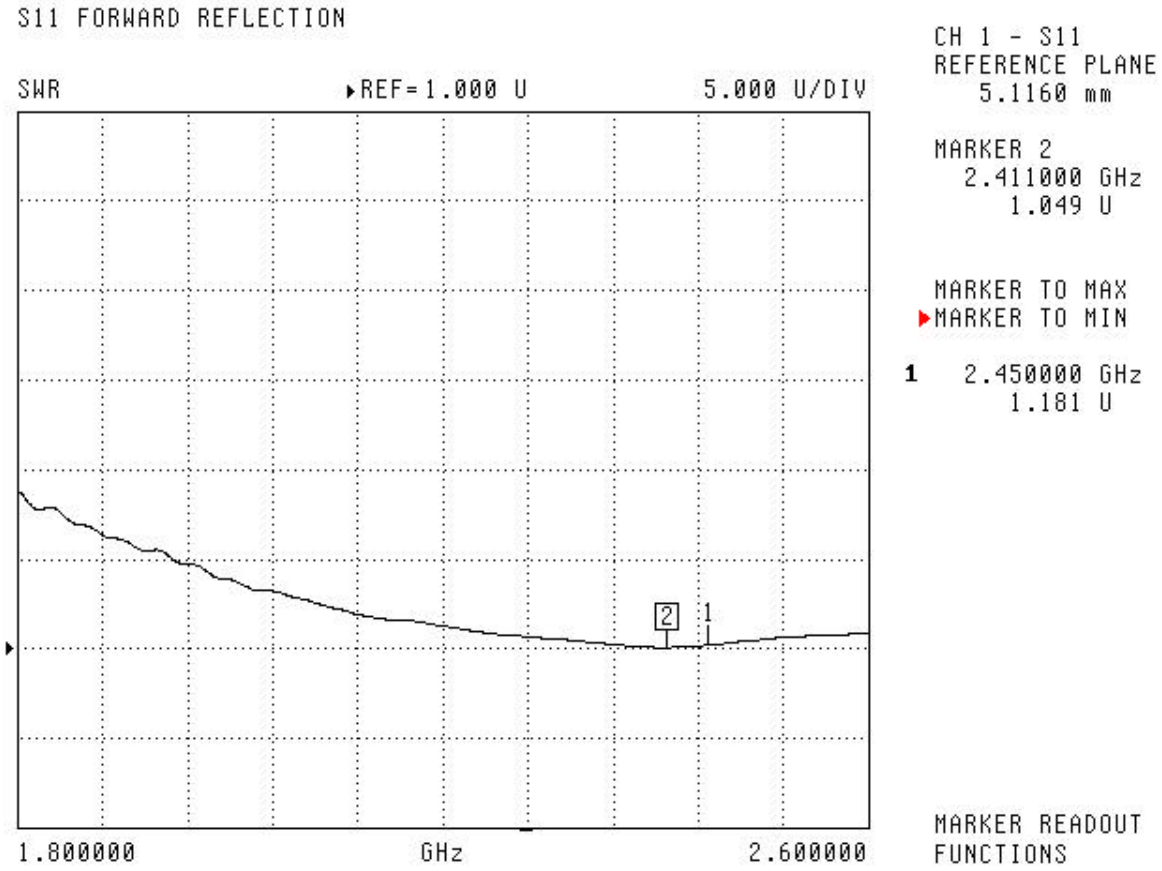
The Following Graphs are the results as displayed on the Vector Network Analyzer.

S11 Parameter Return Loss



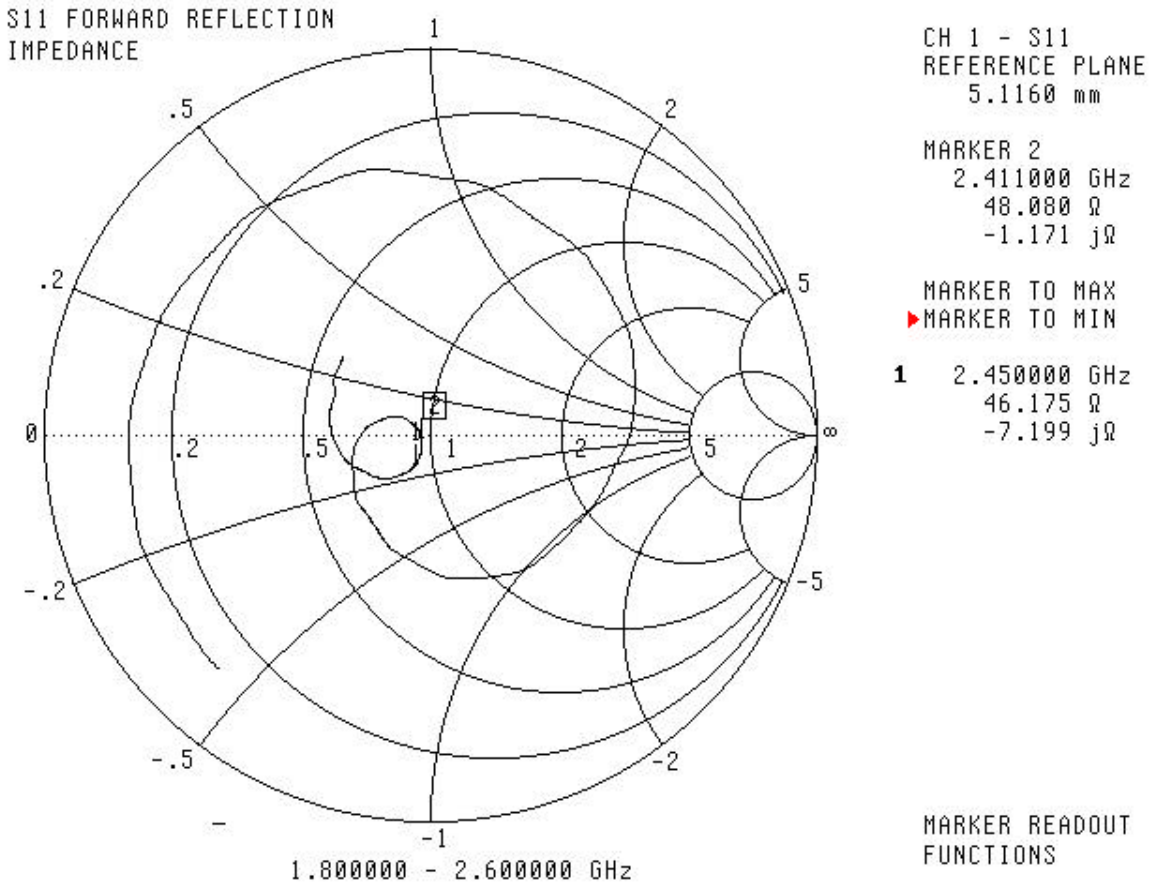
51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

SWR



51 Spectrum Way
Nepean, Ontario, K2R 1E6
e-mail: info@aprel.com
Tel. (613) 820-2730
Fax (613) 820 4161
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

Smith Chart Dipole Impedance

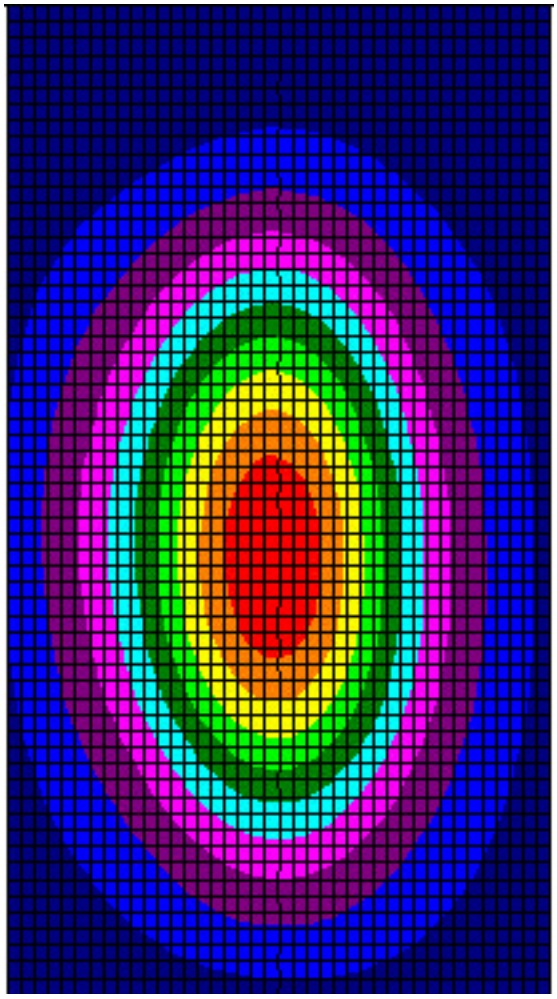


51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

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.



51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.

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

51 Spectrum Way Tel. (613) 820-2730
Nepean, Ontario, K2R 1E6 Fax (613) 820 4161
e-mail: info@aprel.com
© APREL 2002
This report shall not be reproduced, except in full, without the express written approval of APREL Laboratories.