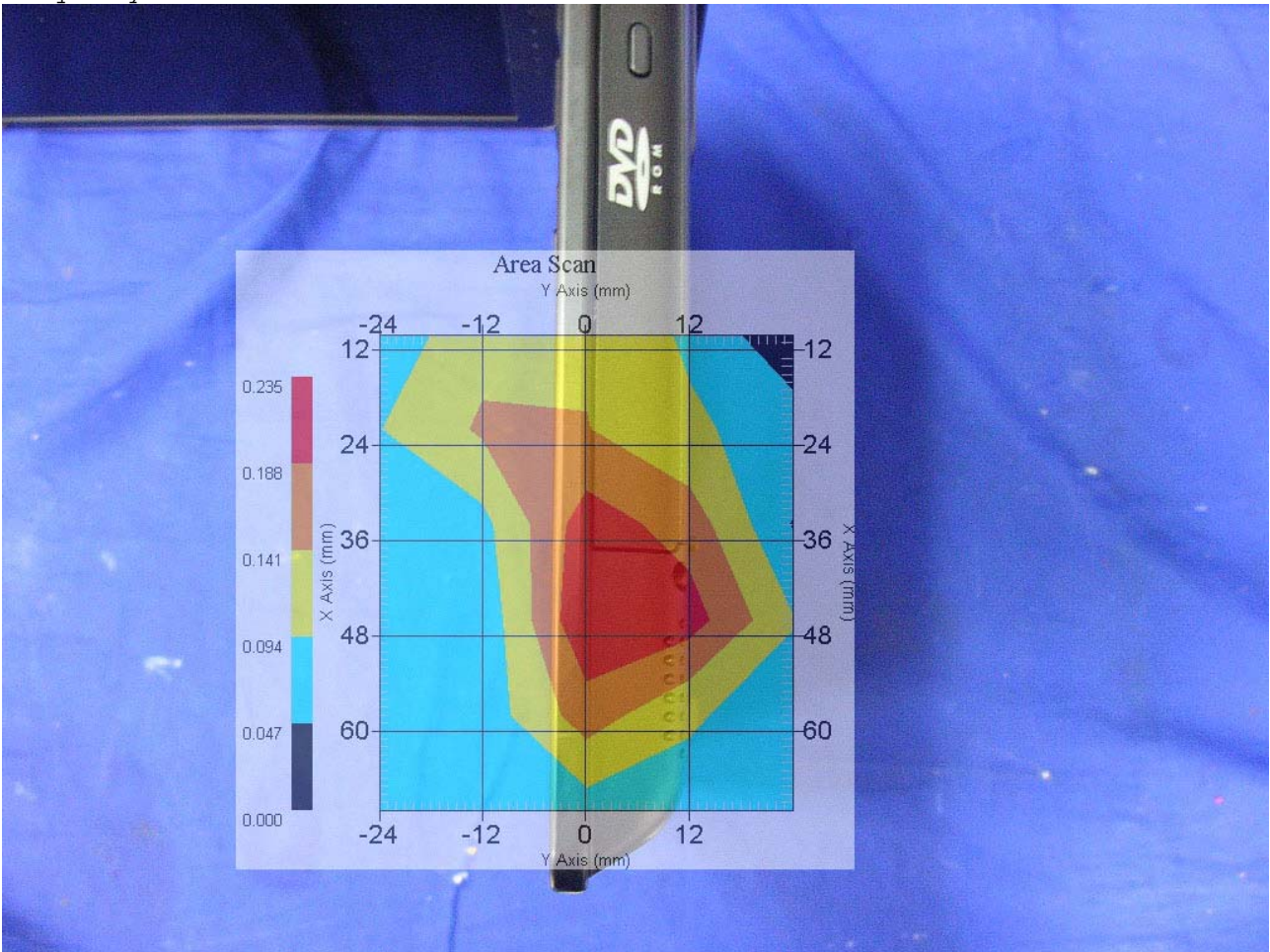


Measurement Data

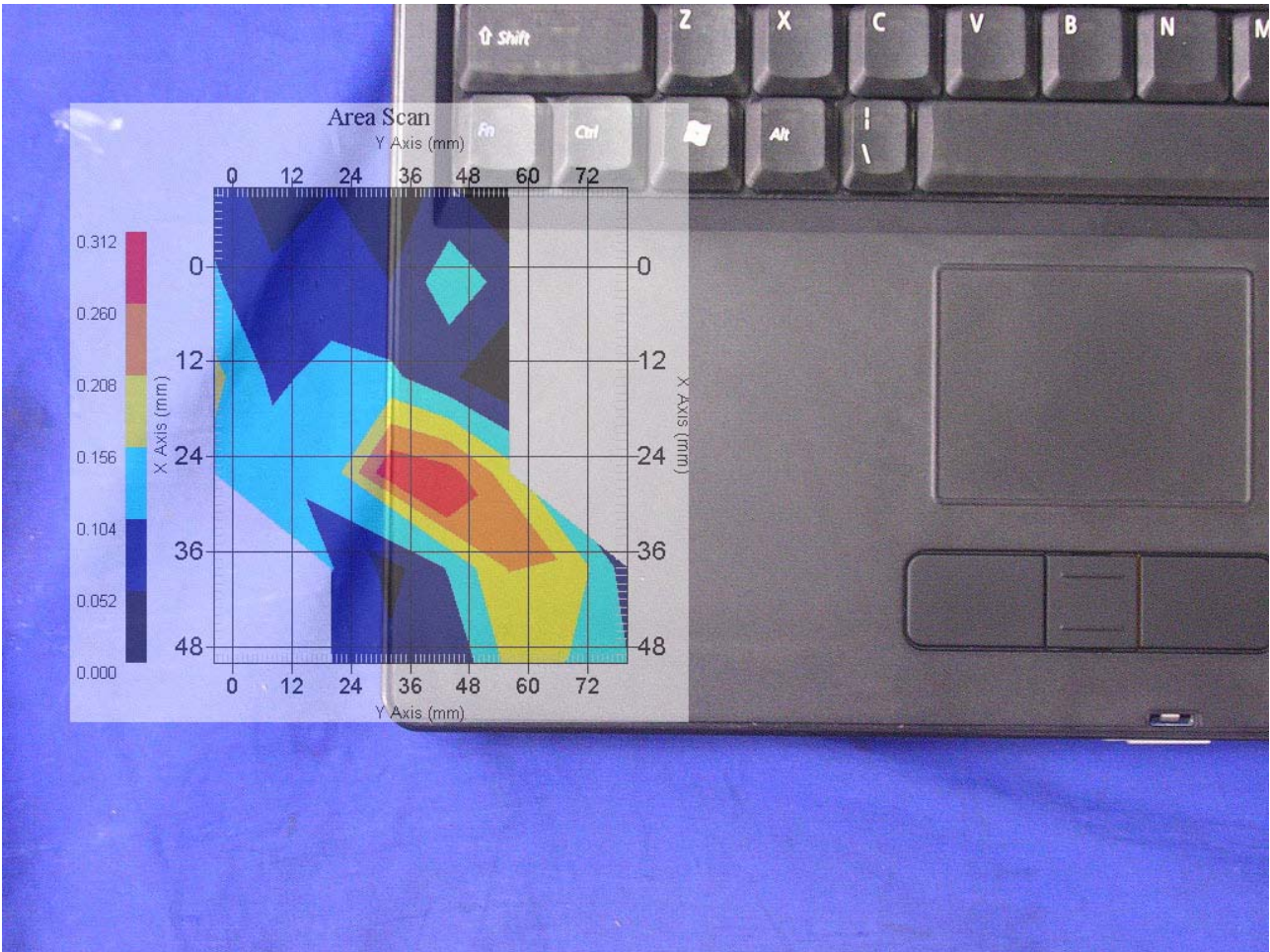
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x5x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.107 W/kg  
Power Drift-Finish: 0.104 W/kg  
Power Drift (%) : -2.803  
DUT Position : Touch EUT Right Side(Aux. Antenna)  
Frequency : 802.11b 2437MHz



1 gram SAR value : 0.223 W/kg  
10 gram SAR value : 0.116 W/kg  
Area Scan Peak SAR : 0.230 W/kg  
Zoom Scan Peak SAR : 0.530 W/kg

Measurement Data

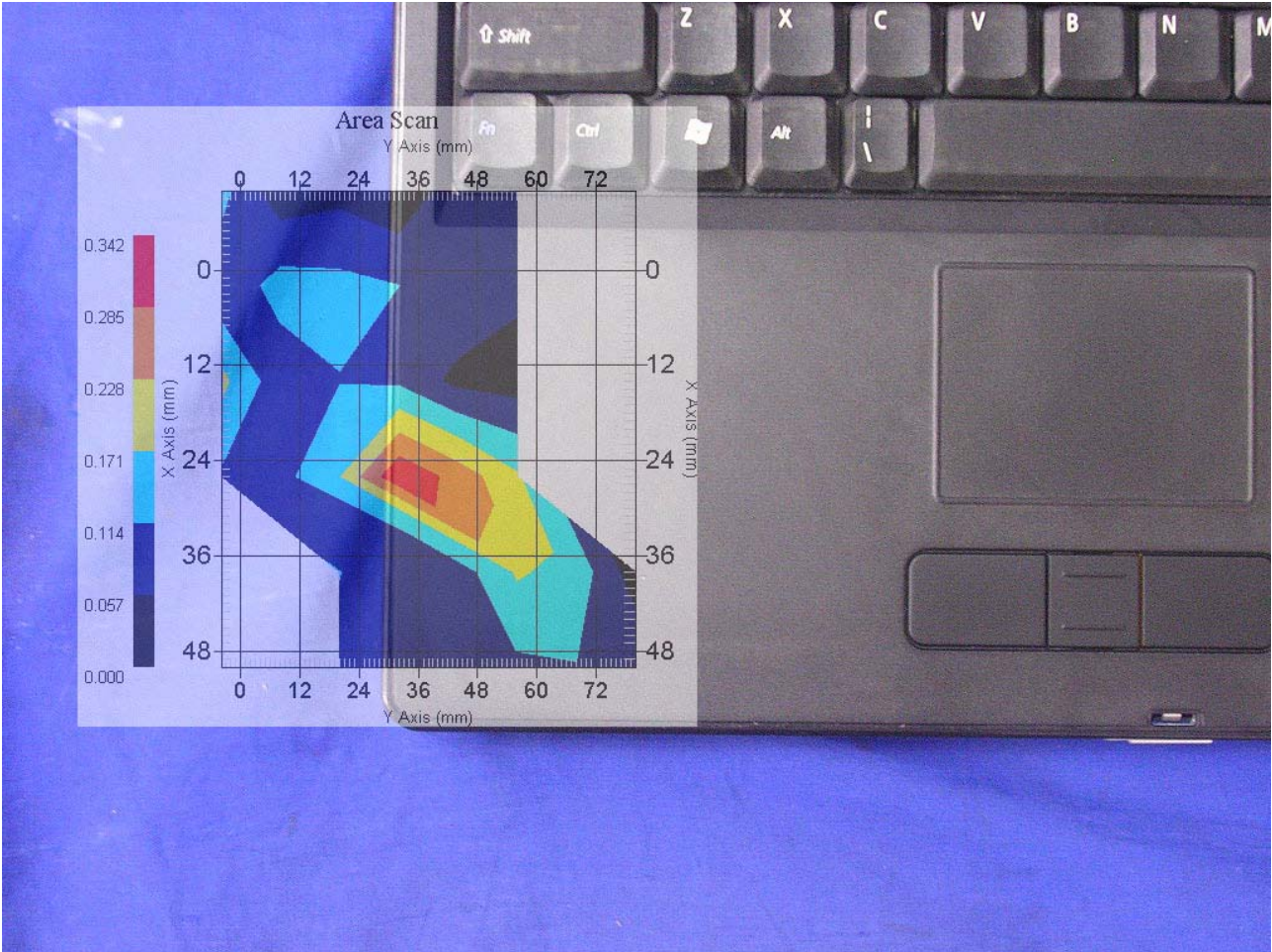
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x6x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.101 W/kg  
Power Drift-Finish: 0.102 W/kg  
Power Drift (%) : 0.990  
DUT Position : Touch EUT Left Side(Main Antenna)  
Frequency : 802.11g 2412MHz



1 gram SAR value : 0.302 W/kg  
10 gram SAR value : 0.170 W/kg  
Area Scan Peak SAR : 0.305 W/kg  
Zoom Scan Peak SAR : 0.600 W/kg

Measurement Data

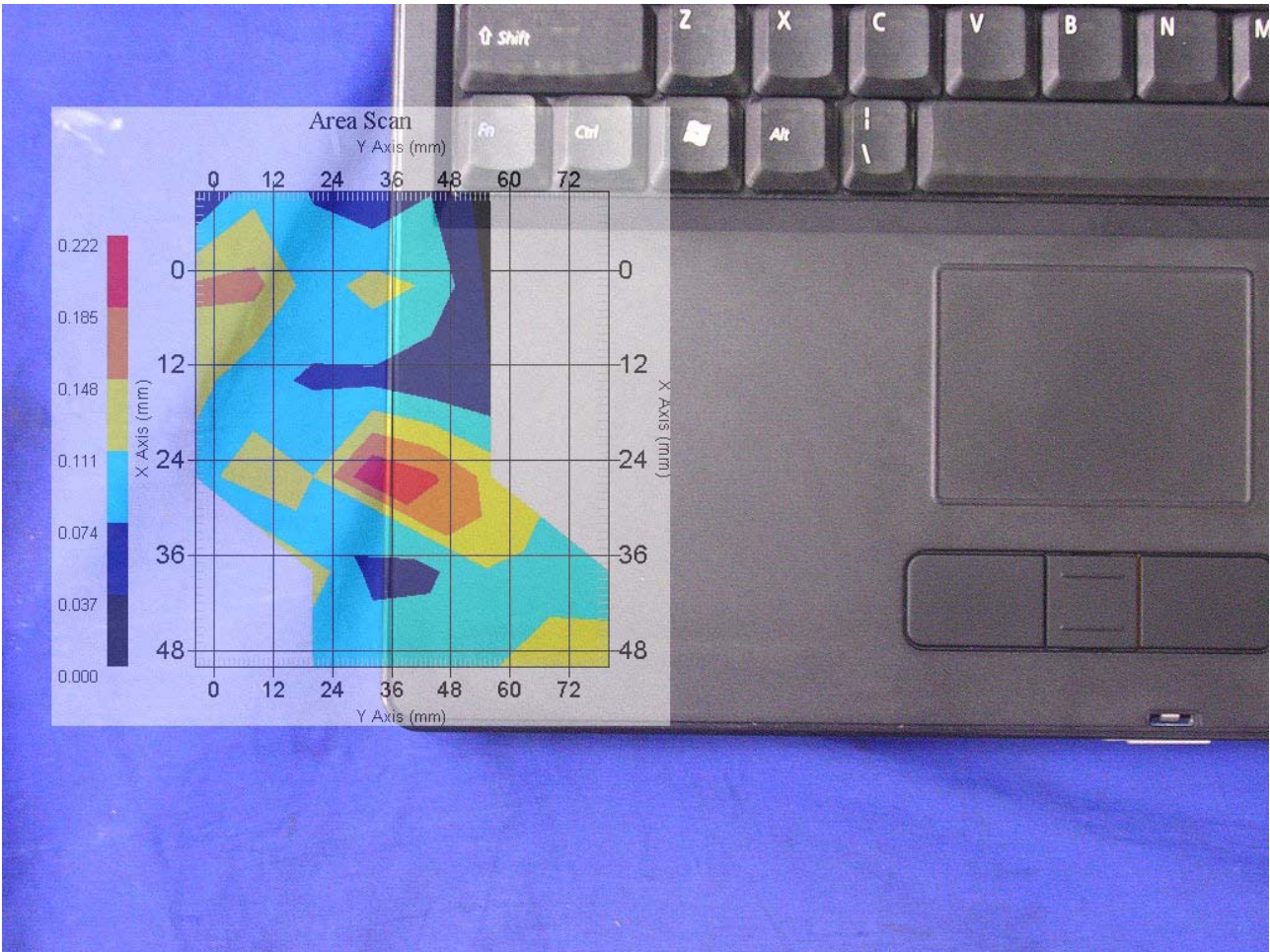
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x6x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.085 W/kg  
Power Drift-Finish: 0.085 W/kg  
Power Drift (%) : 0.000  
DUT Position : Touch EUT Left Side(Main Antenna)  
Frequency : 802.11g 2437MHz



1 gram SAR value : 0.269 W/kg  
10 gram SAR value : 0.198 W/kg  
Area Scan Peak SAR : 0.333 W/kg  
Zoom Scan Peak SAR : 0.540 W/kg

Measurement Data

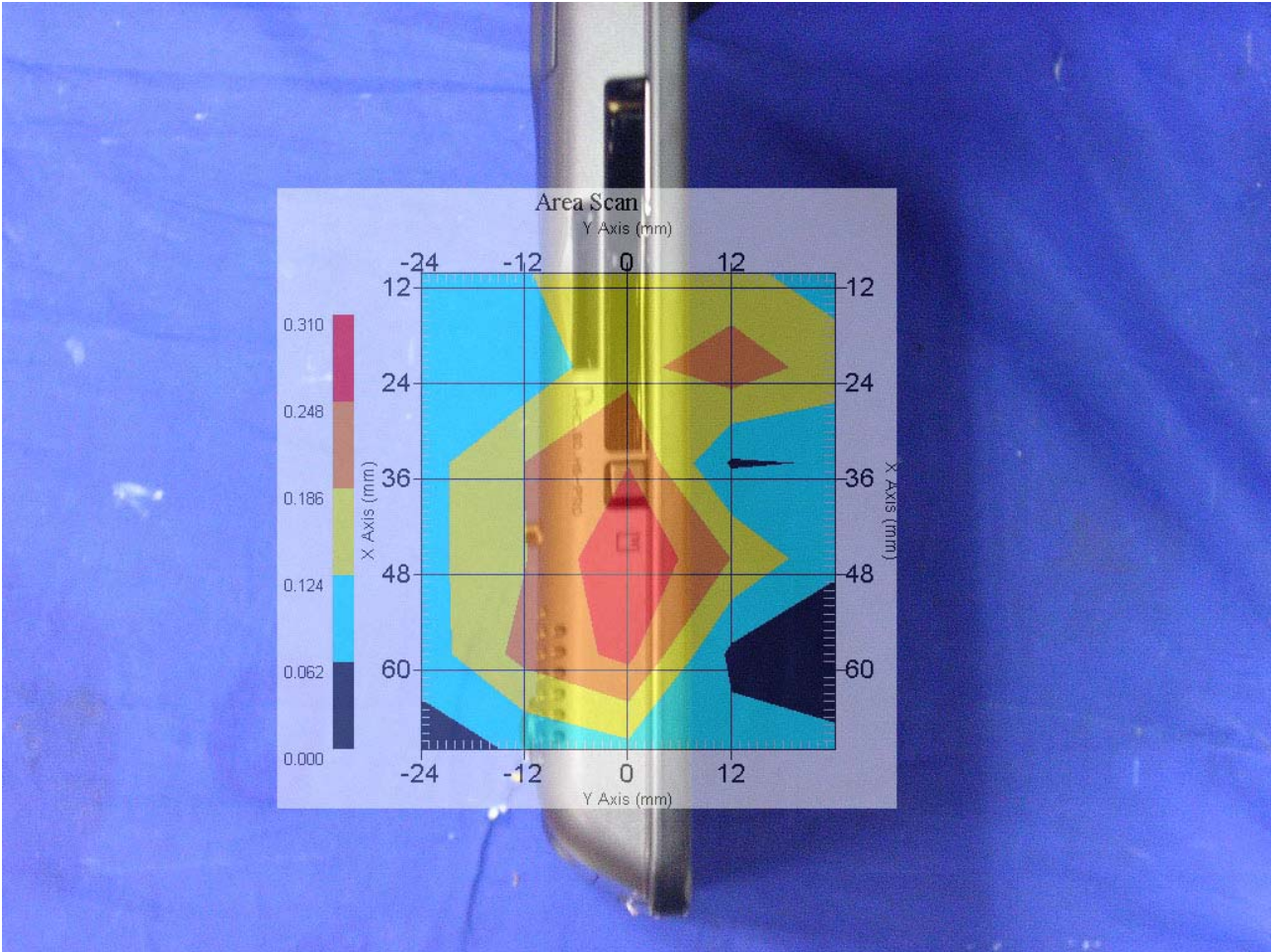
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x6x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.075 W/kg  
Power Drift-Finish: 0.074 W/kg  
Power Drift (%) : -1.333  
DUT Position : Touch EUT Left Side(Main Antenna)  
Frequency : 802.11g 2462MHz



1 gram SAR value : 0.176 W/kg  
10 gram SAR value : 0.117 W/kg  
Area Scan Peak SAR : 0.218 W/kg  
Zoom Scan Peak SAR : 0.370 W/kg

Measurement Data

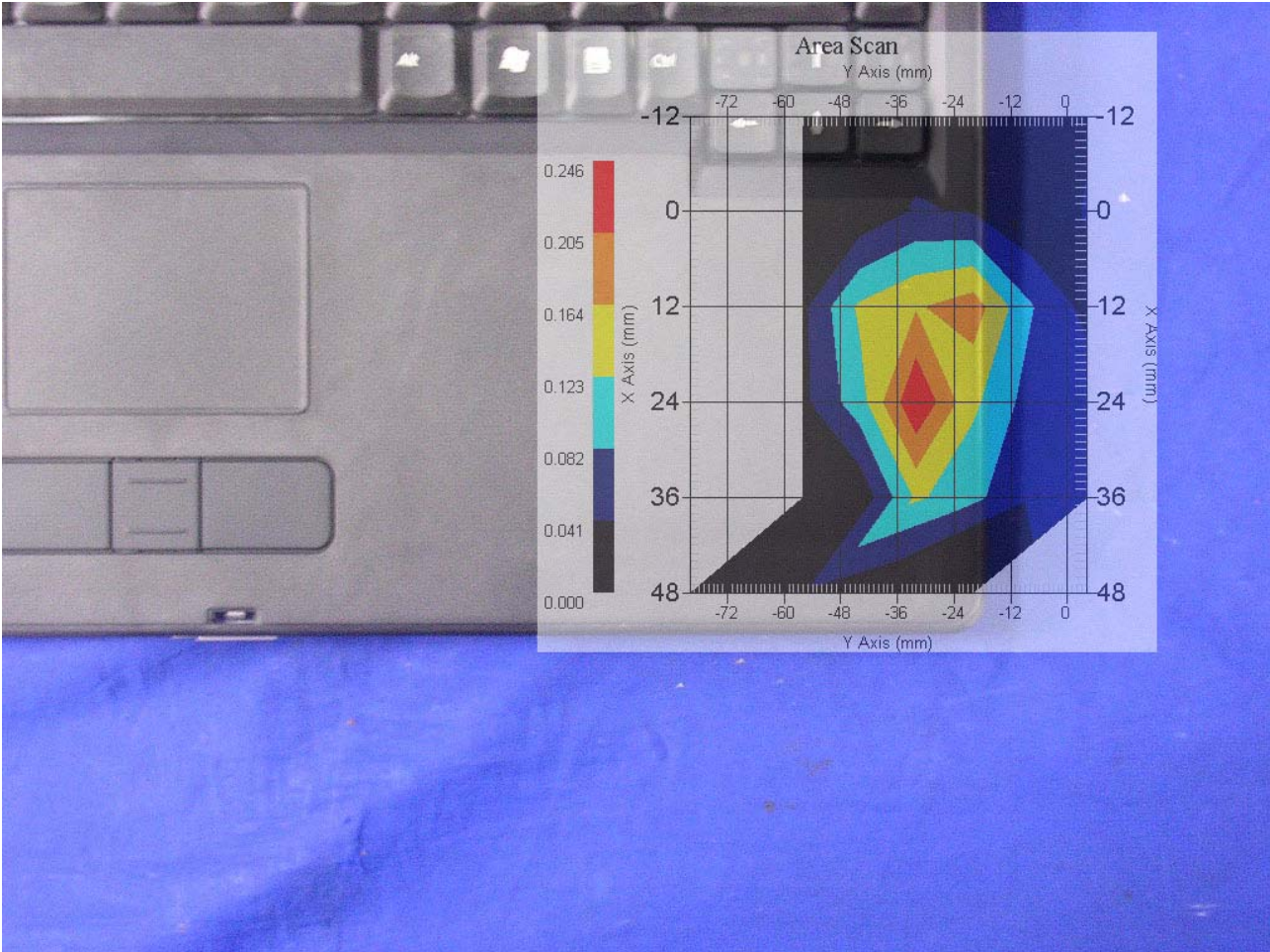
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x5x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.085 W/kg  
Power Drift-Finish: 0.085 W/kg  
Power Drift (%) : 0.000  
DUT Position : Touch EUT Left Side(Main Antenna)  
Frequency : 802.11g 2437MHz



1 gram SAR value : 0.286 W/kg  
10 gram SAR value : 0.164 W/kg  
Area Scan Peak SAR : 0.307 W/kg  
Zoom Scan Peak SAR : 0.510 W/kg

Measurement Data

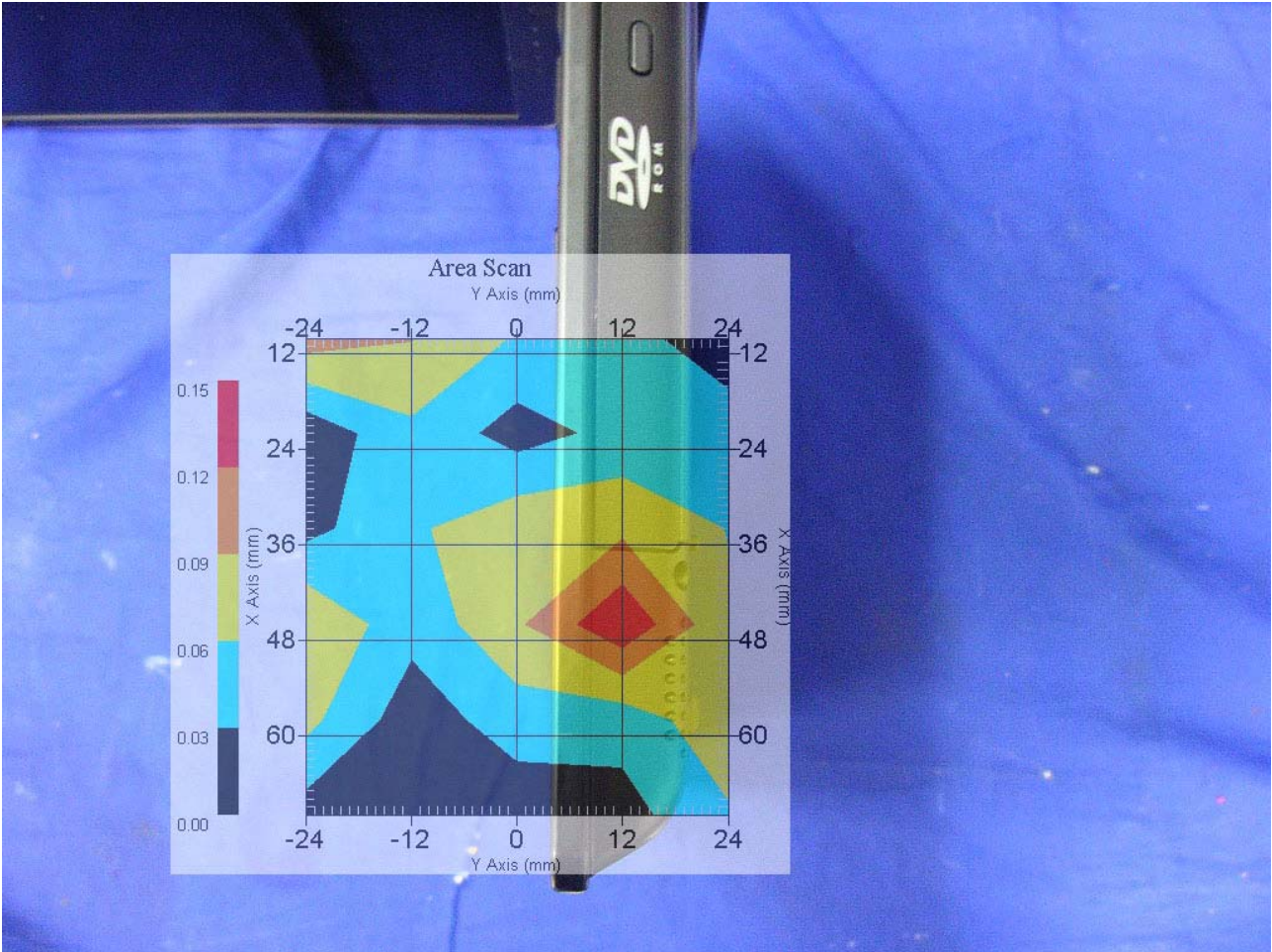
Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x6x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.047 W/kg  
Power Drift-Finish: 0.046 W/kg  
Power Drift (%) : -2.127  
DUT Position : Touch EUT Right Front(Aux. Antenna)  
Frequency : 802.11g 2437MHz



1 gram SAR value : 0.239 W/kg  
10 gram SAR value : 0.105 W/kg  
Area Scan Peak SAR : 0.242 W/kg  
Zoom Scan Peak SAR : 0.560 W/kg

Measurement Data

Crest Factor : 1  
Tissue Temp. : 22.3°C  
Ambient Temp. : 23.4°C  
Area Scan : 6x5x1 : Measurement x=12mm, y=12mm, z=4mm  
Zoom Scan : 7x7x7 : Measurement x=5mm, y=5mm, z=5mm  
Power Drift-Start : 0.010 W/kg  
Power Drift-Finish: 0.010 W/kg  
Power Drift (%) : 0.000  
DUT Position : Touch EUT Right Side(Aux. Antenna)  
Frequency : 802.11g 2437MHz

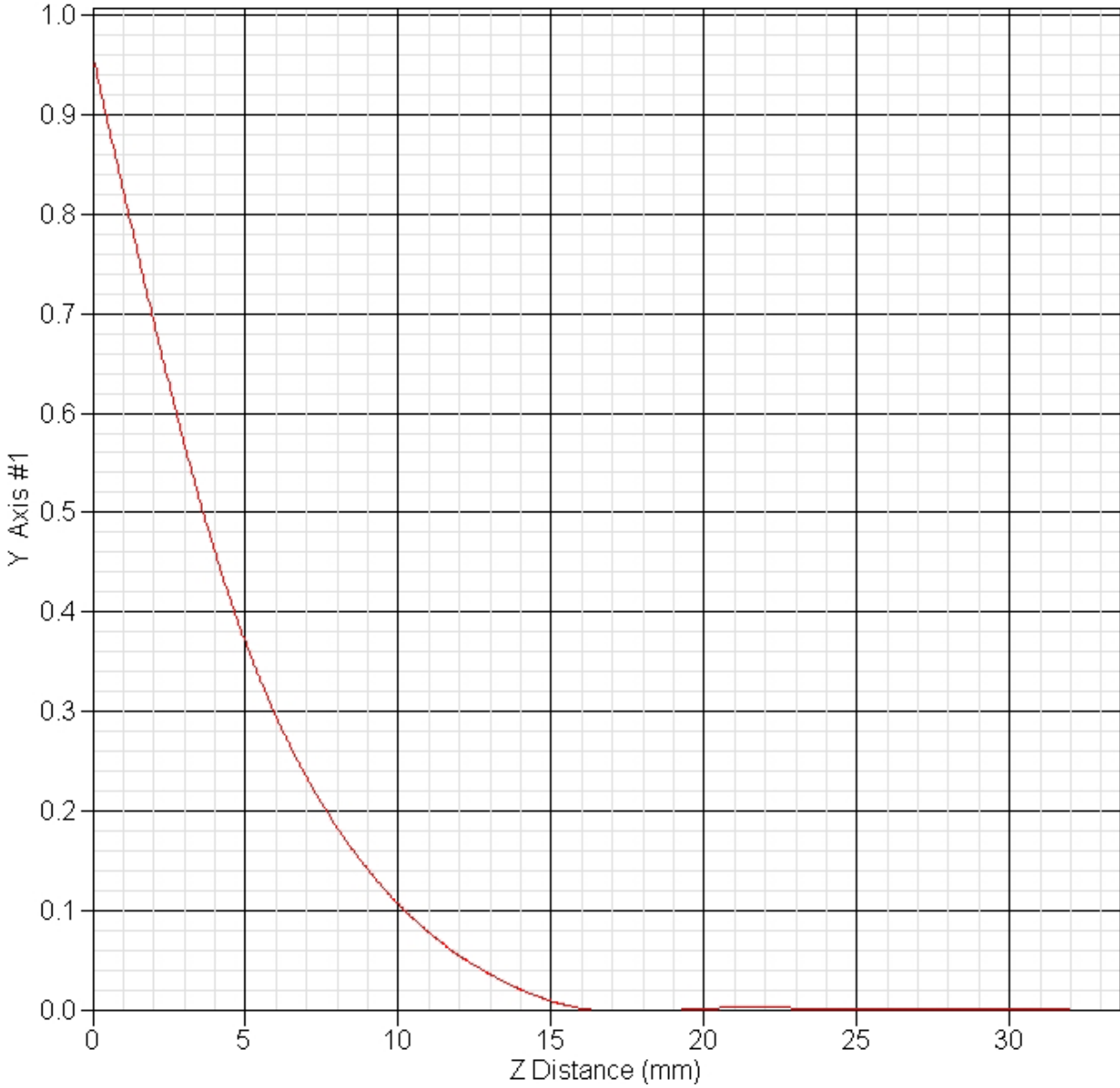


1 gram SAR value : 0.163 W/kg  
10 gram SAR value : 0.105 W/kg  
Area Scan Peak SAR : 0.146 W/kg  
Zoom Scan Peak SAR : 0.410 W/kg

EUT Left Front (Main Antenna) Z-Axis plot

Frequency : 802.11b 2437MHz

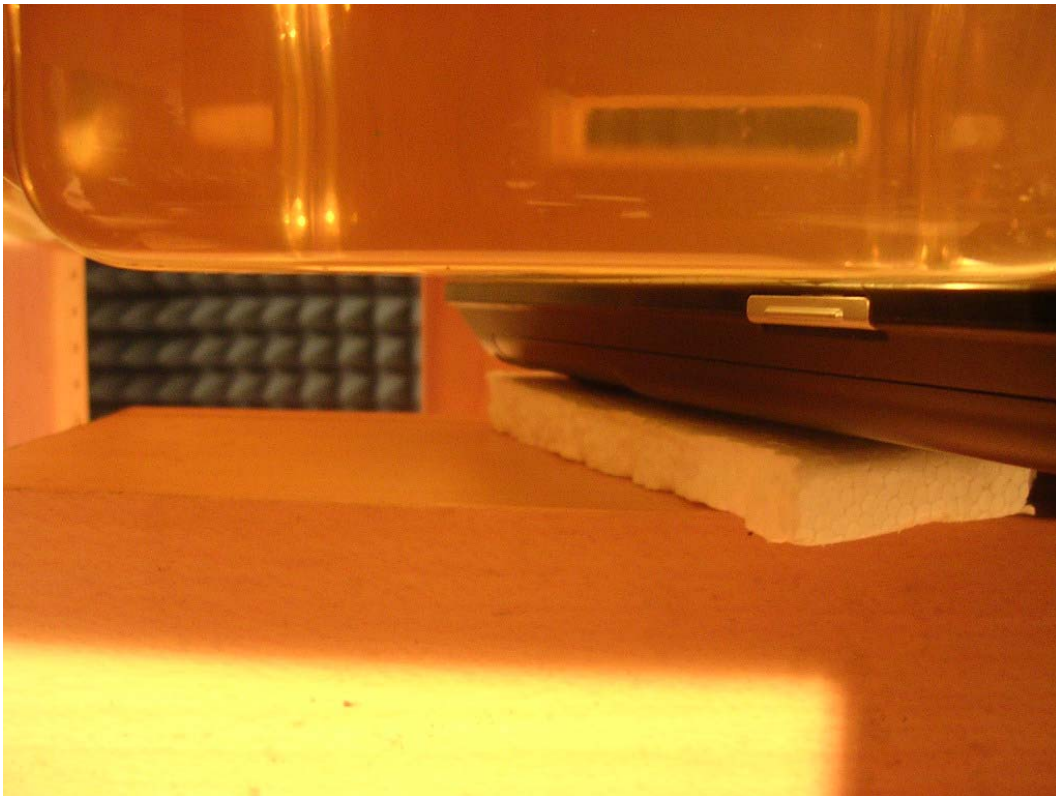
SAR-Z Axis  
at Hotspot x:17.10 y:46.90





**Test Setup Photographs**

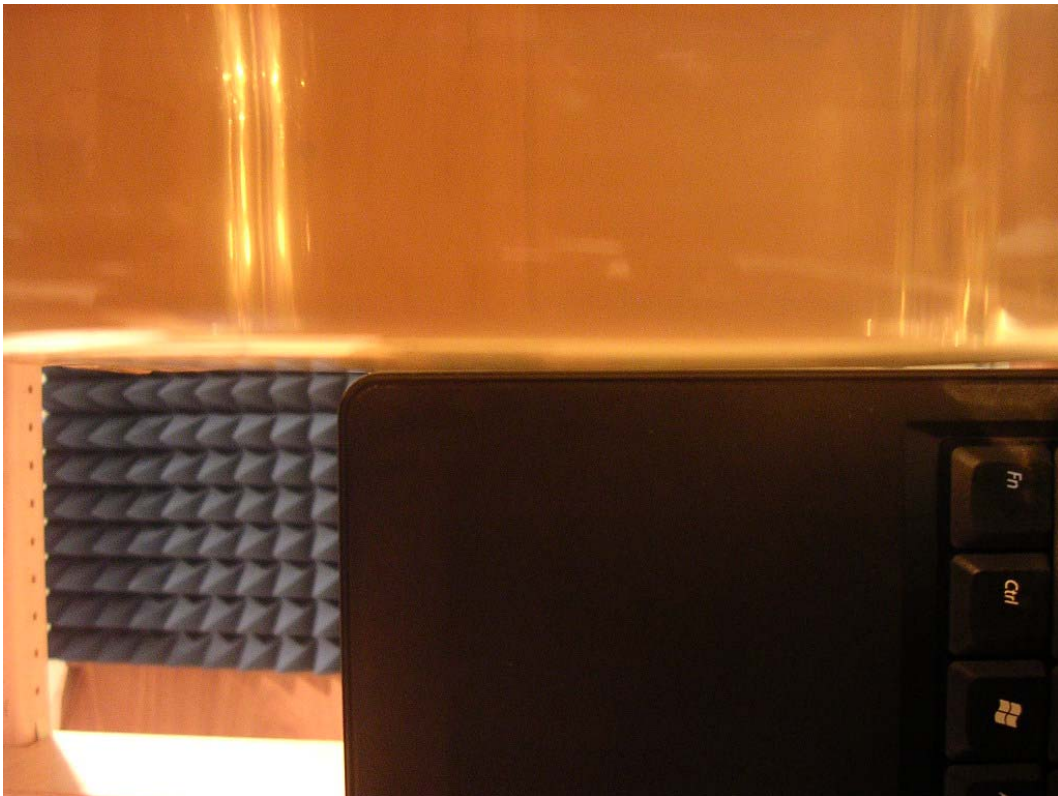
**EUT Left Front (Main Antenna)**



**EUT Right Front (Auxiliary Antenna)**



**EUT Left Side (Main Antenna)**



**EUT Right Side (Auxiliary Antenna)**



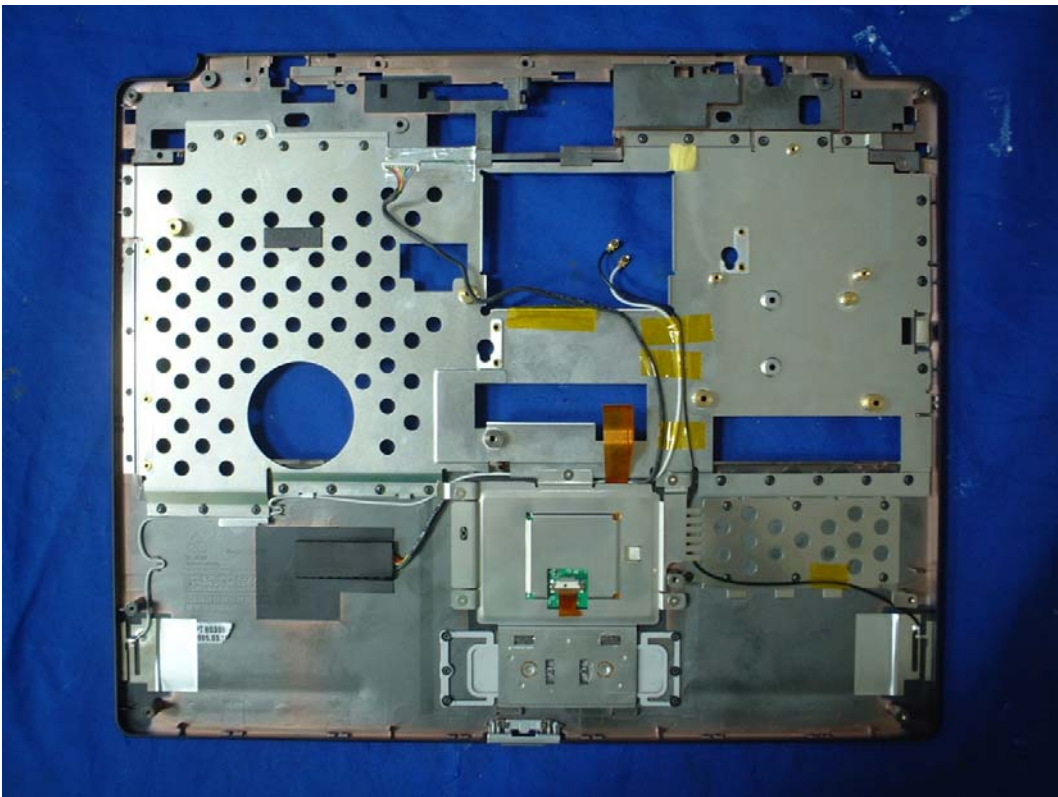
**EUT Back(Main Antenna)**

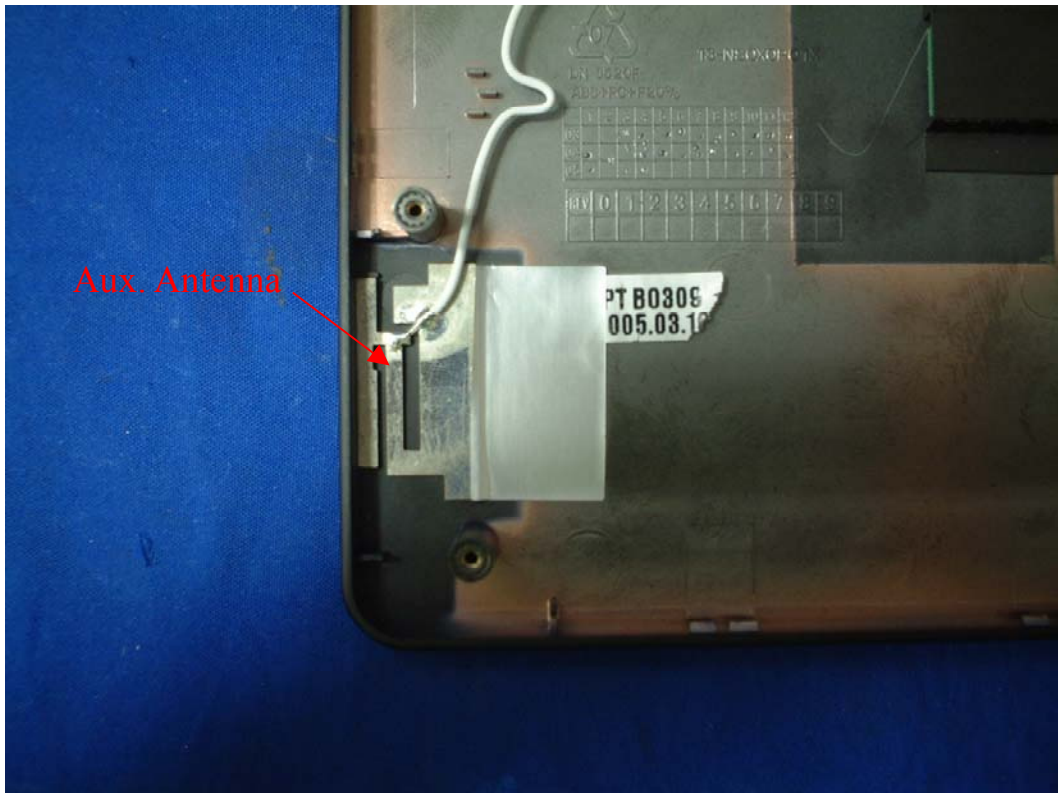
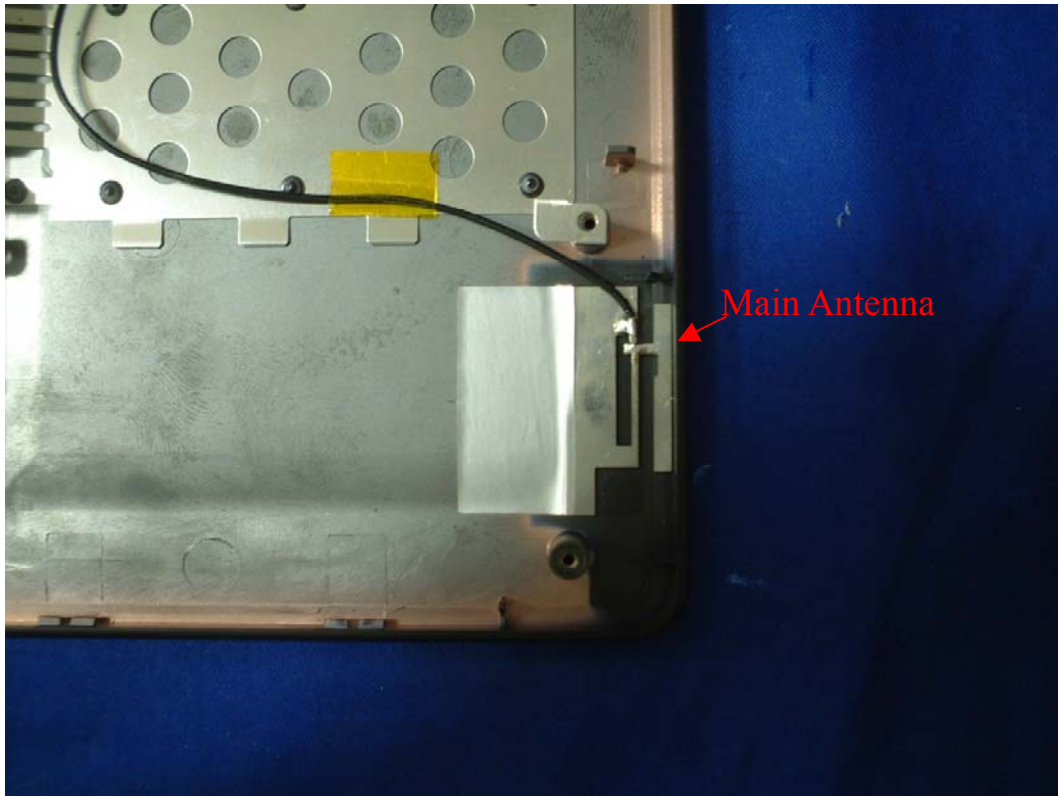


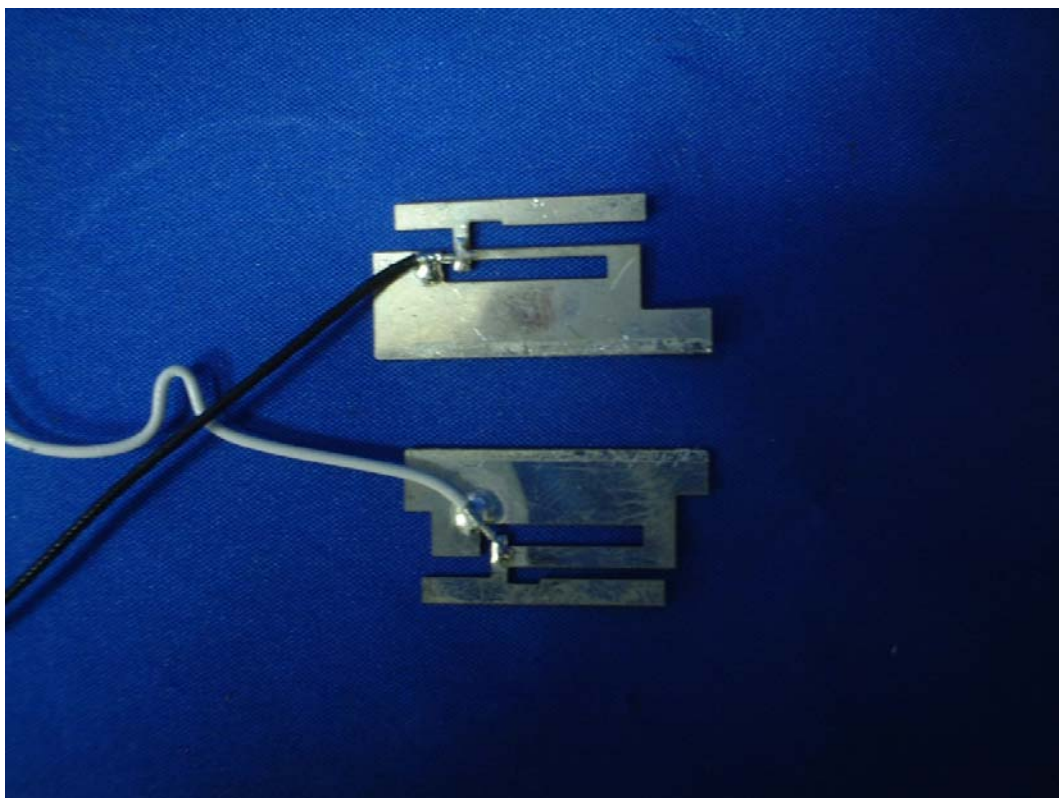
EUT Photographs















## **Appendix - Probe Calibration**

**Miniature Isotropic RF Probe**

**M/N: ALS-E-020**

**S/N: 265**

**2450MHz Head Calibration page2~11**

**2450MHz Body Calibration page12~21**

## NCL CALIBRATION LABORATORIES

Calibration File No.: CP-557

Client: QUIETEK

## 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.: ALS-E-020

Serial No.: 265

HEAD Calibration

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2

Project No: QTKB-ALS-E-020 Probe Cal-5091

Calibrated: 23<sup>rd</sup> March 2005

Released on: 23<sup>rd</sup> March 2005

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: (615) 620-4988  
FAX: (615) 620-4161

## NCL Calibration Laboratories

Division of APREL Laboratories.

---

### Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 265.

### References

SSI/DRB-TP-D01-032-E020-V2 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 265 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

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



---

Ron Dulmage



---

Y. Chen

## NCL Calibration Laboratories

Division of APREL Laboratories.

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### Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	265
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:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	95 mV

## NCL Calibration Laboratories

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Division of APREL Laboratories.

### Sensitivity in Head Tissue

**Frequency:** 2450 MHz

**Epsilon:** 39.2 (+/-5%)

**Sigma:** 1.80 S/m (+/-5%)

### ConvF

**Channel X:** 4.6

**Channel Y:** 4.6

**Channel Z:** 4.6

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

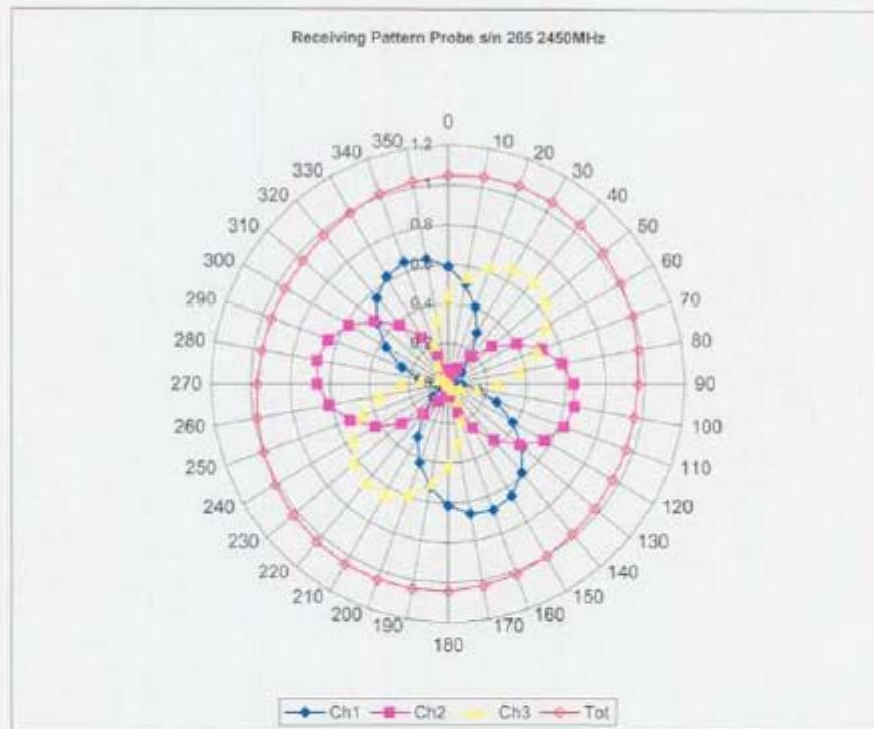
### Boundary Effect:

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 2.44mm.

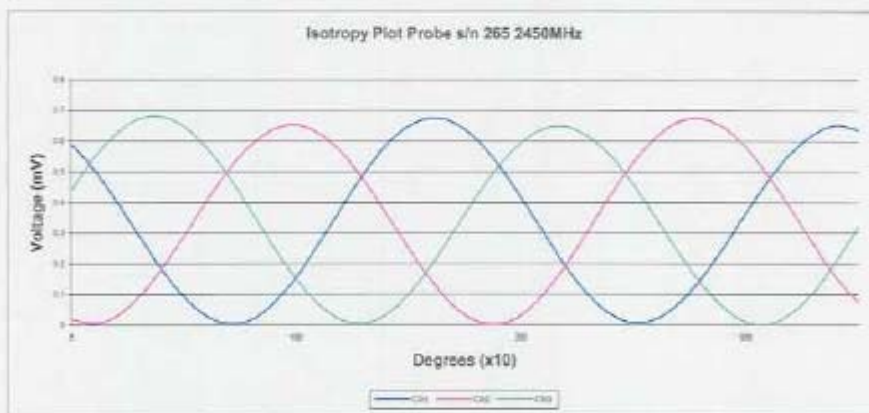
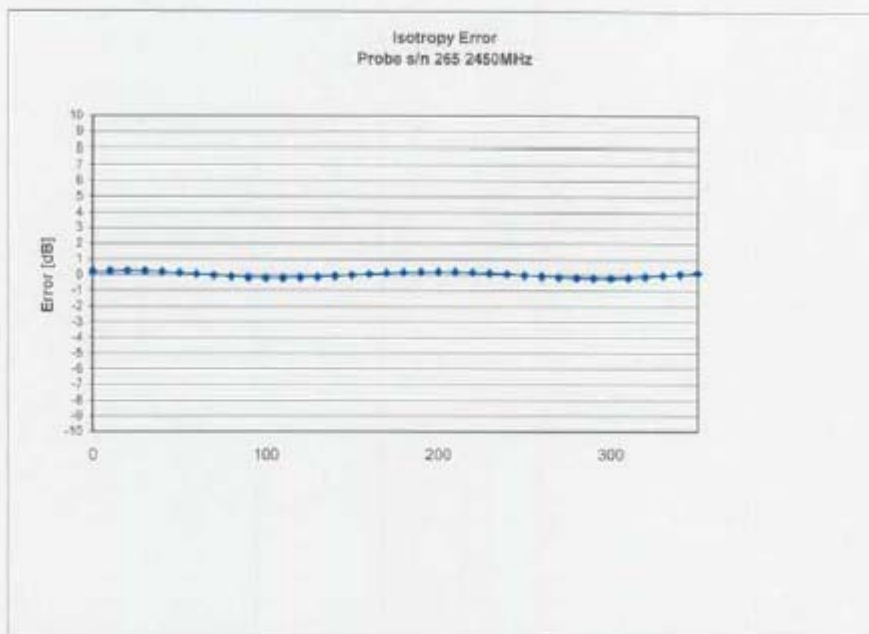
### Spatial Resolution:

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)

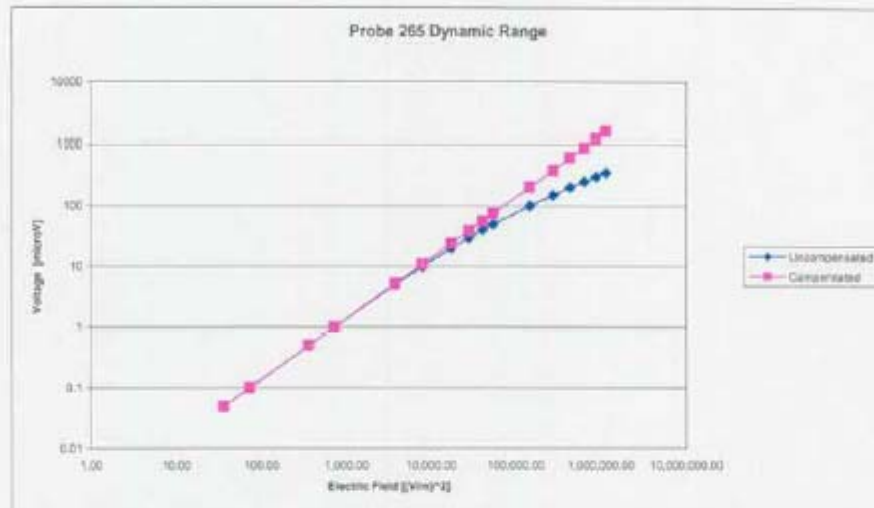


## Isotropy Error 2450 MHz (Air)



Isotropicity in Tissue: 0.10 dB

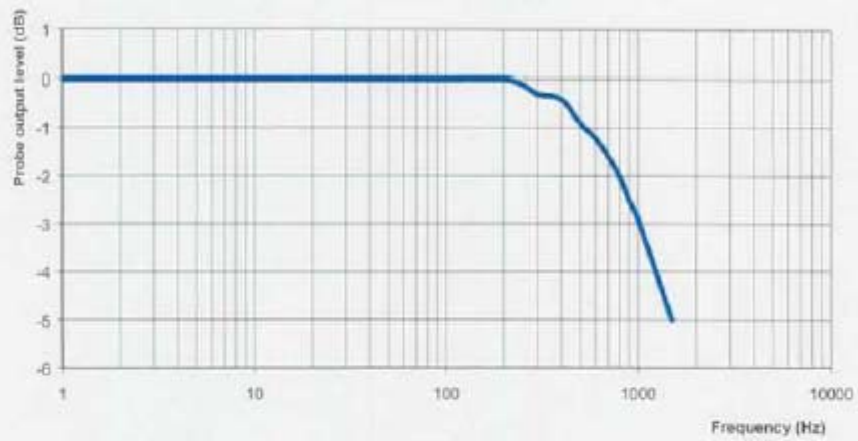
## Dynamic Range





## Video Bandwidth

Probe Frequency Characteristics



Video Bandwidth at 500 Hz      1 dB  
Video Bandwidth at 1000 Hz    3 dB

## NCL Calibration Laboratories

Division of APREL Laboratories

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### Conversion Factor Uncertainty Assessment

<b>Frequency:</b>		2450MHz	
<b>Epsilon:</b>	39.2 (+/-5%)	<b>Sigma:</b>	1.80 S/m (+/-5%)
<b>ConvF</b>			
<b>Channel X:</b>	4.6		7%(K=2)
<b>Channel Y:</b>	4.6		7%(K=2)
<b>Channel Z:</b>	4.6		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 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

## NCL Calibration Laboratories

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Division 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 2004.

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Page 10 of 10

This page has been reviewed for content and attested to on Page 2 of this document.

## NCL CALIBRATION LABORATORIES

Calibration File No.: CP-558

Client: QUIETEK

## 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.: ALS-E-020

Serial No.: 205

BODY Calibration

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2

Project No: QTKB-ALS-E-020 Probe Cal-6001

Calibrated: 23<sup>rd</sup> March 2005

Released on: 23<sup>rd</sup> March 2005

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) 820-6966  
FAX: (613) 820-4101

## NCL Calibration Laboratories

---

Division of APREL Laboratories.

### Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 265.

### References

SSI/DRB-TP-D01-032-E020-V2 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 265 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

We the undersigned attest that to the best of our knowledge the calibration of this probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.



---

Ron Dulmage



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Y. Chen

## NCL Calibration Laboratories

Division of APREL Laboratories.

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### Calibration Results Summary

Probe Type:	E-Field Probe E-020
Serial Number:	265
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:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	1.2 $\mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	95 mV

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Page 3 of 10

This page has been reviewed for content and attested to on Page 2 of this document.

## NCL Calibration Laboratories

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Division of APREL Laboratories.

### Sensitivity in Body Tissue

**Frequency:** 2450 MHz

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

### ConvF

**Channel X:** 4.7

**Channel Y:** 4.7

**Channel Z:** 4.7

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

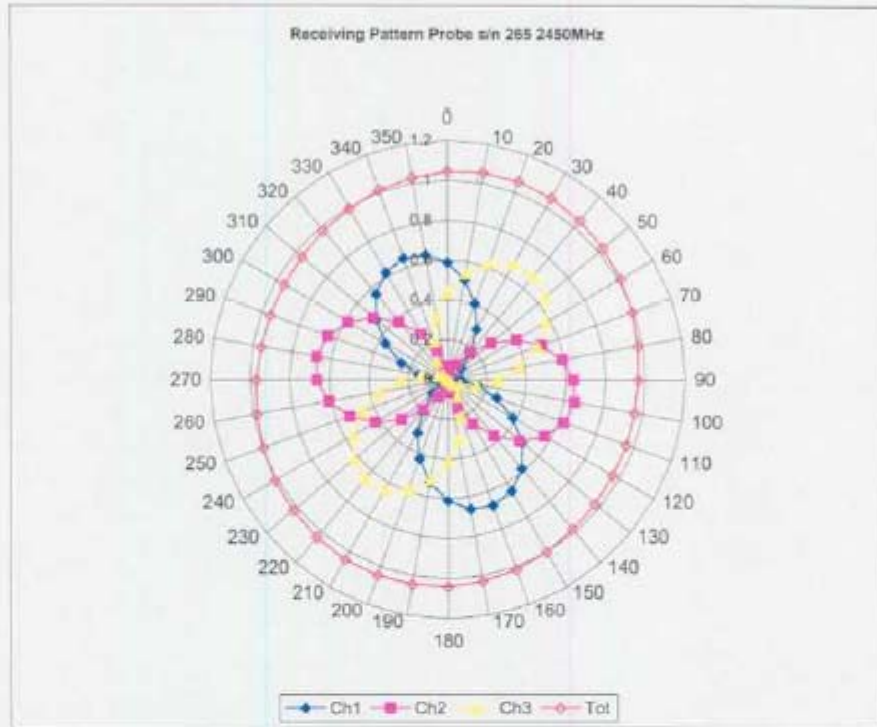
### Boundary Effect:

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 2.44mm.

### 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)

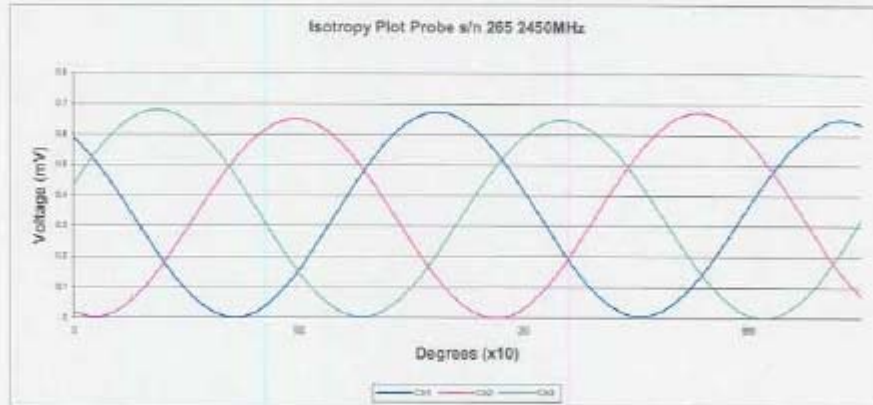
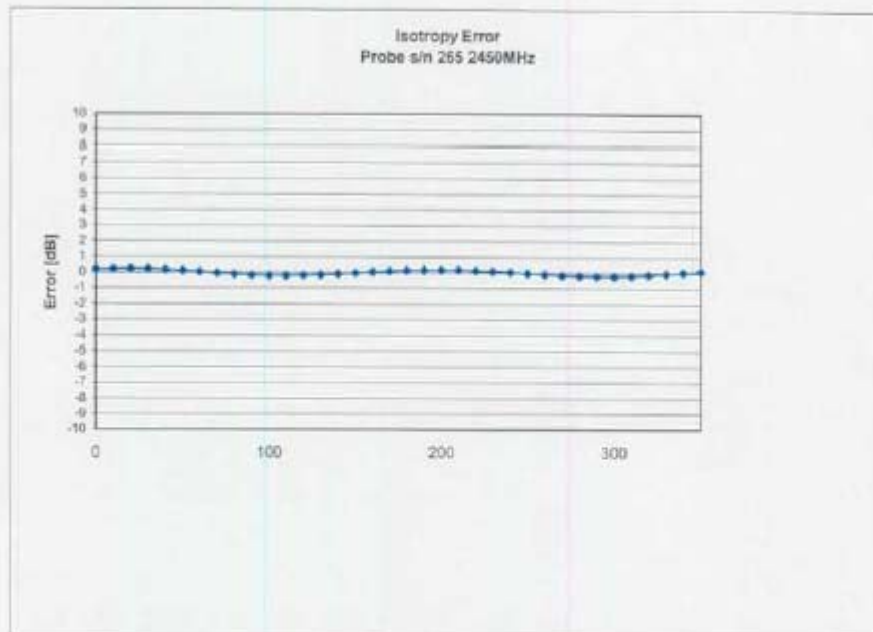




## NCL Calibration Laboratories

Division of APREL Laboratories

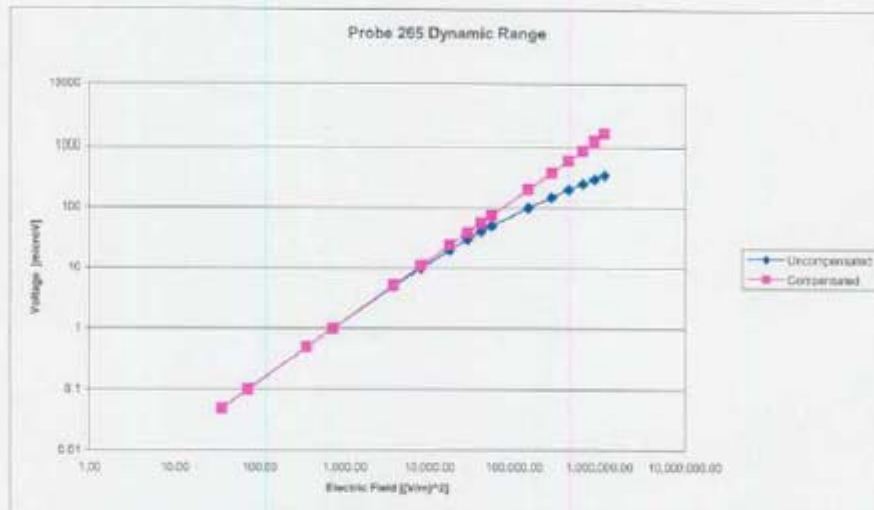
### Isotropy Error 2450 MHz (Air)



Isotropicity in Tissue:

0.10 dB

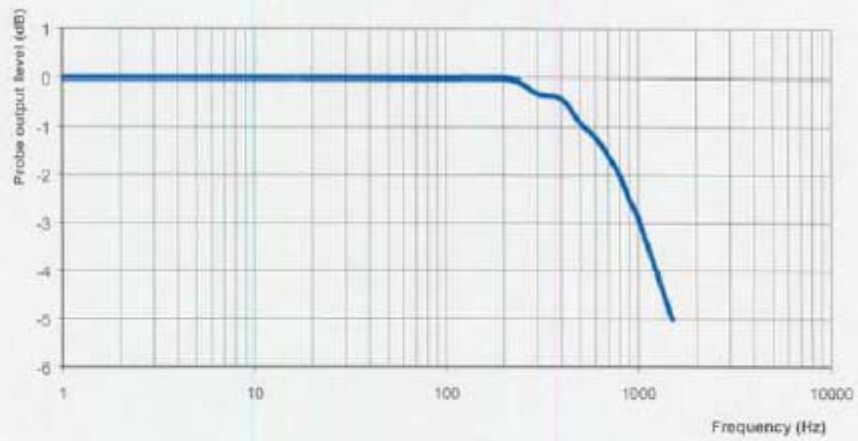
## Dynamic Range



NCL Calibration Laboratories  
Division of APREL Laboratories.

## Video Bandwidth

Probe Frequency Characteristics



Video Bandwidth at 500 Hz      1 dB  
Video Bandwidth at 1000 Hz    3 dB

## NCL Calibration Laboratories

Division of APREL Laboratories.

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### Conversion Factor Uncertainty Assessment

Frequency:		2450MHz	
Epsilon:	52.7 (+/-5%)	Sigma:	1.95 S/m (+/-5%)
ConvF			
Channel X:	4.7		7%(K=2)
Channel Y:	4.7		7%(K=2)
Channel Z:	4.7		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 2.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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Page 9 of 10

This page has been reviewed for content and attested to on Page 2 of this document.

## NCL Calibration Laboratories

Division of APREL Laboratories.

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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 2004.

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Page 10 of 10

This page has been reviewed for content and attested to on Page 2 of this document.



## **Appendix - Dipole Calibration**

**Validation Dipole 2450MHz**

**P/N: ALS-D-2450-S-2**

**S/N: QTK-319**

**NCL CALIBRATION LABORATORIES**

Calibration File No: DC-409  
Project Number: QTKB-ALSAS-10U-5050

**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.

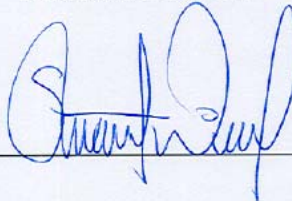
Quietek Validation Dipole

Manufacturer: APREL Laboratories  
Part number: ALS-D-2450-S-2  
Frequency: 2.45 GHz  
Serial No: QTK-319

Customer: Quietek

Calibrated: 23 June 2004  
Released on: 23 June 2004

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

## NCL Calibration Laboratories

Division of APREL Laboratories.

### Calibration Results Summary

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

#### Mechanical Dimensions

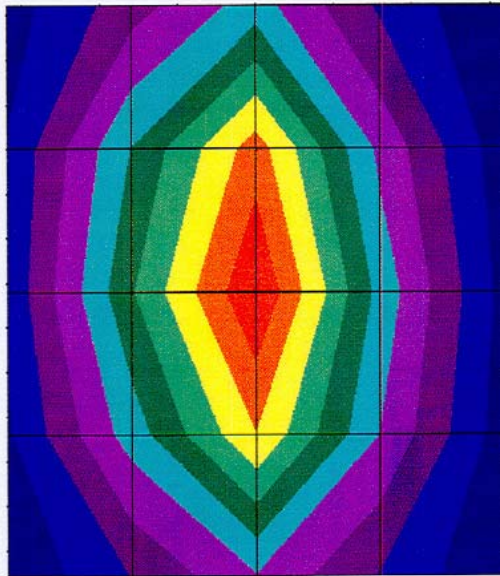
Length: 53.5 mm  
Height: 30.4 mm

#### Electrical Specification

SWR: 1.19 U  
Return Loss: -20.8 dB  
Impedance: 49.4  $\Omega$

#### System Validation Results

Frequency	1 Gram	10 Gram	Peak
2.45 GHz	48.07	25.65	95.6



Page 2 of 9

Calibrated by

Approved by



## NCL Calibration Laboratories

Division of APREL Laboratories.

### Introduction

This Calibration Report has been produced in line with the SSI Dipole Calibration Procedure SSI-TP-018-ALSAS. The results contained within this report are for Validation Dipole QTK-319. 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/APREL mechanical specifications. 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 ALSAS-10U, along with QTK E-020 130 MHz to 26 GHz E-Field Probe Serial Number 212.

### References

SSI-TP-018-ALSAS Dipole Calibration Procedure  
SSI-TP-016 Tissue 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"

### Conditions

Dipole QTK-319 was new taken from stock.

**Ambient Temperature of the Laboratory:** 22 °C +/- 0.5°C  
**Temperature of the Tissue:** 20 °C +/- 0.5°C

## NCL Calibration Laboratories

Division of APREL Laboratories.

### Dipole Calibration Results

#### Mechanical Verification

IEEE Length	IEEE Height	Measured Length	Measured Height
51.5 mm	30.4 mm	53.5 mm	30.4 mm

#### Tissue Validation

Body Tissue 2450 MHz	Measured
Dielectric constant, $\epsilon_r$	52.5
Conductivity, $\sigma$ [S/m]	1.78

**NCL Calibration Laboratories**

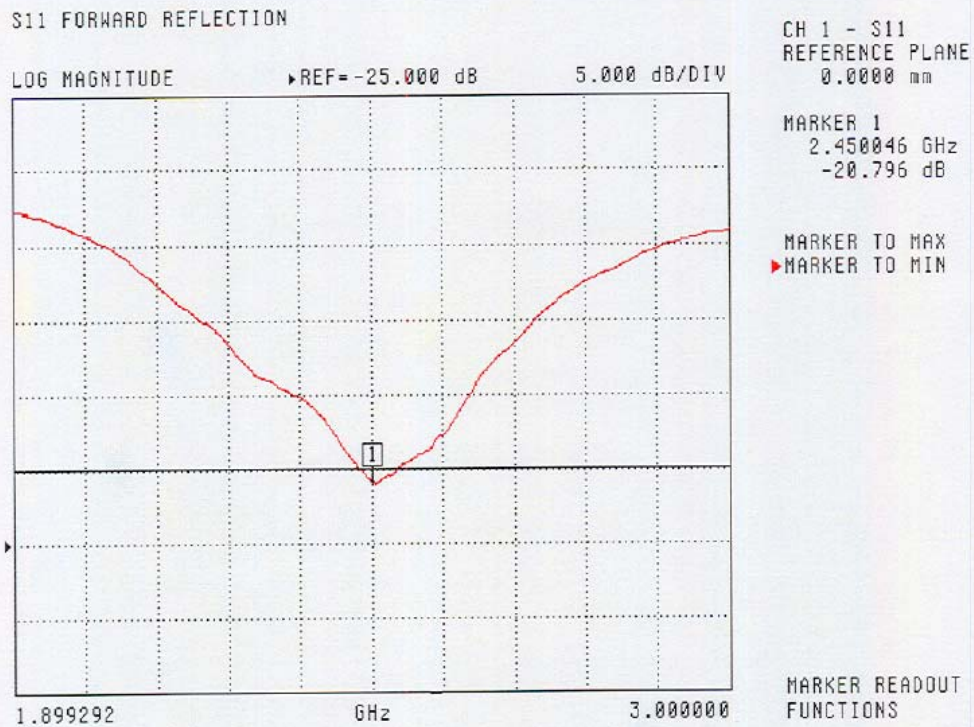
Division of APREL Laboratories.

**Electrical Calibration**

Test	Result
S11 R/L	-20.8 dB
SWR	1.2 U
Impedance	49.4 $\Omega$

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

**S11 Parameter Return Loss**



## NCL Calibration Laboratories

Division of APREL Laboratories.

### SWR

S11 FORWARD REFLECTION

SWR REF=500.000 mU 1.000 U/DIV



CH 1 - S11  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
2.450046 GHz  
1.199 U

MARKER TO MAX  
▶ MARKER TO MIN

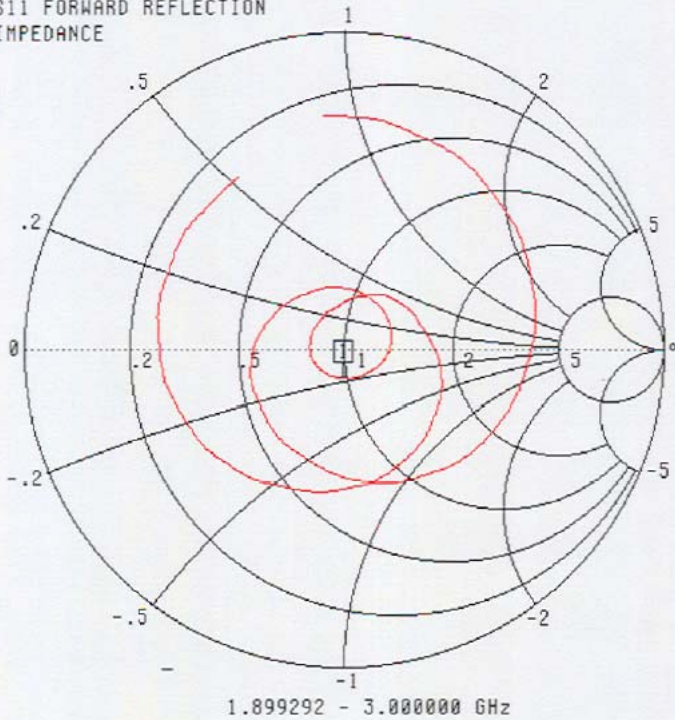
MARKER READOUT  
FUNCTIONS

## NCL Calibration Laboratories

Division of APREL Laboratories.

### Smith Chart Dipole Impedance

S11 FORWARD REFLECTION  
IMPEDANCE



CH 1 - S11  
REFERENCE PLANE  
0.0000 mm

MARKER 1  
2.450046 GHz  
49.365  $\Omega$   
-9.232  $j\Omega$

MARKER TO MAX  
▶ MARKER TO MIN

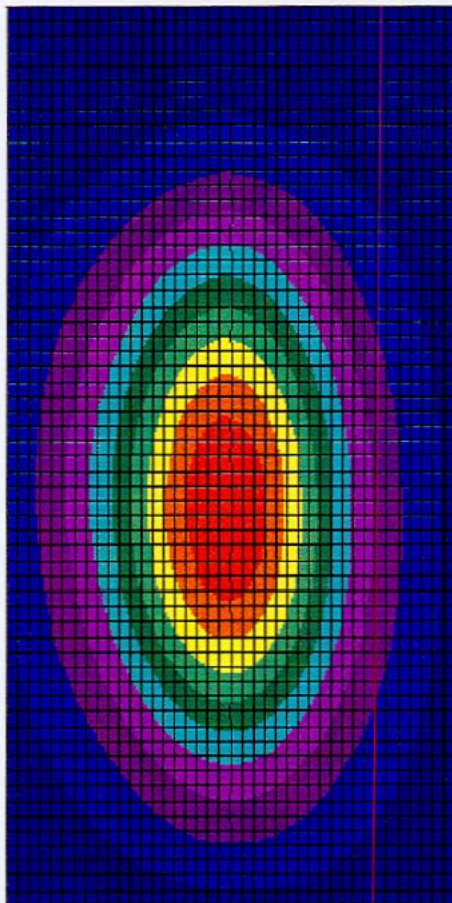
MARKER READOUT  
FUNCTIONS

## NCL Calibration Laboratories

Division of APREL Laboratories.

### System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak Above Feed Point
2.45 GHz	48.07	25.65	95.6



## **NCL Calibration Laboratories**

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Division 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 2003