

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-822

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 835 MHz

Manufacturer: APREL Laboratories

Model No.: ALS-E-020

Serial No.: 264

BODY Calibration

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

Project No: QTKB-E-Probe-5305

Calibrated: 20<sup>th</sup> August 2007  
Released on: 4<sup>th</sup> September 2007

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

## **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-020 264.

### **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

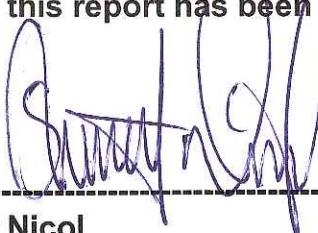
### **Conditions**

Probe 264 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.



Stuart Nicol



J. Hones

**Calibration Results Summary**

**Probe Type:** E-Field Probe E-020

**Serial Number:** 264

**Frequency:** 835 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

## **Sensitivity in Body Tissue**

**Frequency:** 835 MHz

**Epsilon:** 55.2 (+/-5%) **Sigma:** 0.97 S/m (+/-5%)

### **ConvF**

**Channel X:** 6.8

**Channel Y:** 6.8

**Channel Z:** 6.8

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

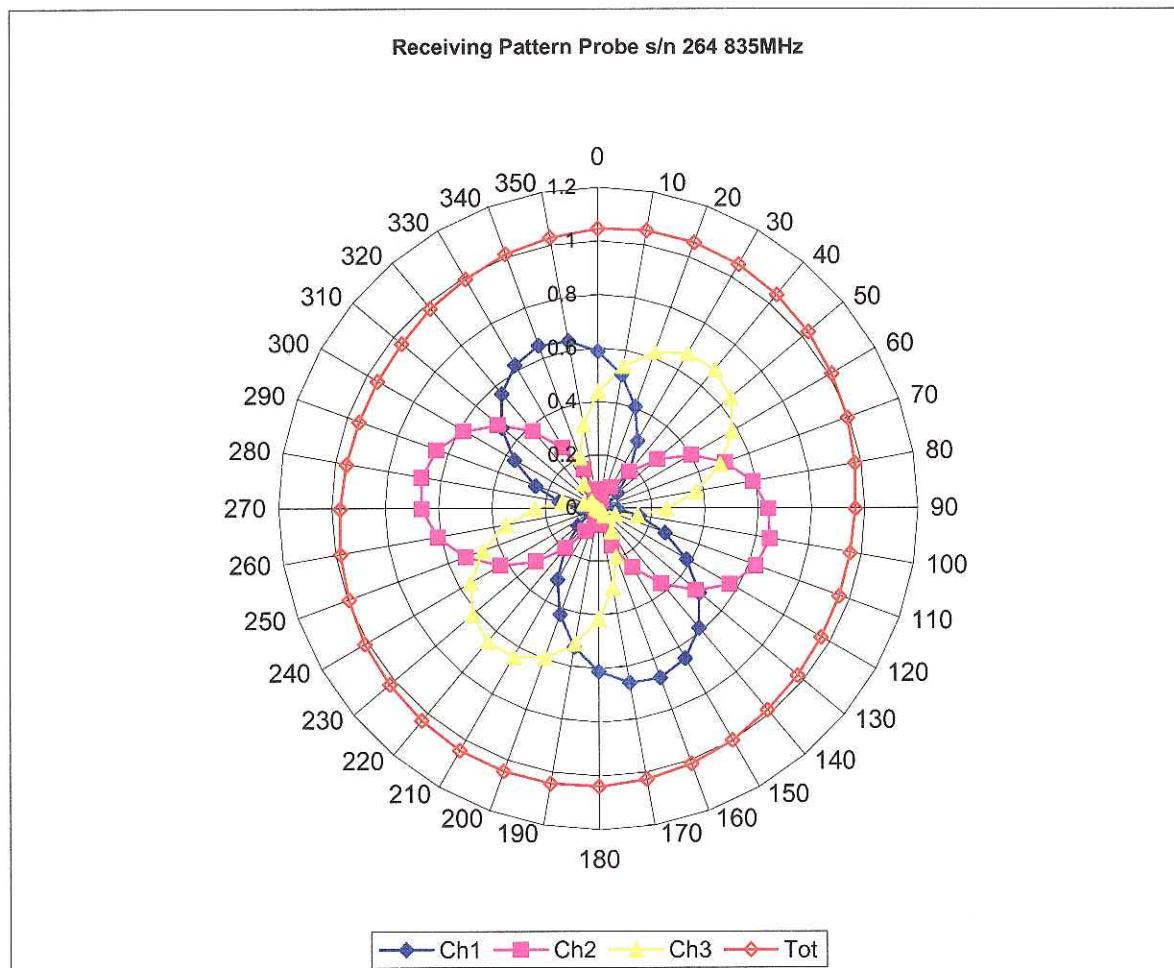
### **Boundary Effect:**

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.

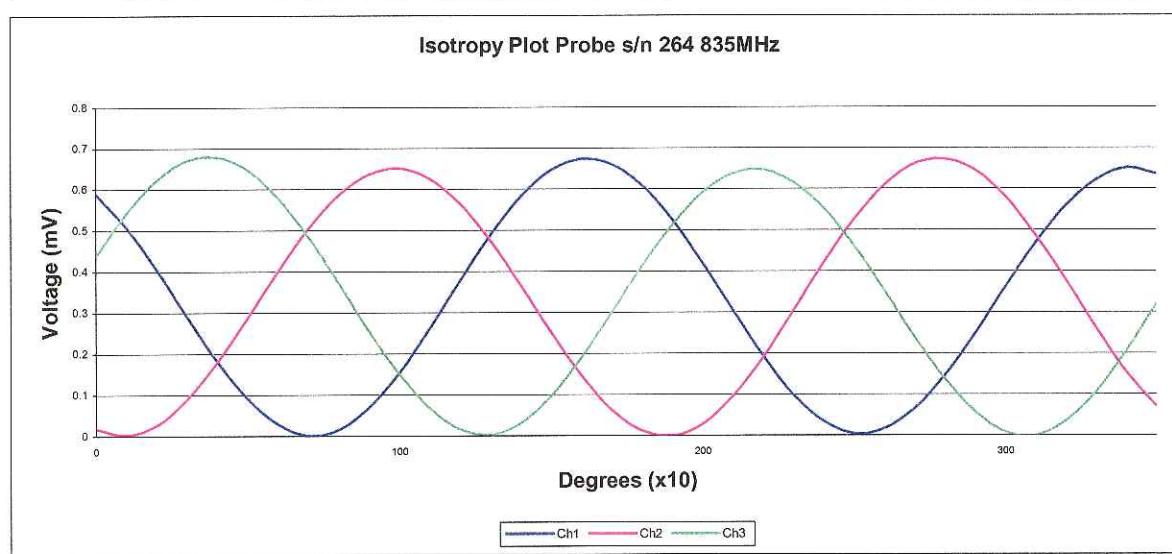
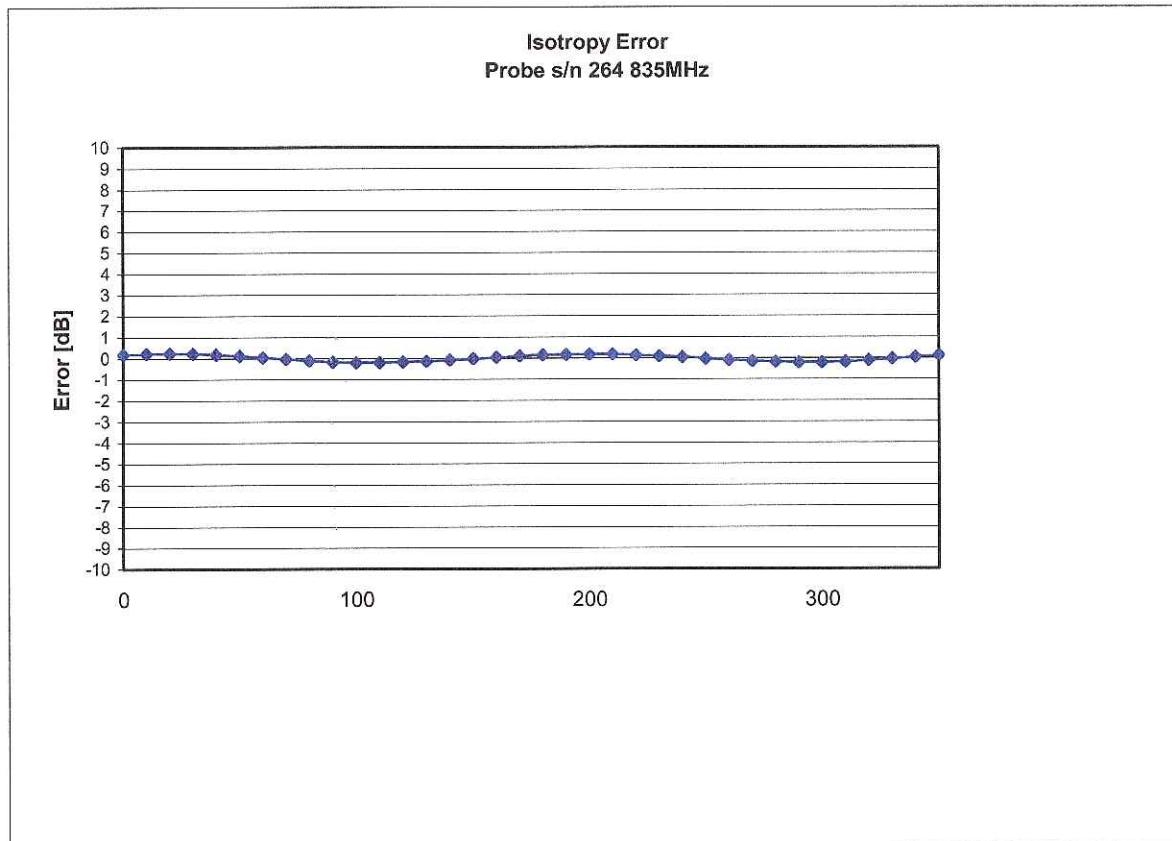
### **Spatial Resolution:**

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 835 MHz (Air)

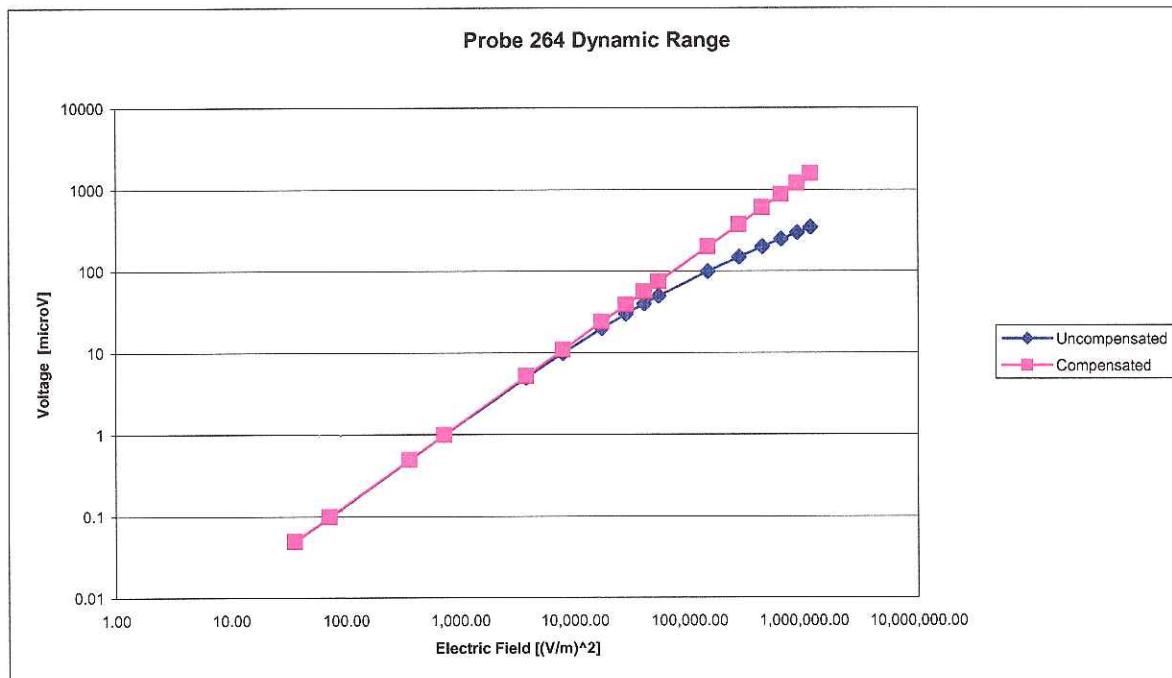


## Isotropy Error 835 MHz (Air)



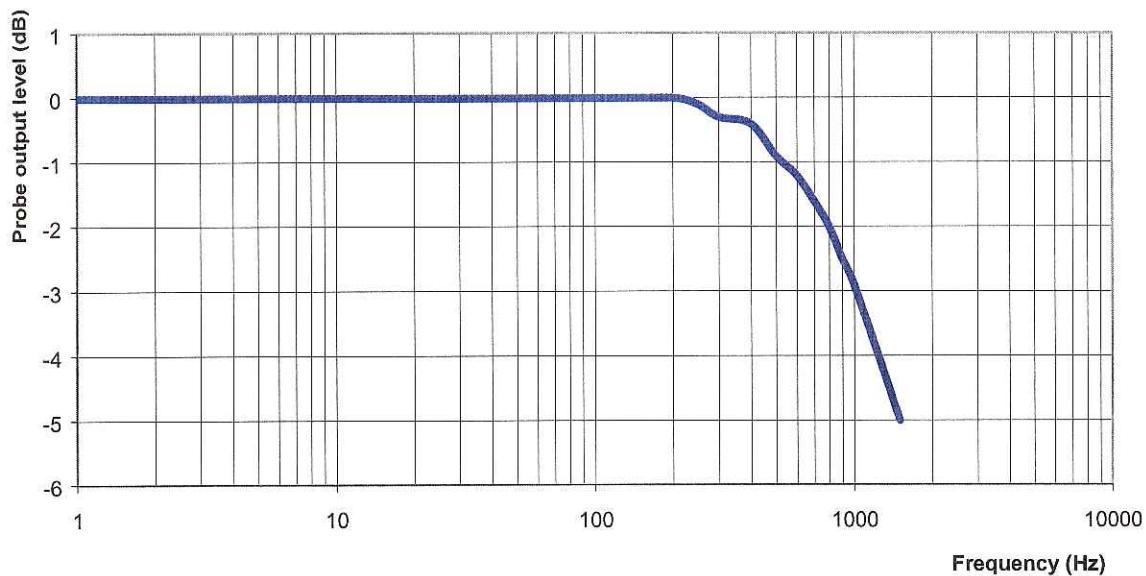
**Isotropicity in Tissue:** 0.10 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



**Video Bandwidth at 500 Hz**

1 dB

**Video Bandwidth at 1000 Hz**

3 dB

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Conversion Factor Uncertainty Assessment**

**Frequency:** 835MHz

**Epsilon:** 55.2 (+/-5%) **Sigma:** 0.97 S/m (+/-5%)

#### **ConvF**

**Channel X:** 6.8 7%(K=2)

**Channel Y:** 6.8 7%(K=2)

**Channel Z:** 6.8 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%.

## **NCL Calibration Laboratories**

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 2007.



## Appendix D. Probe Calibration

**Miniature Isotropic RF Probe**

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

**S/N: 264**

**1900MHz Head Calibration**

**1900MHz Body Calibration**

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-824

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 1900 MHz

Manufacturer: APREL Laboratories

Model No.: ALS-E-020

Serial No.: 264

HEAD Calibration

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

Project No: QTKB-E-Probe-5305

Calibrated: 21<sup>st</sup> August 2007  
Released on: 4<sup>th</sup> September 2007

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

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

**NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
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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-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 264.

## **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

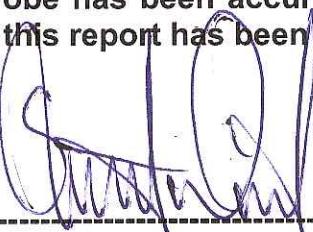
## **Conditions**

Probe 264 was a re-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.



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**Stuart Nicol**



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**J. Hones**

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**NCL Calibration Laboratories**

Division of APREL Laboratories.

## Calibration Results Summary

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	264
<b>Frequency:</b>	1900 MHz
<b>Sensor Offset:</b>	1.56 mm
<b>Sensor Length:</b>	2.5 mm
<b>Tip Enclosure:</b>	Ertalyte*
<b>Tip Diameter:</b>	<5 mm
<b>Tip Length:</b>	60 mm
<b>Total Length:</b>	290 mm

\*Resistive to recommended tissue recipes per IEEE-1528

### Sensitivity in Air

<b>Channel X:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Channel Y:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Channel Z:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Diode Compression Point:</b>	95 mV

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Sensitivity in Head Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 40.0 (+/-5%) **Sigma:** 1.40 S/m (+/-5%)

### **ConvF**

**Channel X:** 5.5

**Channel Y:** 5.5

**Channel Z:** 5.5

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

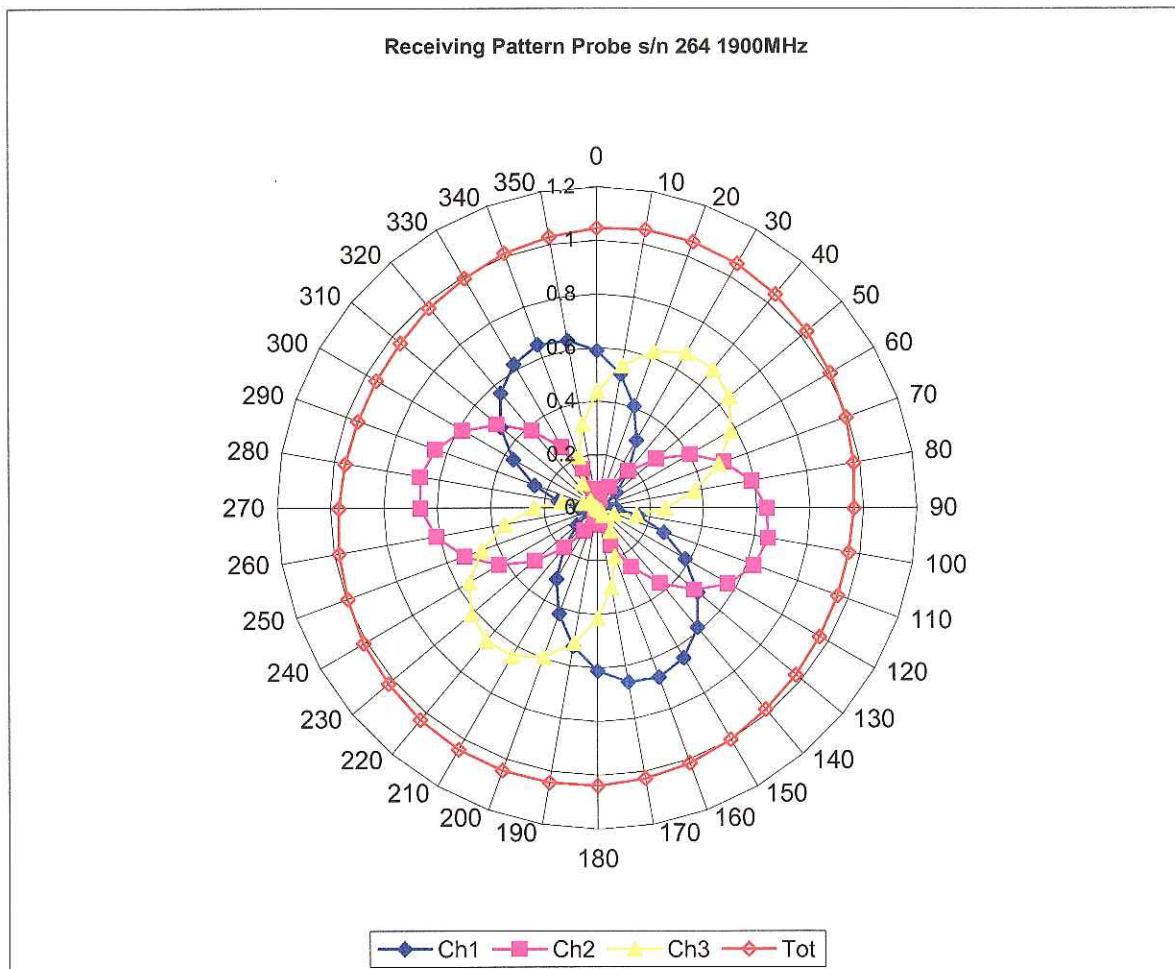
### **Boundary Effect:**

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.

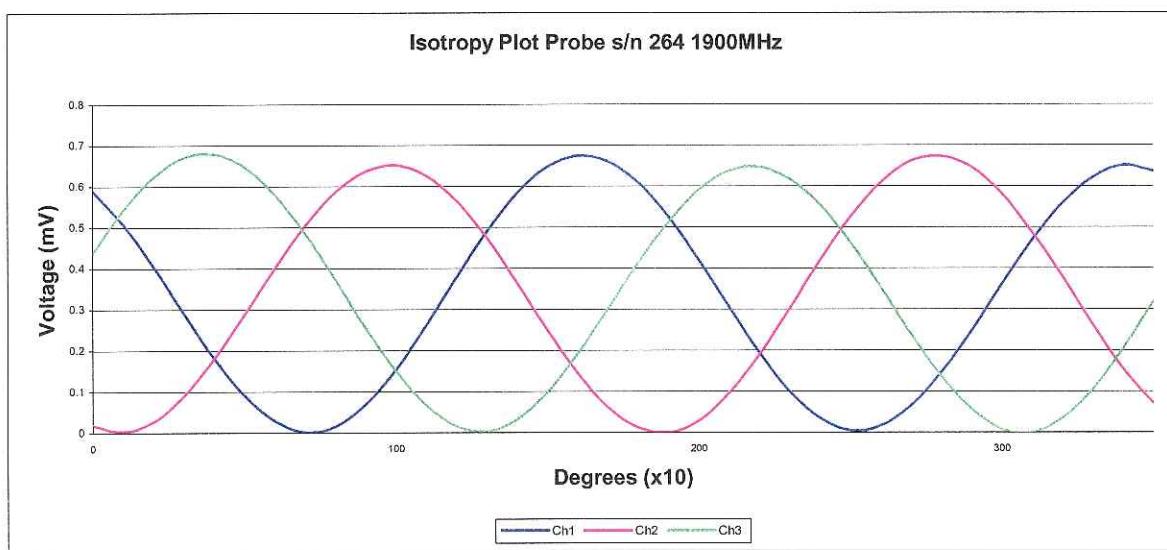
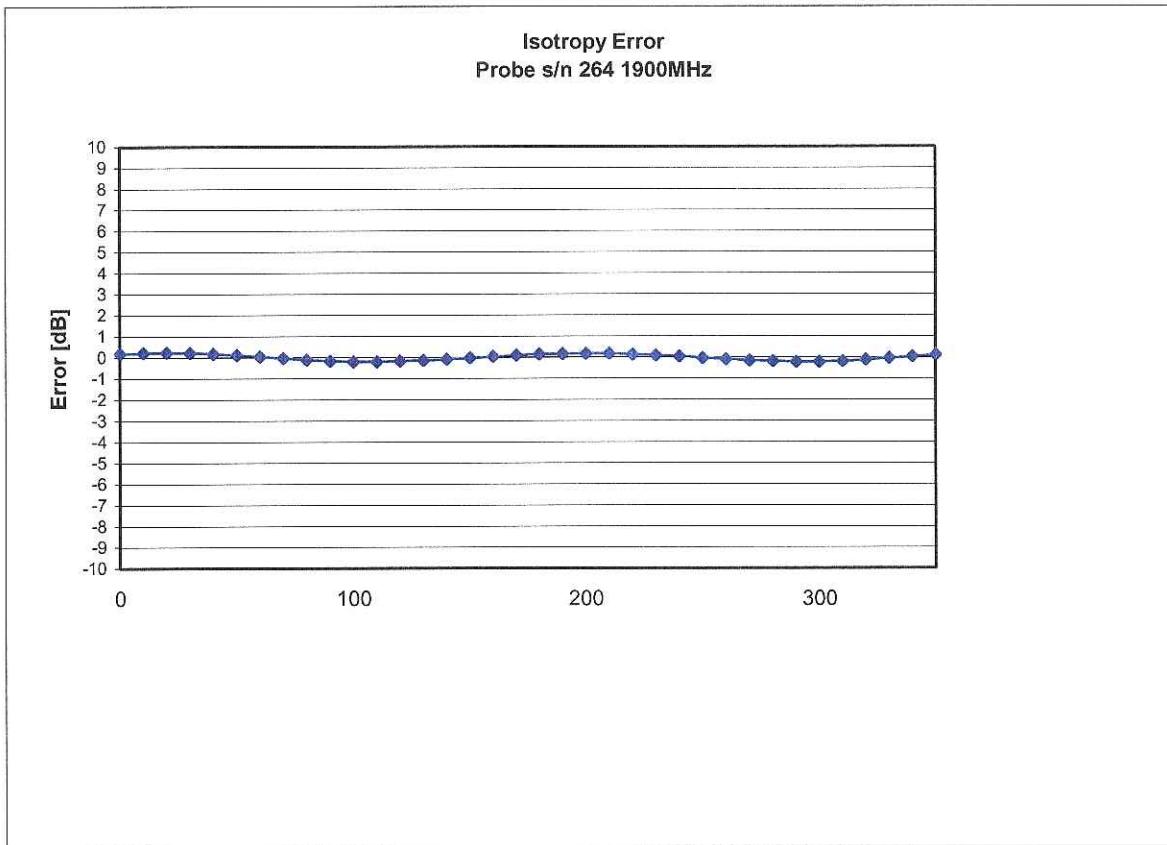
### **Spatial Resolution:**

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 1900 MHz (Air)



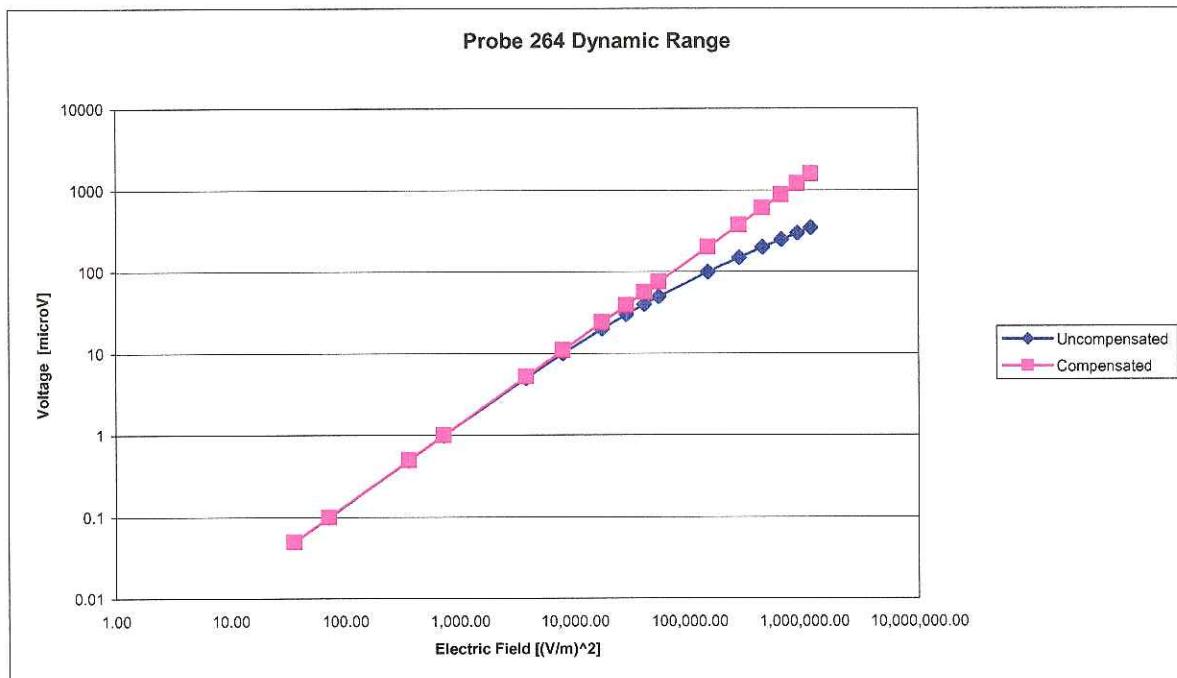
## Isotropy Error 1900 MHz (Air)



**Isotropicity in Tissue:**

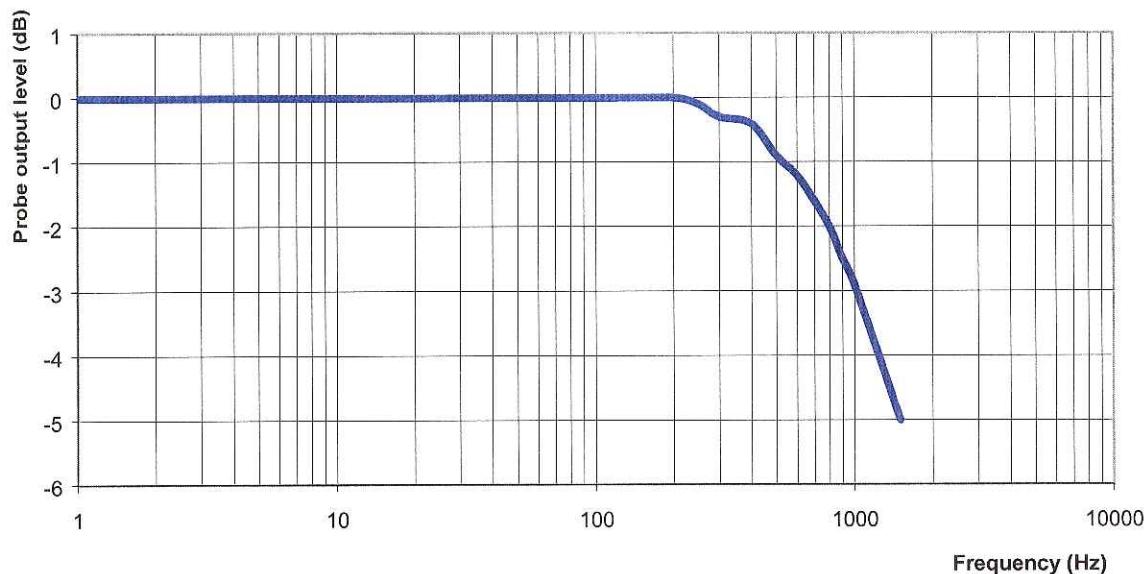
0.10 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



<b>Video Bandwidth at 500 Hz</b>	1 dB
<b>Video Bandwidth at 1000 Hz</b>	3 dB

## **Conversion Factor Uncertainty Assessment**

**Frequency:** 1900MHz

**Epsilon:** 40.0 (+/-5%) **Sigma:** 1.40 S/m (+/-5%)

### **ConvF**

**Channel X:** 5.5 7%(K=2)

**Channel Y:** 5.5 7%(K=2)

**Channel Z:** 5.5 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%.

## **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 2007.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-831

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 1900 MHz

Manufacturer: APREL Laboratories

Model No.: ALS-E-020

Serial No.: 264

BODY Calibration

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

Project No: QTKB-E-Probe-5305

Calibrated: 21<sup>st</sup> August 2007  
Released on: 4<sup>th</sup> September 2007

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

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

**NCL** CALIBRATION LABORATORIES

51 SPECTRUM WAY  
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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-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 264.

## **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 264 was a re-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.



Stuart Nicol



J. Hones

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Calibration Results Summary**

<b>Probe Type:</b>	E-Field Probe E-020
<b>Serial Number:</b>	264
<b>Frequency:</b>	1900 MHz
<b>Sensor Offset:</b>	1.56 mm
<b>Sensor Length:</b>	2.5 mm
<b>Tip Enclosure:</b>	Ertalyte*
<b>Tip Diameter:</b>	<5 mm
<b>Tip Length:</b>	60 mm
<b>Total Length:</b>	290 mm

\*Resistive to recommended tissue recipes per IEEE-1528

### **Sensitivity in Air**

<b>Channel X:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Channel Y:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Channel Z:</b>	1.2 $\mu$ V/(V/m) <sup>2</sup>
<b>Diode Compression Point:</b>	95 mV

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Sensitivity in Body Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 53.3 (+/-5%) **Sigma:** 1.52 S/m (+/-5%)

#### **ConvF**

**Channel X:** 5.75

**Channel Y:** 5.75

**Channel Z:** 5.75

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

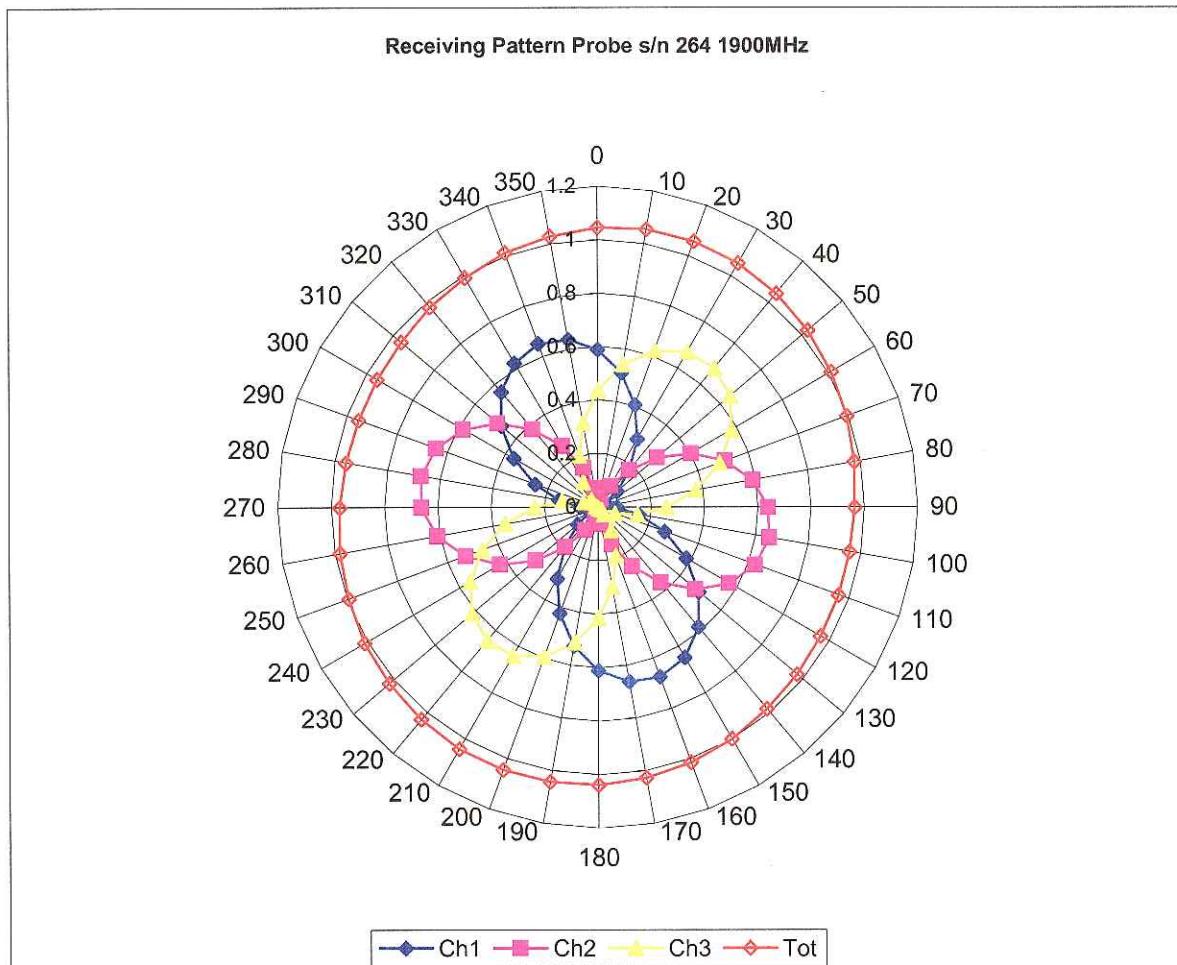
### **Boundary Effect:**

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.

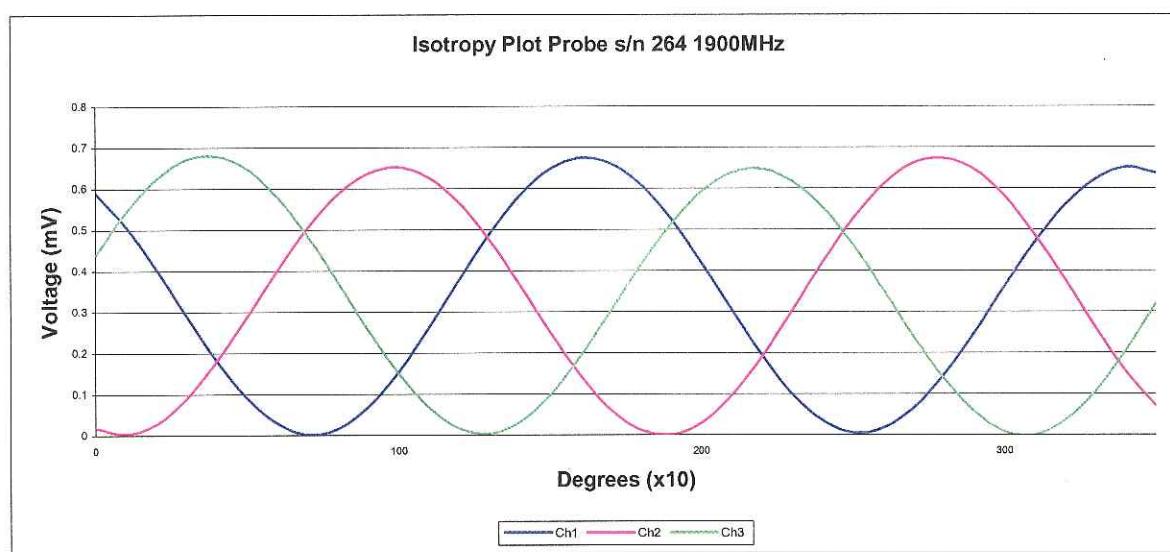
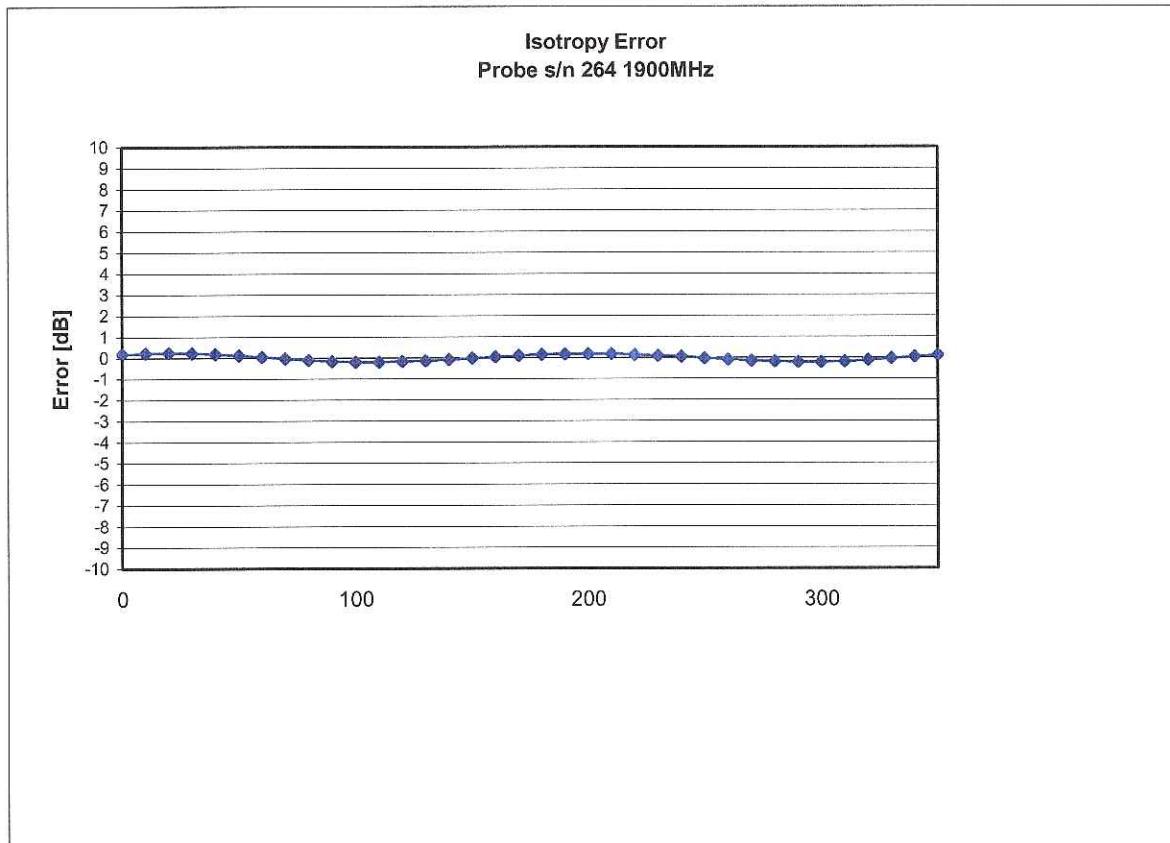
### **Spatial Resolution:**

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 1900 MHz (Air)



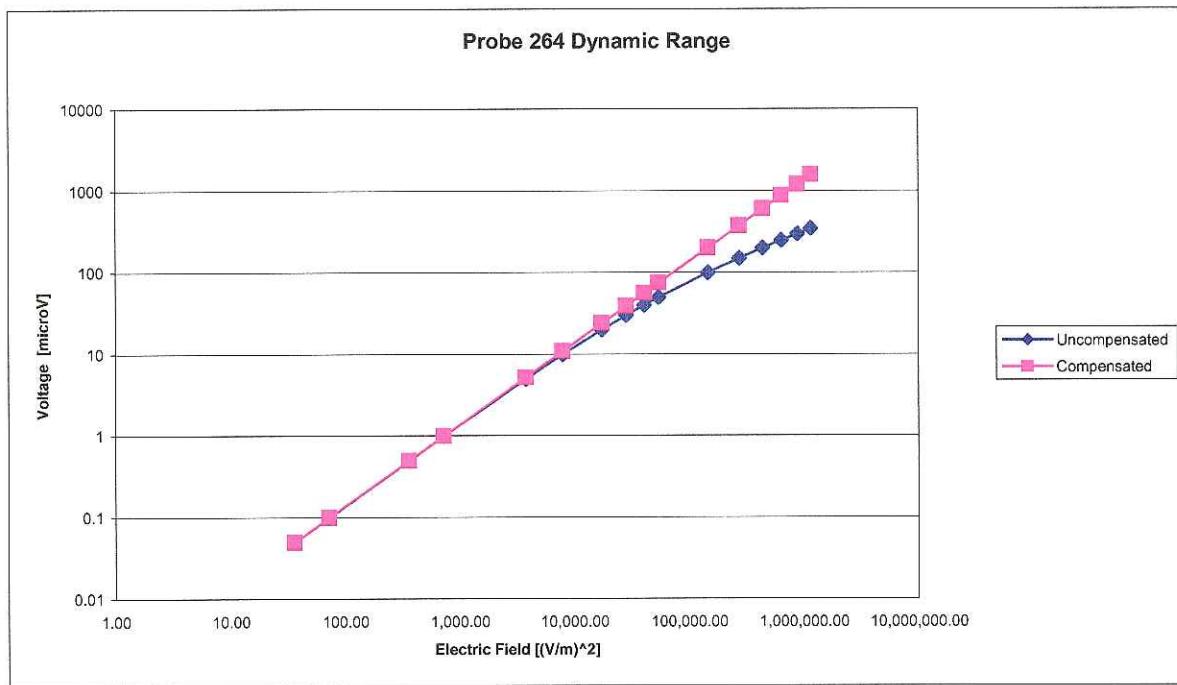
## Isotropy Error 1900 MHz (Air)



**Isotropicity in Tissue:**

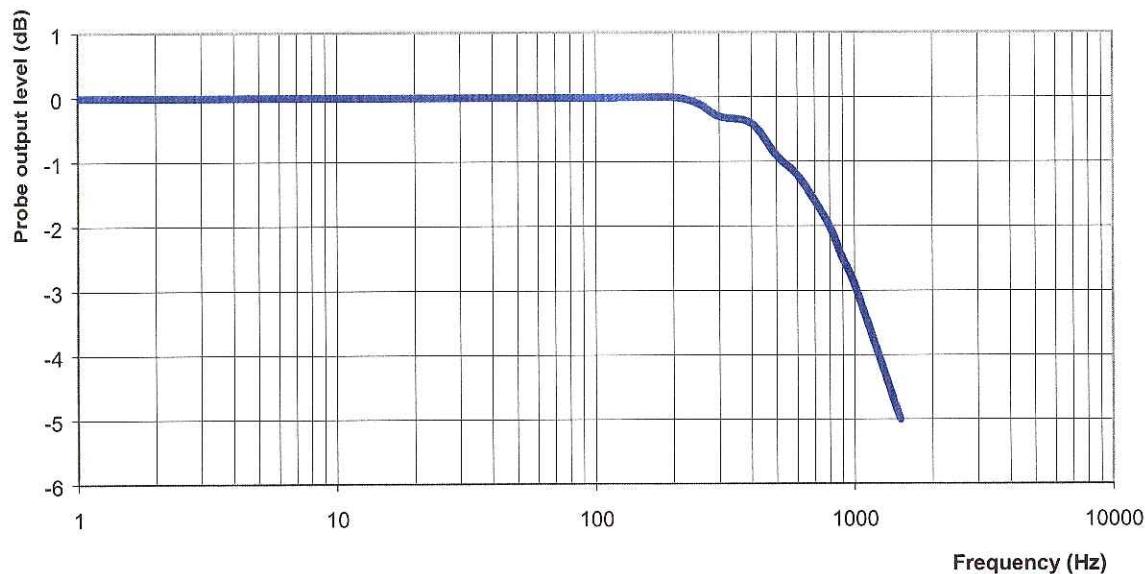
0.10 dB

## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



**Video Bandwidth at 500 Hz**

1 dB

**Video Bandwidth at 1000 Hz**

3 dB

## **Conversion Factor Uncertainty Assessment**

**Frequency:** 1900MHz

**Epsilon:** 53.3 (+/-5%) **Sigma:** 1.52 S/m (+/-5%)

### **ConvF**

**Channel X:** 5.75 7%(K=2)

**Channel Y:** 5.75 7%(K=2)

**Channel Z:** 5.75 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%.

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Test Equipment**

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