

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-695

Client.: Wistron

## 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 1800 MHz

BODY Calibration

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 266

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2  
Project No: QTKB-ALS-E020-CAL-5238

Calibrated: 21<sup>st</sup> June 2006  
Released on: 22<sup>nd</sup> June 2006

APREL Laboratories Certified Under Laboratory 48 of SCC

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-020 266.

### **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

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

### **Conditions**

Probe 266 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**  
-----  
**Jesse Hones**

## **Calibration Results Summary**

|                       |                     |
|-----------------------|---------------------|
| <b>Probe Type:</b>    | E-Field Probe E-020 |
| <b>Serial Number:</b> | 266                 |
| <b>Frequency:</b>     | 1800 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>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Y:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Z:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Diode Compression Point:</b> | 95 mV                                   |

## **NCL Calibration Laboratories**

---

Division of APREL Laboratories.

### **Sensitivity in Body Tissue**

**Frequency:** 1800 MHz

**Epsilon:** 53.3 (+/-5%)

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

#### **ConvF**

**Channel X:** 5.63

**Channel Y:** 5.63

**Channel Z:** 5.63

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

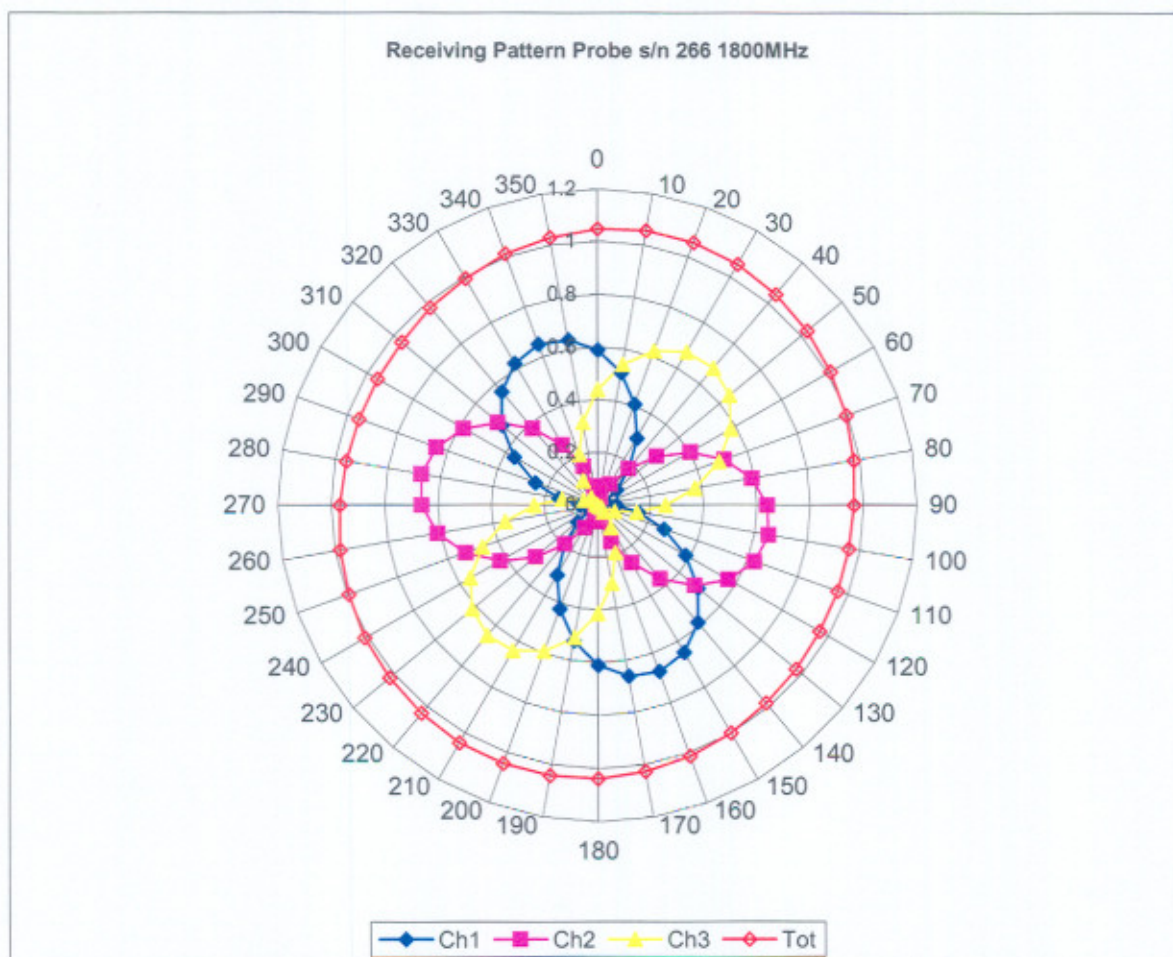
### **Boundary Effect:**

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.

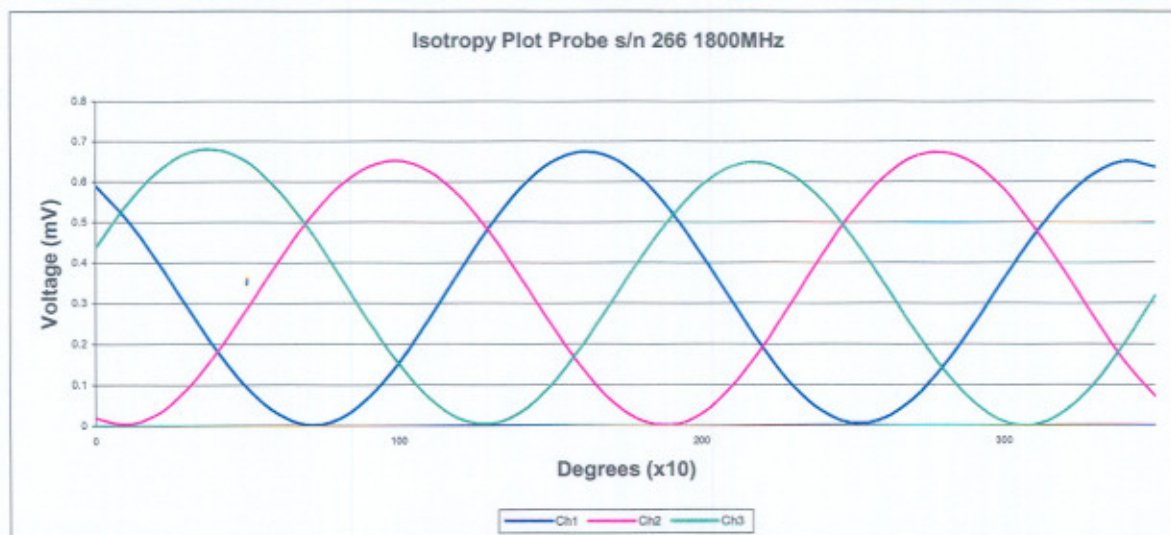
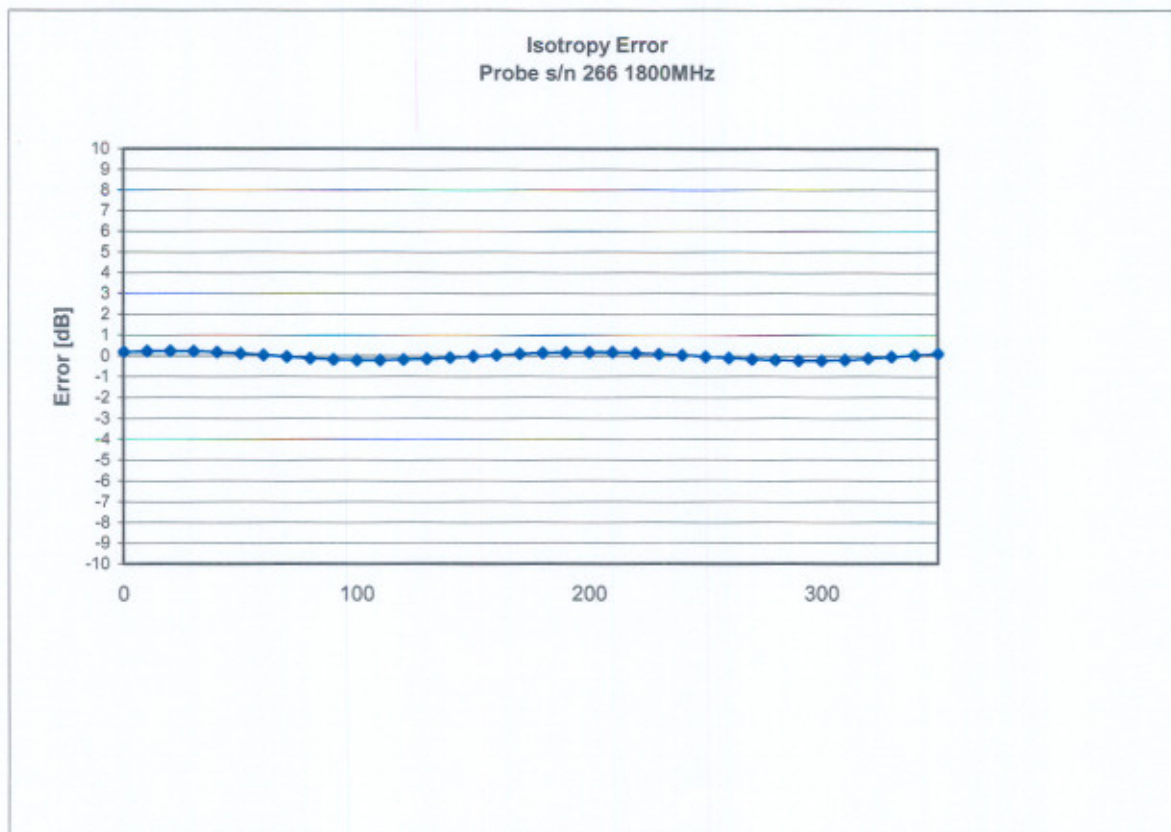
### **Spatial Resolution:**

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 1800 MHz (Air)



## Isotropy Error 1800 MHz (Air)



Isotropy in Tissue:

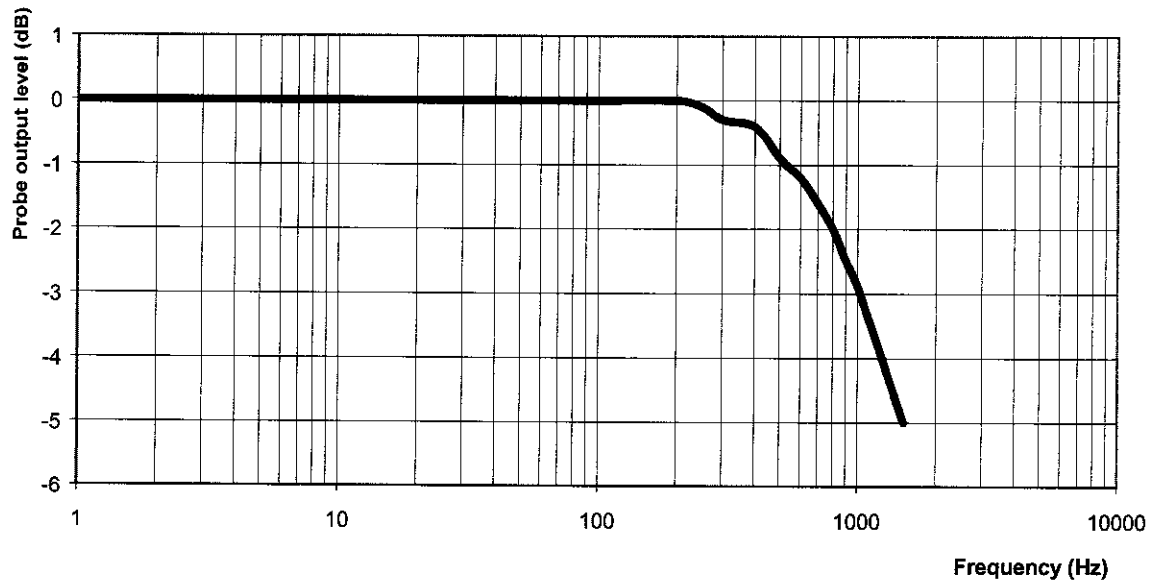
0.10 dB



Figure 1 is a log-log plot titled "Probe 266 Dynamic Range". The y-axis is labeled "Voltage [microV]" and ranges from 0.01 to 10,000. The x-axis is labeled "Electric Field [(V/m)^2]" and ranges from 1.00 to 10,000,000.00. Two data series are plotted: "Uncompensated" (blue line with diamond markers) and "Compensated" (pink line with square markers). The compensated data shows a much wider dynamic range, extending from approximately 0.05 microV at 40 (V/m)^2 to about 1500 microV at 2,000,000 (V/m)^2. The uncompensated data only extends from about 0.05 microV to 300 microV at the same electric field range. Both series show a linear relationship on the log-log scale, indicating a power-law relationship between voltage and electric field.

## 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:** 1800MHz

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

### **ConvF**

**Channel X:** 5.63      7%(K=2)

**Channel Y:** 5.63      7%(K=2)

**Channel Z:** 5.63      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**

---

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.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-696

Client.: Wistron

## 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.: E-020

Serial No.: 266

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2  
Project No: QTKB-ALS-E020-CAL-5238

Calibrated: 21<sup>st</sup> June 2006  
Released on: 22<sup>nd</sup> June 2006

APREL Laboratories Certified Under Laboratory 48 of SCC

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-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-020 266.

## 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

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

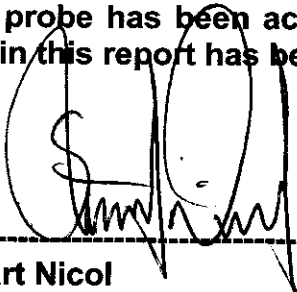
## Conditions

Probe 266 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**



-----  
**Jesse Hones**

## **Calibration Results Summary**

|                       |                     |
|-----------------------|---------------------|
| <b>Probe Type:</b>    | E-Field Probe E-020 |
| <b>Serial Number:</b> | 266                 |
| <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>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Y:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Z:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Diode Compression Point:</b> | 95 mV                                   |

## **NCL Calibration Laboratories**

---

Division of APREL Laboratories.

### **Sensitivity in Head Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 40.0 (+/-5%)      **Sigma:** 1.40 S/m (+/-10%)

### **ConvF**

**Channel X:** 5.22

**Channel Y:** 5.22

**Channel Z:** 5.22

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

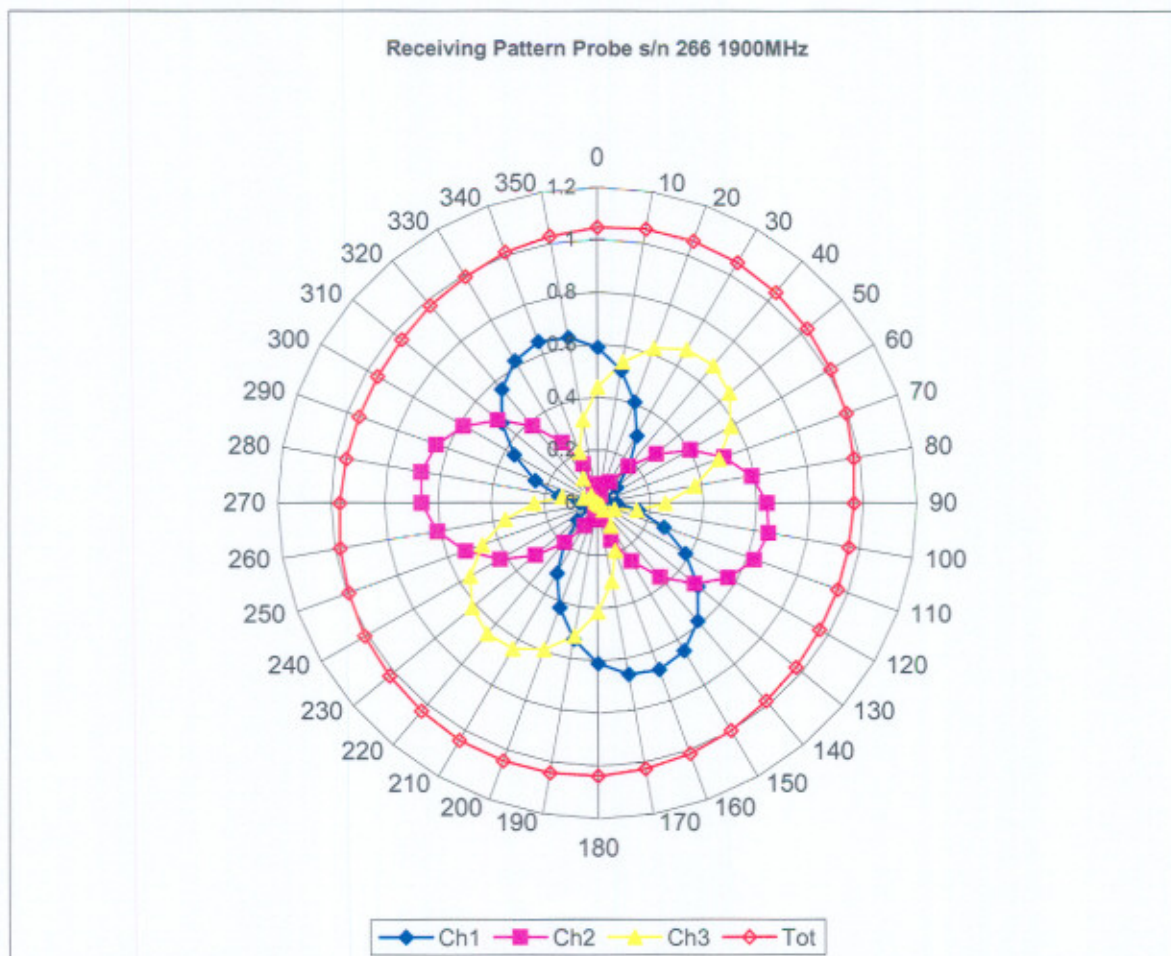
### **Boundary Effect:**

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:**

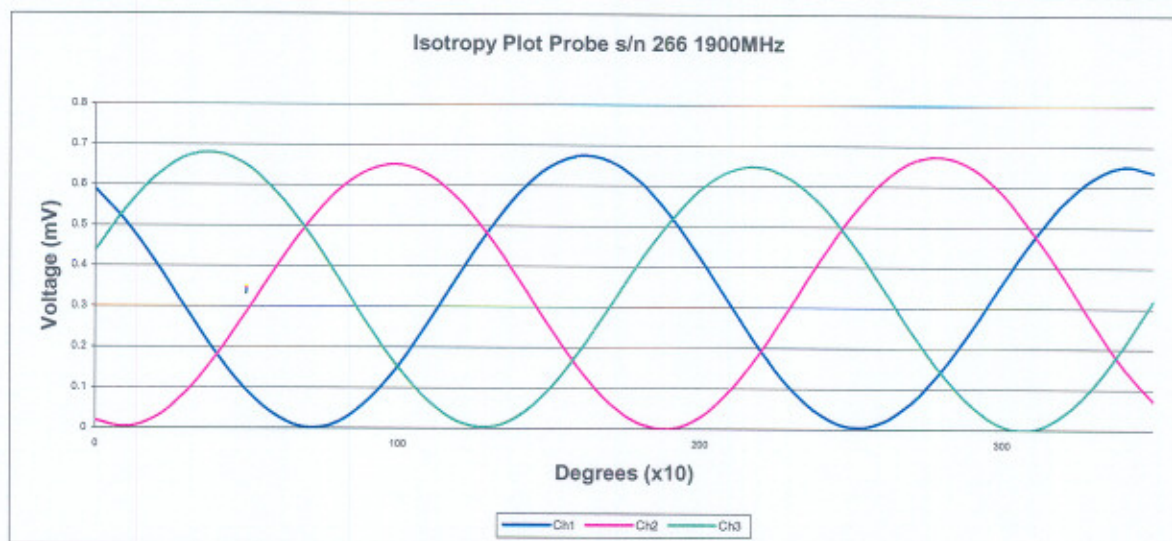
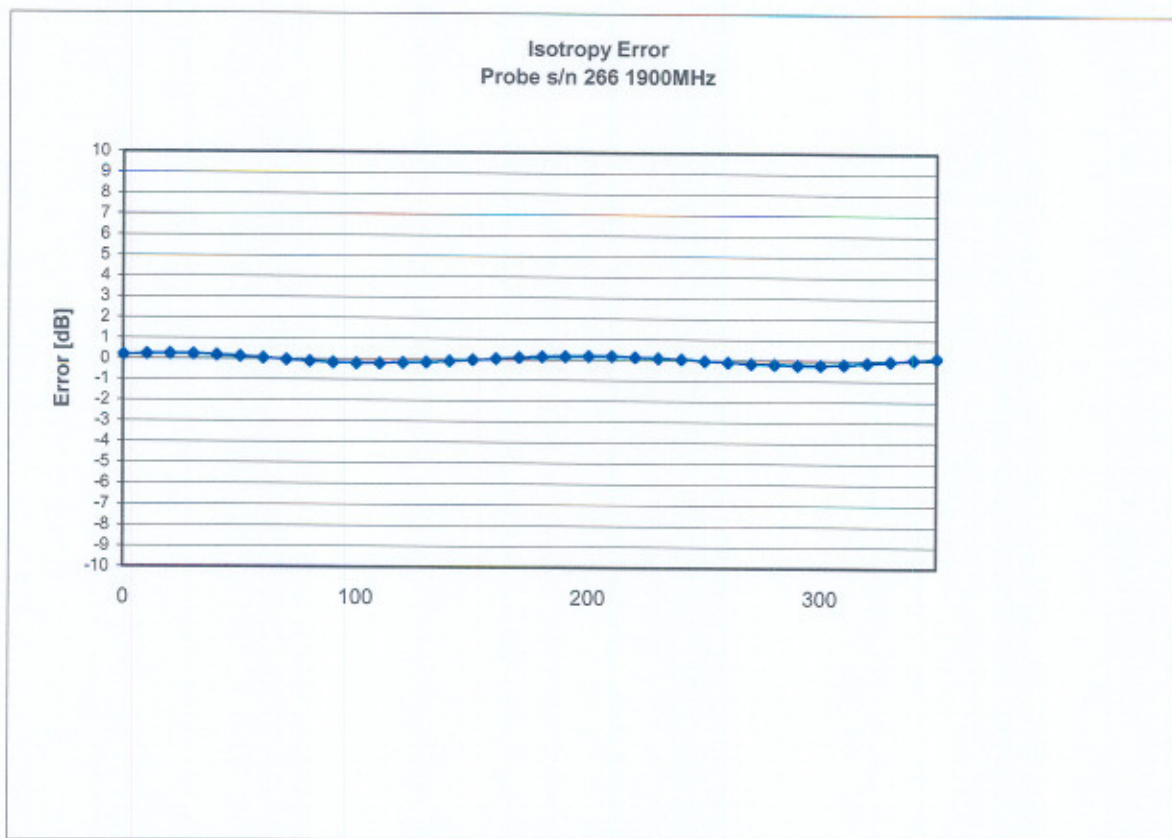
The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

## Receiving Pattern 1900 MHz (Air)





## Isotropy Error 1900 MHz (Air)



Isotropy Tissue:

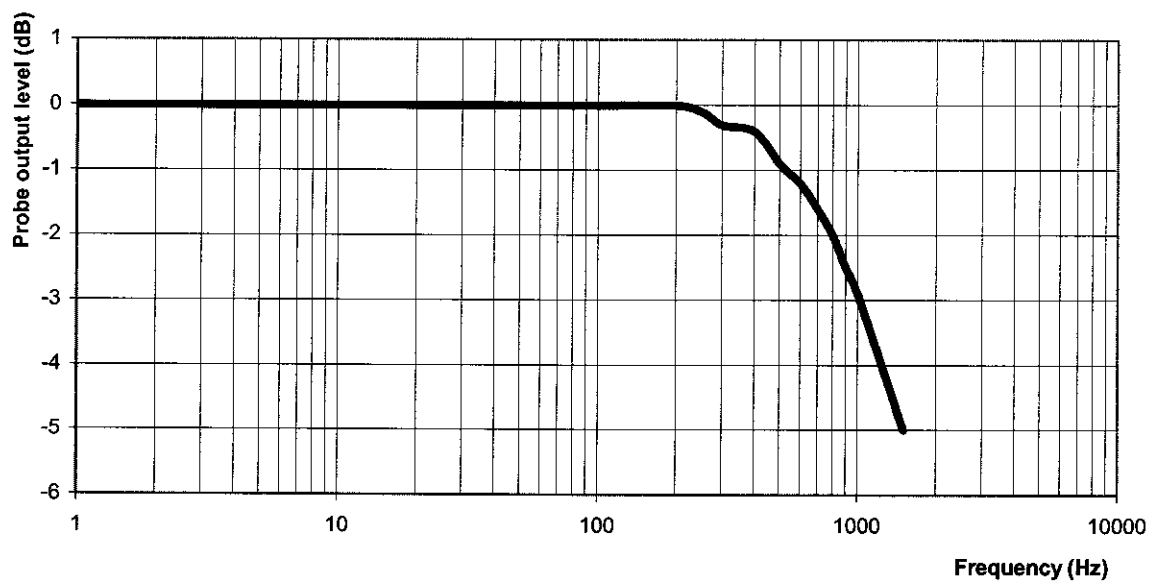
0.10 dB

## 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**

### **Sensitivity in Head Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 40.0 (+/-5%)

**Sigma:** 1.40 S/m (+/-10%)

#### **ConvF**

**Channel X:** 5.22 7%(K=2)

**Channel Y:** 5.22 7%(K=2)

**Channel Z:** 5.22 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 2.5mm 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 2006.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-697

Client.: Wistron

## 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

BODY Calibration

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 266

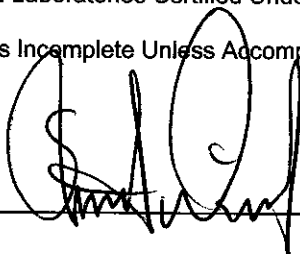
Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2  
Project No: QTKB-ALS-E020-CAL-5238

Calibrated: 21<sup>st</sup> June 2006  
Released on: 22<sup>nd</sup> June 2006

APREL Laboratories Certified Under Laboratory 48 of SCC

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-020 266.

### **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

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

### **Conditions**

Probe 266 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**



---

**Jesse Hones**



## **NCL Calibration Laboratories**

Division of APREL Laboratories.

---

### **Calibration Results Summary**

|                       |                     |
|-----------------------|---------------------|
| <b>Probe Type:</b>    | E-Field Probe E-020 |
| <b>Serial Number:</b> | 266                 |
| <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>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Y:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Z:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Diode Compression Point:</b> | 95 mV                                   |

## **NCL Calibration Laboratories**

---

Division of APREL Laboratories.

### **Sensitivity in Body Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 53.3 (+/-5%)

**Sigma:** 1.52 S/m (+/-10%)

#### **ConvF**

**Channel X:** 5.41

**Channel Y:** 5.41

**Channel Z:** 5.41

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

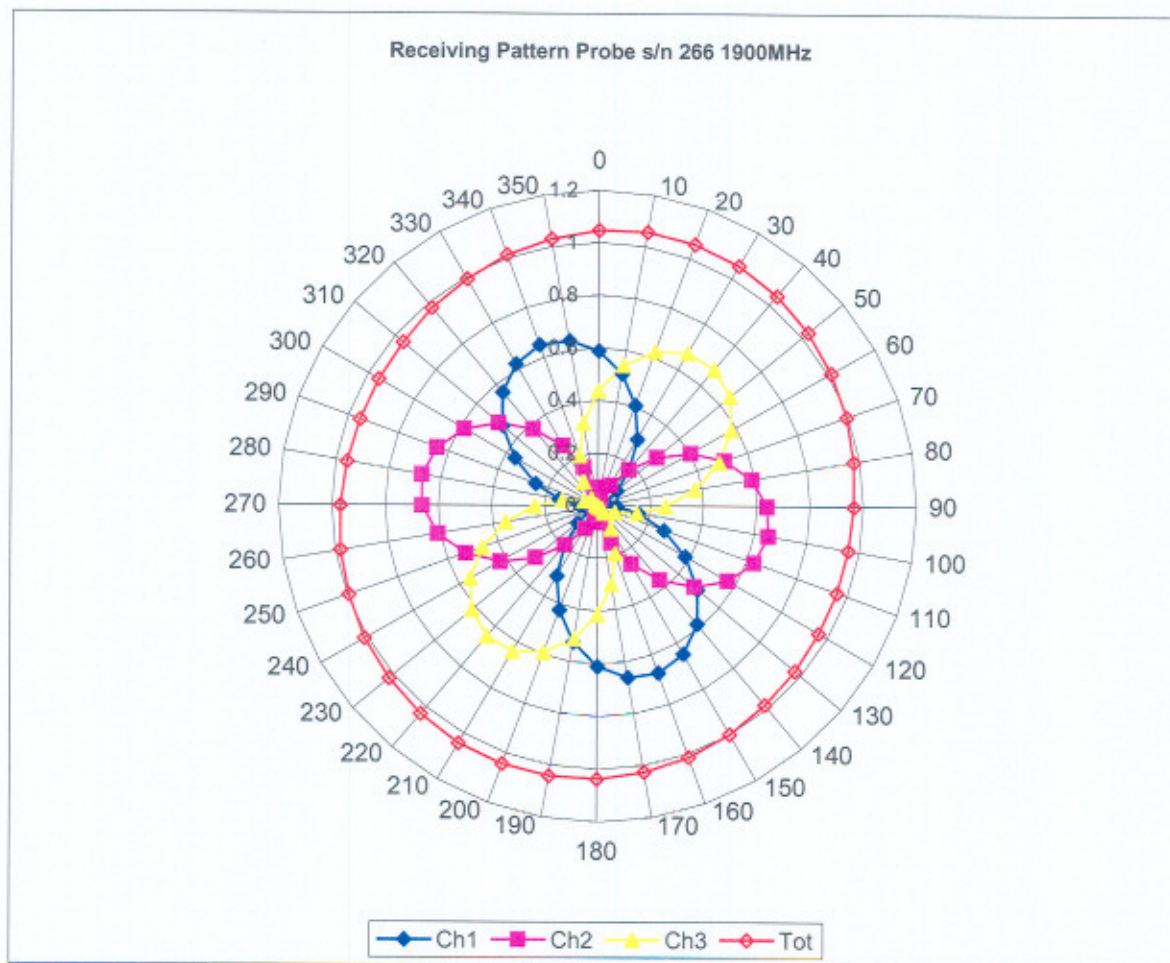
### **Boundary Effect:**

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.

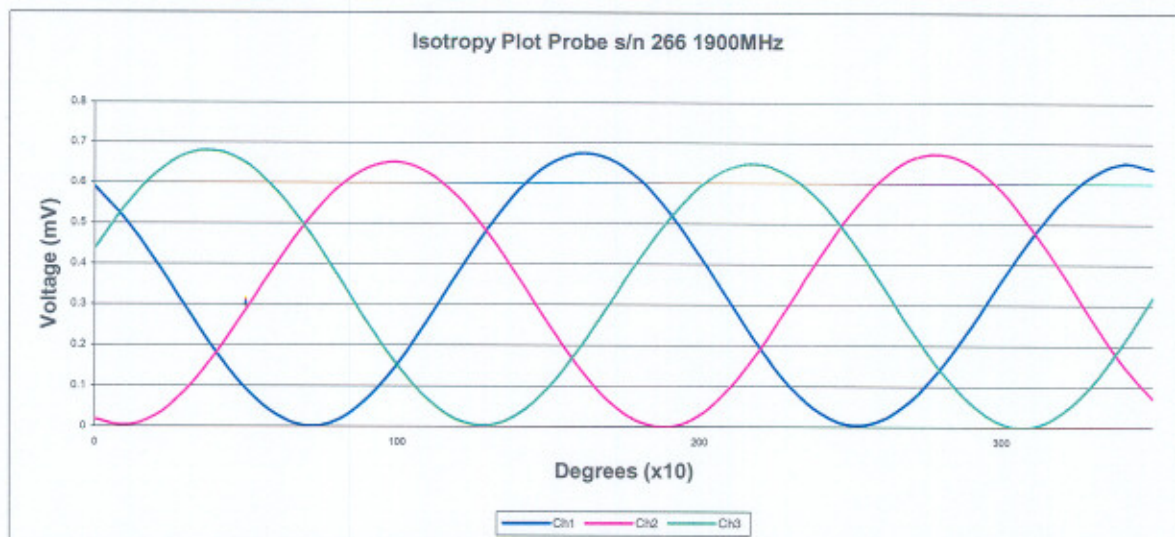
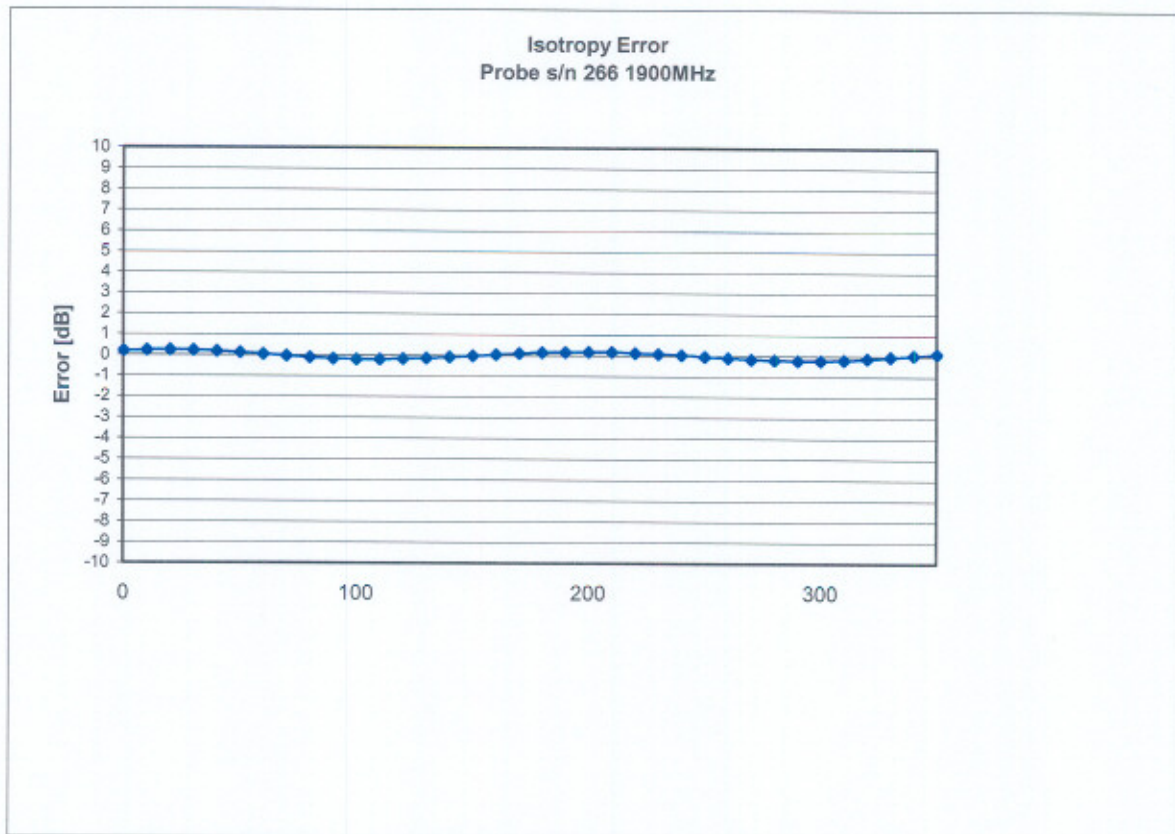
### **Spatial Resolution:**

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)



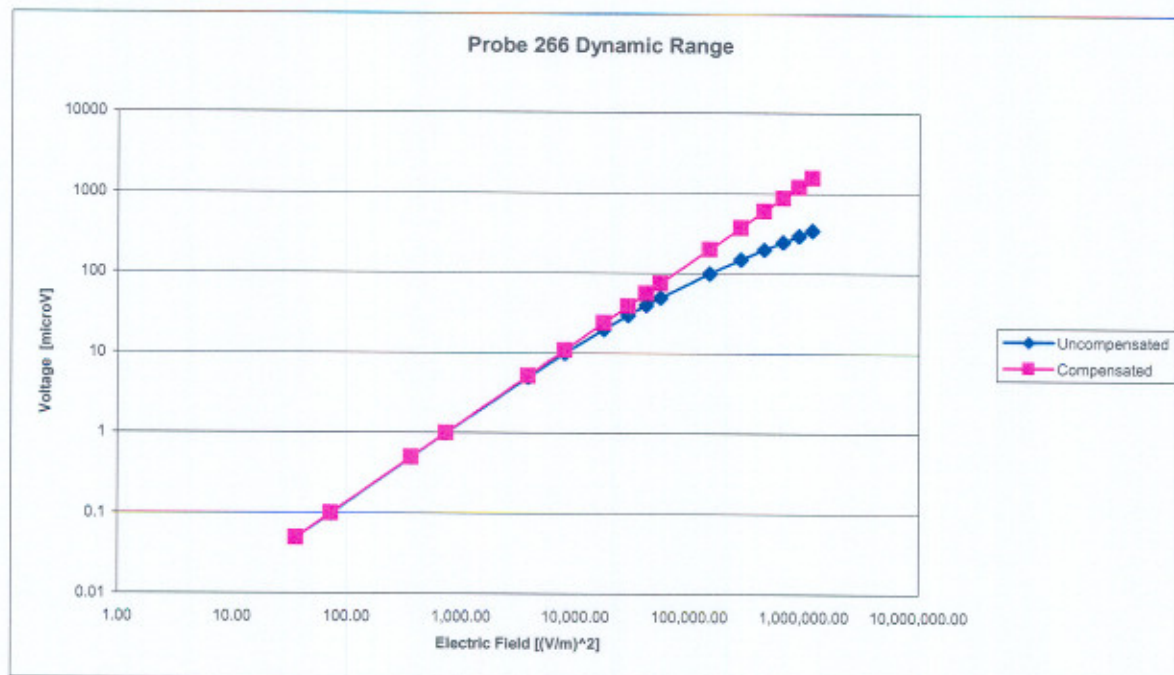
## Isotropy Error 1900 MHz (Air)



Isotropy Tissue:

0.10 dB

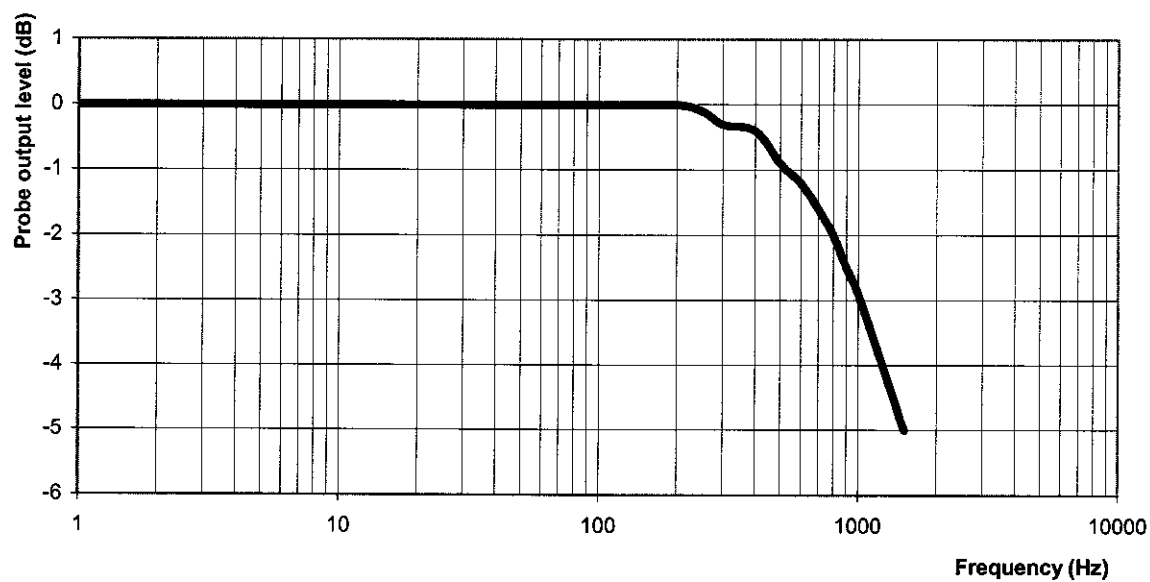
## Dynamic Range





## Video Bandwidth

**Probe Frequency Characteristics**



|                                     |             |
|-------------------------------------|-------------|
| <b>Video Bandwidth at 500 Hz</b>    | <b>1 dB</b> |
| <b>Video Bandwidth at 1.02 KHz:</b> | <b>3 dB</b> |

## **Conversion Factor Uncertainty Assessment**

### **Sensitivity in Body Tissue**

**Frequency:** 1900 MHz

**Epsilon:** 53.3 (+/-5%)

**Sigma:** 1.52 S/m (+/-10%)

#### **ConvF**

**Channel X:** 5.41 7%(K=2)

**Channel Y:** 5.41 7%(K=2)

**Channel Z:** 5.41 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 2.5mm 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 2006.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-698

Client.: Wistron

## 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.: 266

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2  
Project No: QTKB-ALS-E020-CAL-5238

Calibrated: 21<sup>st</sup> June 2006  
Released on: 22<sup>nd</sup> June 2006

APREL Laboratories Certified Under Laboratory 48 of SCC

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-020 266.

### 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

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

### Conditions

Probe 266 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**  
-----  
**Jesse Hones**

## **Calibration Results Summary**

|                       |                     |
|-----------------------|---------------------|
| <b>Probe Type:</b>    | E-Field Probe E-020 |
| <b>Serial Number:</b> | 266                 |
| <b>Frequency:</b>     | 2450 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>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Y:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Z:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Diode Compression Point:</b> | 95 mV                                   |

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

---

### **Sensitivity in Head Tissue**

**Frequency:** 2450 MHz

**Epsilon:** 39.2 (+/-5%)      **Sigma:** 1.80 S/m (+/-10%)

#### **ConvF**

**Channel X:** 4.9

**Channel Y:** 4.9

**Channel Z:** 4.9

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

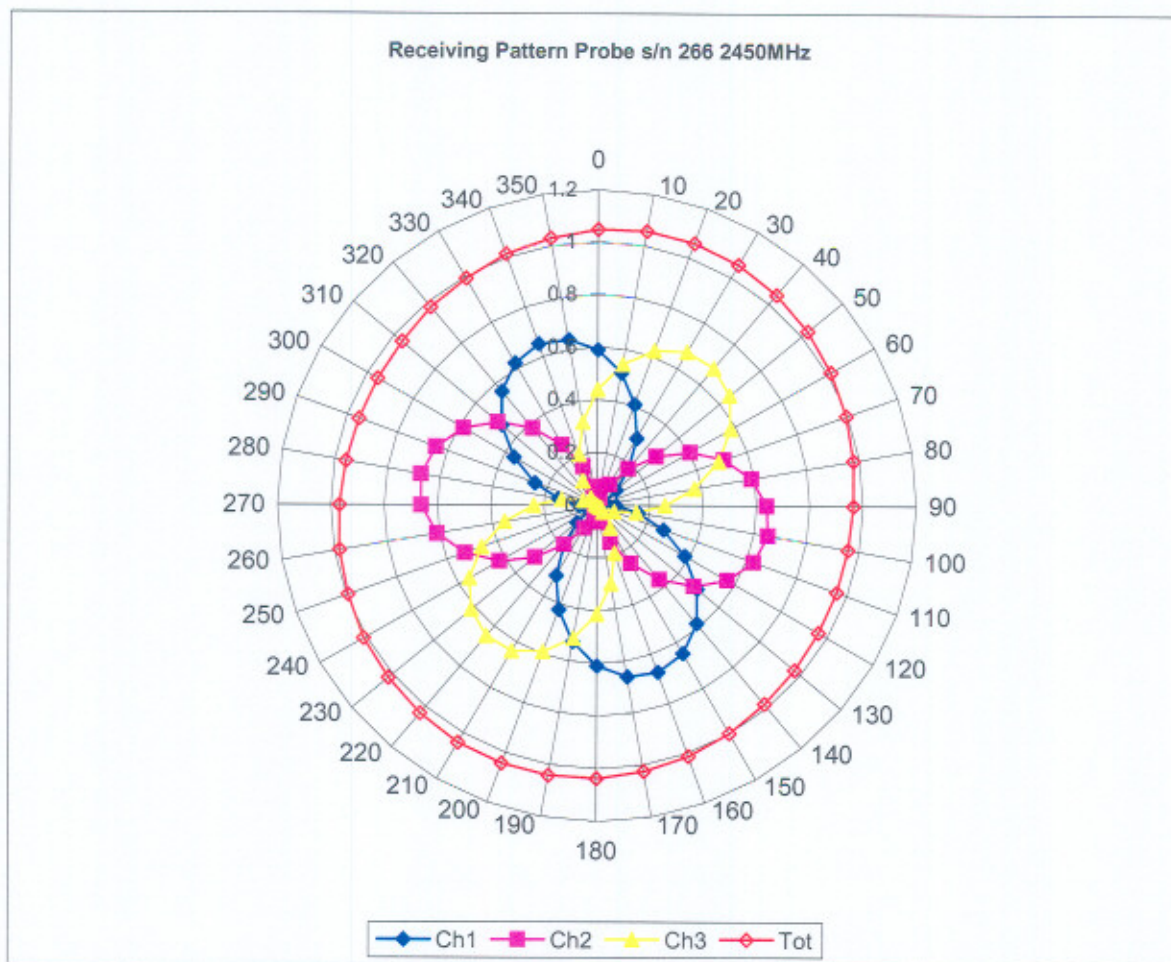
### **Boundary Effect:**

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.

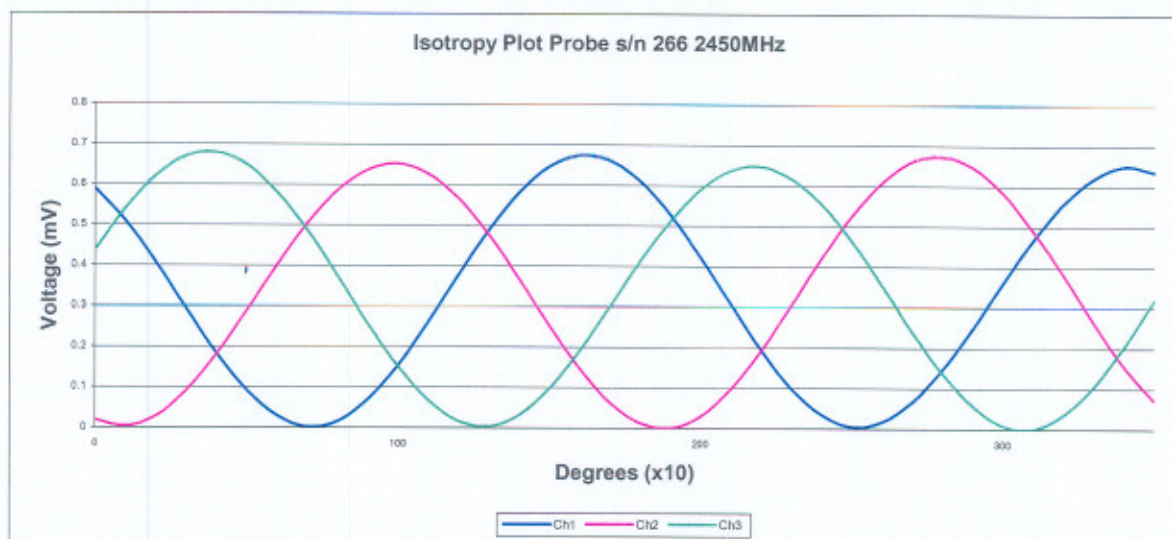
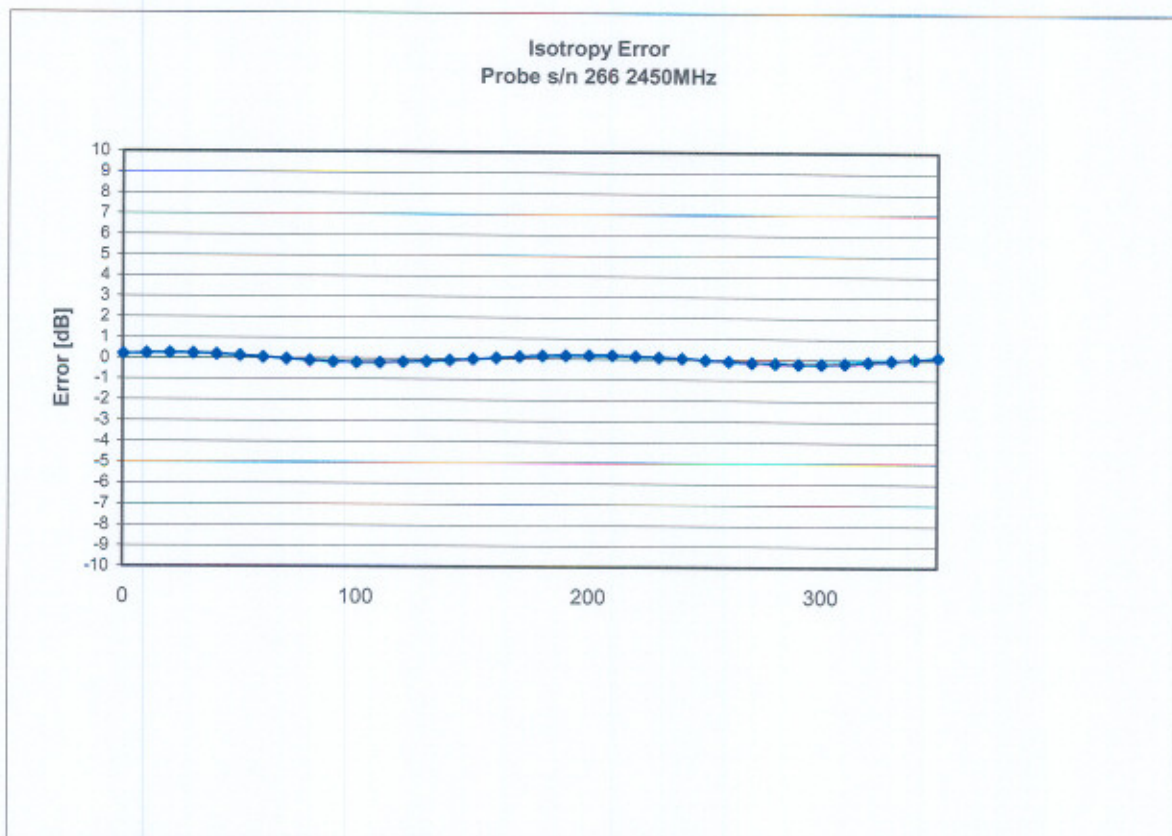
### **Spatial Resolution:**

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)

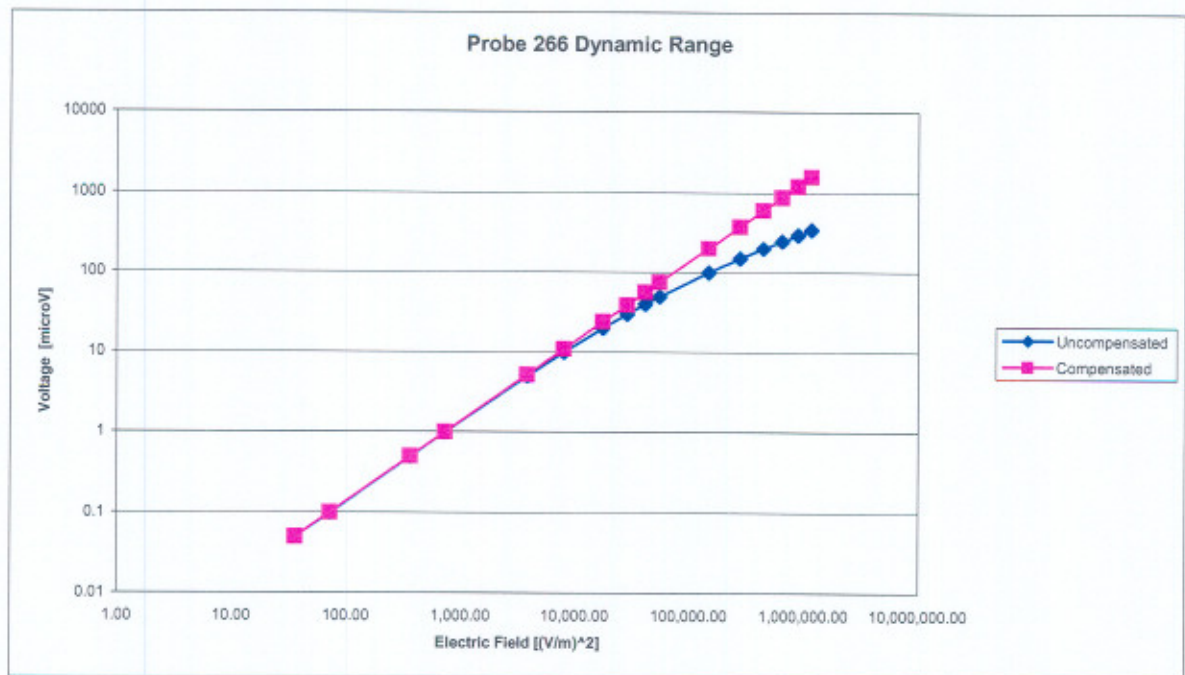


Isotropy Tissue:

0.10 dB

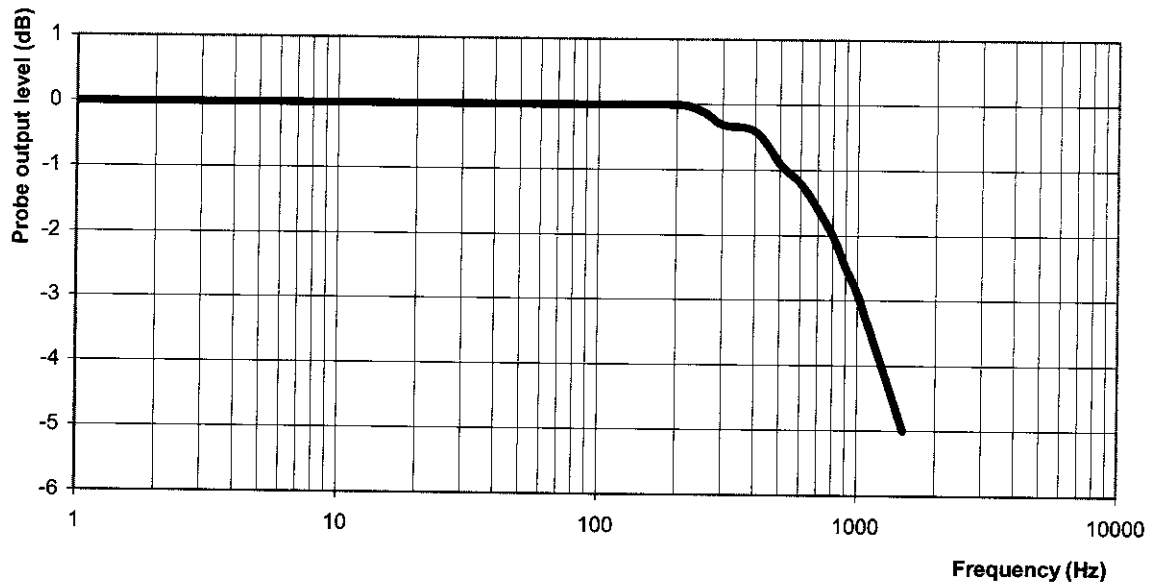


## Dynamic Range



## Video Bandwidth

**Probe Frequency Characteristics**



|                                     |             |
|-------------------------------------|-------------|
| <b>Video Bandwidth at 500 Hz</b>    | <b>1 dB</b> |
| <b>Video Bandwidth at 1.02 KHz:</b> | <b>3 dB</b> |

## **Conversion Factor Uncertainty Assessment**

### **Sensitivity in Head Tissue**

**Frequency:** 2450 MHz

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

**Sigma:** 1.80 S/m (+/-10%)

#### **ConvF**

**Channel X:** 4.9 7%(K=2)

**Channel Y:** 4.9 7%(K=2)

**Channel Z:** 4.9 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 2.5mm 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 2006.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-699

Client.: Wistron

## 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

BODY Calibration

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 266

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

Project No: QTKB-ALS-E020-CAL-5238

Calibrated: 21<sup>st</sup> June 2006

Released on: 22<sup>nd</sup> June 2006

APREL Laboratories Certified Under Laboratory 48 of SCC

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-020 266.

### **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

IEC 62209 "Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures –Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 300 MHz to 3 GHz)"

IEEE 1309 Draft Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9kHz to 40GHz

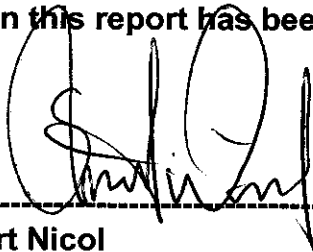
### **Conditions**

Probe 266 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**  
-----  
**Jesse Hones**

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

---

### **Calibration Results Summary**

|                       |                     |
|-----------------------|---------------------|
| <b>Probe Type:</b>    | E-Field Probe E-020 |
| <b>Serial Number:</b> | 266                 |
| <b>Frequency:</b>     | 2450 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>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Y:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Channel Z:</b>               | $1.2 \mu\text{V}/(\text{V}/\text{m})^2$ |
| <b>Diode Compression Point:</b> | 95 mV                                   |

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

---

### **Sensitivity in Body Tissue**

**Frequency:** 2450 MHz

**Epsilon:** 52.7 (+/-5%)      **Sigma:** 1.95 S/m (+/-10%)

#### **ConvF**

**Channel X:** 5.02

**Channel Y:** 5.02

**Channel Z:** 5.02

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

### **Boundary Effect:**

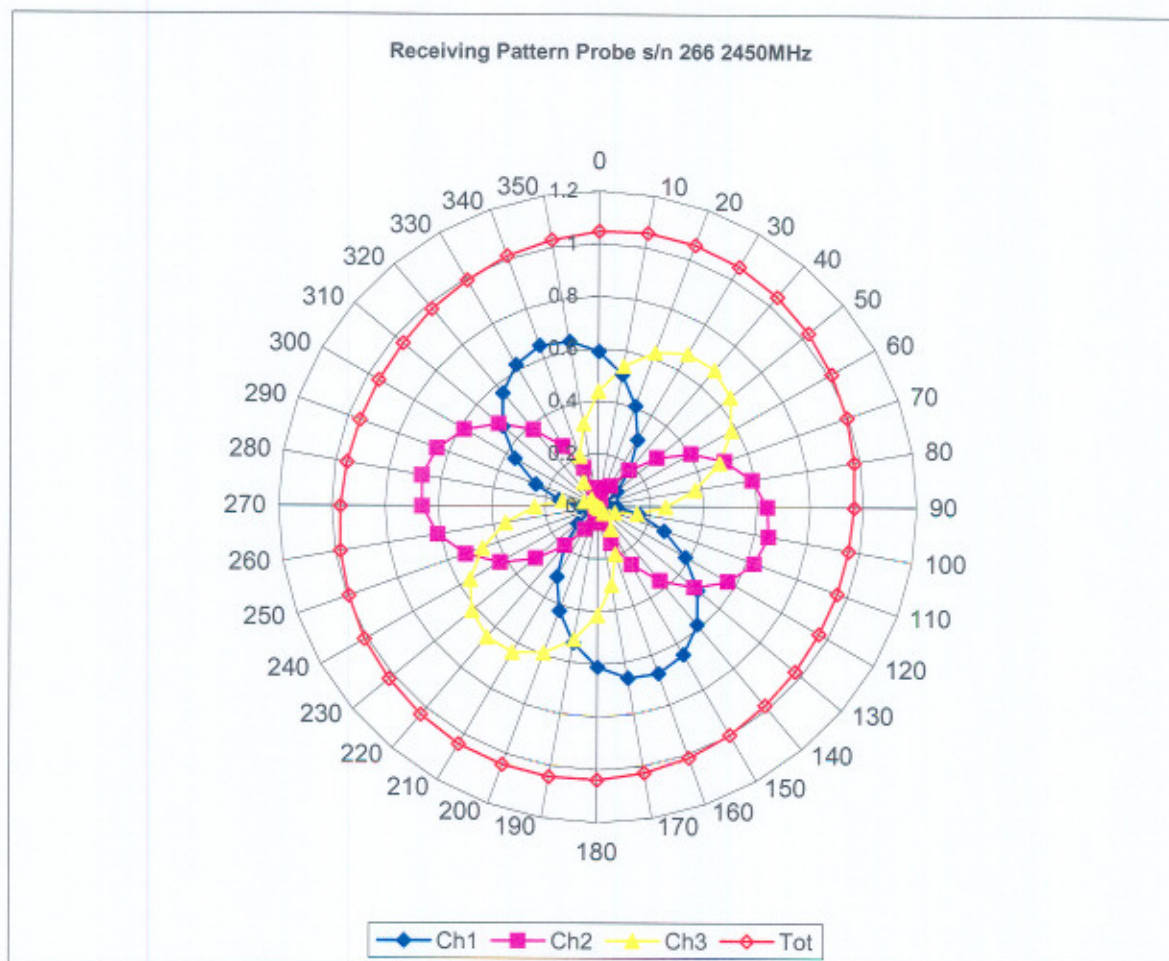
Uncertainty resulting from the boundary effect is less than 2% for the distance between the tip of the probe and the tissue boundary, when less than 2.44mm.

### **Spatial Resolution:**

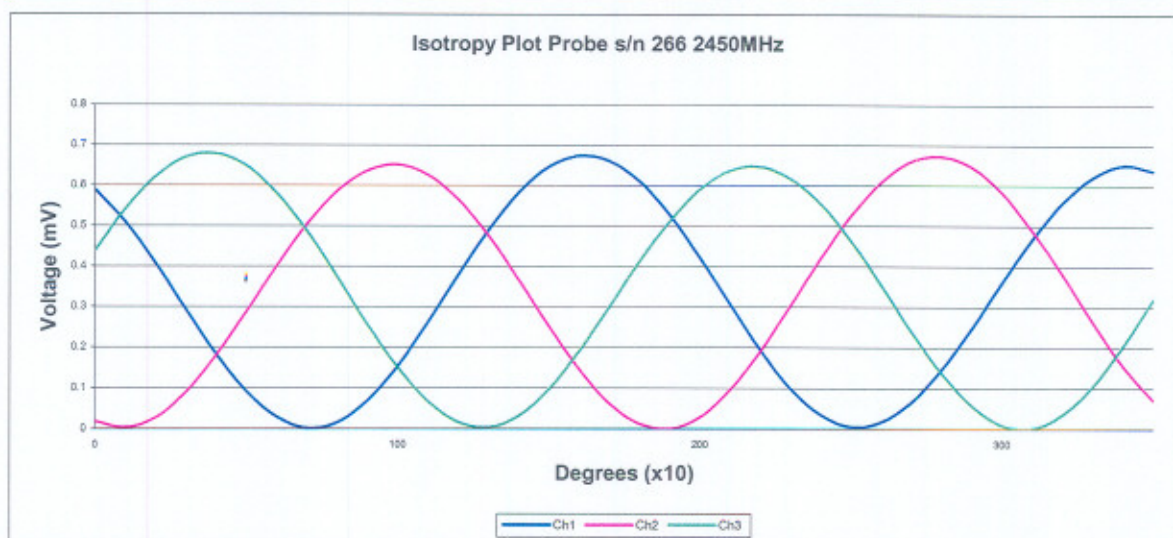
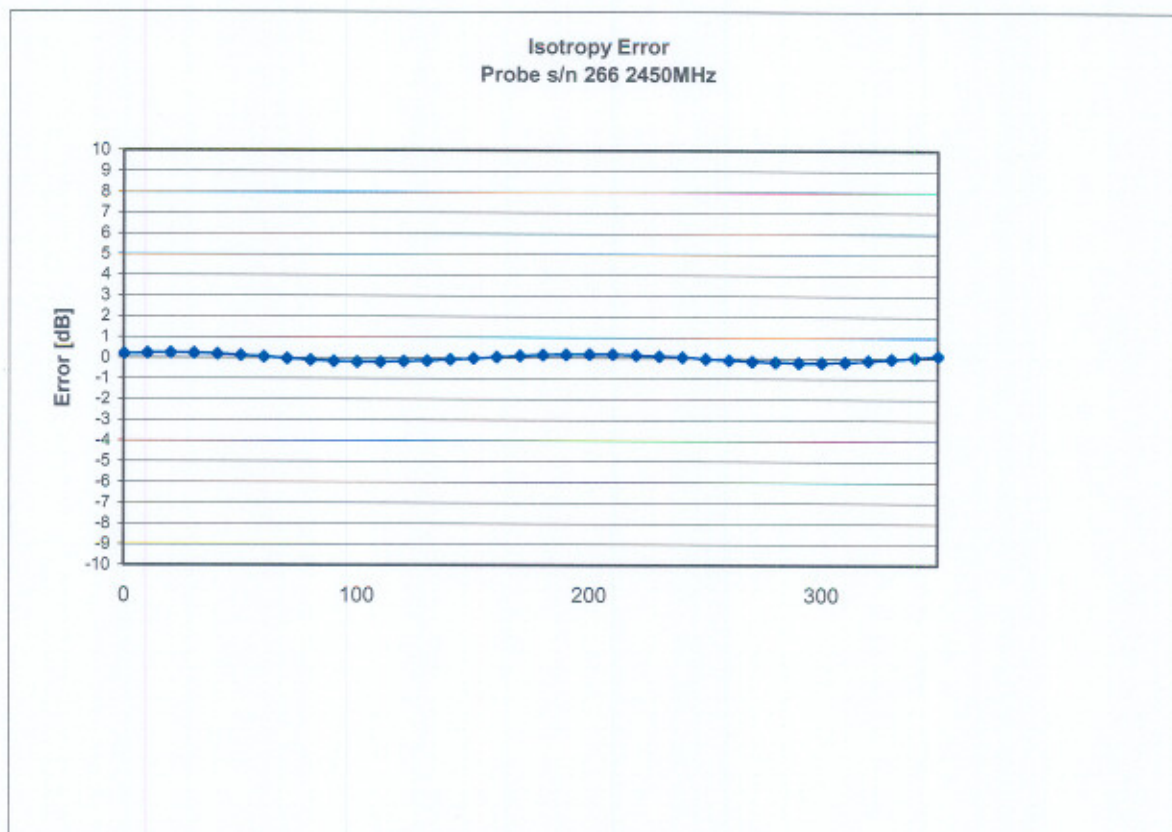
The measured probe tip diameter is 5 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.



## Receiving Pattern 2450 MHz (Air)



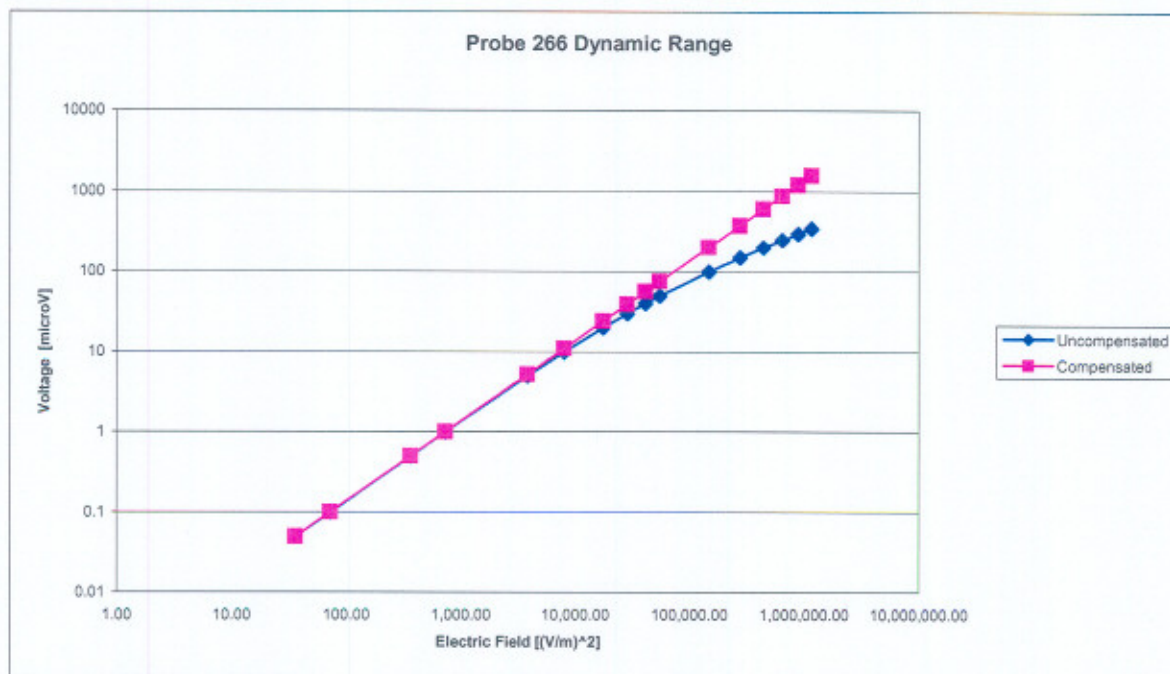
## Isotropy Error 2450 MHz (Air)



Isotropicity Tissue:

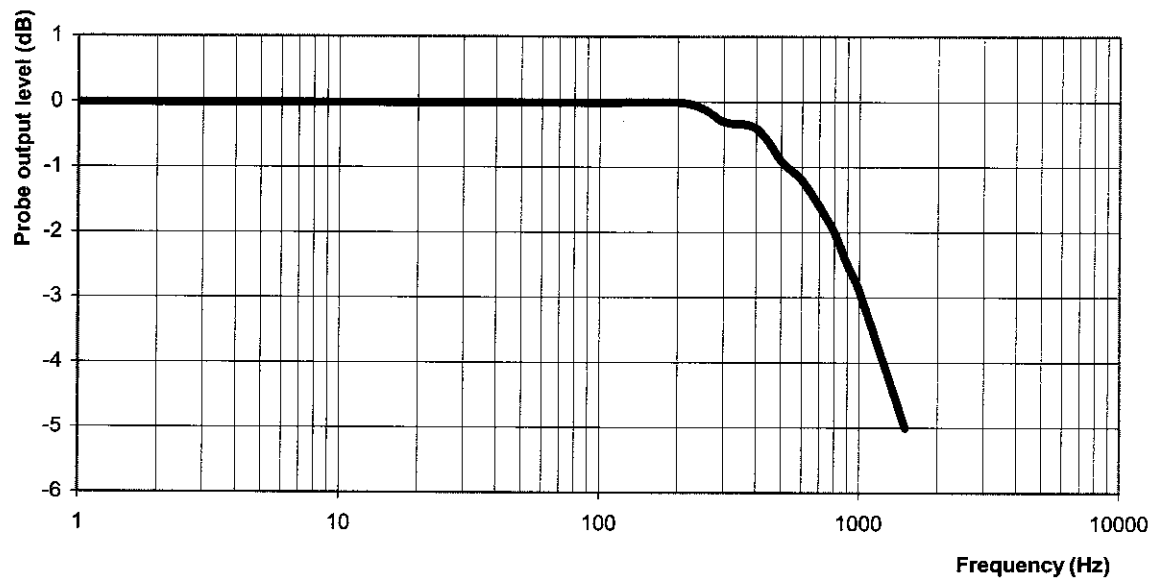
0.10 dB

## 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**

### **Sensitivity in Body Tissue**

**Frequency:** 2450 MHz

**Epsilon:** 52.7 (+/-5%)

**Sigma:** 1.95 S/m (+/-10%)

#### **ConvF**

**Channel X:** 5.02 7%(K=2)

**Channel Y:** 5.02 7%(K=2)

**Channel Z:** 5.02 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 2.5mm 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 2006.