

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-700

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 5200 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: 20th June 2006
Released on: 22nd 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
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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

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

| | |
|-----------------------|---------------------|
| Probe Type: | E-Field Probe E-020 |
| Serial Number: | 266 |
| Frequency: | 5200 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

Division of APREL Laboratories.

Sensitivity in Head Tissue

Frequency: 5200 MHz

Epsilon: 36.0 (+/-5%) **Sigma:** 4.65 S/m (+/-10%)

ConvF

Channel X: 3.82

Channel Y: 3.82

Channel Z: 3.82

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

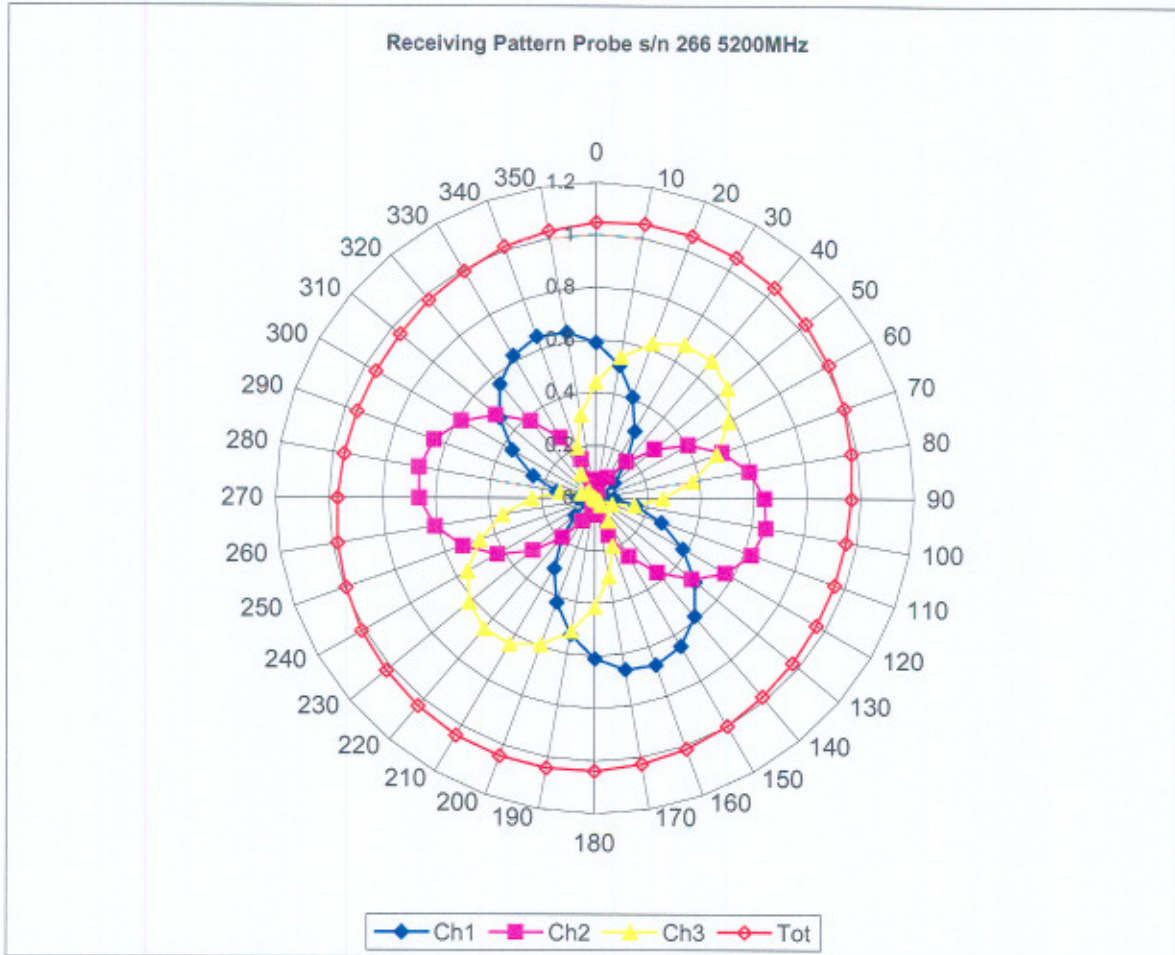
Boundary Effect:

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.

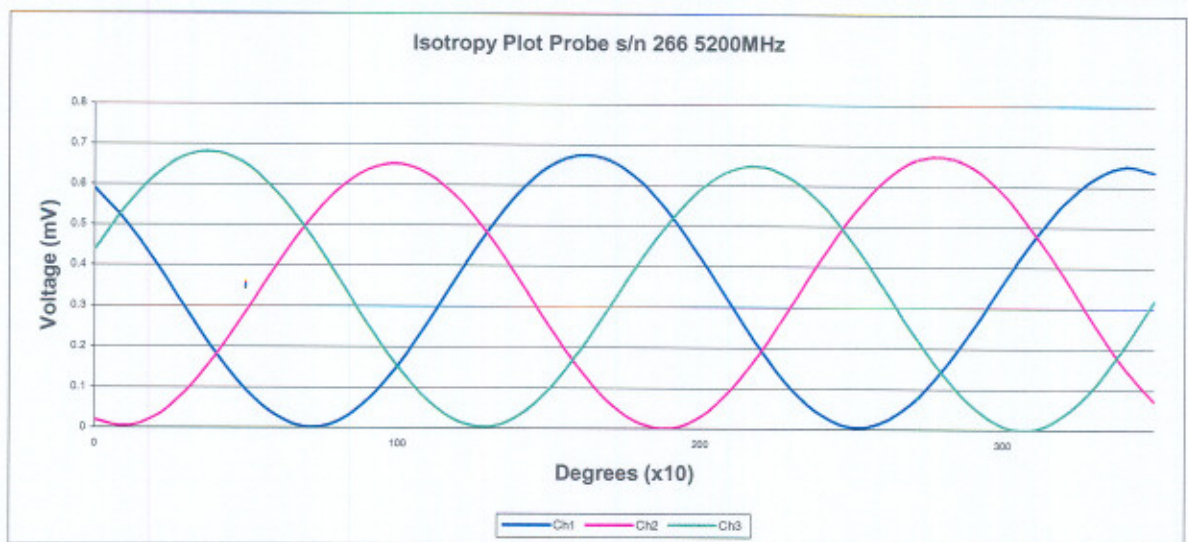
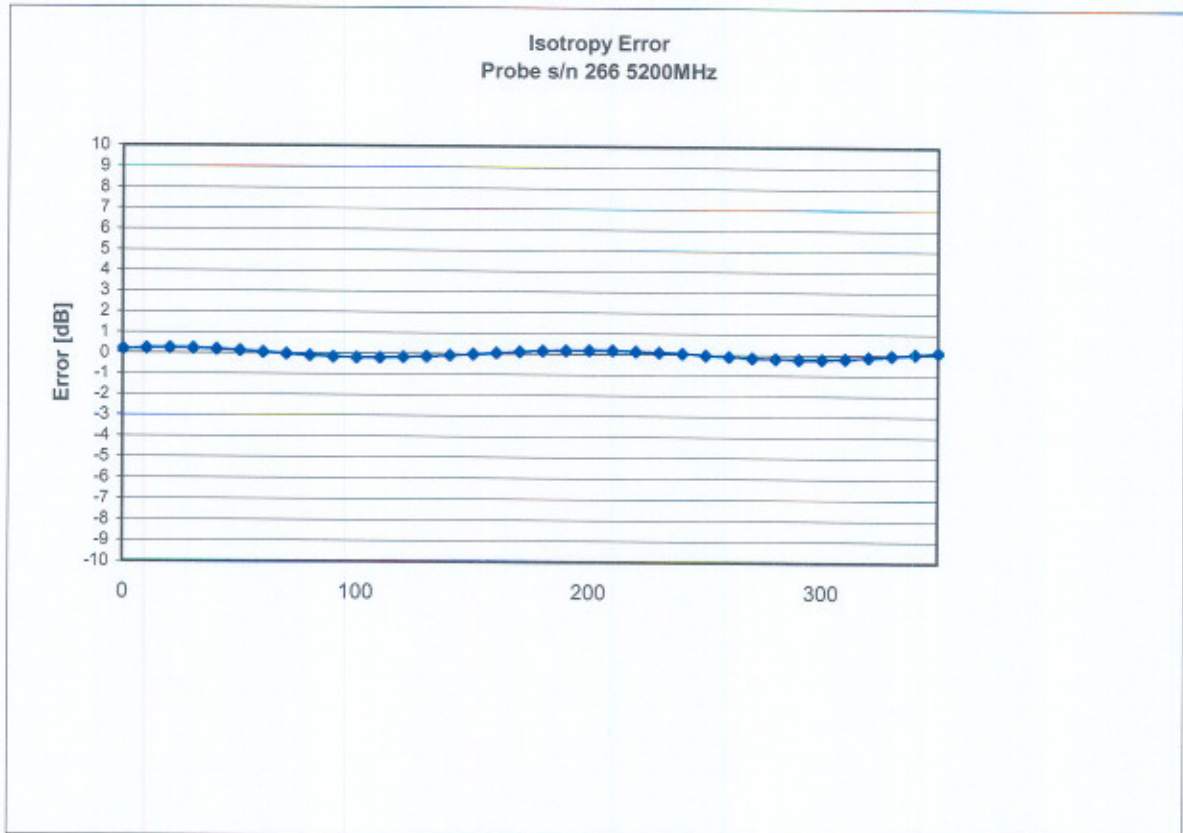
Spatial Resolution:

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 5200 MHz (Air)



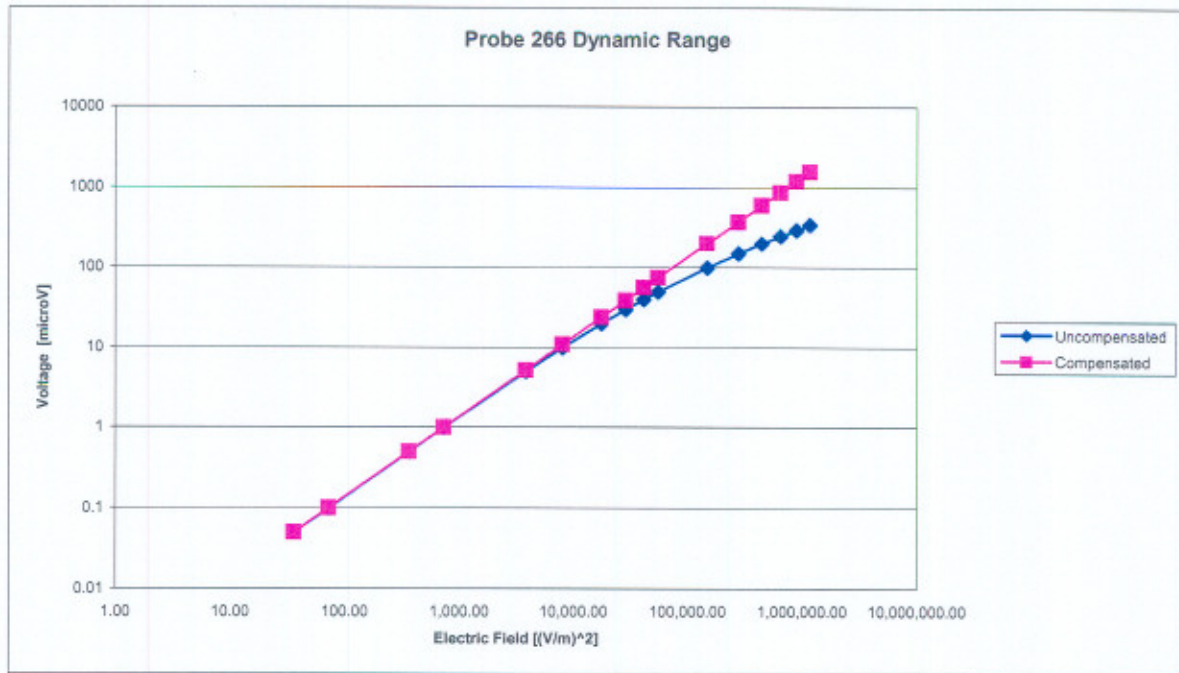
Isotropy Error 5200 MHz (Air)



Isotropicity Tissue:

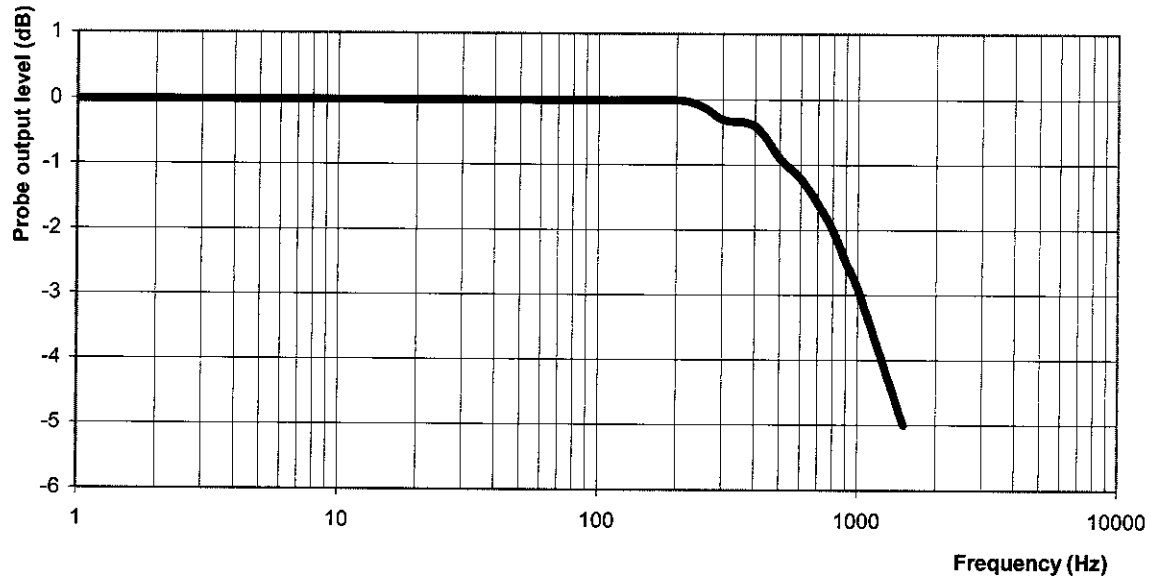
0.10 dB

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 Head Tissue

| | | | |
|-------------------|--------------|---------------|-------------------|
| Frequency: | | 5200 MHz | |
| Epsilon: | 36.0 (+/-5%) | Sigma: | 4.65 S/m (+/-10%) |
| ConvF | | | |
| Channel X: | 3.82 | | 7%(K=2) |
| Channel Y: | 3.82 | | 7%(K=2) |
| Channel Z: | 3.82 | | 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-701

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 5200 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: 20th June 2006
Released on: 22nd 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

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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

| | |
|-----------------------|---------------------|
| Probe Type: | E-Field Probe E-020 |
| Serial Number: | 266 |
| Frequency: | 5200 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

Division of APREL Laboratories.

Sensitivity in Body Tissue

Frequency: 5200 MHz

Epsilon: 43.0 (+/-10%)

Sigma: 5.75 S/m (+/-10%)

ConvF

Channel X: 4.4

Channel Y: 4.4

Channel Z: 4.4

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

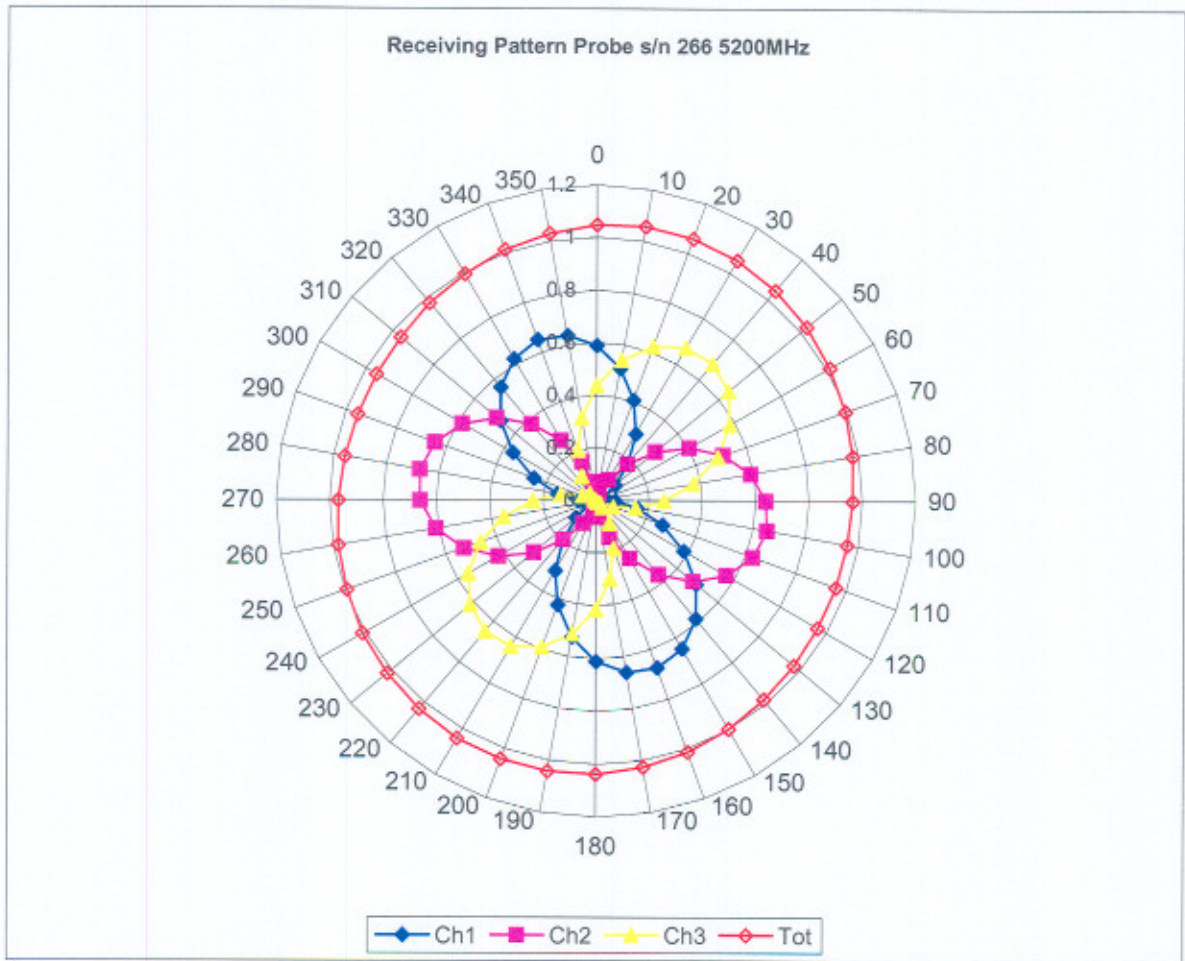
Boundary Effect:

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.

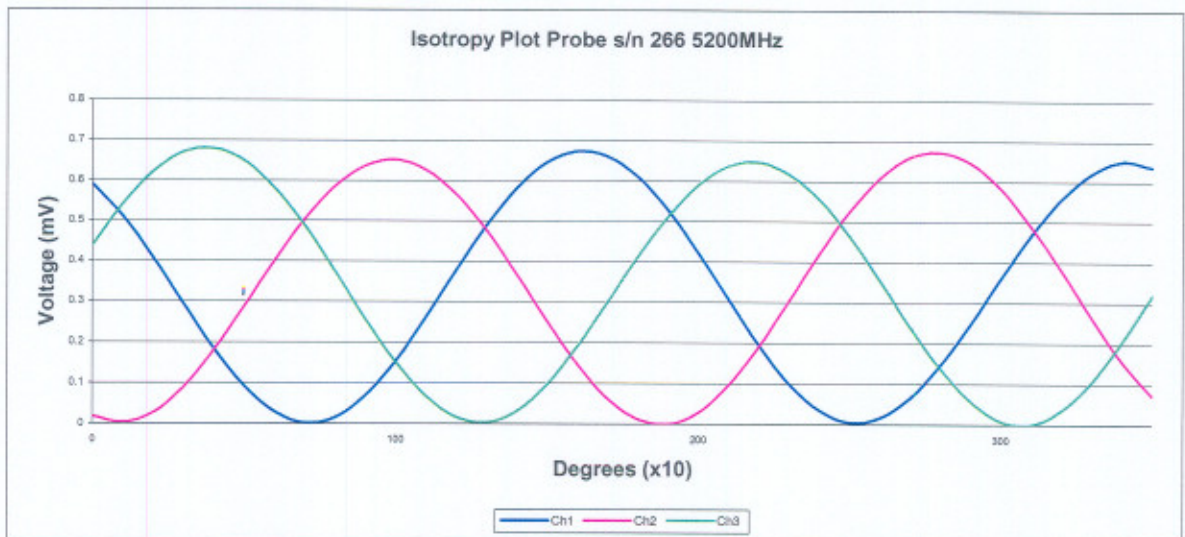
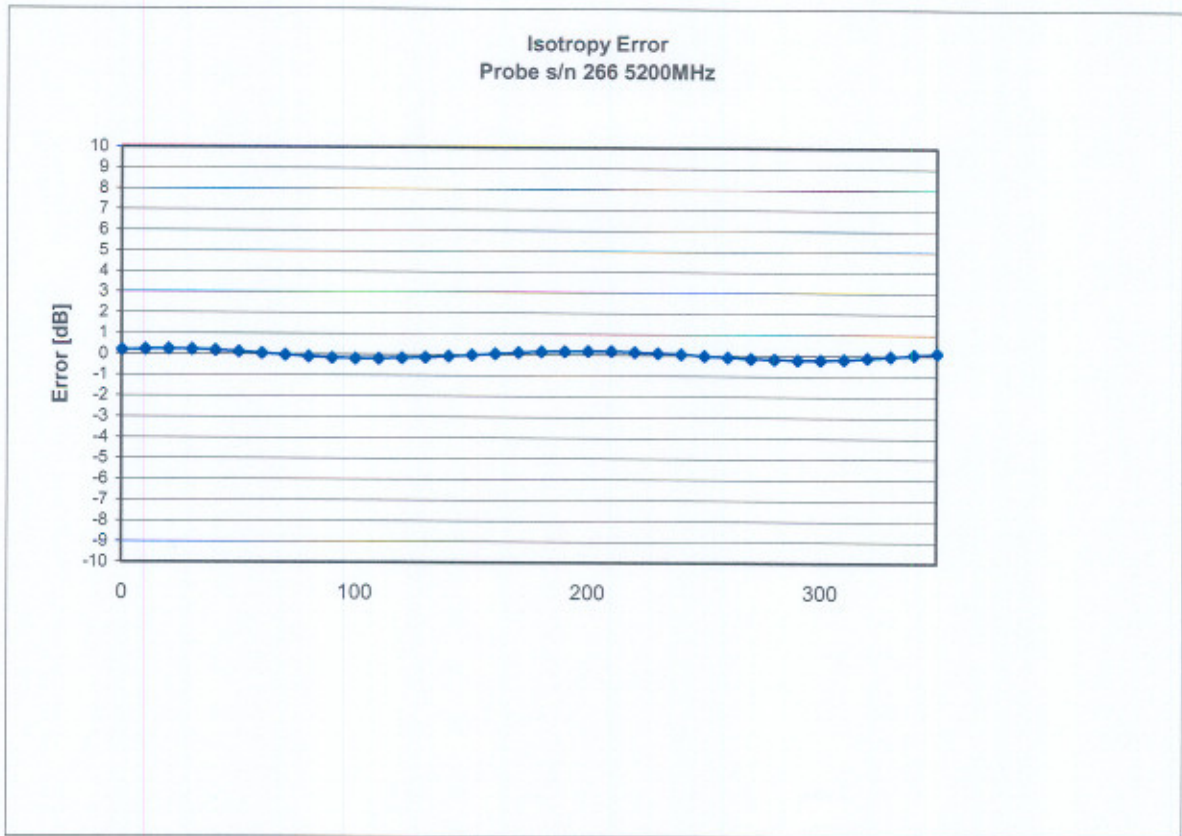
Spatial Resolution:

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 5200 MHz (Air)



Isotropy Error 5200 MHz (Air)



Isotropicity in Tissue:

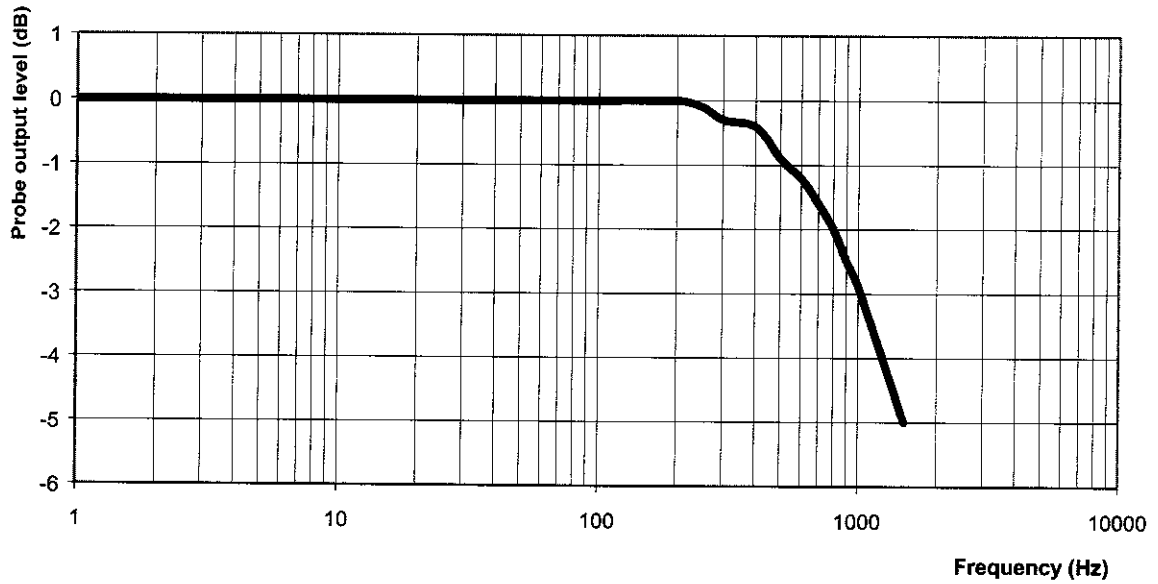
0.10 dB

Dynamic Range



Video Bandwidth

Probe Frequency Characteristics



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

Conversion Factor Uncertainty Assessment

Frequency: 5200MHz
Epsilon: 43.0 (+/-10%) **Sigma:** 5.75 S/m (+/-10%)

ConvF

Channel X: 4.4 7%(K=2)
Channel Y: 4.4 7%(K=2)
Channel Z: 4.4 7%(K=2)

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 M Ω .

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-702

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 5800 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: 20th June 2006
Released on: 22nd 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

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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

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

| | |
|-----------------------|---------------------|
| Probe Type: | E-Field Probe E-020 |
| Serial Number: | 266 |
| Frequency: | 5800 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

Division of APREL Laboratories.

Sensitivity in Head Tissue

Frequency: 5800 MHz

Epsilon: 35.4 (+/-5%)

Sigma: 5.27 S/m (+/-10%)

ConvF

Channel X: 3.72

Channel Y: 3.72

Channel Z: 3.72

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

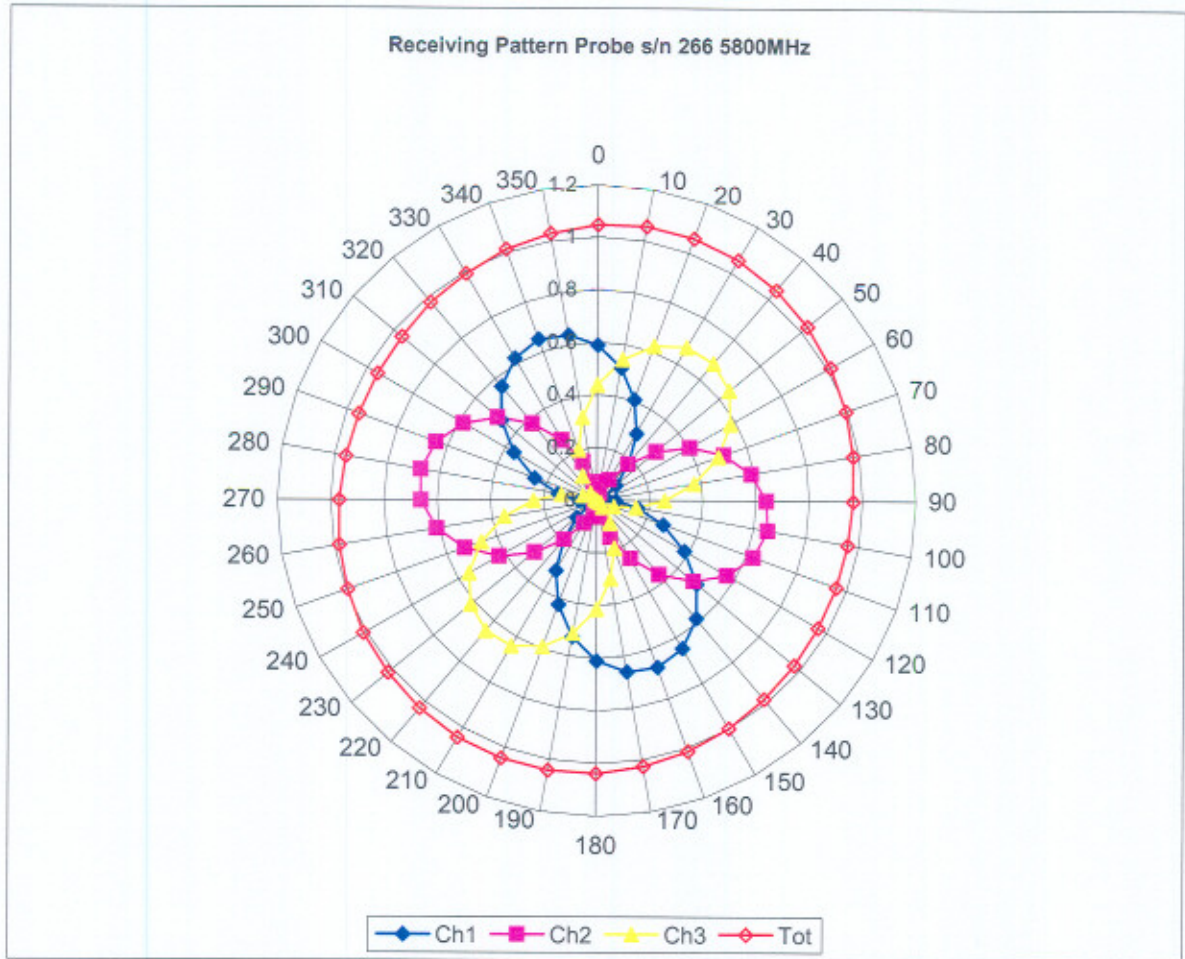
Boundary Effect:

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.

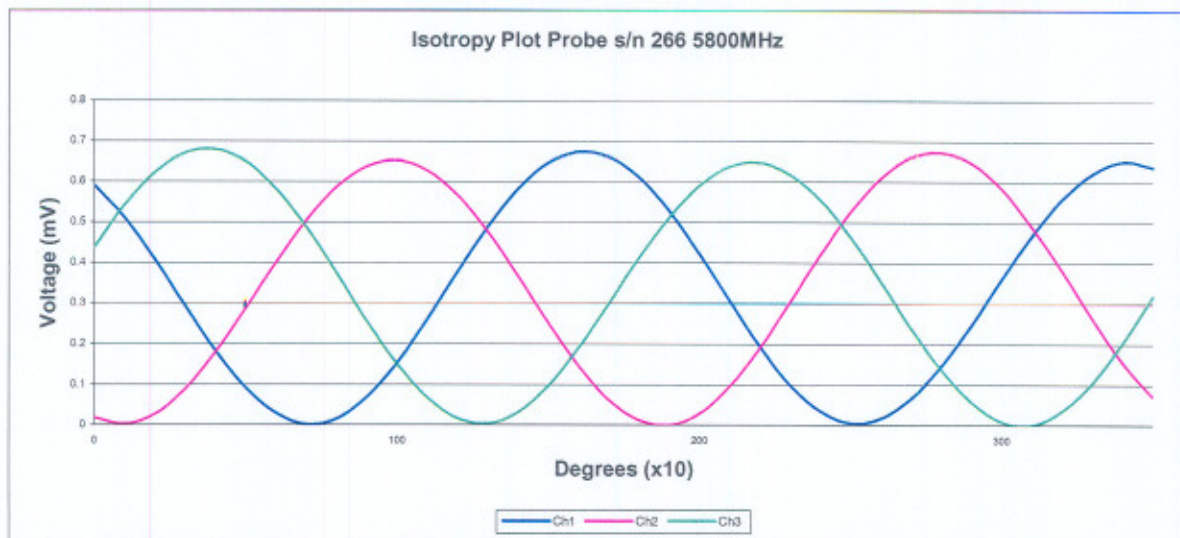
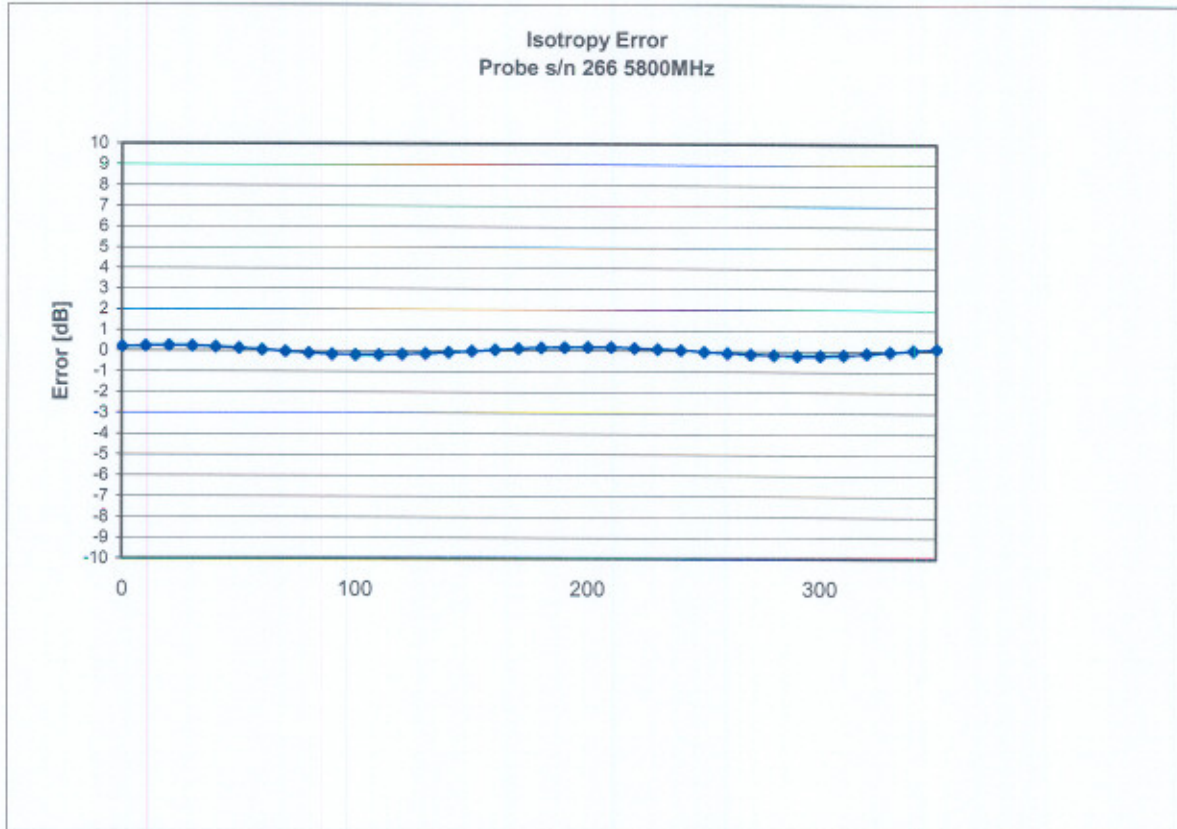
Spatial Resolution:

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 5800 MHz (Air)



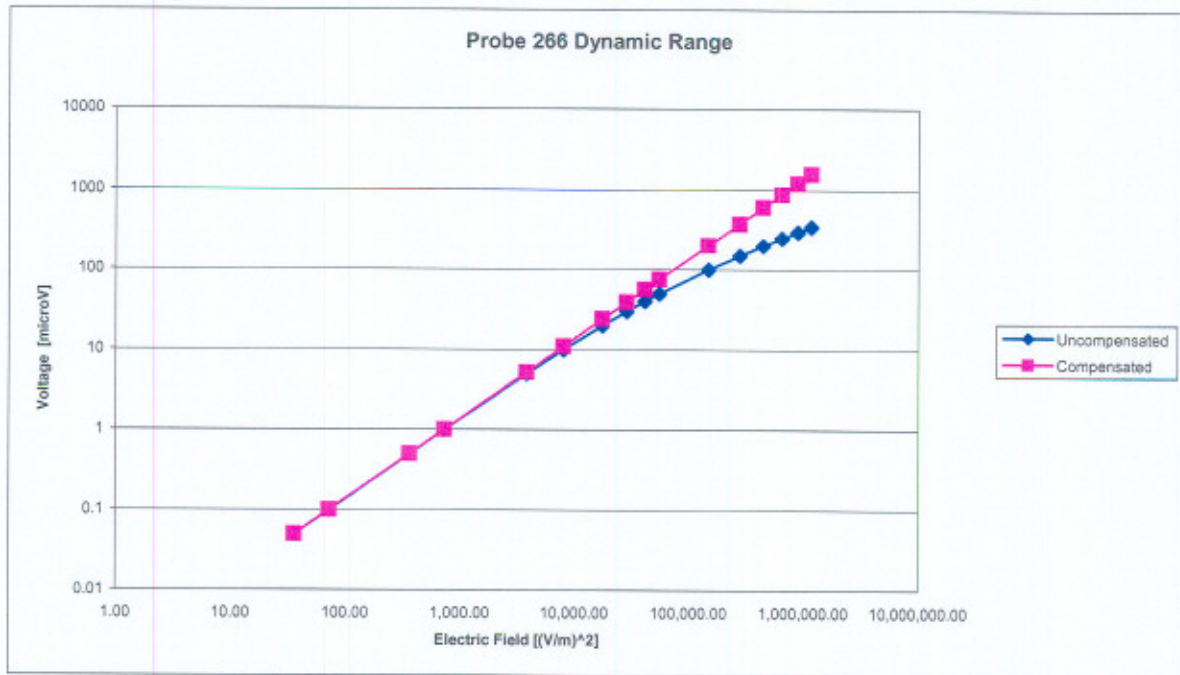
Isotropy Error 5800 MHz (Air)



Isotropicity Tissue:

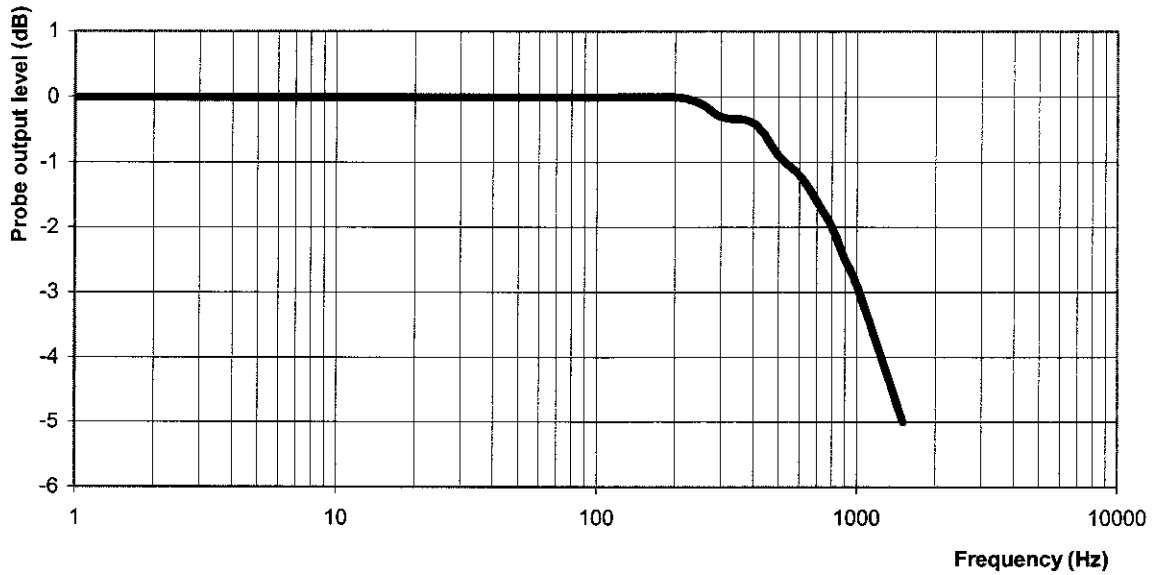
0.10 dB

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 Head Tissue

Frequency: 5800 MHz

Epsilon: 35.4 (+/-5%)

Sigma: 5.27 S/m (+/-10%)

ConvF

Channel X: 3.72 7%(K=2)

Channel Y: 3.72 7%(K=2)

Channel Z: 3.72 7%(K=2)

To minimize the uncertainty calculation all tissue sensitivity values were calculated using a load impedance of 5 M Ω .

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-703

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 5800 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: 20th June 2006

Released on: 22nd 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

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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

| | |
|-----------------------|---------------------|
| Probe Type: | E-Field Probe E-020 |
| Serial Number: | 266 |
| Frequency: | 5800 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

Division of APREL Laboratories.

Sensitivity in Body Tissue

Frequency: 5800 MHz

Epsilon: 48.2 (+/-10%) **Sigma:** 6.0 S/m (+/-10%)

ConvF

Channel X: 4.2

Channel Y: 4.2

Channel Z: 4.2

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

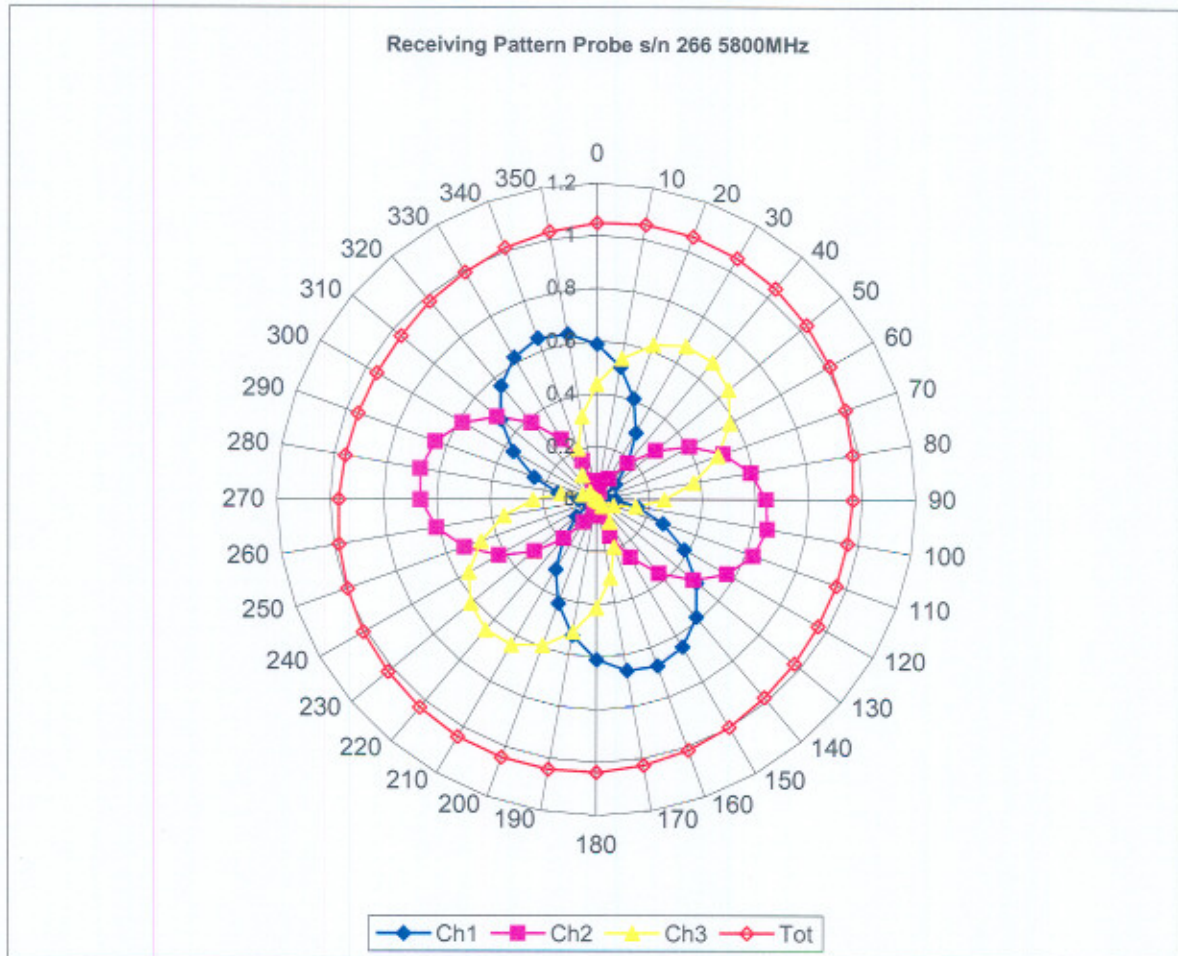
Boundary Effect:

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.

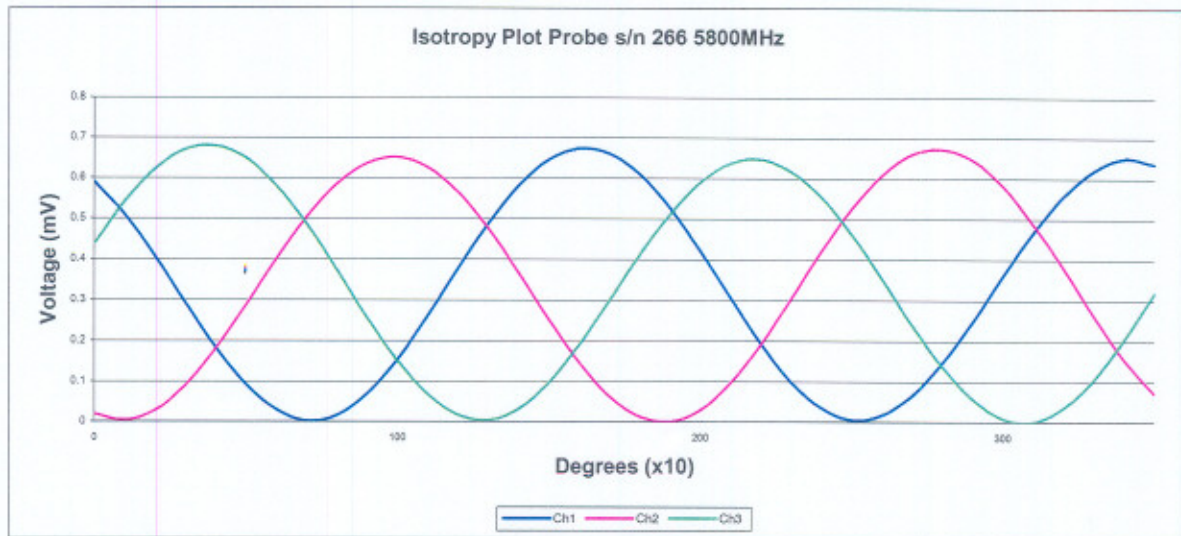
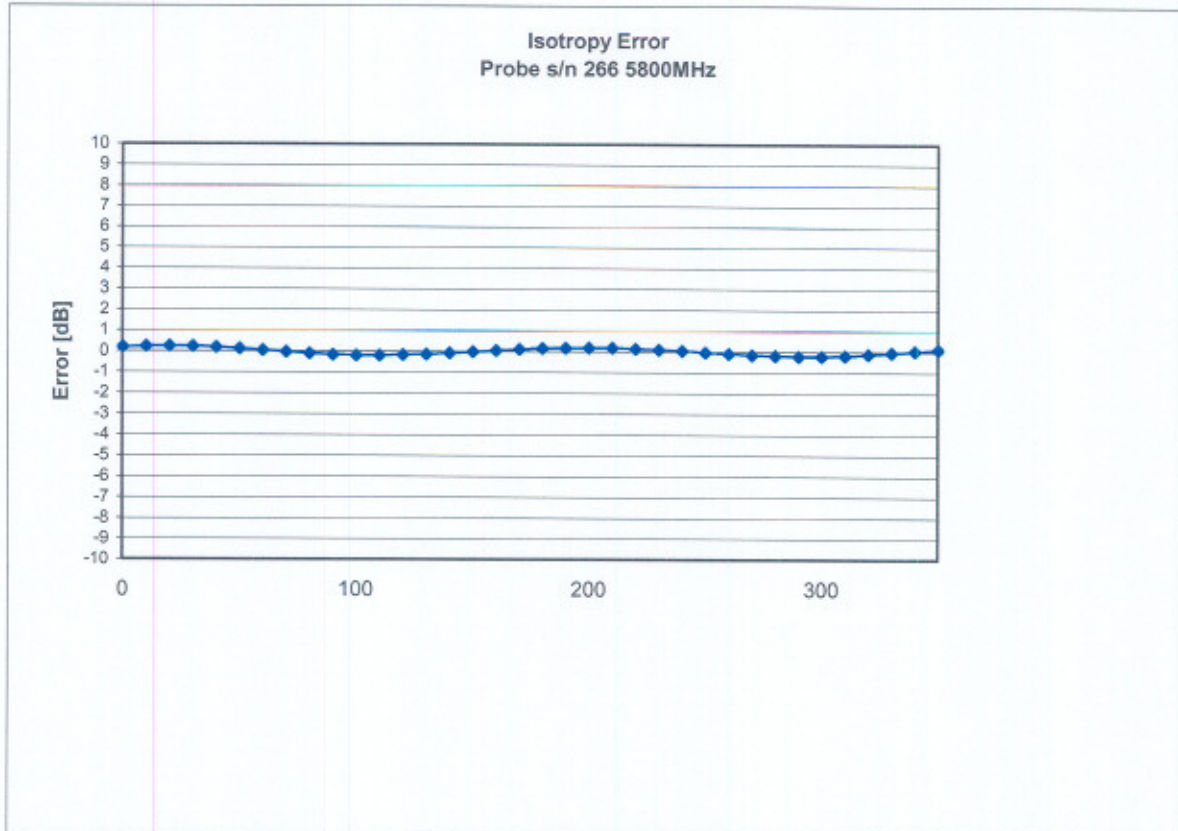
Spatial Resolution:

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 5800 MHz (Air)



Isotropy Error 5800 MHz (Air)

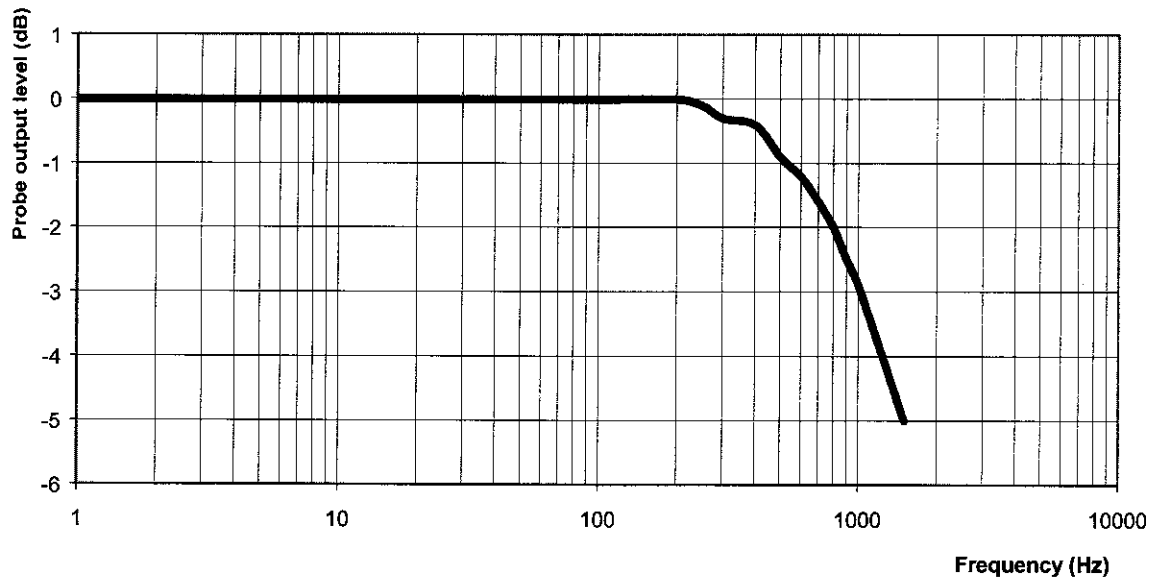


Isotropicity in Tissue:

0.10 dB

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: 5800MHz
Epsilon: 48.2 (+/-10%) **Sigma:** 6.0 S/m (+/-10%)

ConvF

Channel X: 4.2 7%(K=2)
Channel Y: 4.2 7%(K=2)
Channel Z: 4.2 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 2004.