

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-310

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-010

Serial No.: 163

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

Calibrated: 28th March 2003

Released on: 28th March 2003

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4161

Introduction

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-010 163.

References

SSI/DRB-TP-D01-032 E-Field Probe Calibration Procedure

IEEE P-1528 *DRAFT* "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"

SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 163 was a new probe calibration at 2450MHz.

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

Temperature of the Tissue: 21 °C +/- 0.5°C

Calibration Results Summary

Probe Type:	E-Field Probe E-010
Serial Number:	163
Frequency:	2450 MHz
Sensor Offset:	2.38 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Glass*
Tip Diameter:	7 mm
Tip Length:	40 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-P1528

Sensitivity in Air

Channel X:	$0.58 \mu\text{V}/(\text{V}/\text{m})^2$
Channel Y:	$0.58 \mu\text{V}/(\text{V}/\text{m})^2$
Channel Z:	$0.58 \mu\text{V}/(\text{V}/\text{m})^2$
Diode Compression Point:	76 mV

Sensitivity in Body Tissue

Frequency: 2450 MHz

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

ConvF

Channel X: 6.6

Channel Y: 6.6

Channel Z: 6.6

Tissue sensitivity values were calculated using a load impedance of 5 M Ω .

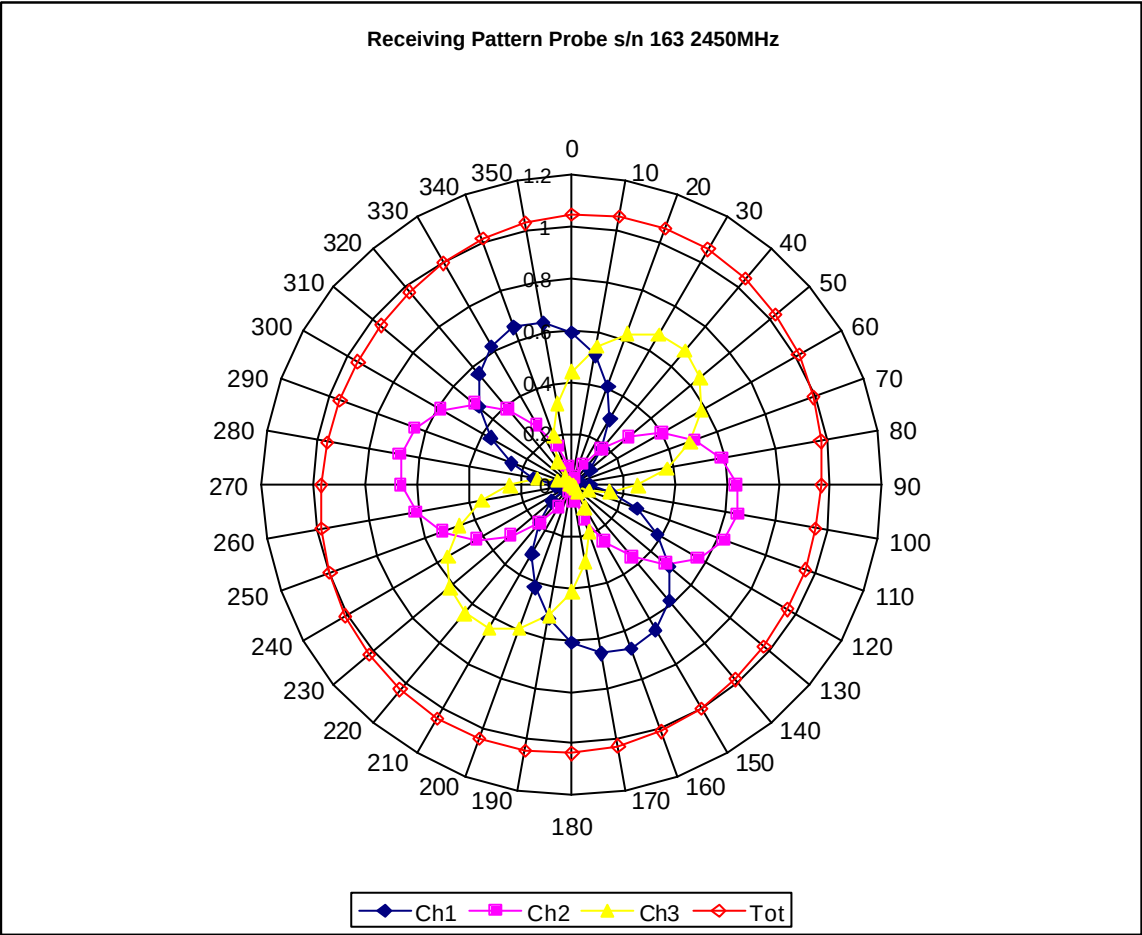
Boundary Effect:

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

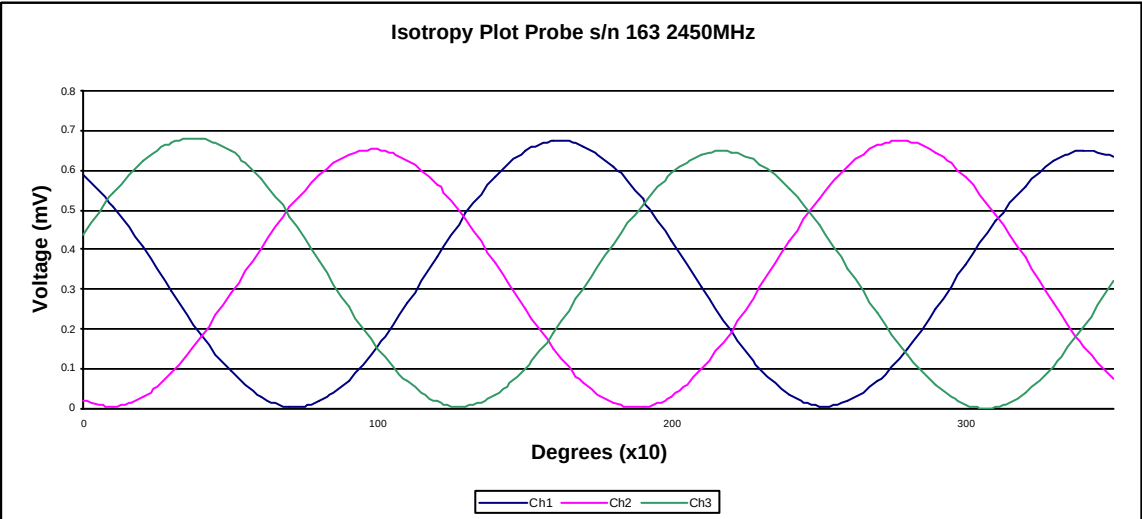
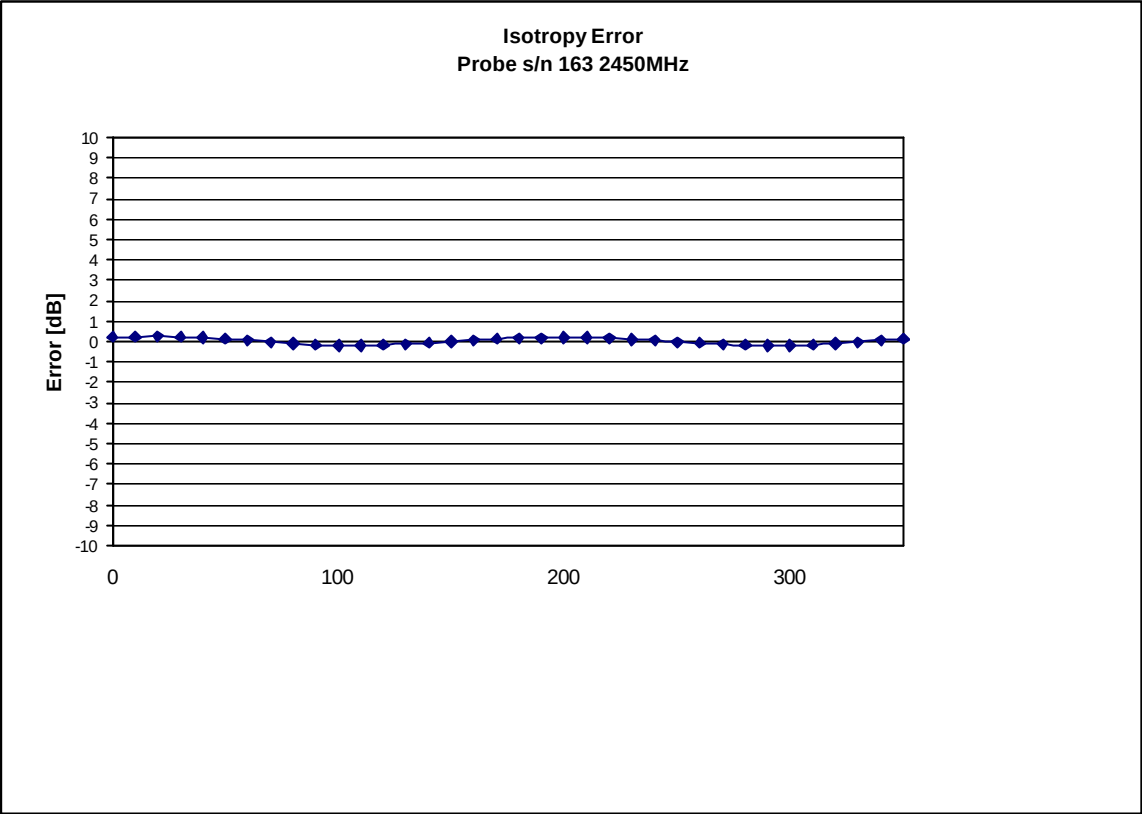
Spatial Resolution:

The measured probe tip diameter is 7 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 2450 MHz (Air)

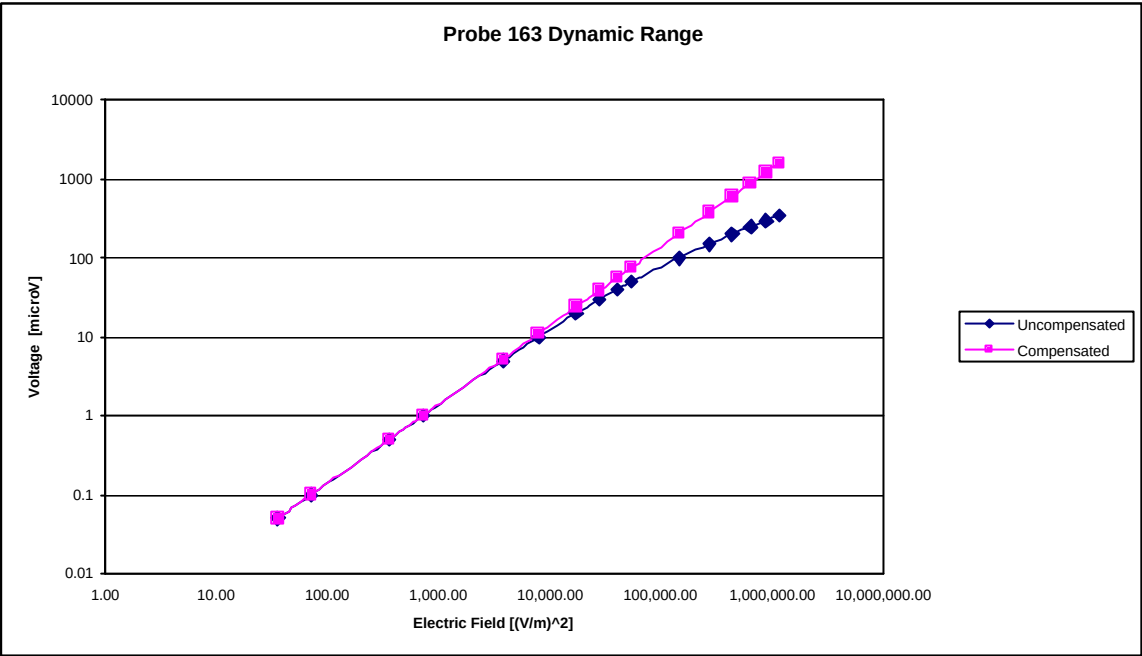


Isotropy Error 2450 MHz (Air)

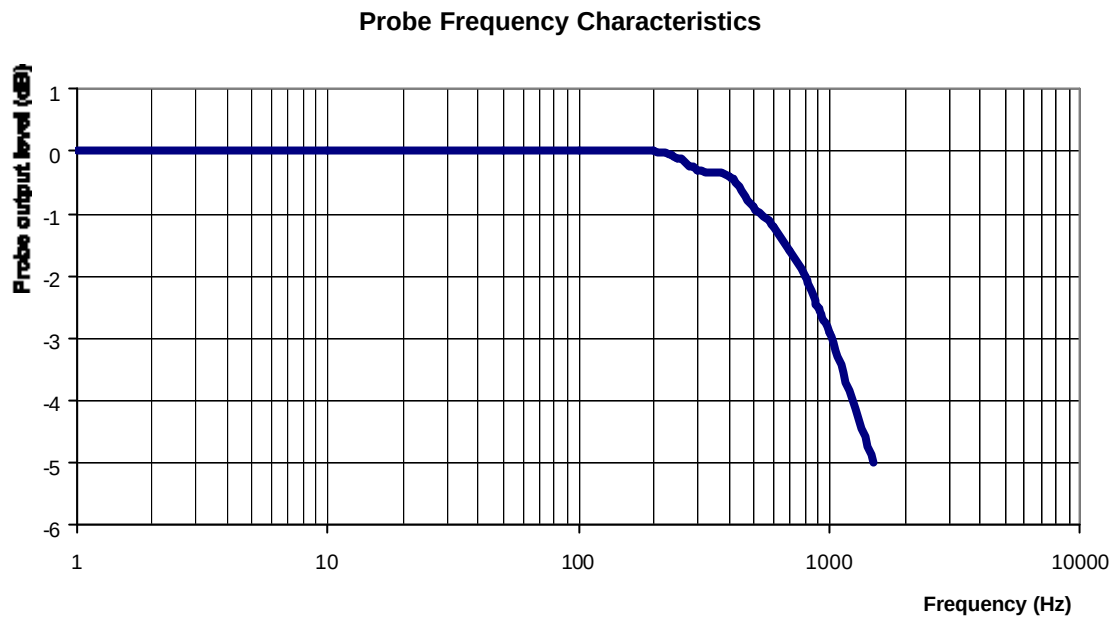


Isotropy: 0.13 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment

Frequency: 2450MHz

Epsilon: 52.7 (+/-5%)

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

ConvF

Channel X: 6.6 7%(K=2)

Channel Y: 6.6 7%(K=2)

Channel Z: 6.6 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 2.6mm the evaluated uncertainty (**increase in the probe sensitivity**) is less than 2%.

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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 2002