Appendix B
Calibration Files

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Phone (613) 820-2730
Fax (613) 820-4161

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1131

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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 5600 MHz

Manufacturer: APREL Laboratories
Model No.: E-030
Serial No.: 222

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 8th February 2010
Released on: 8th February 2010

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-030 222.

References

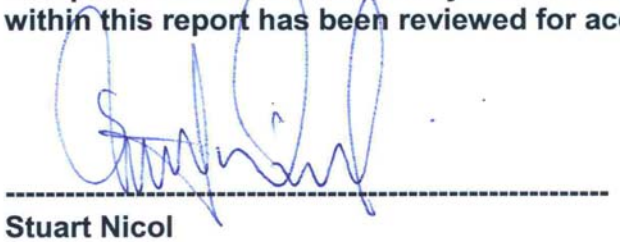
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 222 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-030
Serial Number:	222
Frequency:	5600 MHz
Sensor Offset:	0.44 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5600 MHz

Epsilon: 47.1 (+/-10%) **Sigma:** 5.87 S/m (+/-10%)

ConvF

Channel X: 3.2

Channel Y: 3.2

Channel Z: 3.2

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 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Sensitivity Calibration:

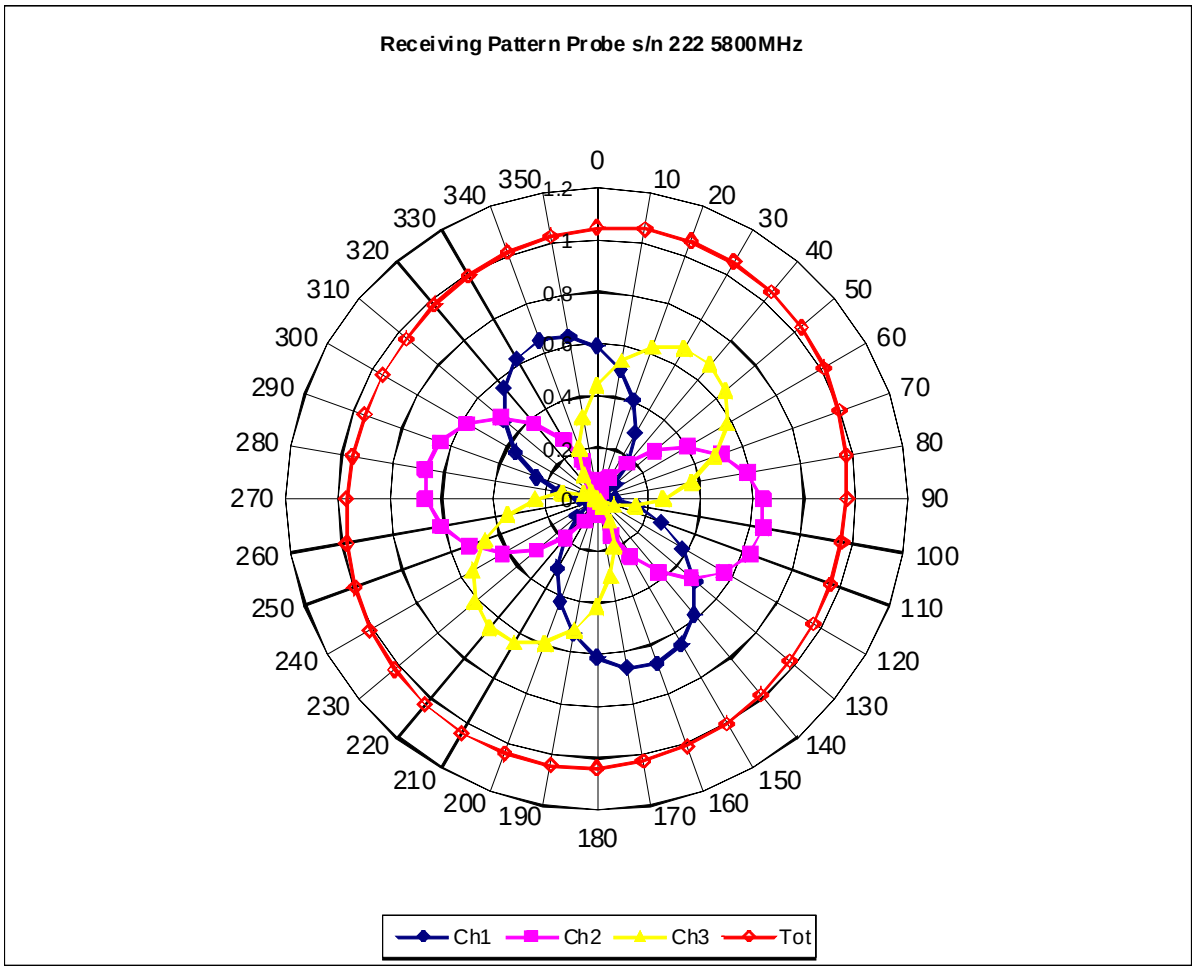
Sensitivity is calibrated in a wave guide following standard calibration procedures as described in IEEE-1528.

Probe Linearity:

Probe linearity is calculated based on the mean voltage measured from the probe and then equated to SAR W/Kg following procedures described in IEEE-1528.

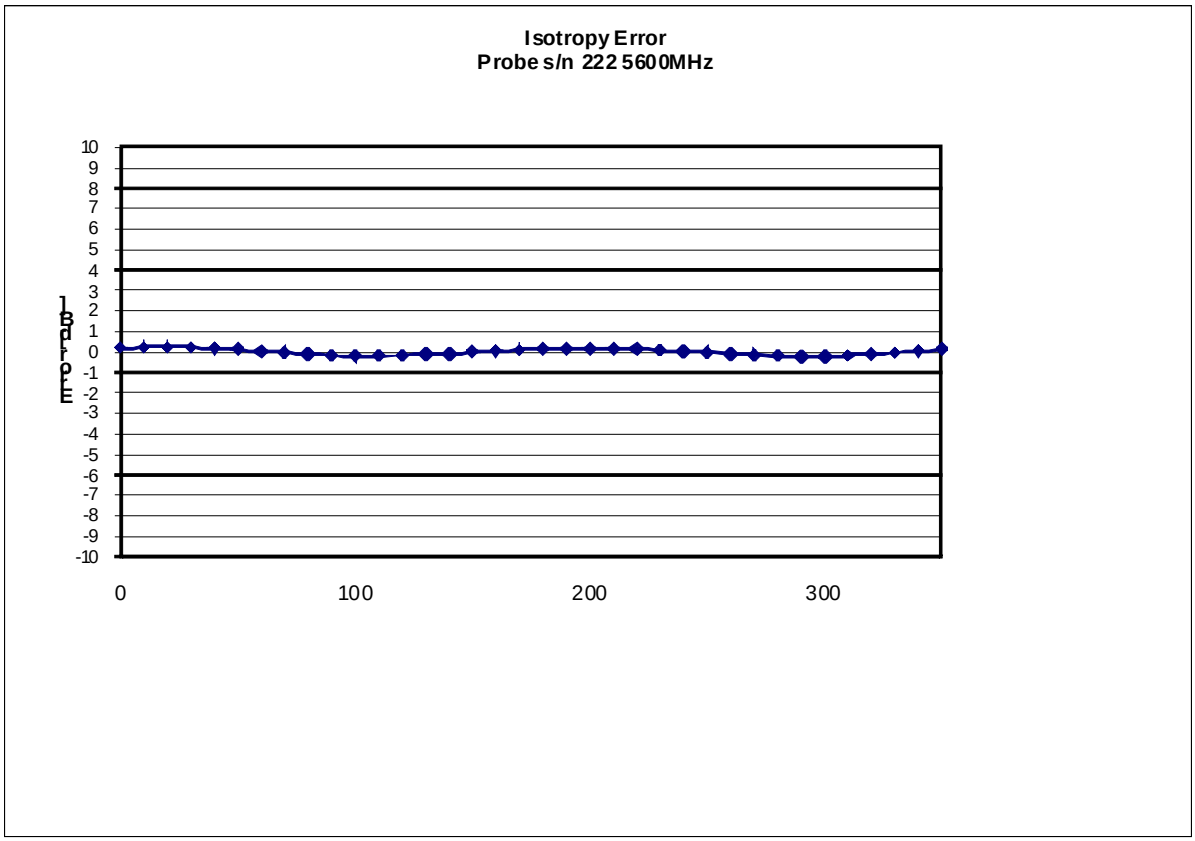
NOTE:
IEEE-1528 does not extend beyond 3GHz for frequency range and as such reference values for tissue dielectric have been taken from FCC Supplement C.

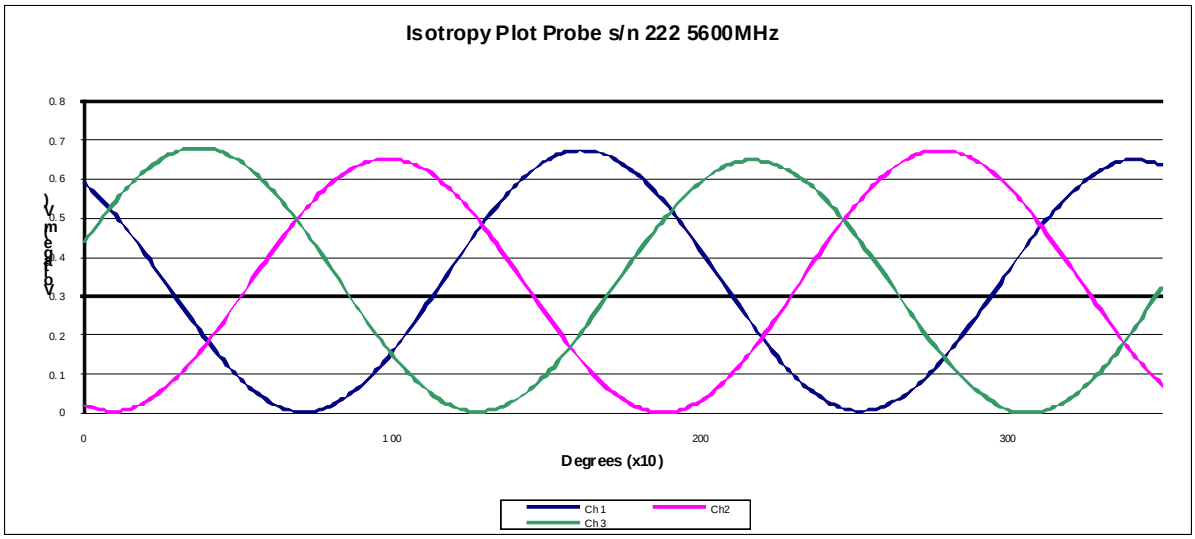
Receiving Pattern 5600 MHz (Air)



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

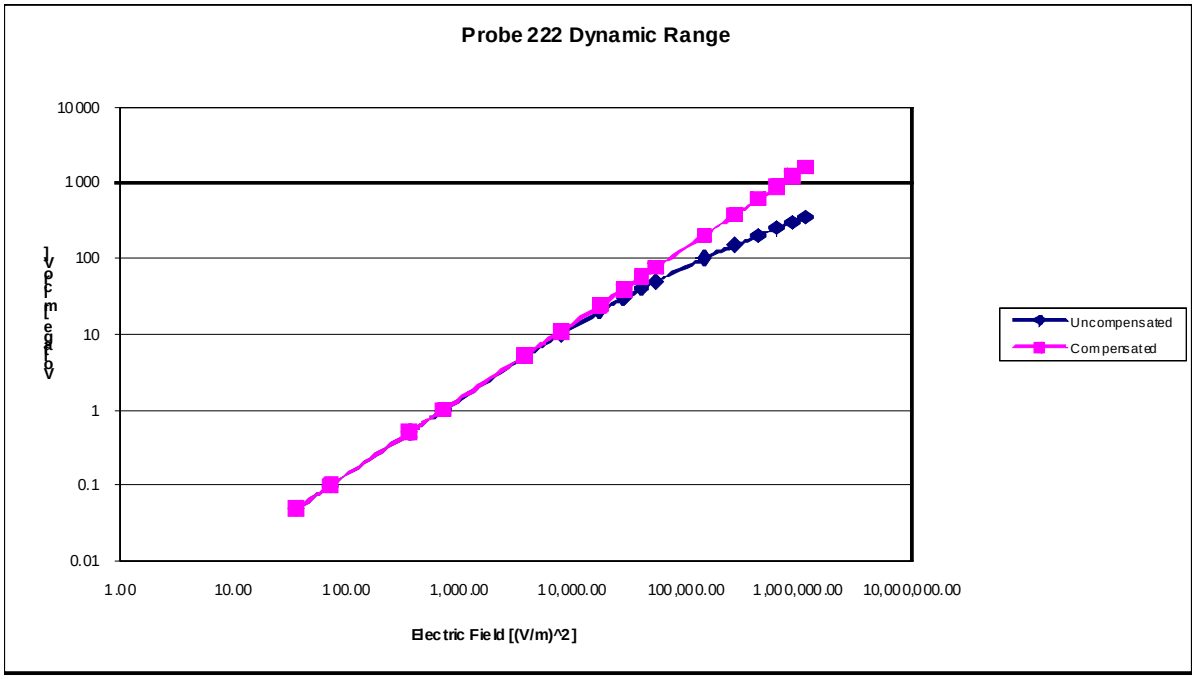
Isotropy Error 5600 MHz (Air)



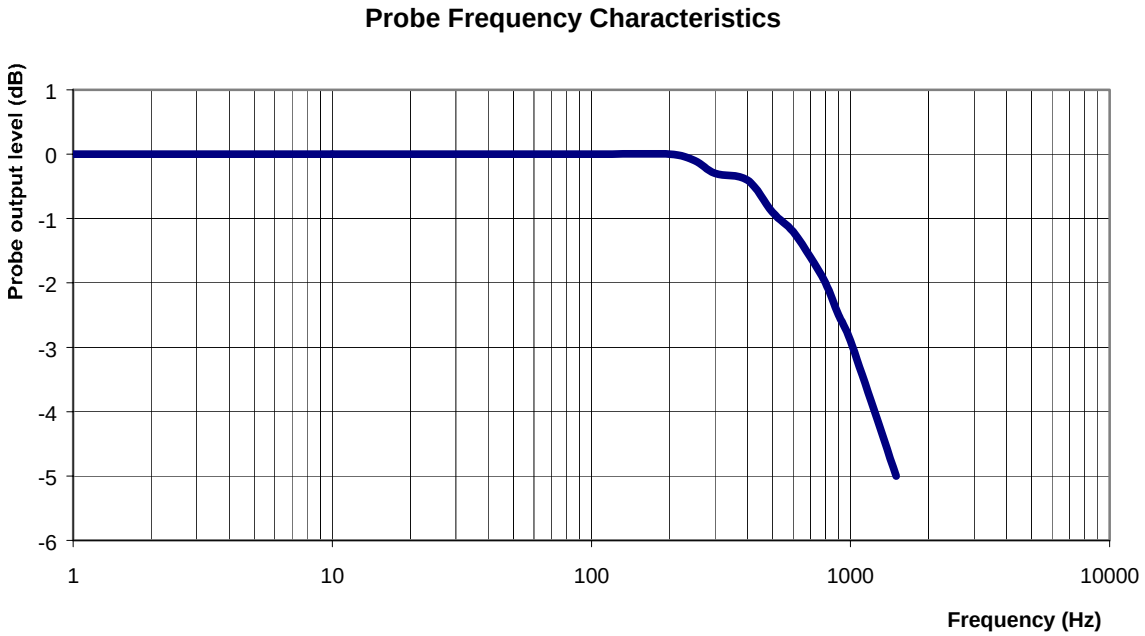


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment

Sensitivity in Body Tissue Measured

Frequency:		5600 MHz	
Epsilon:	47.1 (+/-10%)	**Sigma:**	5.87 S/m (+/-10%)
ConvF			
Channel X:	3.2	7%(K=2)	
Channel Y:	3.2	7%(K=2)	
Channel Z:	3.2	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 0.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1130

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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-030
Serial No.: 222

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 5th February 2010
Released on: 5th February 2010

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-030 222.

References

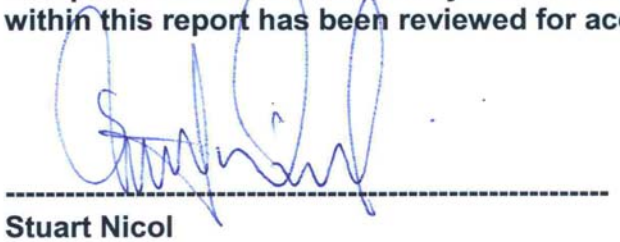
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 222 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-030
Serial Number:	222
Frequency:	5200 MHz
Sensor Offset:	0.44 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5200 MHz

Epsilon: 46.1 (+/-10%) **Sigma:** 5.45 S/m (+/-10%)

ConvF

Channel X: 3.1

Channel Y: 3.1

Channel Z: 3.1

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 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Sensitivity Calibration:

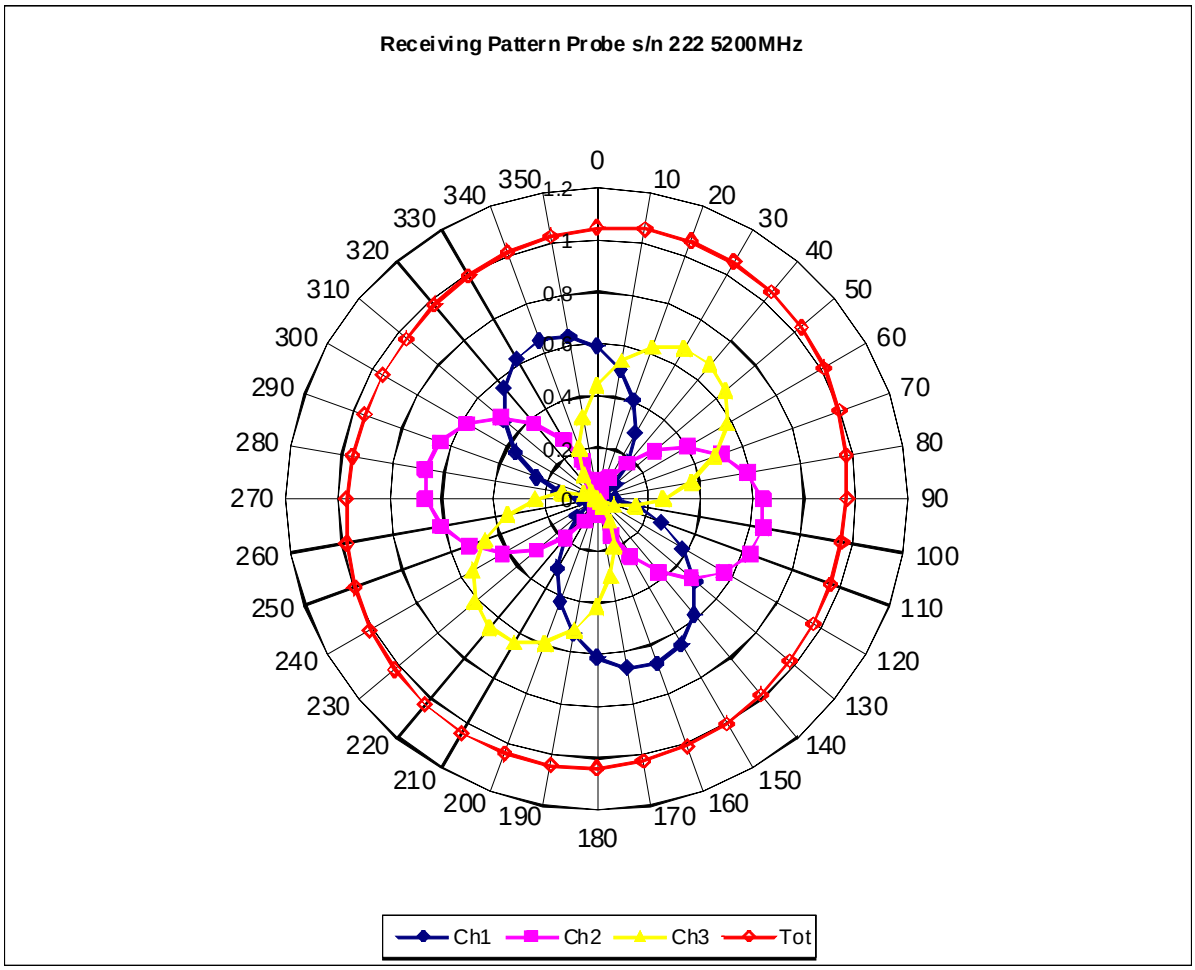
Sensitivity is calibrated in a wave guide following standard calibration procedures as described in IEEE-1528.

Probe Linearity:

Probe linearity is calculated based on the mean voltage measured from the probe and then equated to SAR W/Kg following procedures described in IEEE-1528.

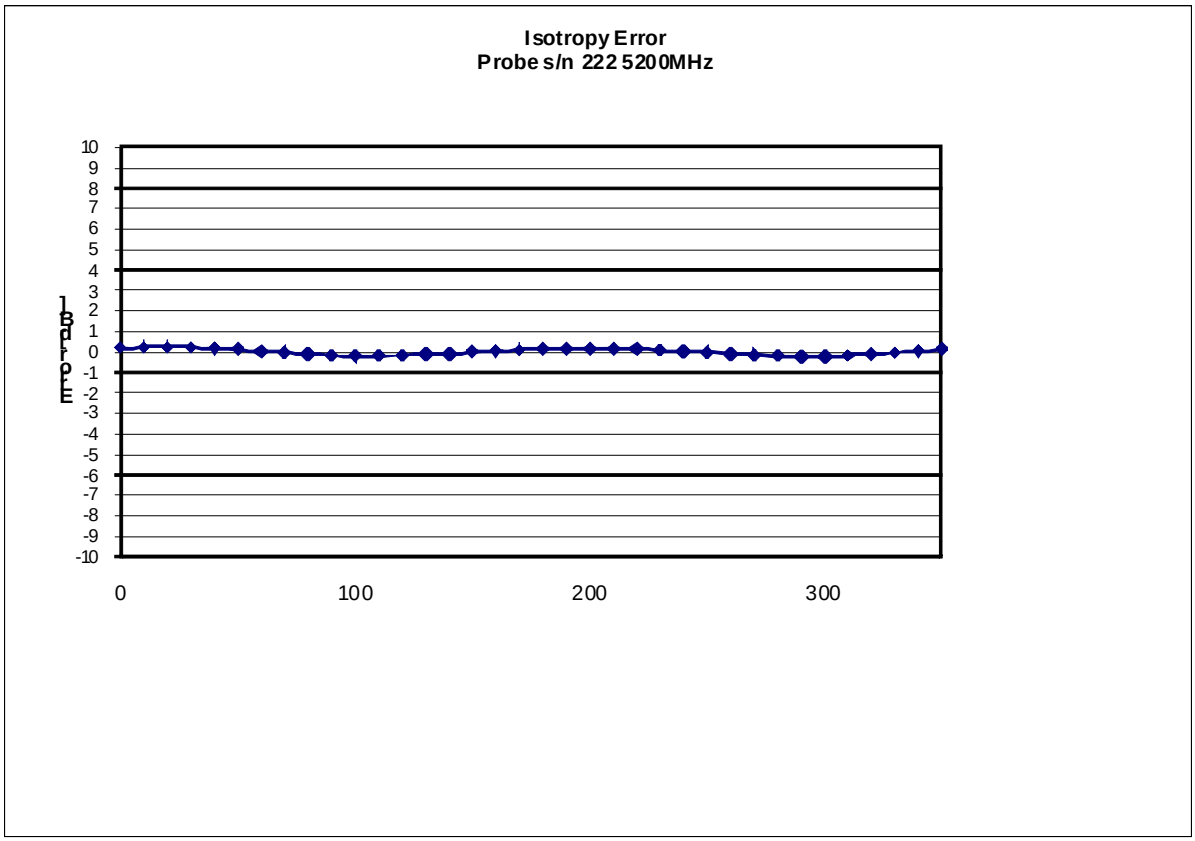
NOTE:
IEEE-1528 does not extend beyond 3GHz for frequency range and as such reference values for tissue dielectric have been taken from FCC Supplement C.

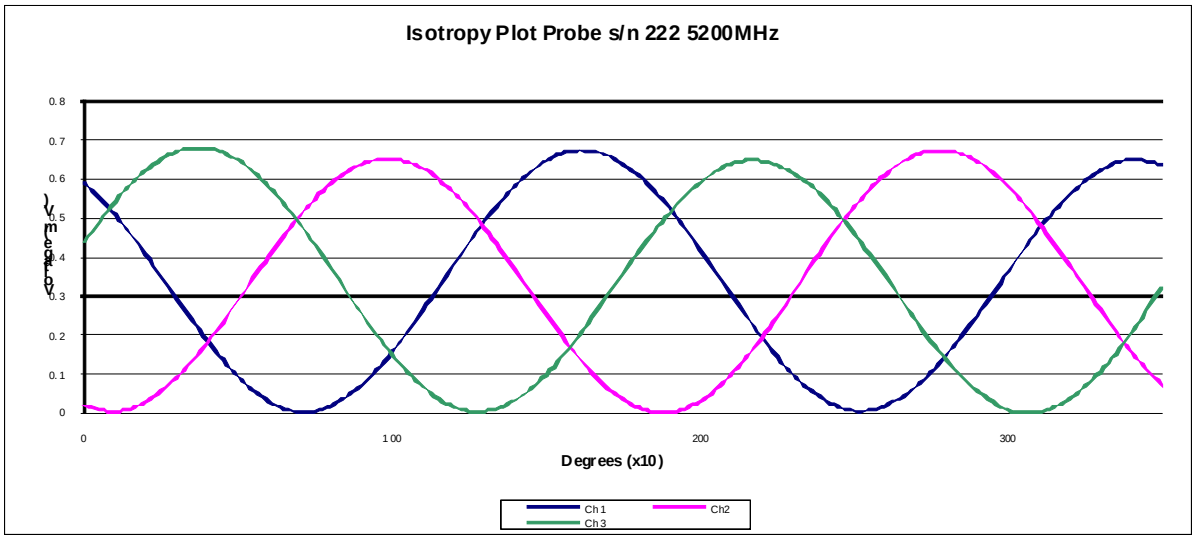
Receiving Pattern 5200 MHz (Air)



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

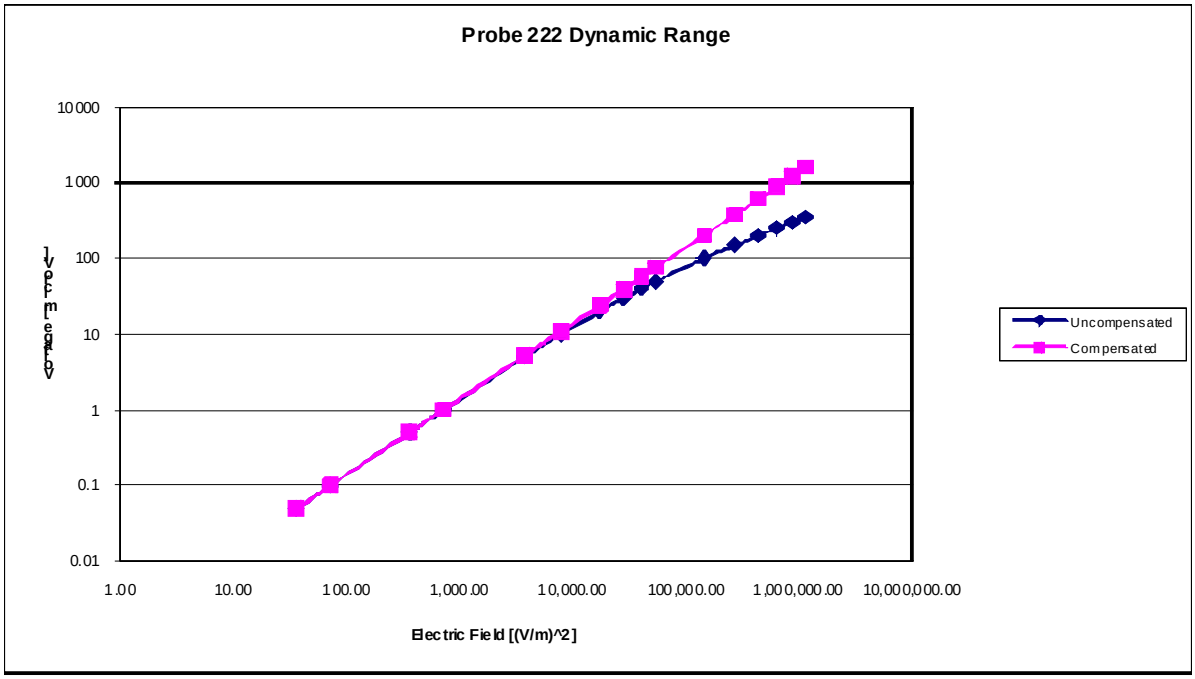
Isotropy Error 5200 MHz (Air)



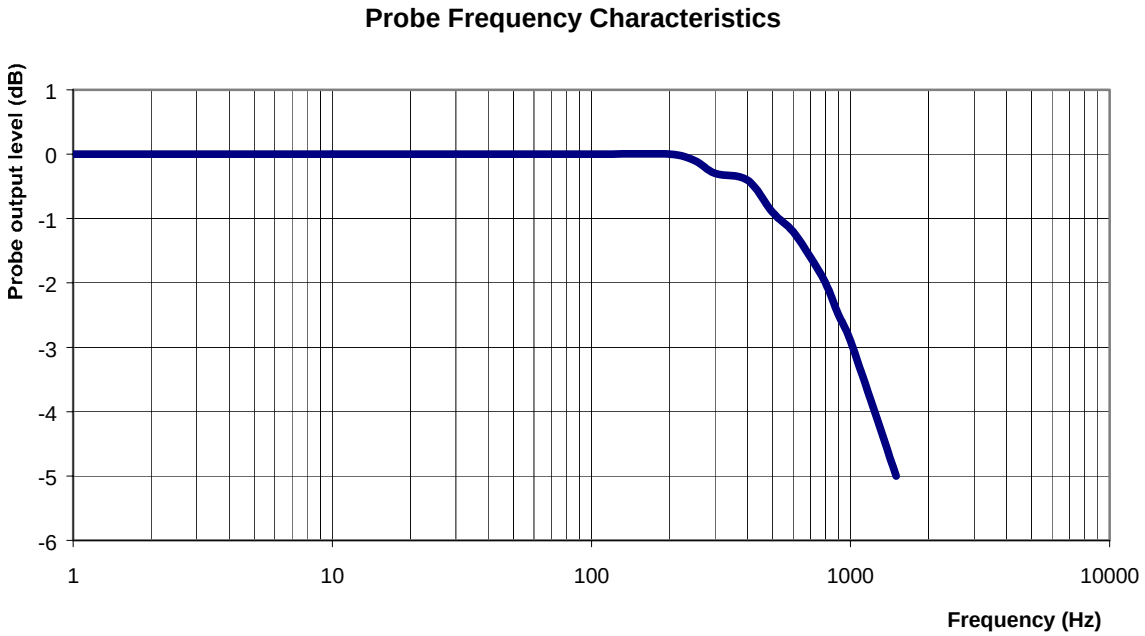


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment Measured

Frequency:		5200MHz	
Epsilon:	46.1 (+/-10%)	**Sigma:**	5.45 S/m (+/-10%)
ConvF			
Channel X:	3.1	7%(K=2)	
Channel Y:	3.1	7%(K=2)	
Channel Z:	3.1	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 0.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1129

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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 2600 MHz

Manufacturer: APREL Laboratories
Model No.: E-030
Serial No.: 222

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 4th February 2010
Released on: 4th February 2010

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-030 222.

References

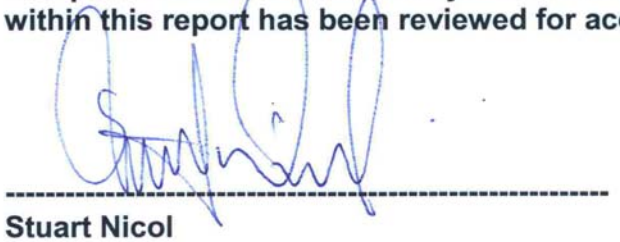
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 222 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-030
Serial Number:	222
Frequency:	2600 MHz
Sensor Offset:	0.44 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 2600 MHz

Epsilon: 51.3 (+/-5%) **Sigma:** 2.14 S/m (+/-5%)

ConvF

Channel X: 3.95

Channel Y: 3.95

Channel Z: 3.95

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq and corrected for broadband calibration factor.

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 1.44mm.

Spatial Resolution:

The measured probe tip diameter is 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

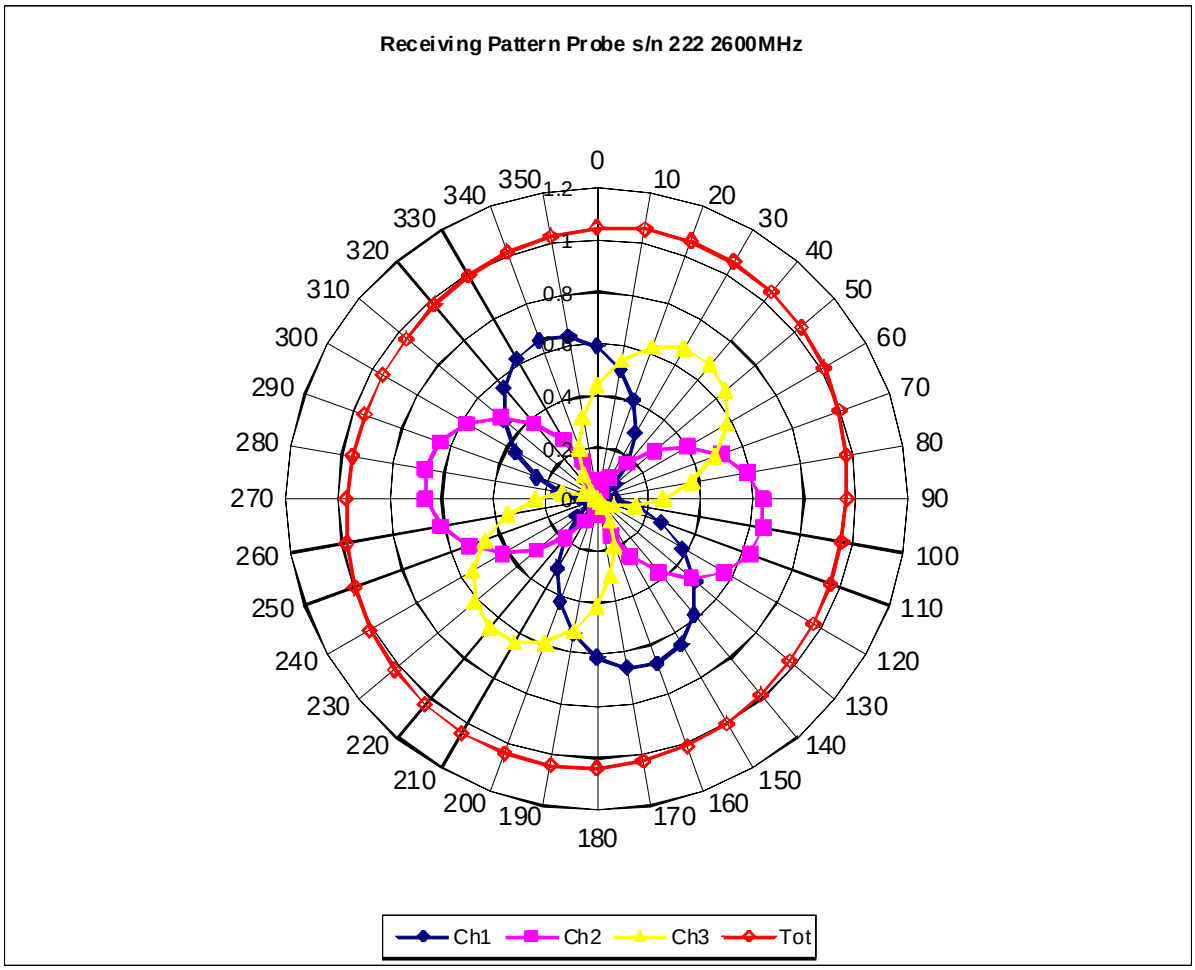
Sensitivity Calibration:

Sensitivity is calibrated in a wave guide following standard calibration procedures as described in IEEE-1528.

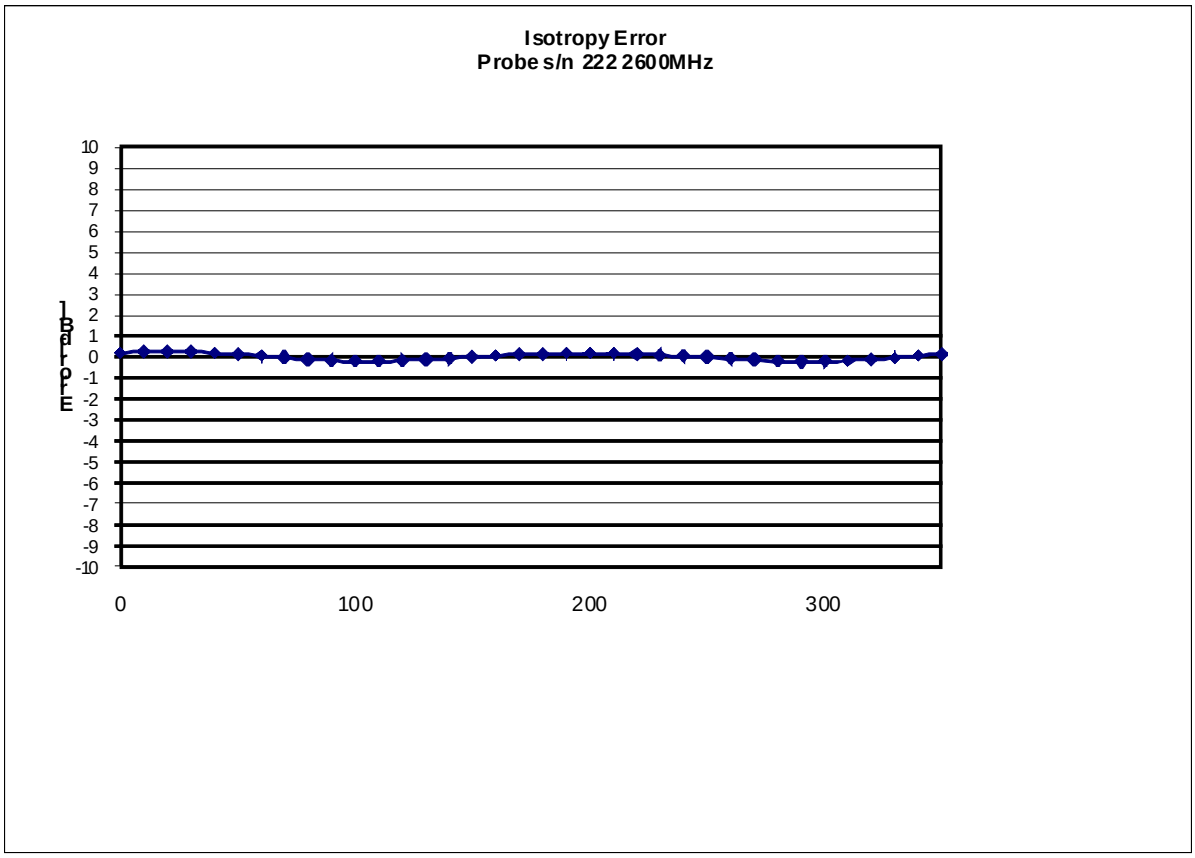
Probe Linearity:

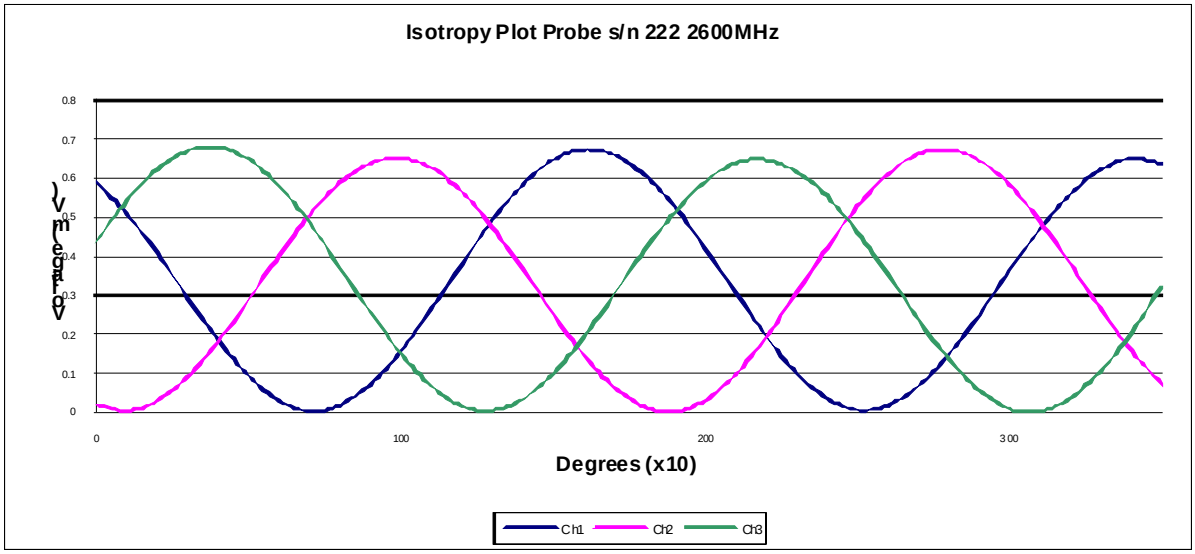
Probe linearity is calculated based on the mean voltage measured from the probe and then equated to SAR W/Kg following procedures described in IEEE-1528.

Receiving Pattern 2600 MHz (Air)



Isotropy Error 2600 MHz (Air)

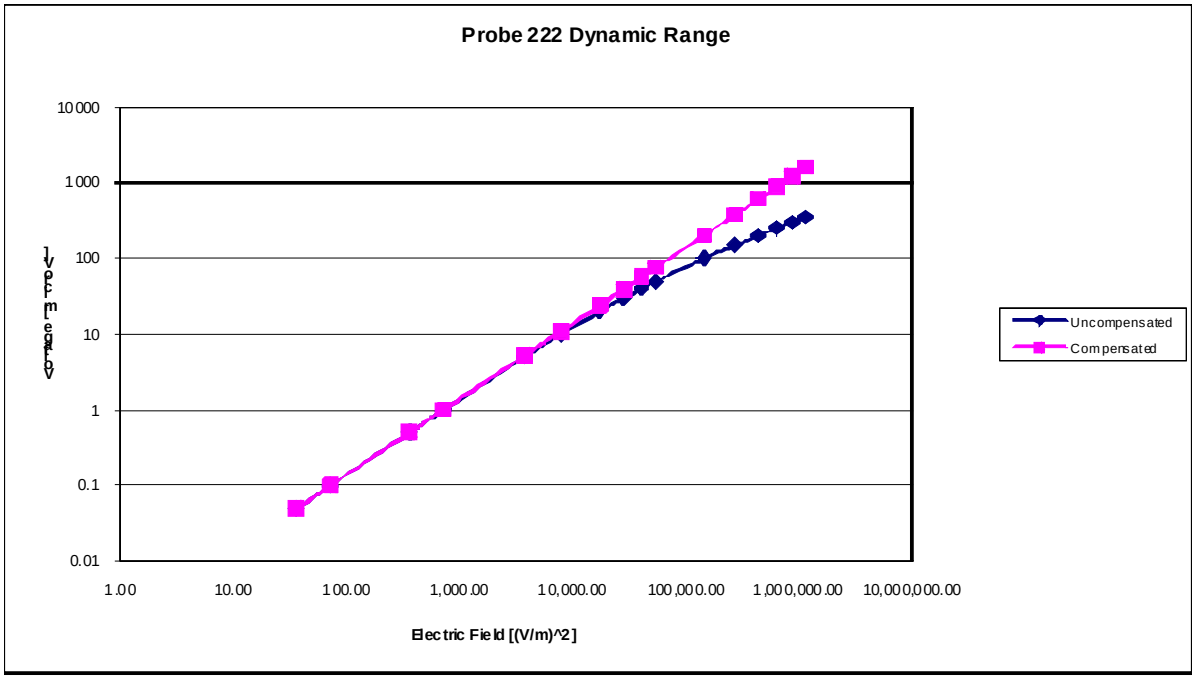




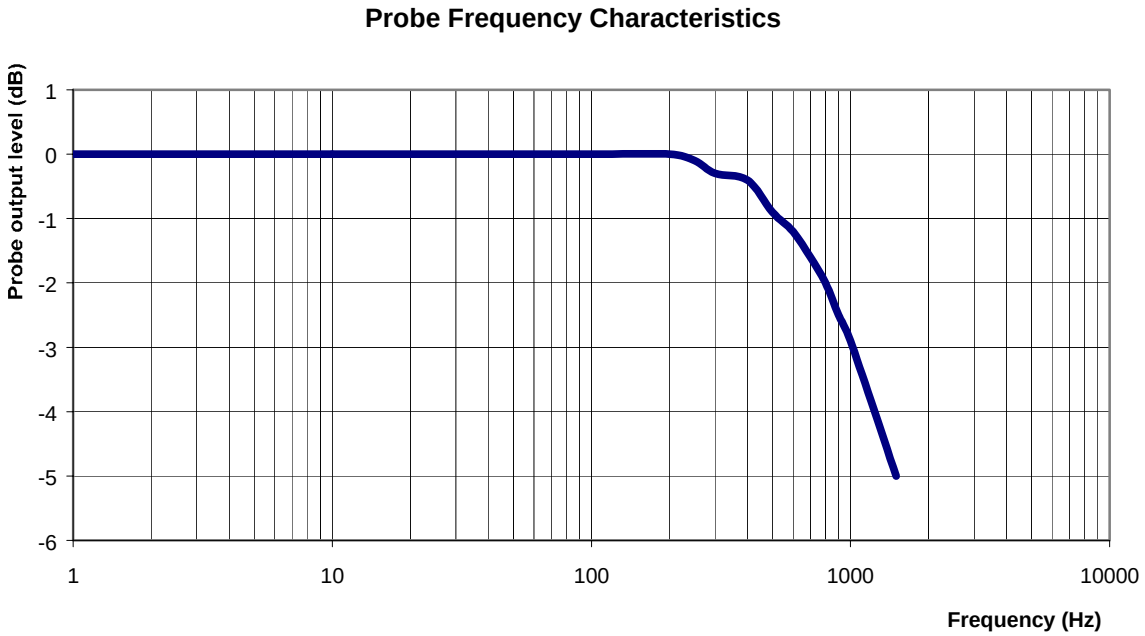
Isotropicity in Tissue: 0.10 dB

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

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment Measured

Frequency:		2600MHz	
Epsilon:	51.3 (+/-5%)	**Sigma:**	2.14 S/m (+/-5%)
ConvF			
Channel X:	3.95	7%(K=2)	
Channel Y:	3.95	7%(K=2)	
Channel Z:	3.95	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 0.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1128

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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-030
Serial No.: 222

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 3rd February 2010
Released on: 3rd February 2010

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-030 222.

References

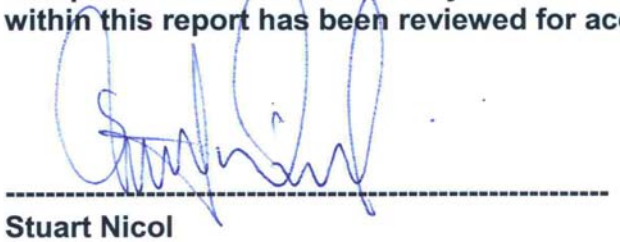
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 222 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-030
Serial Number:	222
Frequency:	2450 MHz
Sensor Offset:	0.44 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 μV/(V/m)^2
Channel Y:	1.2 μV/(V/m)^2
Channel Z:	1.2 μV/(V/m)^2
Diode Compression Point:	95 mV

Sensitivity in Body Tissue Measured

Frequency: 2450 MHz

Epsilon: 53.1 (+/-5%) **Sigma:** 1.98 S/m (+/-5%)

ConvF

Channel X: 4.0

Channel Y: 4.0

Channel Z: 4.0

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq and corrected for broadband calibration factor.

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 1.44mm.

Spatial Resolution:

The measured probe tip diameter is 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

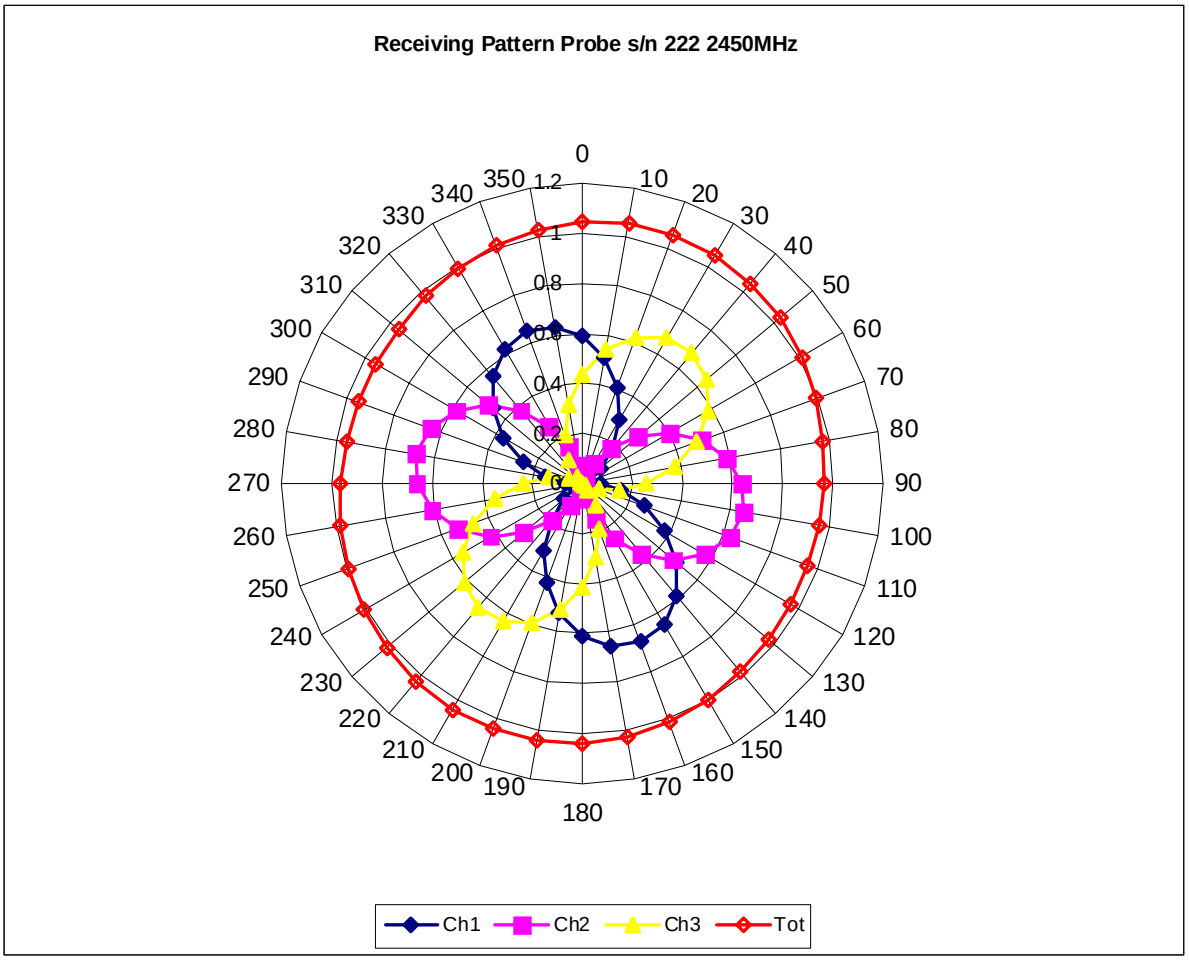
Sensitivity Calibration:

Sensitivity is calibrated in a wave guide following standard calibration procedures as described in IEEE-1528.

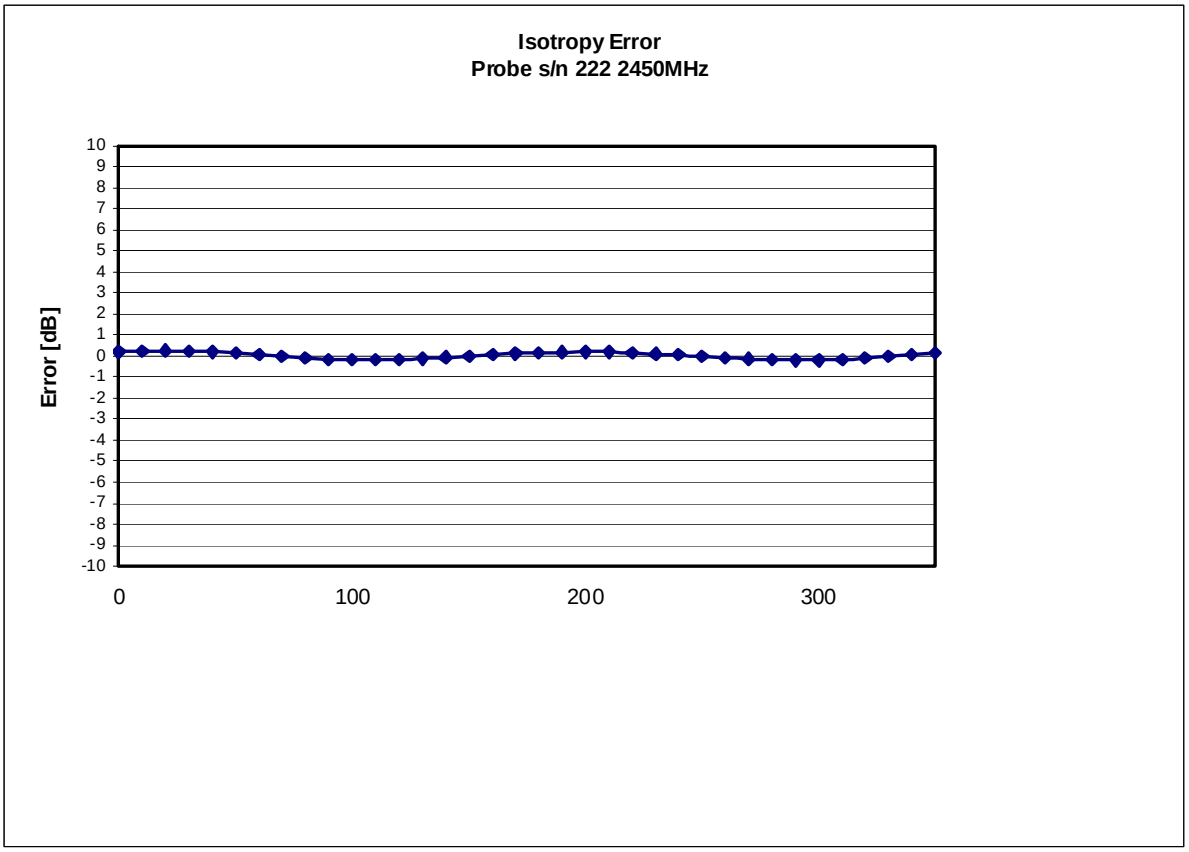
Probe Linearity:

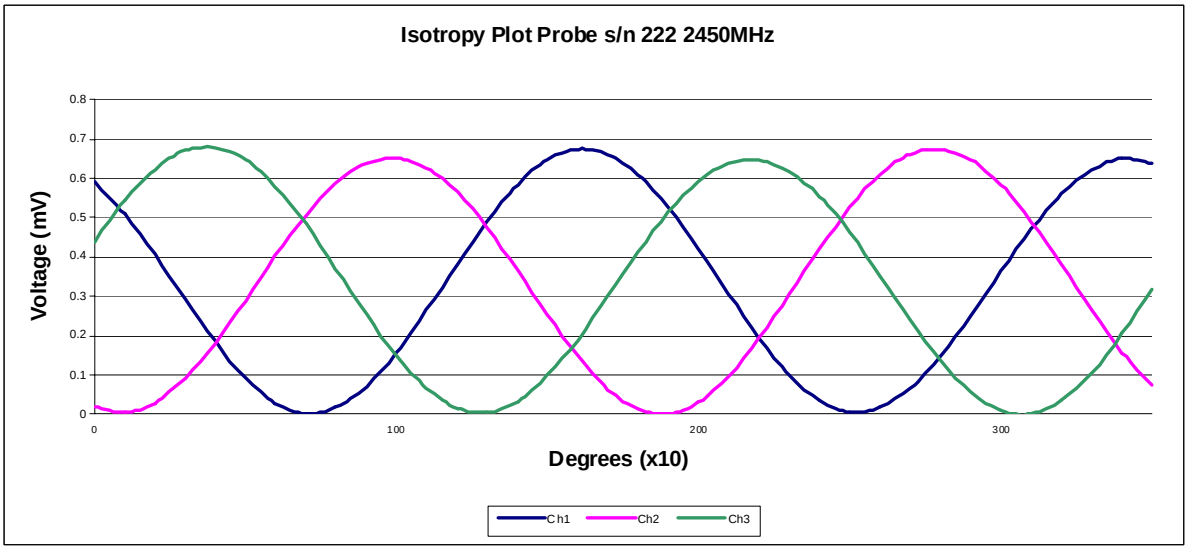
Probe linearity is calculated based on the mean voltage measured from the probe and then equated to SAR W/Kg following procedures described in IEEE-1528.

Receiving Pattern 2450 MHz (Air)



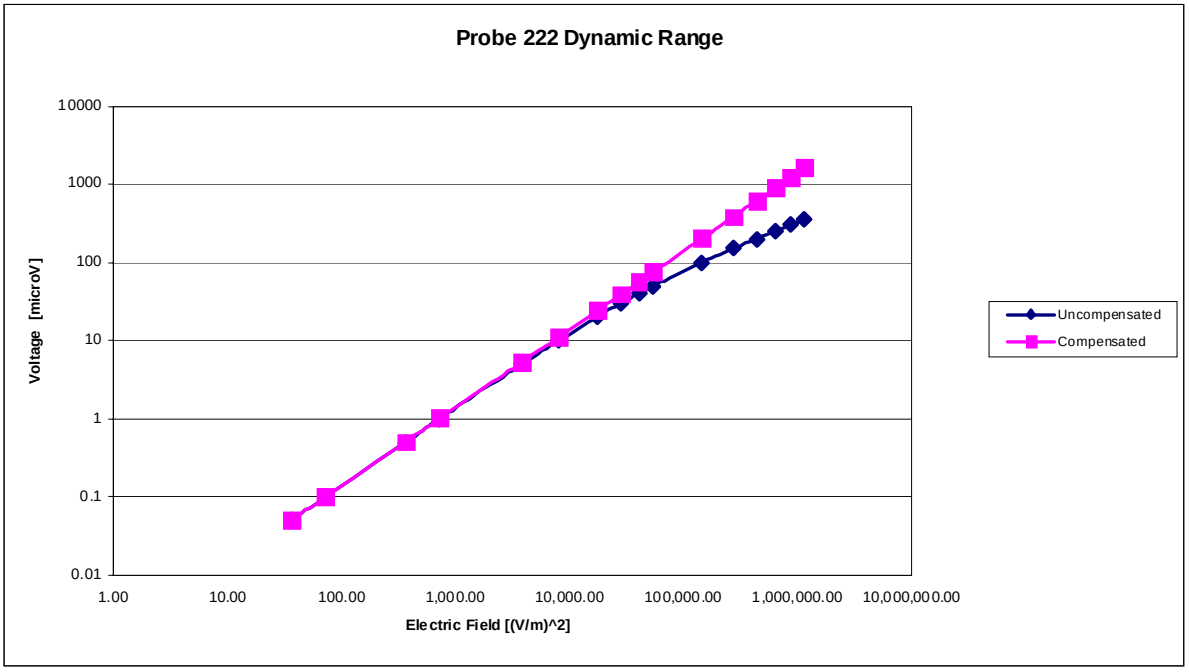
Isotropy Error 2450 MHz (Air)



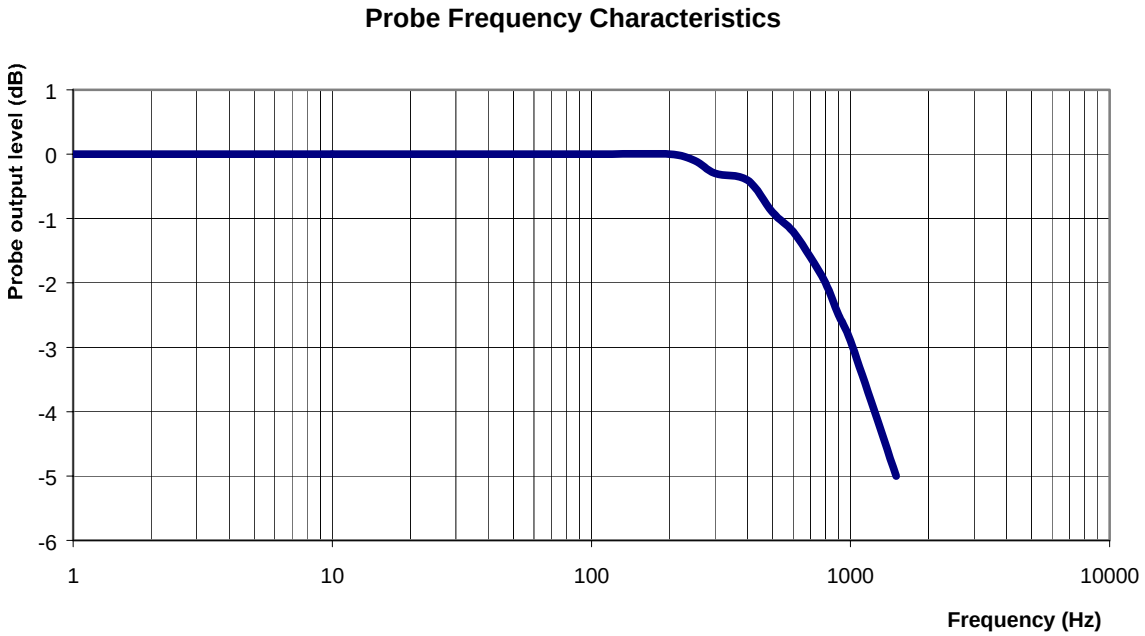


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment Measured

Frequency:		2450MHz	
Epsilon:	53.1 (+/-5%)	**Sigma:**	1.98 S/m (+/-5%)
ConvF			
Channel X:	4.0	7%(K=2)	
Channel Y:	4.0	7%(K=2)	
Channel Z:	4.0	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 0.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-1132

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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

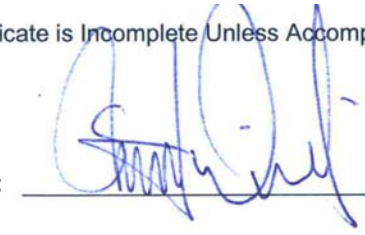
Manufacturer: APREL Laboratories
Model No.: E-030
Serial No.: 222

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 9th February 2010
Released on: 9th February 2010

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-030 222.

References

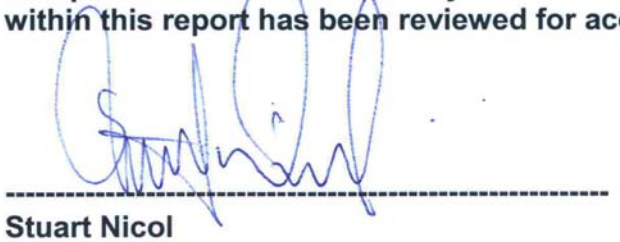
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 222 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-030
Serial Number:	222
Frequency:	5800 MHz
Sensor Offset:	0.44 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5800 MHz

Epsilon: 49.1 (+/-10%) **Sigma:** 6.2 S/m (+/-10%)

ConvF

Channel X: 3.2

Channel Y: 3.2

Channel Z: 3.2

Tissue sensitivity values were calculated using the load impedance of the APREL Laboratories Daq-Paq and corrected for broadband calibration factor.

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 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Sensitivity Calibration:

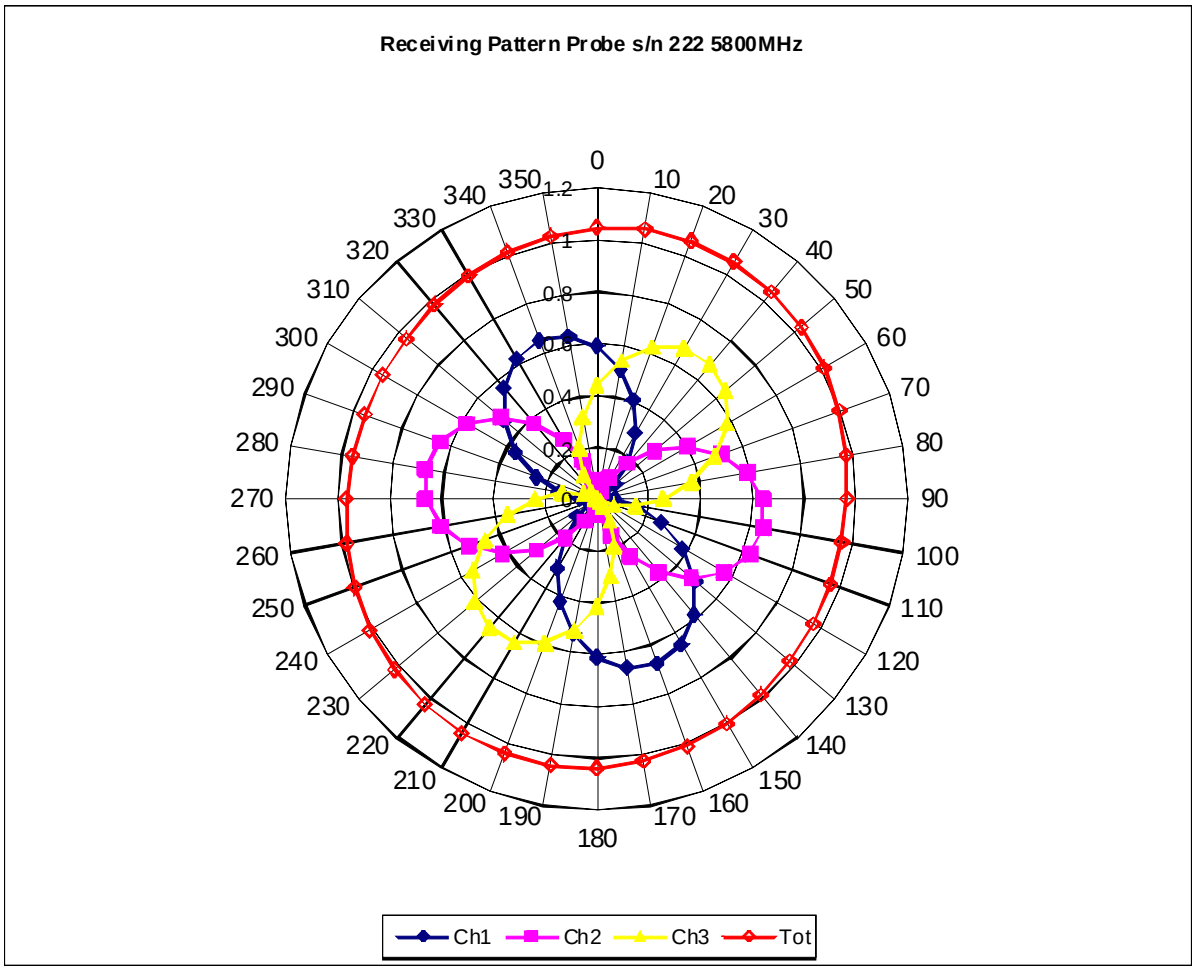
Sensitivity is calibrated in a wave guide following standard calibration procedures as described in IEEE-1528.

Probe Linearity:

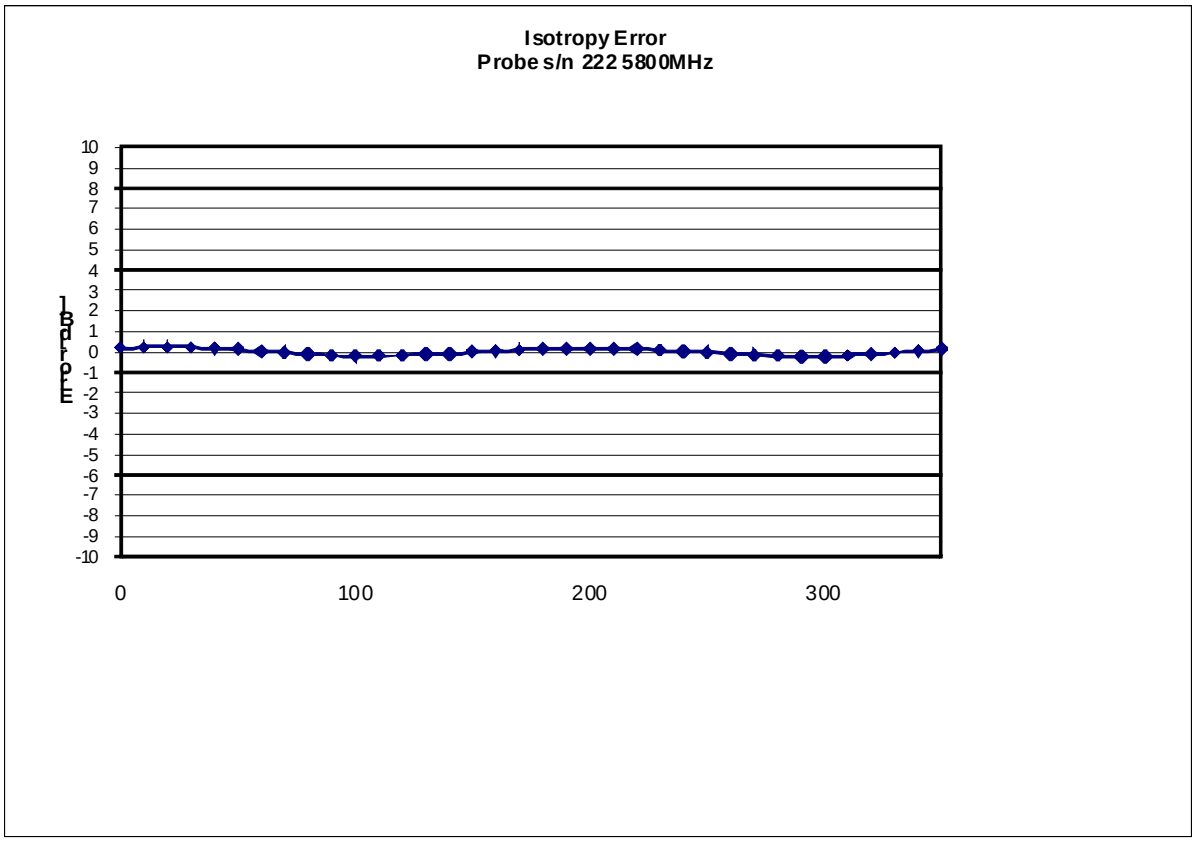
Probe linearity is calculated based on the mean voltage measured from the probe and then equated to SAR W/Kg following procedures described in IEEE-1528.

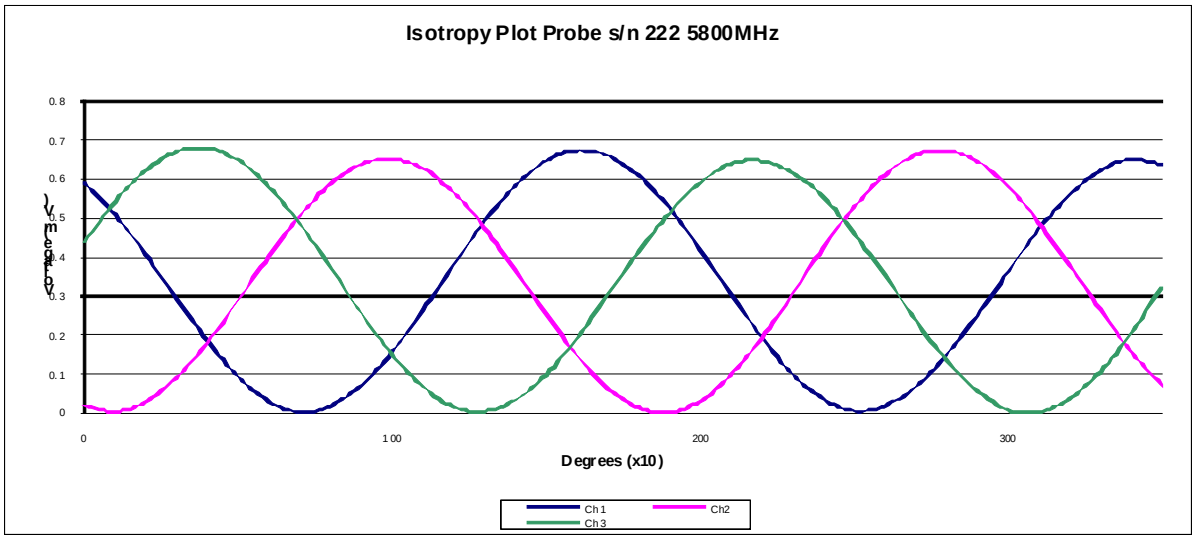
NOTE:
IEEE-1528 does not extend beyond 3GHz for frequency range and as such reference values for tissue dielectric have been taken from FCC Supplement C.

Receiving Pattern 5800 MHz (Air)



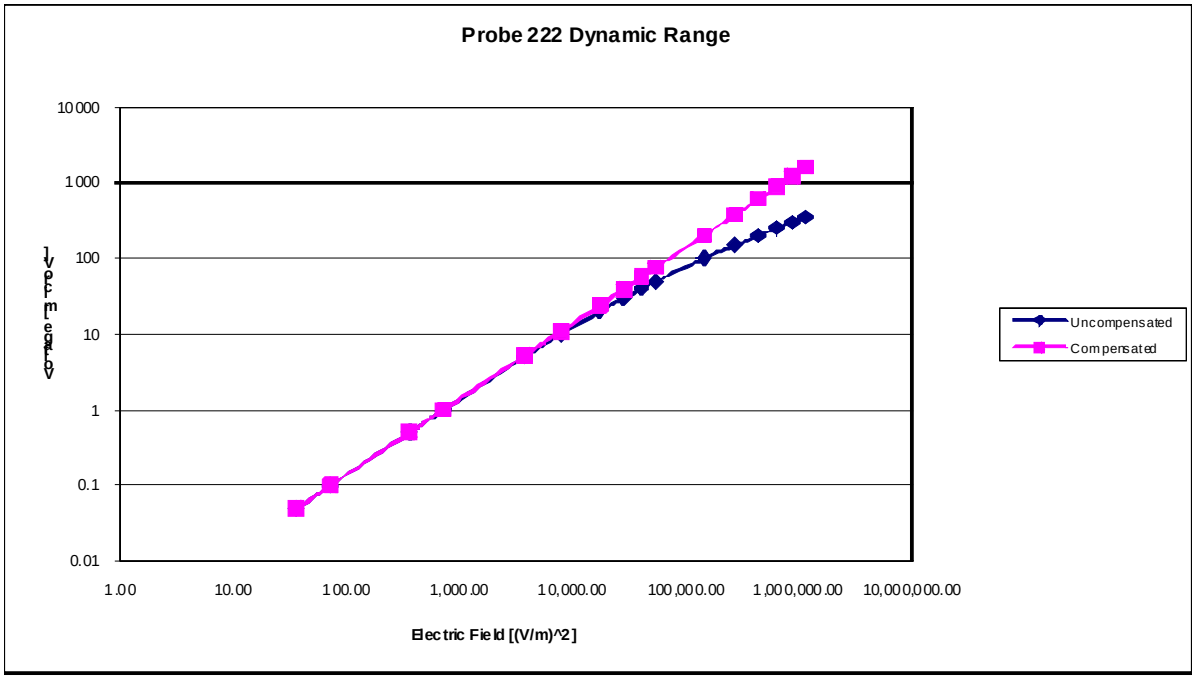
Isotropy Error 5800 MHz (Air)



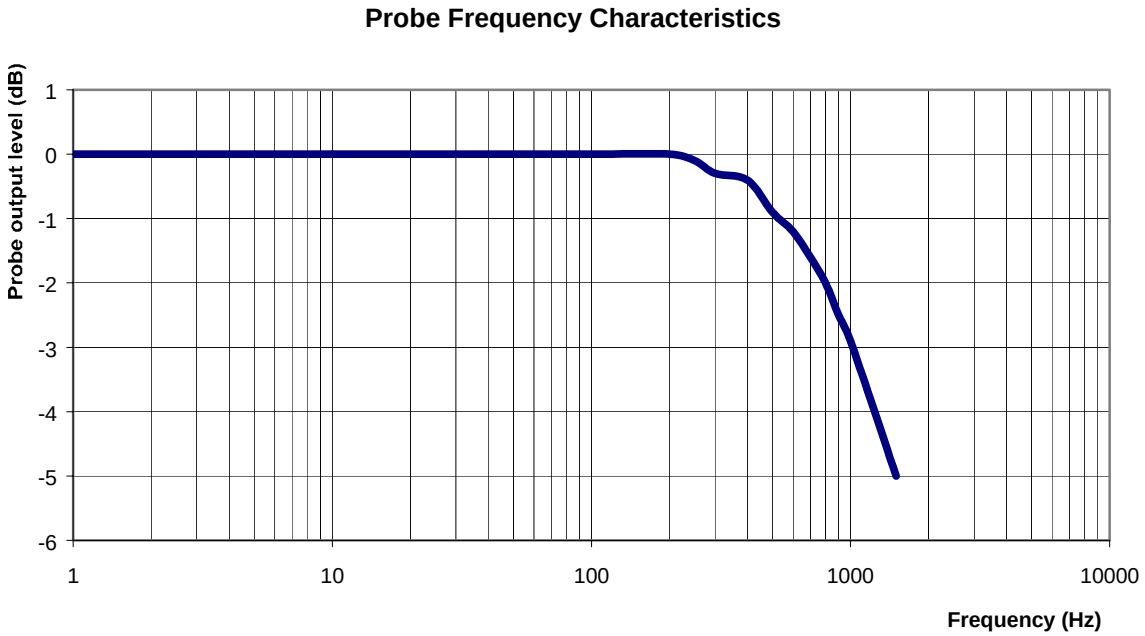


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment Measured

Frequency:		5800MHz	
Epsilon:	49.1 (+/-10%)	**Sigma:**	6.2 S/m (+/-10%)
ConvF			
Channel X:	3.2	7%(K=2)	
Channel Y:	3.2	7%(K=2)	
Channel Z:	3.2	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 0.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-916
Project Number: APREL-ALSAS 10U

C E R T I F I C A T E OF C A L I B R A T I O N

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-1900-S-2
Frequency: 1900 MHz
Serial No: 1900-210-00704

Customer: APREL

Calibrated:2nd March 2009
Released on: 2nd march 2009

Released By: _____

NCL CALIBRATION LABORATORIES
51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6
Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 1900-210-00704 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 device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

D. Brooks

Calibration Results Summary

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

Mechanical Dimensions

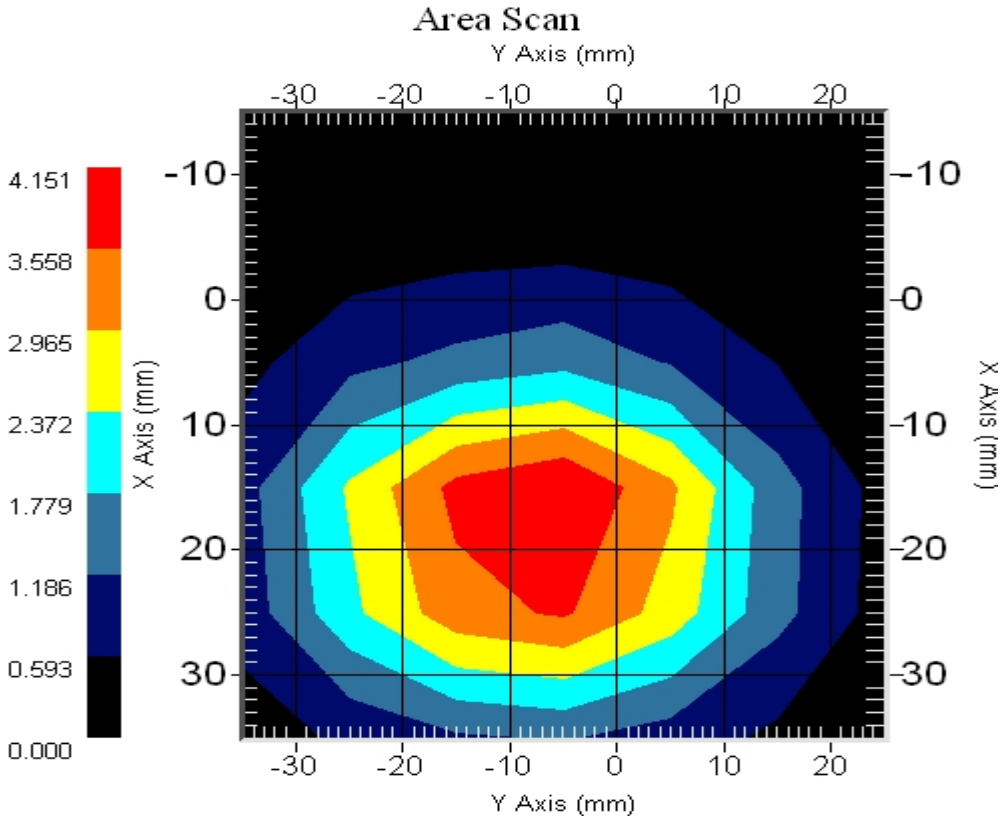
Length: 68.0 mm
Height: 39.5 mm

Electrical Specification

SWR: 1.10 U
Return Loss: -26.3 dB
Impedance: 48.4 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
1900 MHz	37.96	19.81	70.56



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 1900-210-00704. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the 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 APREL 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 1900-210-00704 was a re-calibration.

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

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
68.0 mm	39.5 mm	69.1mm	40.3 mm

Tissue Validation

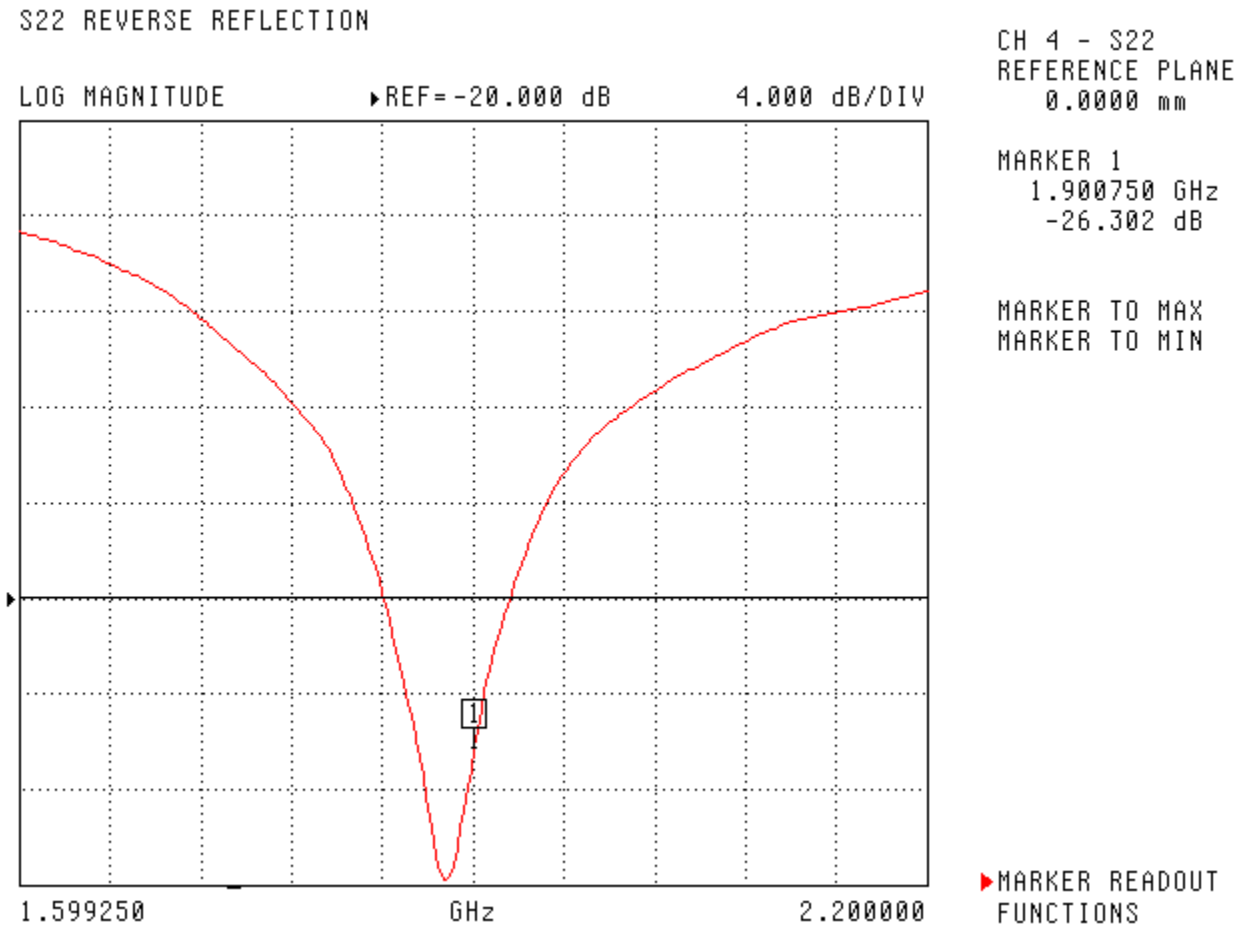
Head Tissue 1900 MHz	Measured
Dielectric constant, ε_r	40.0
Conductivity, σ [S/m]	1.40

Electrical Calibration

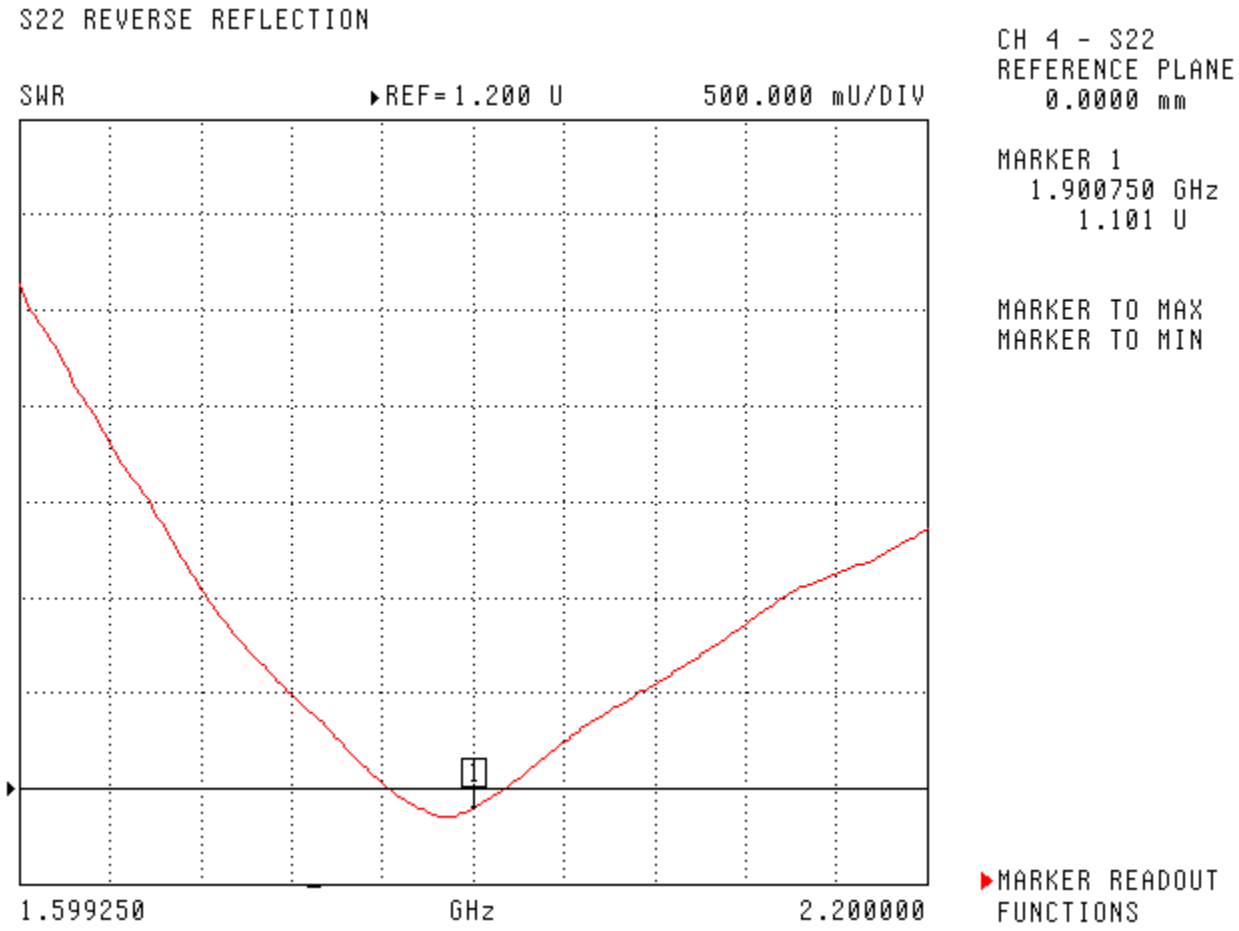
Test	Result
S11 R/L	-26.3 dB
SWR	1.10 U
Impedance	48.4 Ω

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

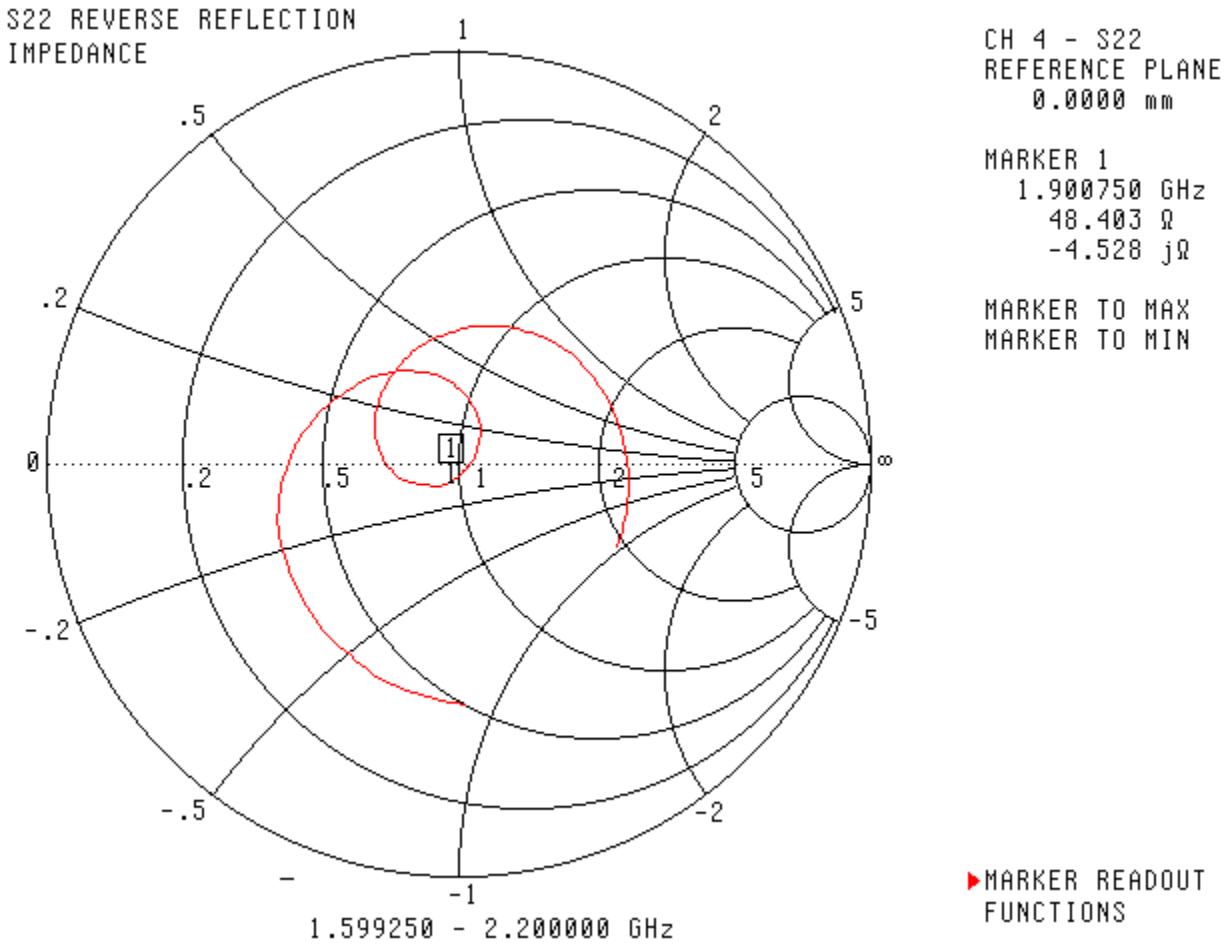
S11 Parameter Return Loss



SWR

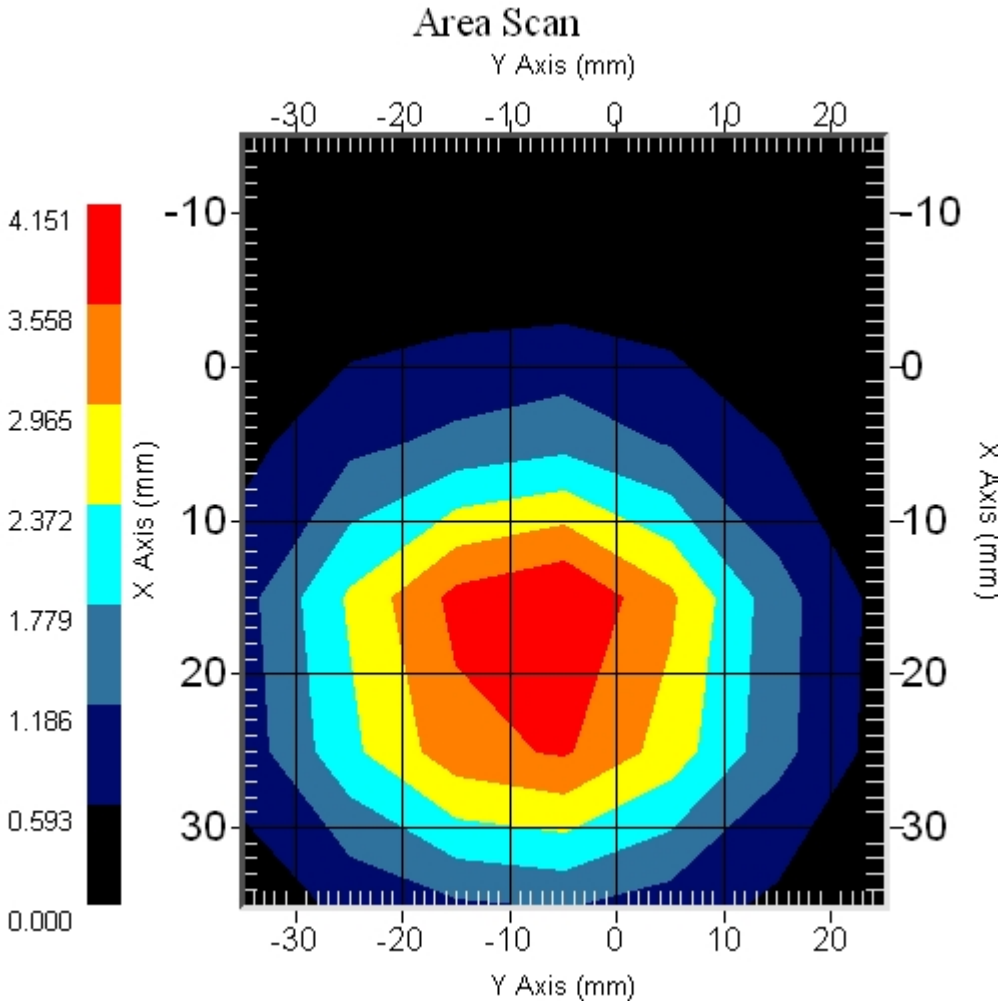


Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
1900 MHz	37.96	19.81	70.56



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-913

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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.: E-020
Serial No.: 225

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 4th May 2009
Released on: 4th May 2009

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-020 226.

References

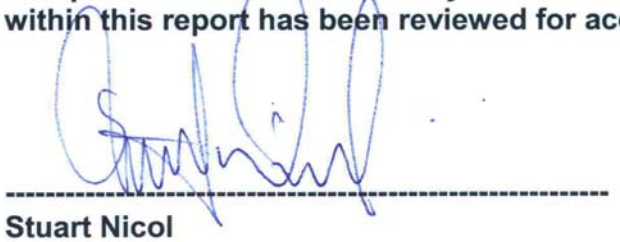
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 225 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:	226
Frequency:	835 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

Channel X:	1.2 μV/(V/m)^2
Channel Y:	1.2 μV/(V/m)^2
Channel Z:	1.2 μV/(V/m)^2
Diode Compression Point:	95 mV

Sensitivity in Body Tissue

Frequency: 835 MHz

Epsilon: 56.1 (+/-5%) **Sigma:** 0.95 S/m (+/-5%)

ConvF

Channel X: 6.6

Channel Y: 6.6

Channel Z: 6.6

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

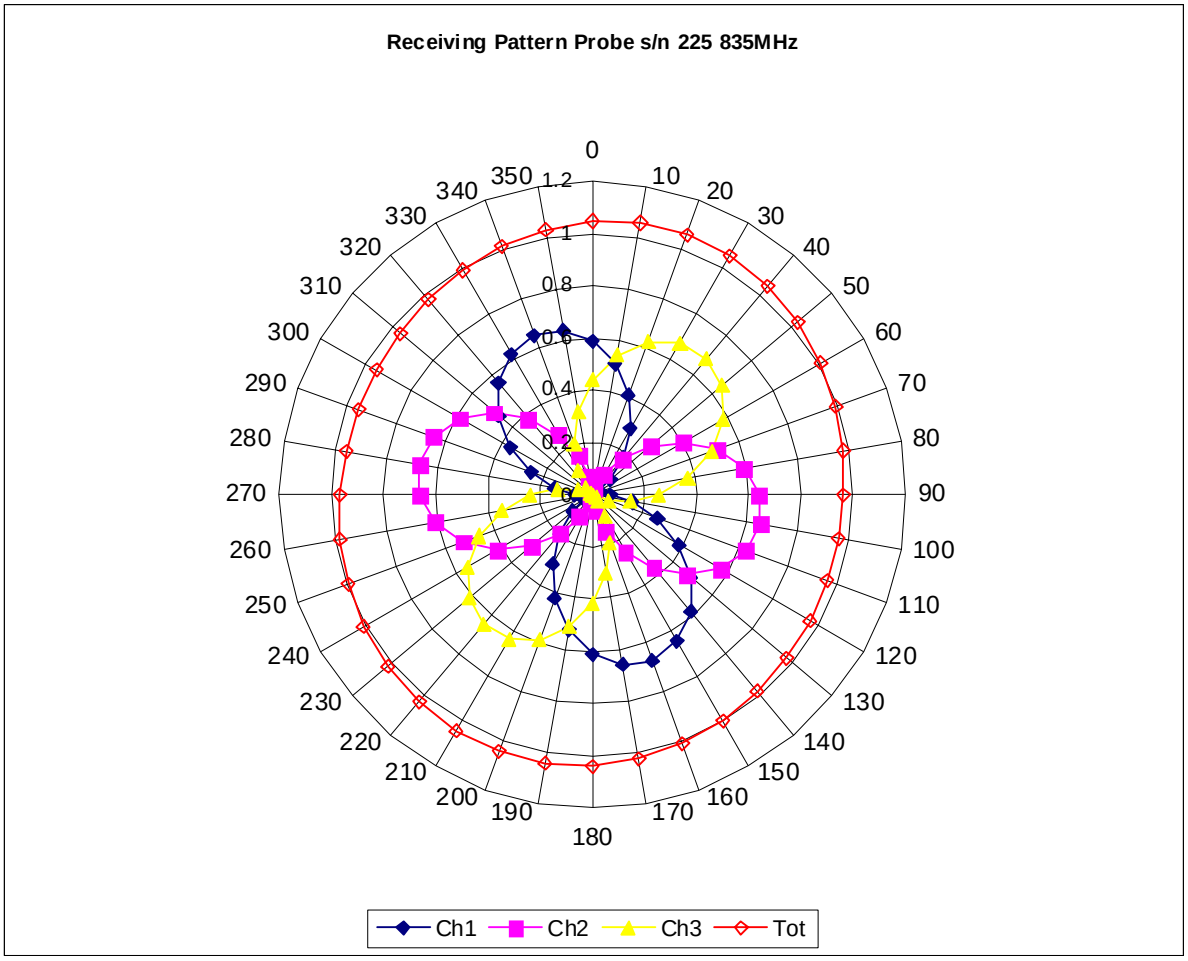
Boundary Effect:

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 1.44mm.

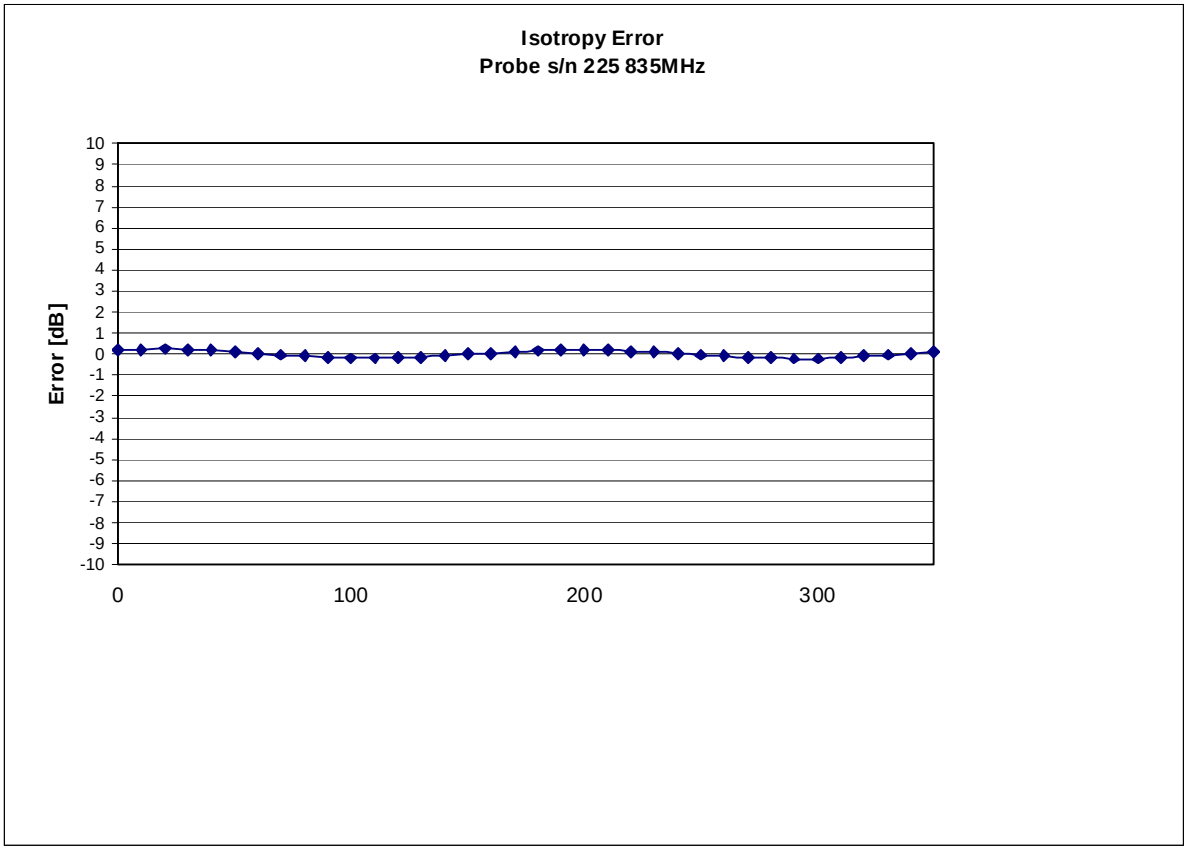
Spatial Resolution:

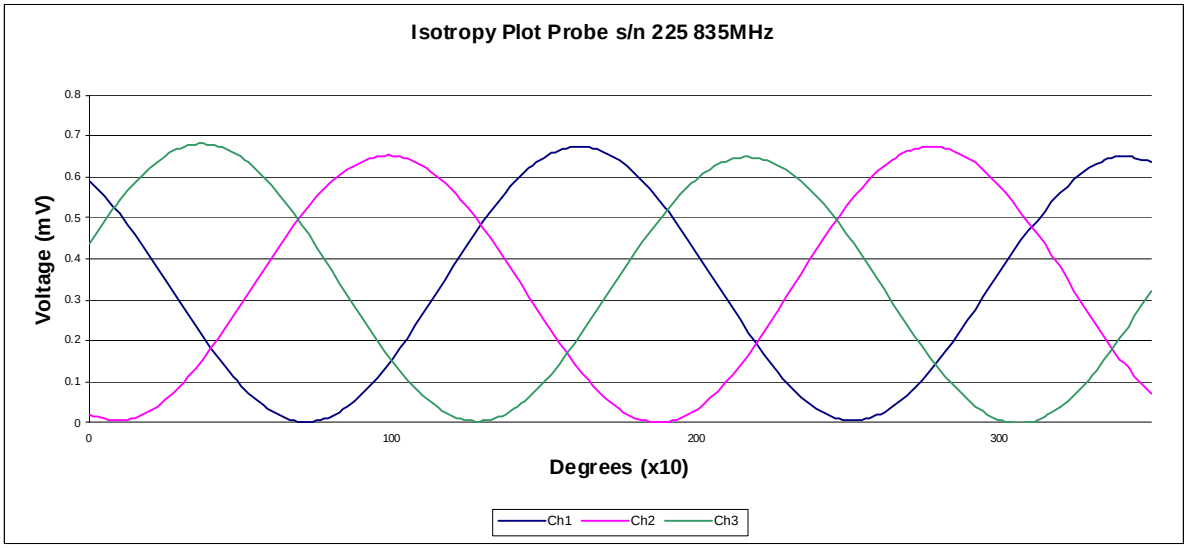
The measured probe tip diameter is 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 835 MHz (Air)



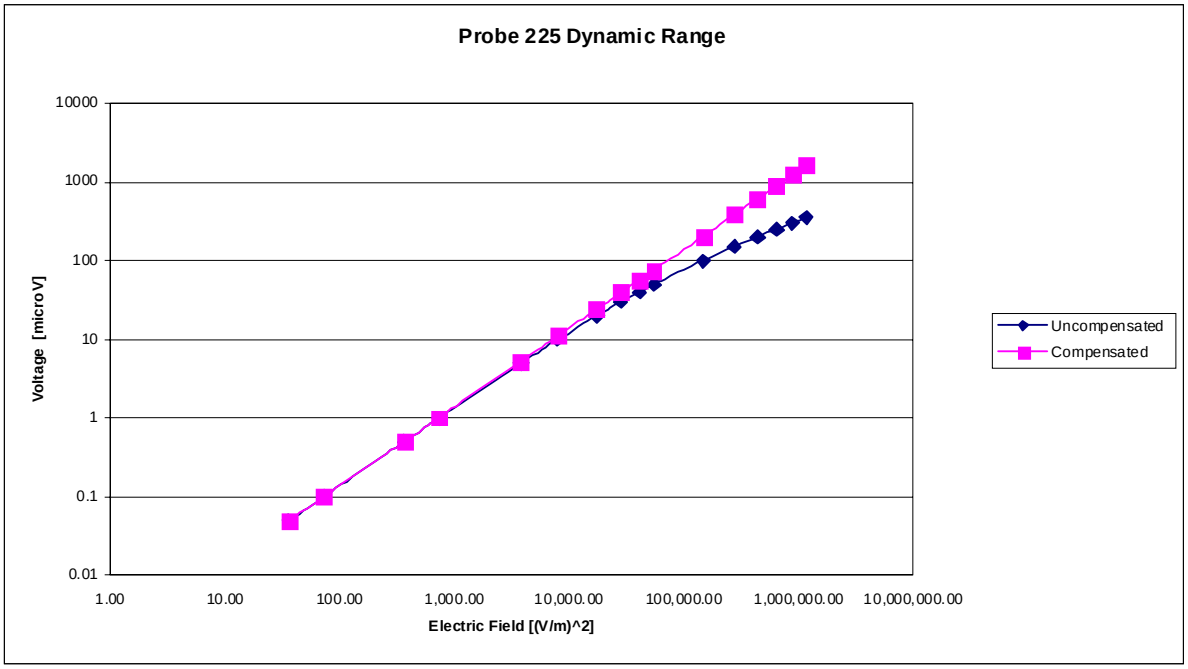
Isotropy Error 835 MHz (Air)



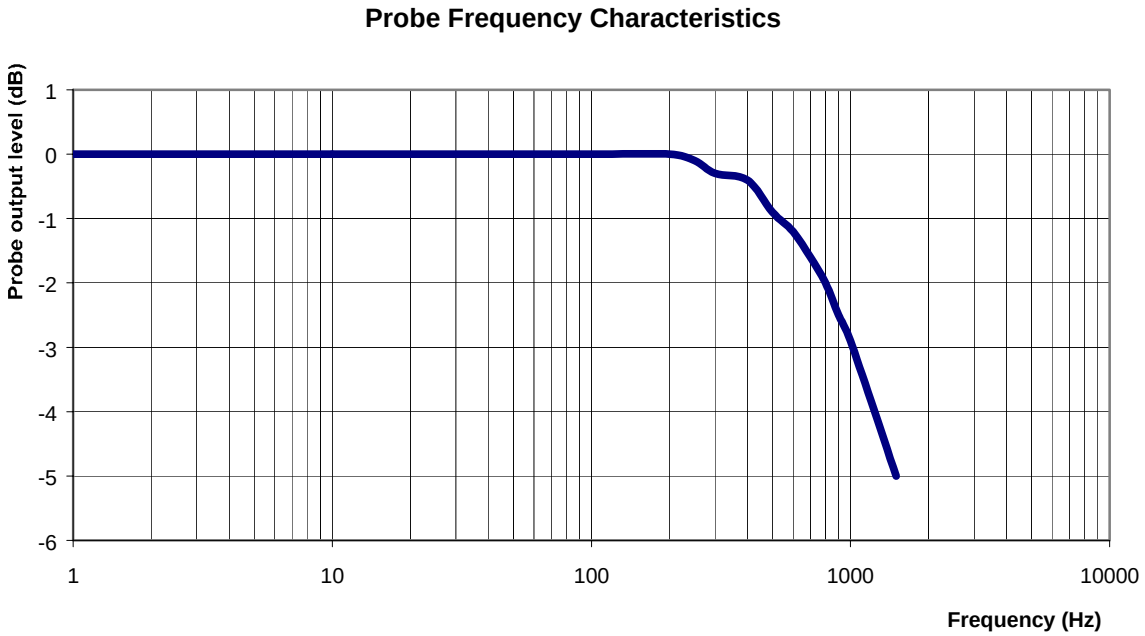


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment

Frequency:		835MHz	
Epsilon:	56.1 (+/-5%)	**Sigma:**	0.95 S/m (+/-5%)
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 MΩ.

Boundary Effect:

For a distance of 1.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-914

Client.: APREL

C E R T I F I C A T E OF C A L I B R A T I O N

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.: 225

Calibration in Body Tissue

Calibration Procedure: SSI/DRB-TP-D01-032-E020-V2
Project No: Internal APREL

Calibrated: 4th May 2009
Released on: 4th May 2009

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-020 226.

References

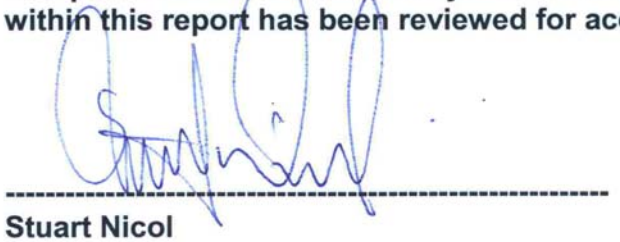
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 “Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques”
SSI-TP-011 Tissue Calibration Procedure

Conditions

Probe 225 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:	226
Frequency:	1900 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	**<**2.9 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue

Frequency: 1900 MHz

Epsilon: 54.0 (+/-5%) **Sigma:** 1.45 S/m (+/-5%)

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.

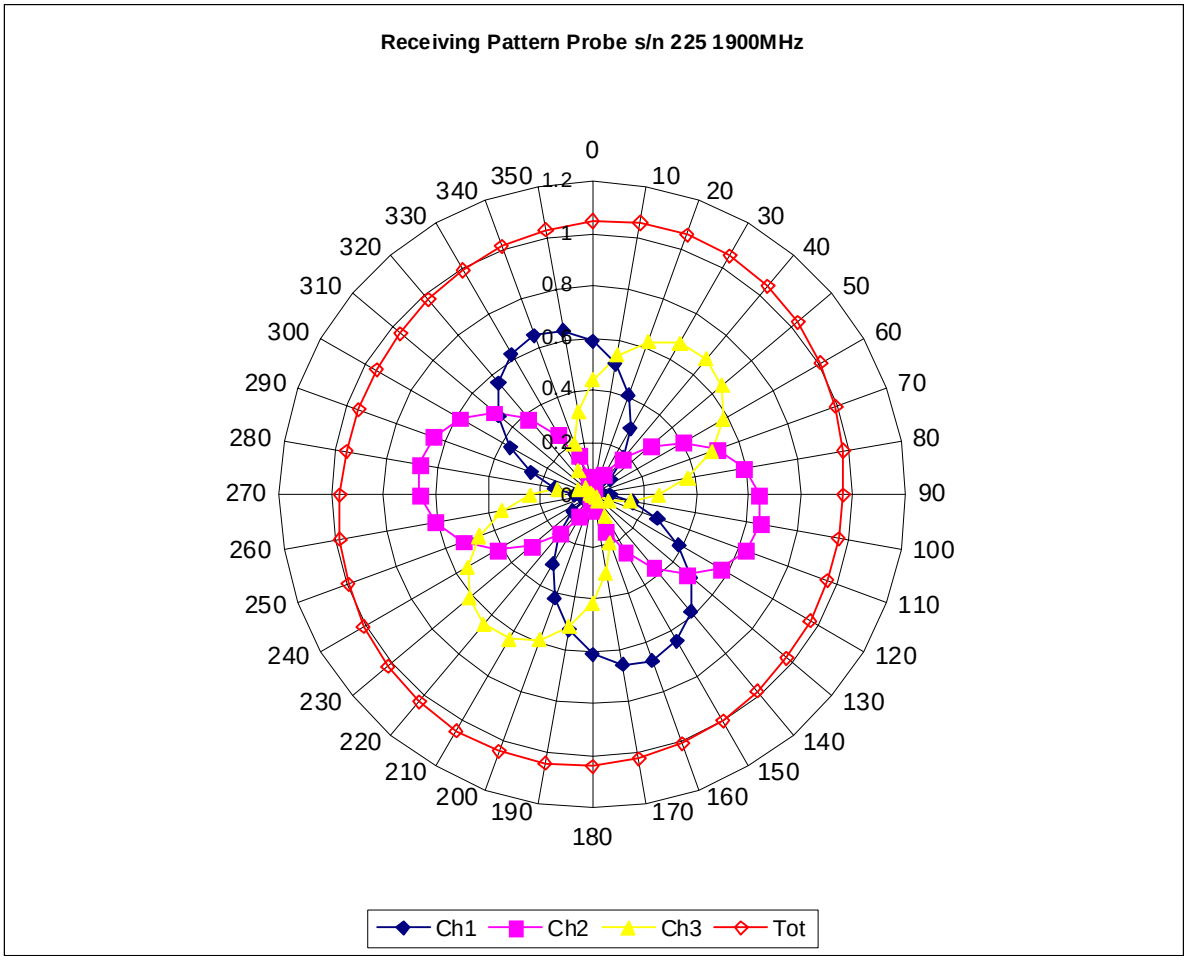
Boundary Effect:

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 1.44mm.

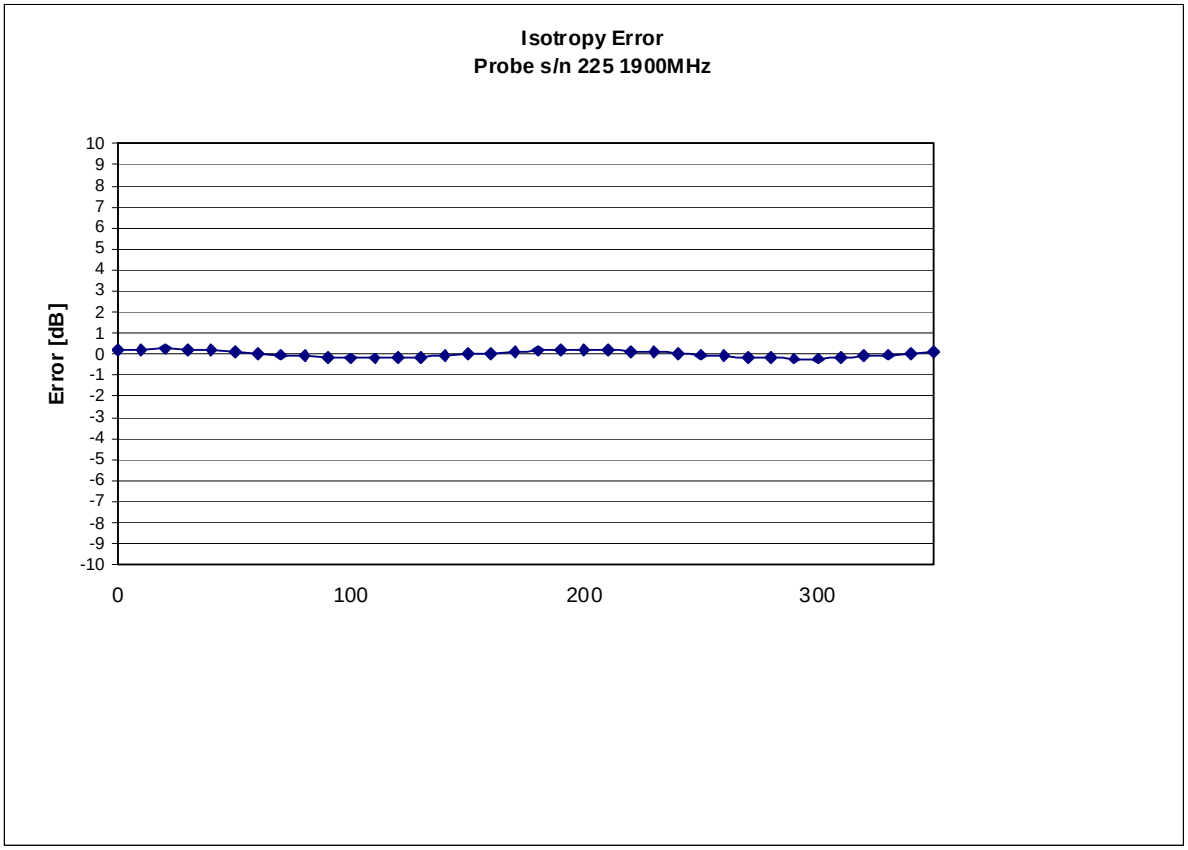
Spatial Resolution:

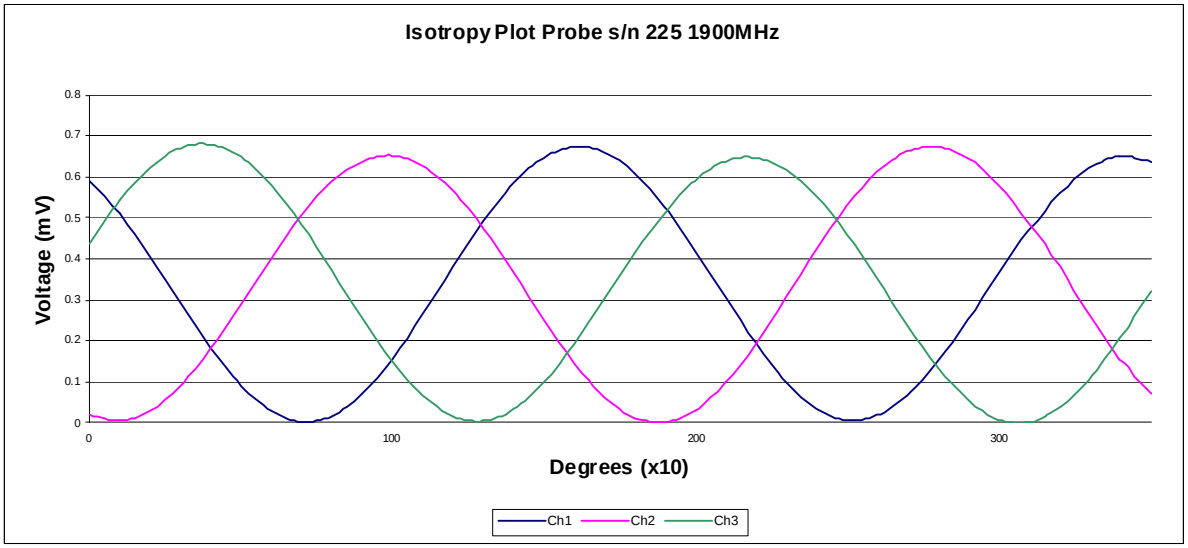
The measured probe tip diameter is 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 1900 MHz (Air)



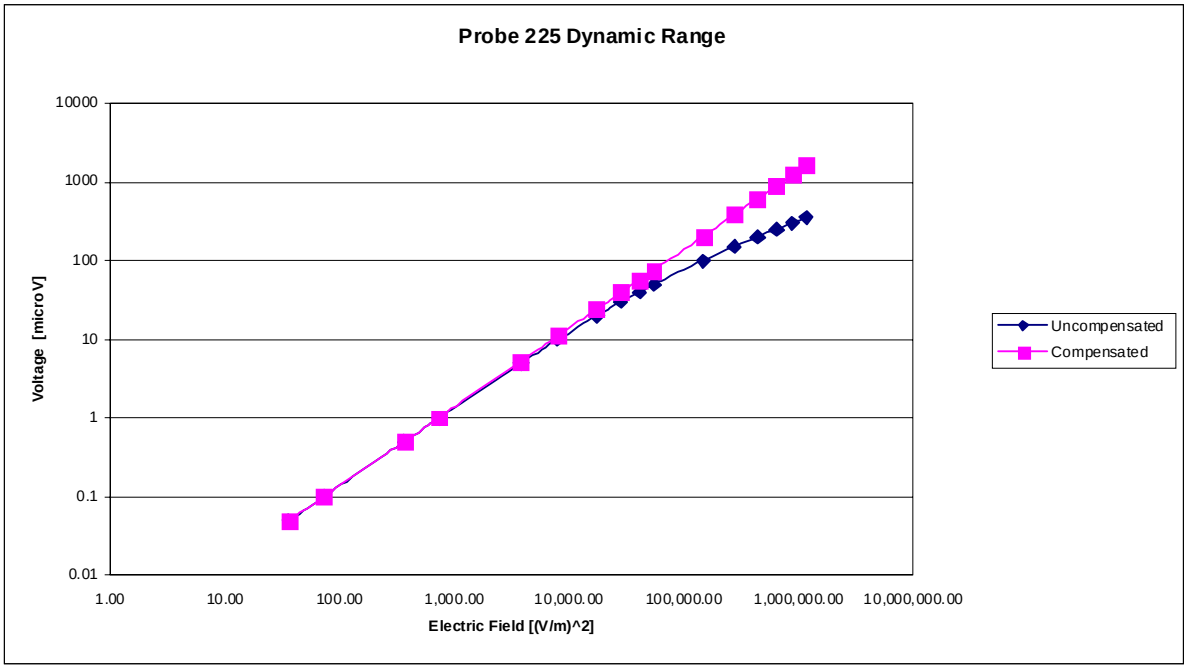
Isotropy Error 1900 MHz (Air)



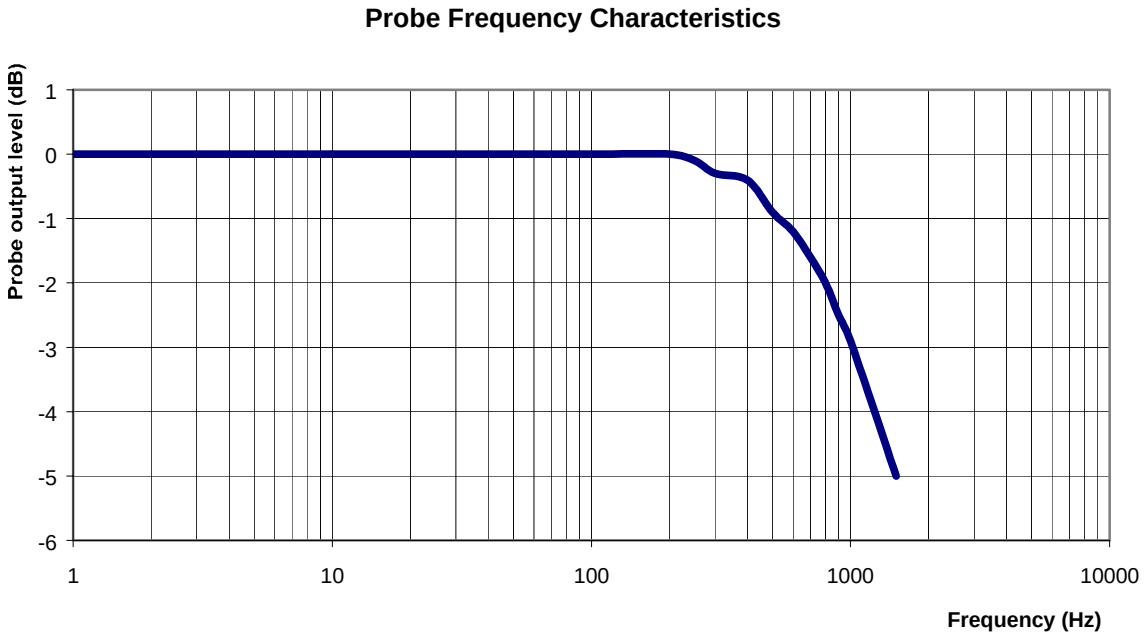


Isotropicity in Tissue: 0.10 dB

Dynamic Range



Video Bandwidth



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

Conversion Factor Uncertainty Assessment

Frequency:		1900MHz	
Epsilon:	54.0 (+/-5%)	**Sigma:**	1.45 S/m (+/-5%)
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 MΩ.

Boundary Effect:

For a distance of 1.4mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2%.

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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-889
Project Number: APREL-ALSAS10U

C E R T I F I C A T E OF C A L I B R A T I O N

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-2450-S-2
Frequency: 2450 MHz
Serial No: 301581

Customer: APREL

Calibrated: 4th May 2009
Released on: 4th May 2009

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
CANADA K2R 1E6

Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 301581 was new and 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 device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

Constantine Teodorian

This page has been reviewed for content and attested to by signature within this document.

Calibration Results Summary

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

Mechanical Dimensions

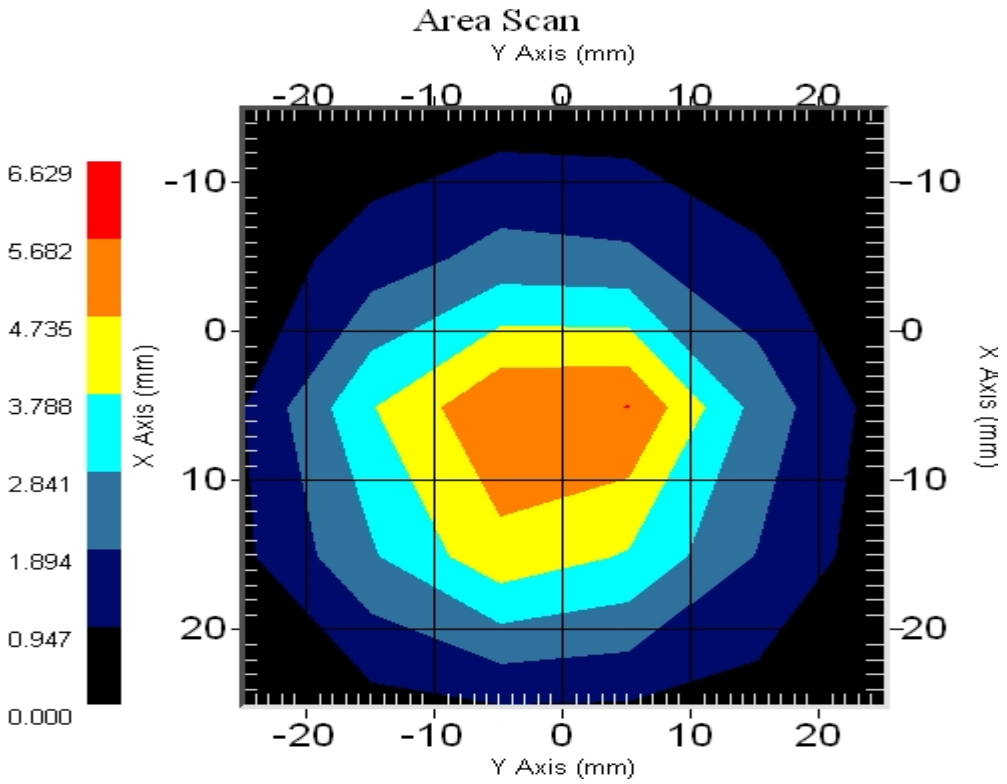
Length: 52.4 mm
Height: 30.3 mm

Electrical Specification

SWR: 1.056 U
Return Loss: -32.0 dB
Impedance: 50.2 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
2450 MHz	53.1	24.4	101.8



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 301581. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the 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 APREL 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”
IEC-62209 “Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures”
Part 1: “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)”
IEC-62209 “Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices – Human models, instrumentation, and procedures”
Part 2 *Draft*: “Procedure to determine the Specific Absorption Rate (SAR) for hand-held devices used in close proximity of the ear (frequency range of 30 MHz to 6 GHz)”

Conditions

Dipole 301581 was new taken from stock.

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

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
51.5 mm	30.4 mm	52.4 mm	30.3 mm

Tissue Validation

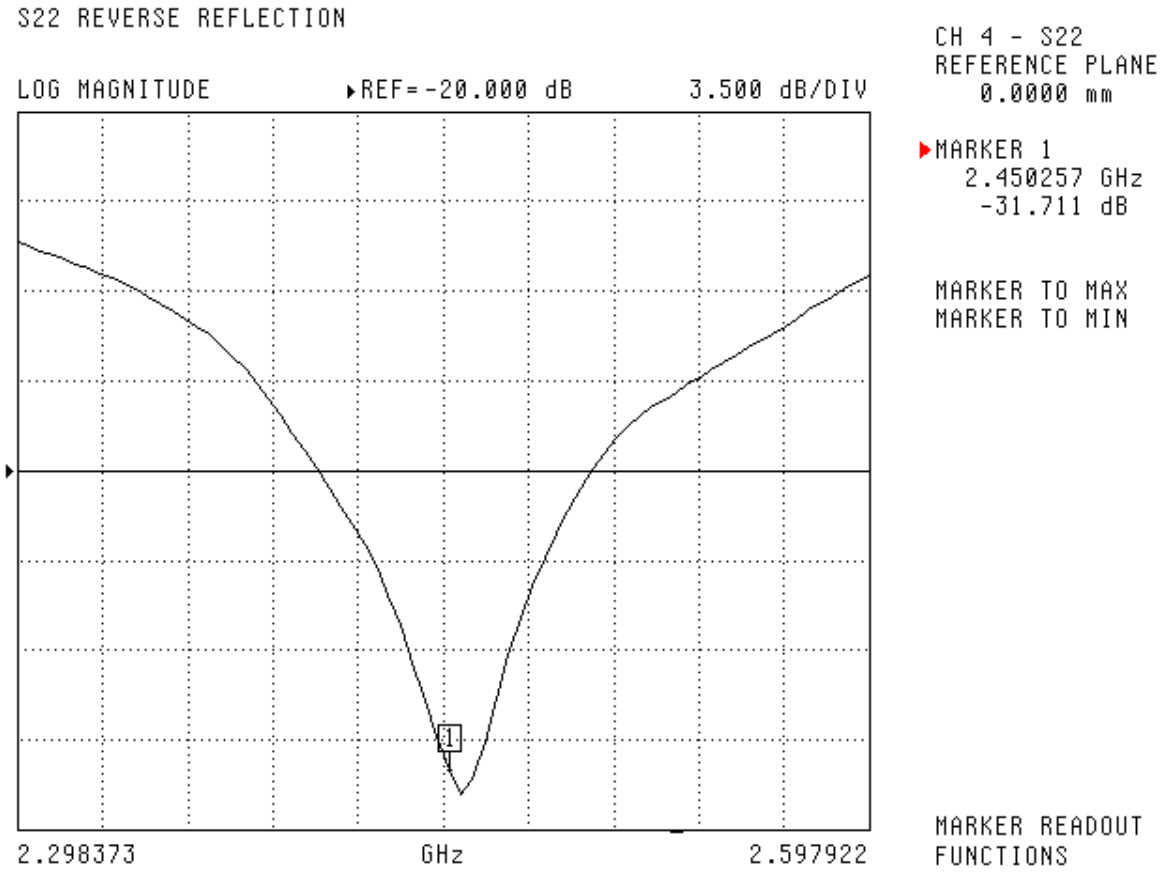
Head Tissue 2450 MHz	Measured
Dielectric constant, ε_r	39.2
Conductivity, σ [S/m]	1.80

Electrical Calibration

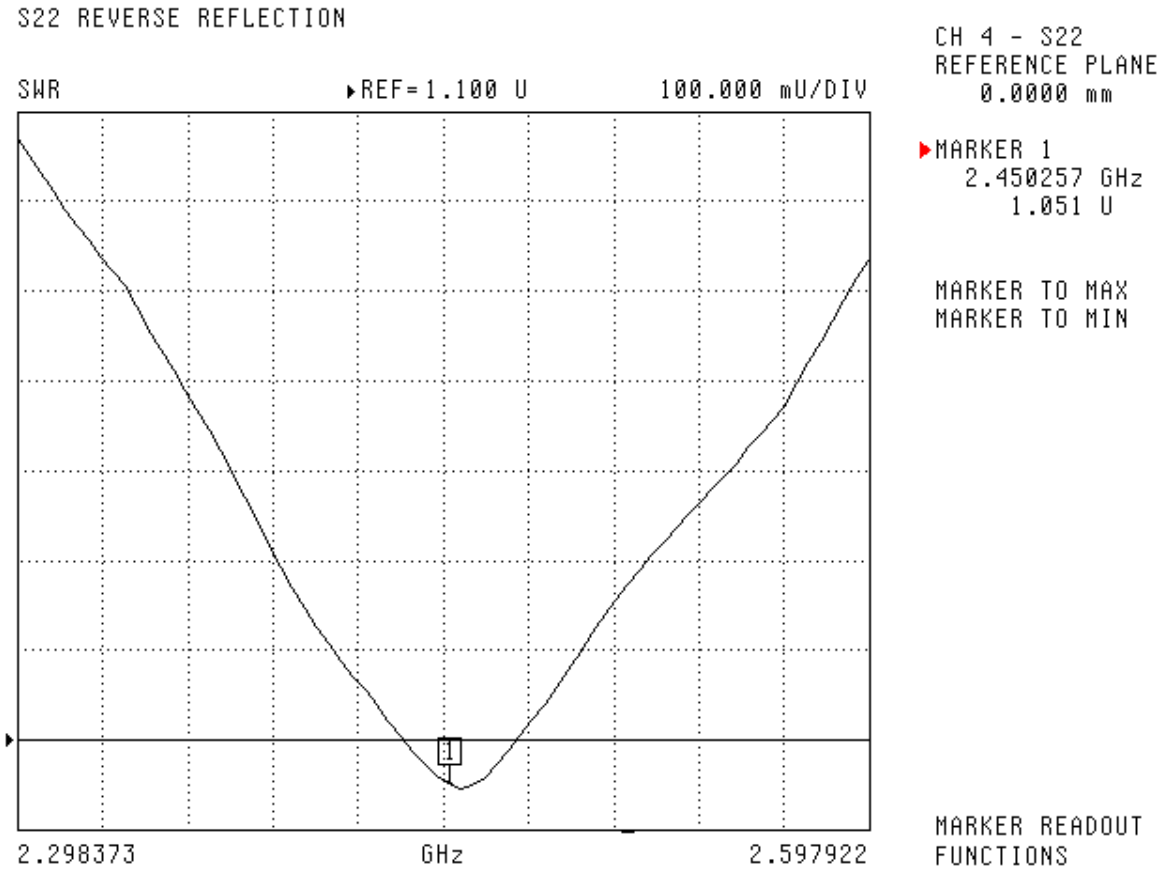
Test	Result
S11 R/L	-32.0 dB
SWR	1.05 U
Impedance	50.2 Ω

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

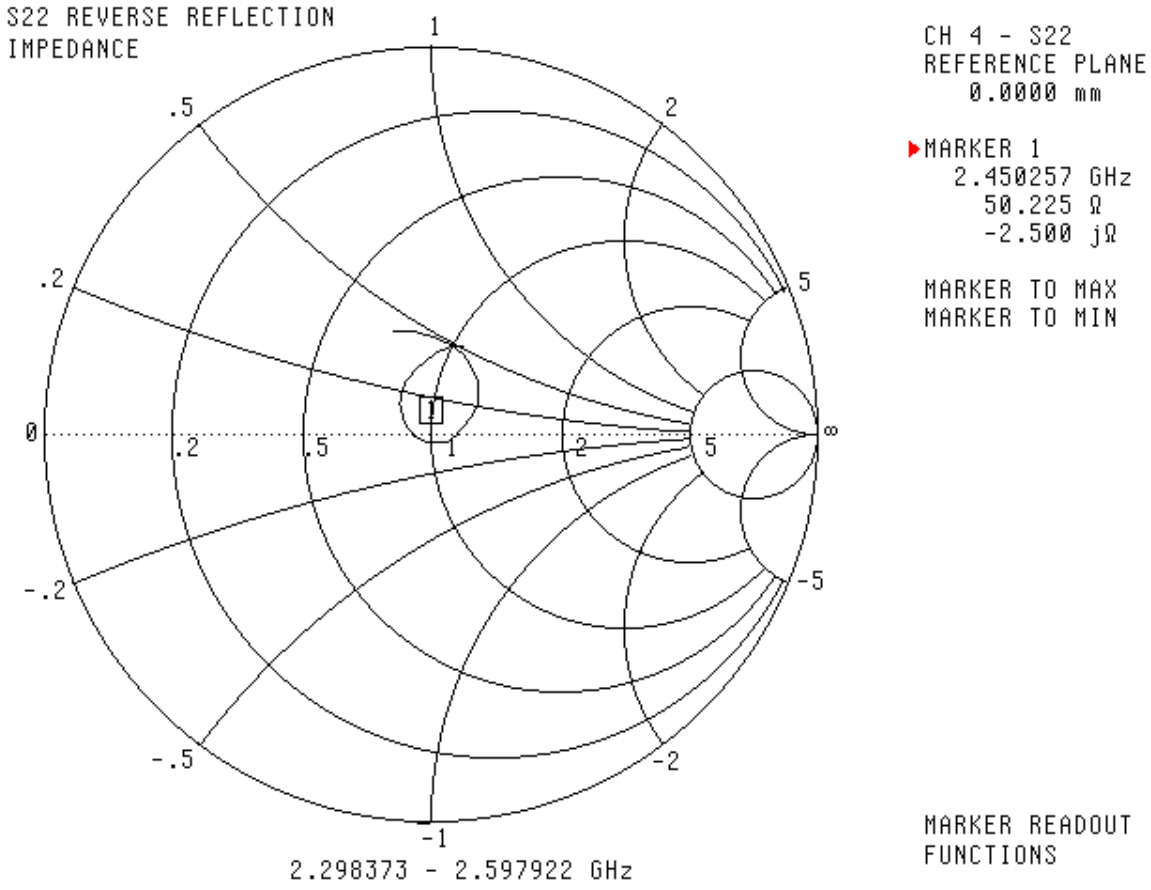
S11 Parameter Return Loss



SWR

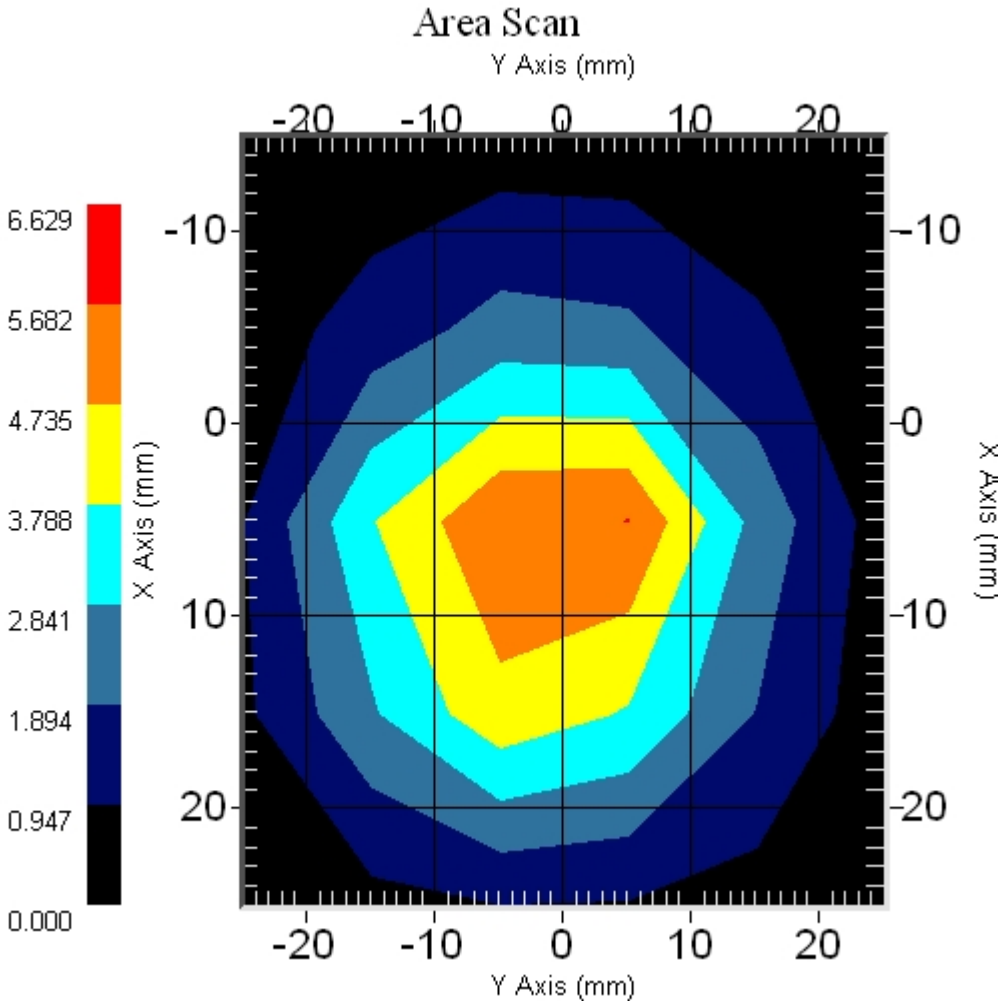


Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Frequency	1 Gram	10 Gram	Peak
2450 MHz	53.1	24.4	101.8



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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-890
Project Number: APREL-ALSAS 10U

C E R T I F I C A T E OF C A L I B R A T I O N

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-5258-S-2
Frequency: 5.2GHz to 5.8GHz
Serial No: 5258-235-00802

Customer: APREL

Serial Number: ALS-BB-001

Calibrated: 25th May 2009
Released on: 25th May 2009

Released By: _____

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
NEPEAN, ONTARIO
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Division of APREL Lab.
TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 5258-235-00802 was new and 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 device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

Constantine Teodorian

This page has been reviewed for content and attested to by signature within this document.

Calibration Results Summary

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

Mechanical Dimensions

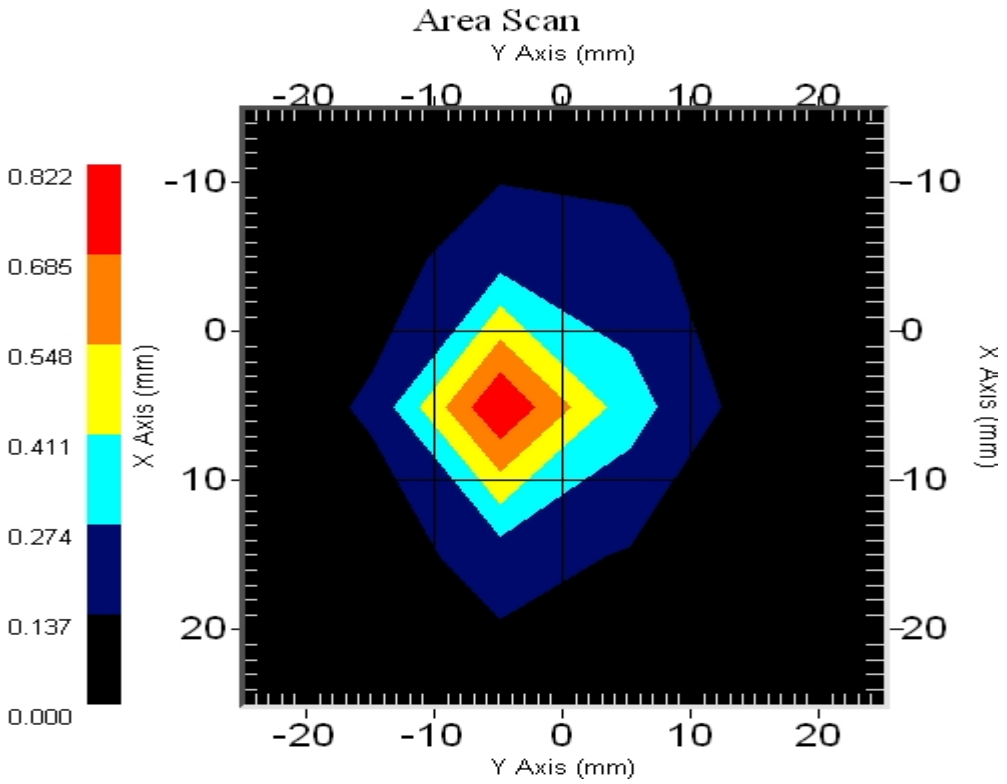
Length: 23.3 mm
Height: 20.3 mm

Electrical Specification

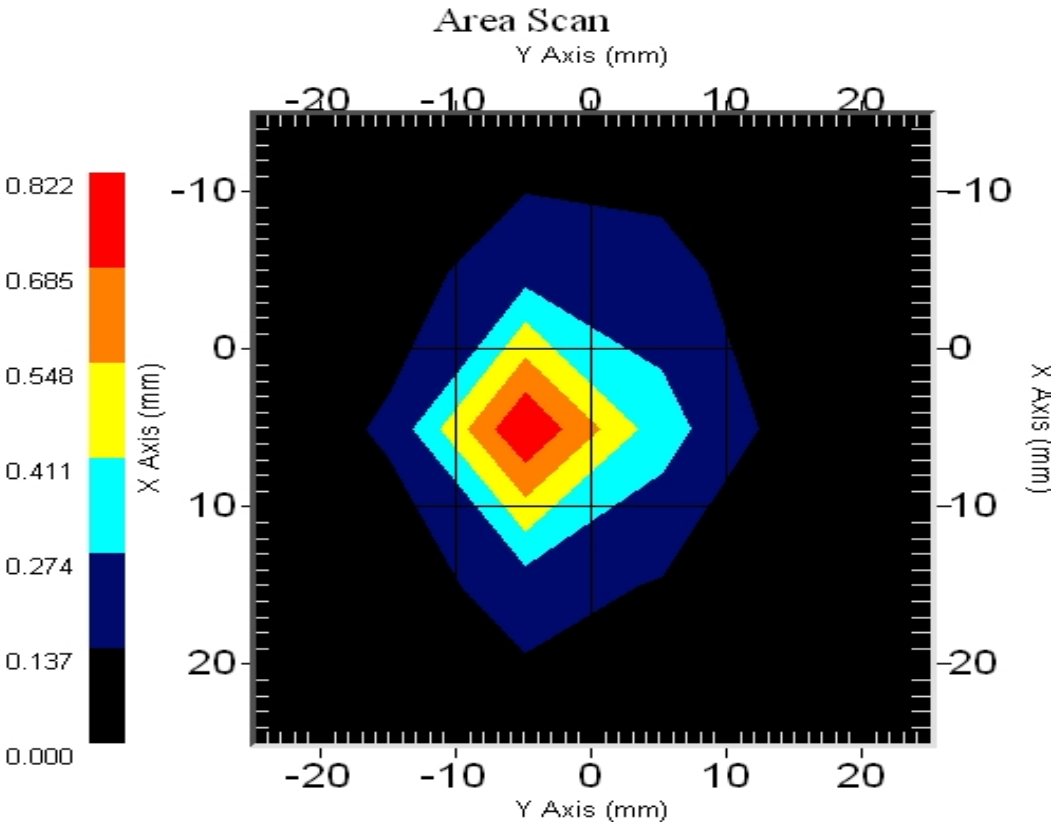
SWR: 1.22 U
Return Loss: -20.0 dB
Impedance: 50.0 Ω

System Validation Results

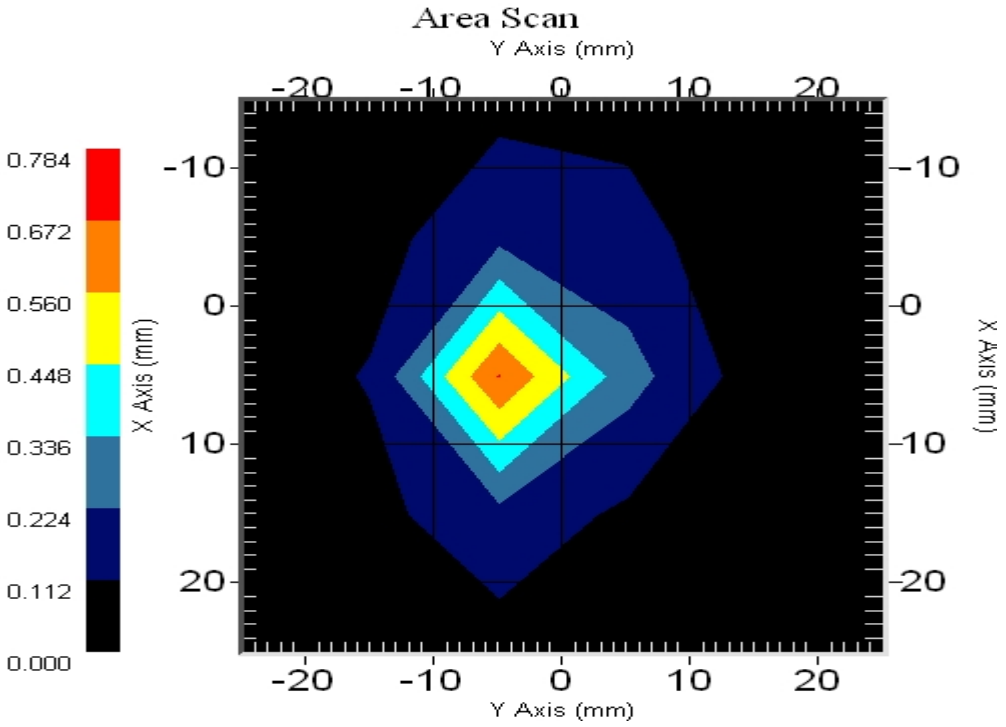
Frequency	1 Gram	10 Gram	Peak
5200 MHz	51.9	17.9	223.1



Frequency	1 Gram	10 Gram	Peak
5600 MHz	52.97	18.2	243.1



Frequency	1 Gram	10 Gram	Peak
5800 MHz	48.97	17.2	207.1



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 5258-235-00802. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the 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 APREL E-030 018 E-Field Probe.

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 5258-235-00802 was new taken from stock.

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

Dipole Calibration Results

Tissue Validation

Head Tissue 5200 MHz	Measured
Dielectric constant, ε_r	47.0
Conductivity, σ [S/m]	5.30

Head Tissue 5600 MHz	Measured
Dielectric constant, ε_r	46.1
Conductivity, σ [S/m]	5.78

Head Tissue 5800 MHz	Measured
Dielectric constant, ε_r	46.7
Conductivity, σ [S/m]	6.22

Mechanical Verification

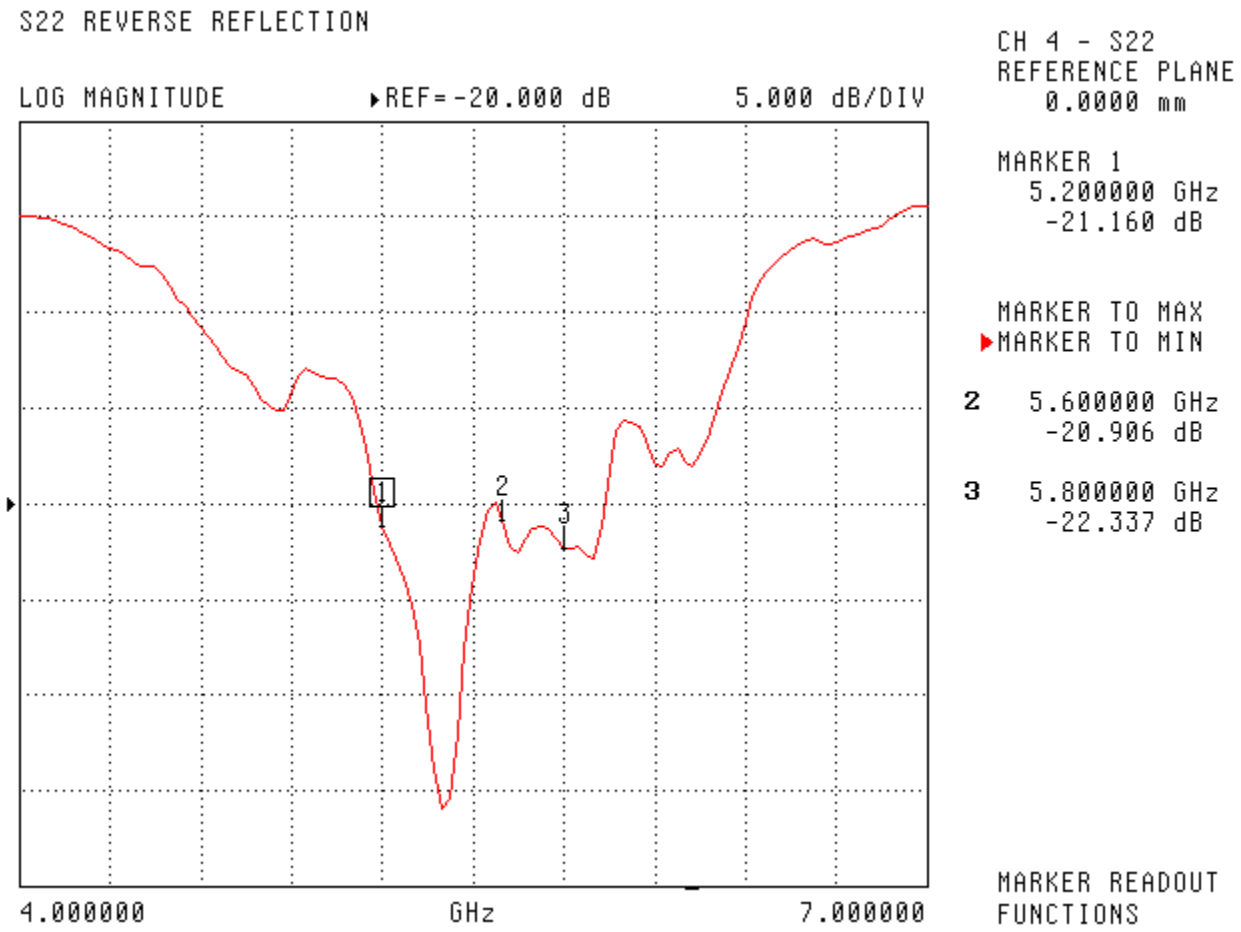
APREL Length	APREL Height	Measured Length	Measured Height
23.1 mm	20.7 mm	23.3 mm	20.3 mm

Electrical Calibration

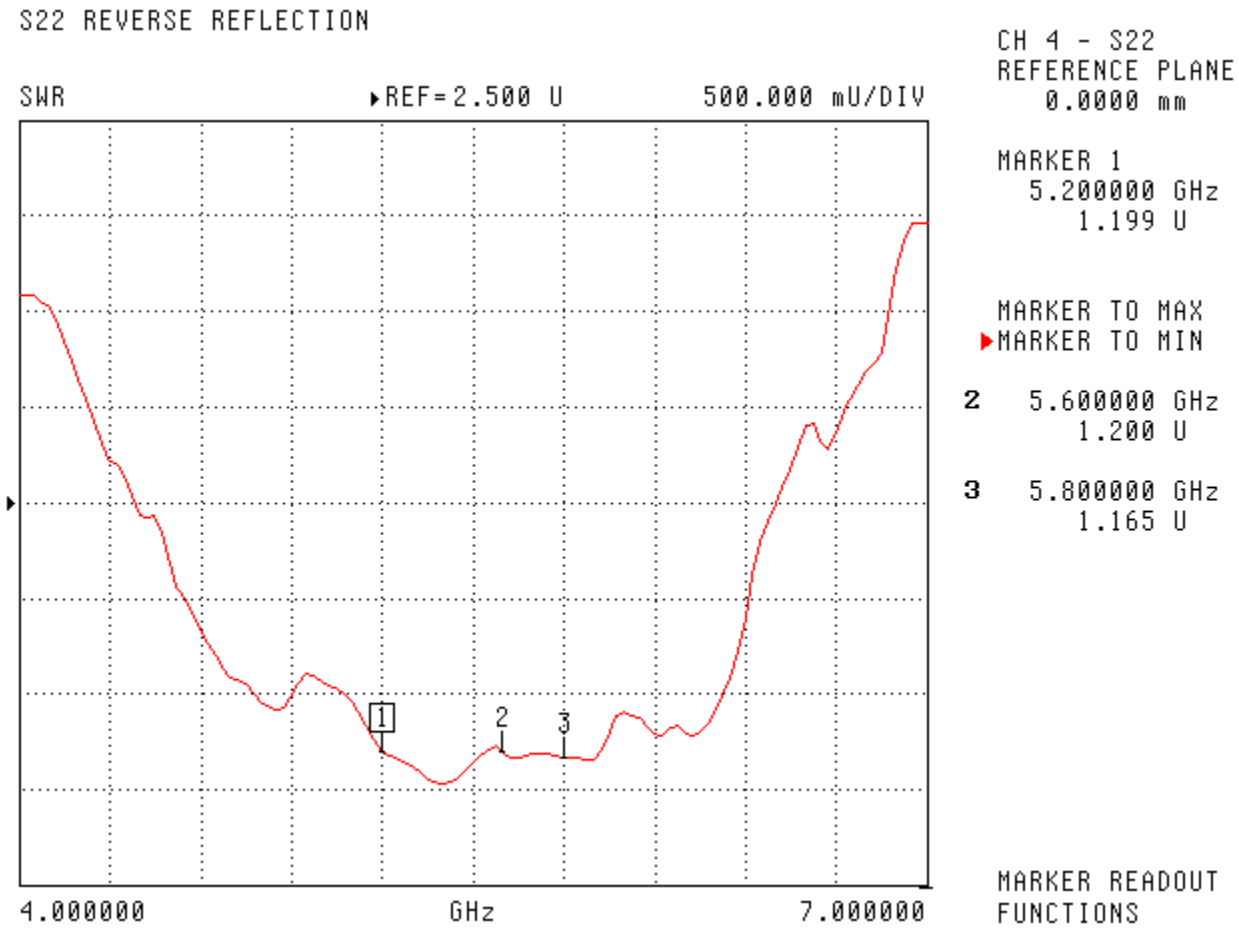
S11	5200MHz	5800MHz
RL (dB)	-21.16	-22.34
SWR	1.2	1.17
Impedance (ohms)	51.38	43.92

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

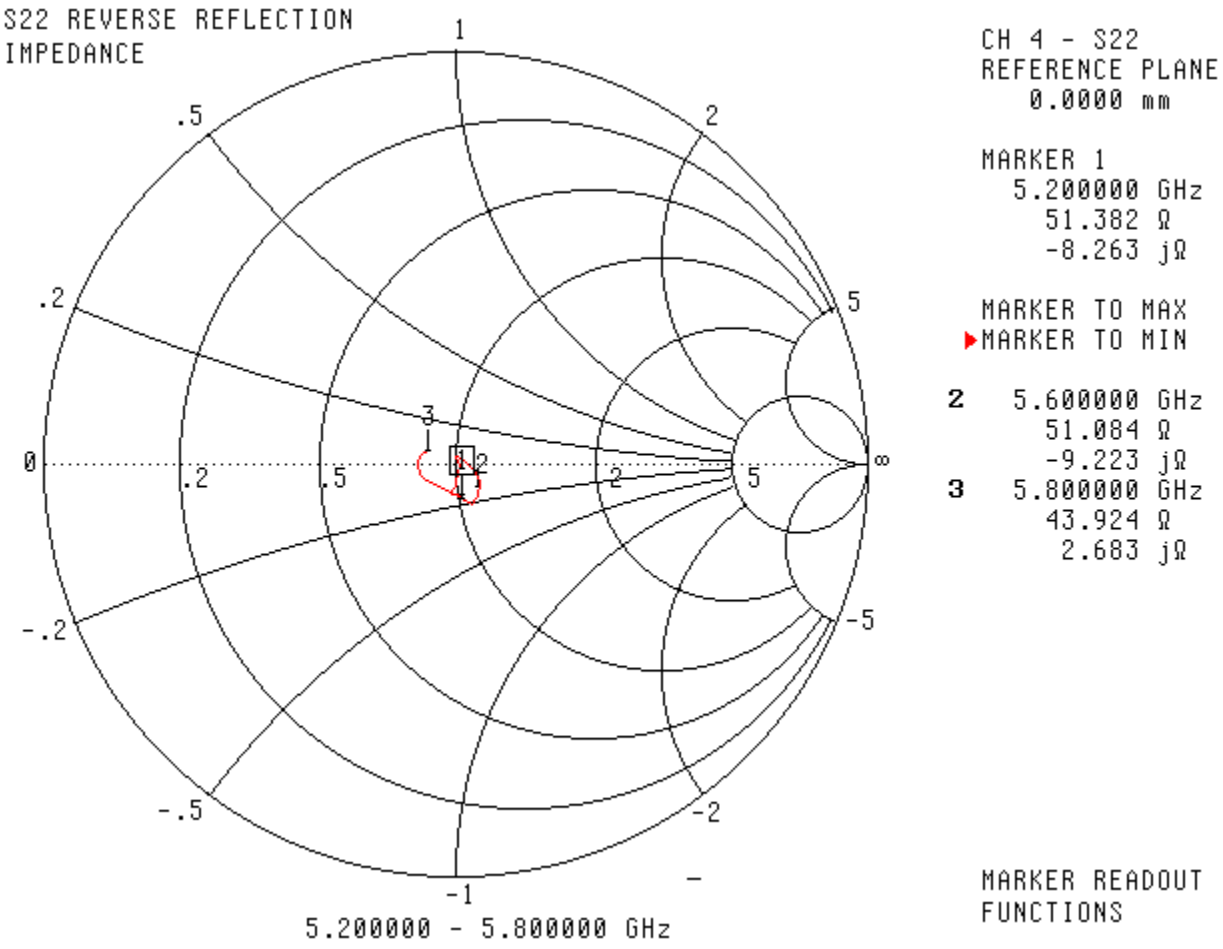
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



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 2009.

NCL CALIBRATION LABORATORIES

Calibration File No: DC-915
Project Number: APREL-ALSAS-10U

C E R T I F I C A T E OF C A L I B R A T I O N

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.

APREL Validation Dipole

Manufacturer: APREL Laboratories
Part number: ALS-D-835-S-2
Frequency: 835 MHz
Serial No: 835-180-00554

Customer: APREL

Calibrated: 2nd March 2009
Released on: 2nd March 2009

Released By: _____

NCL **CALIBRATION LABORATORIES**

51 SPECTRUM WAY
NEPEAN, ONTARIO
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TEL: (613) 820-4988
FAX: (613) 820-4162

Conditions

Dipole 835-180-00554 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 device has been accurately conducted and that all information contained within this report has been reviewed for accuracy.

Stuart Nicol

D. Brooks

Calibration Results Summary

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

Mechanical Dimensions

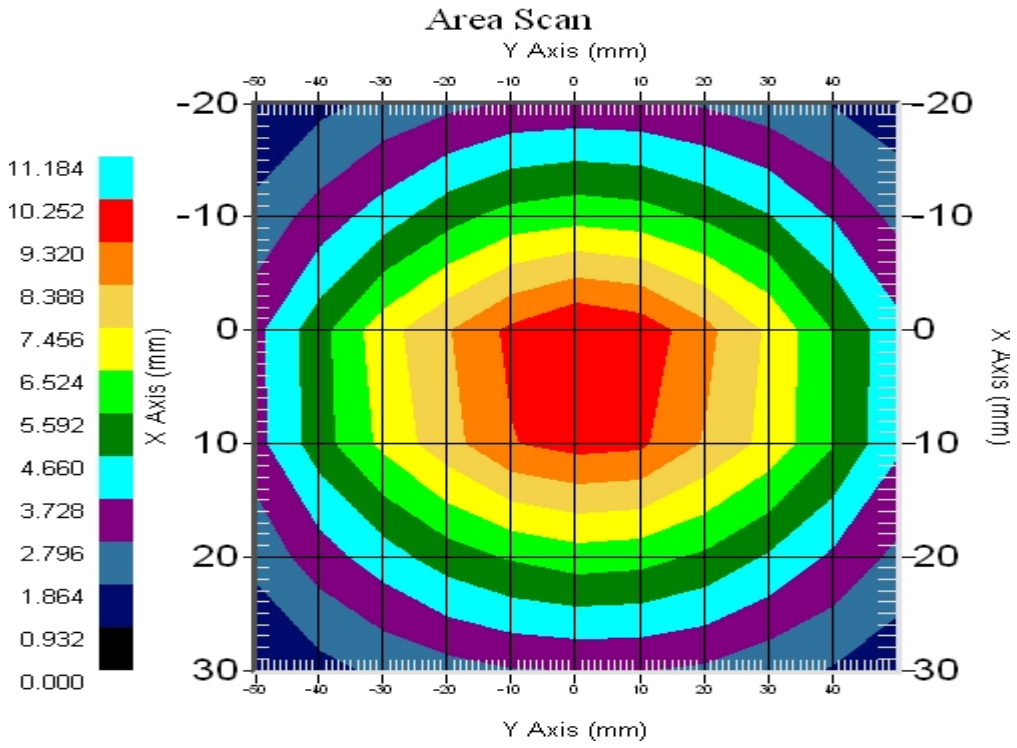
Length: 161.0 mm
Height: 89.8 mm

Electrical Specification

SWR: 1.01 U
Return Loss: -48.6 dB
Impedance: 49.6 Ω

System Validation Results

Frequency	1 Gram	10 Gram	Peak
835 MHz	9.49	6.1	14.21



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 835-180-00554. The calibration routine consisted of a three-step process. Step 1 was a mechanical verification of the dipole to ensure that it meets the 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 APREL 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 835-180-00554 was a re-calibration.

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

Dipole Calibration Results

Mechanical Verification

APREL Length	APREL Height	Measured Length	Measured Height
161.0 mm	89.8 mm	162.2 mm	90.3 mm

Tissue Validation

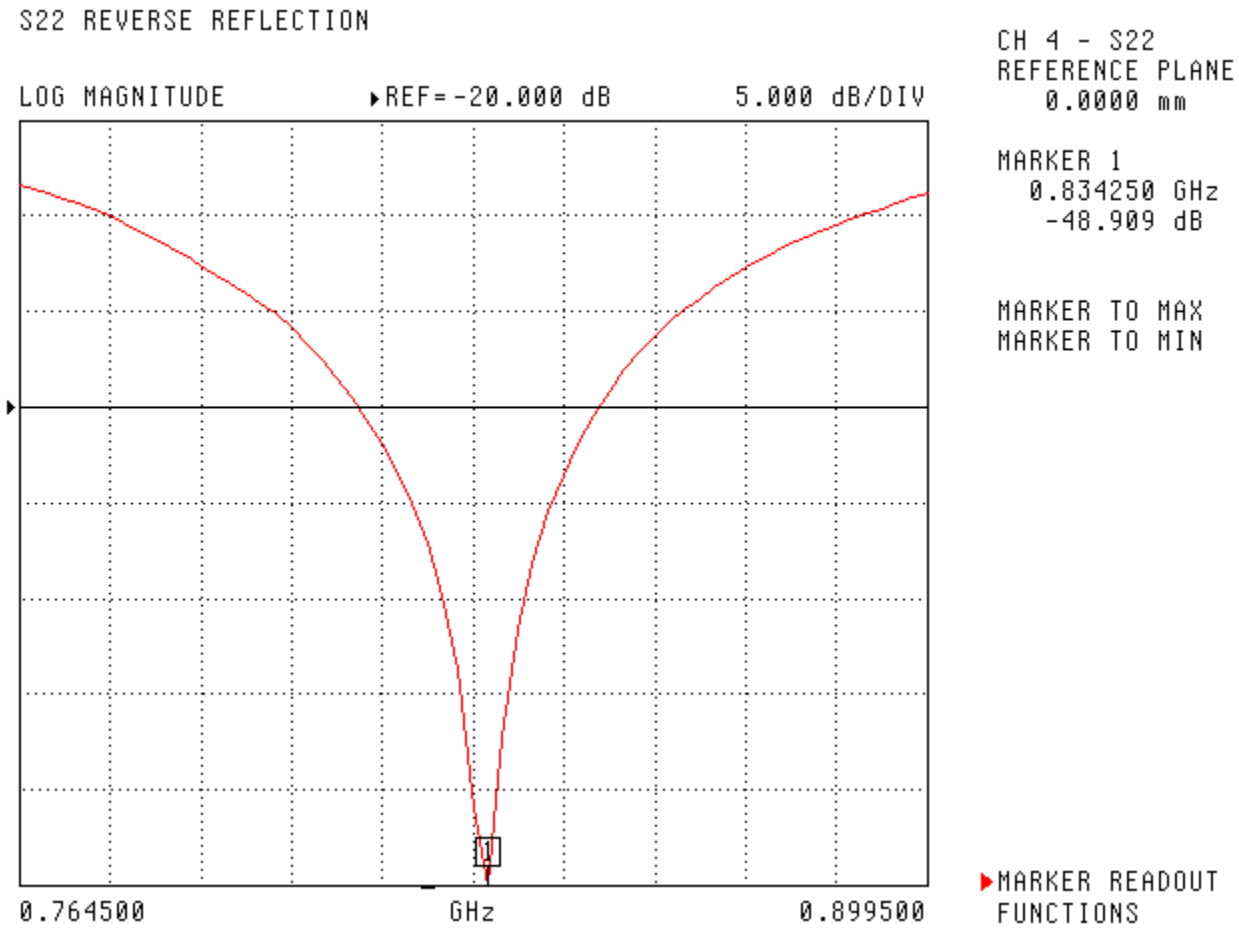
Head Tissue 835MHz	Measured
Dielectric constant, ε_r	41.5
Conductivity, σ [S/m]	0.90

Electrical Calibration

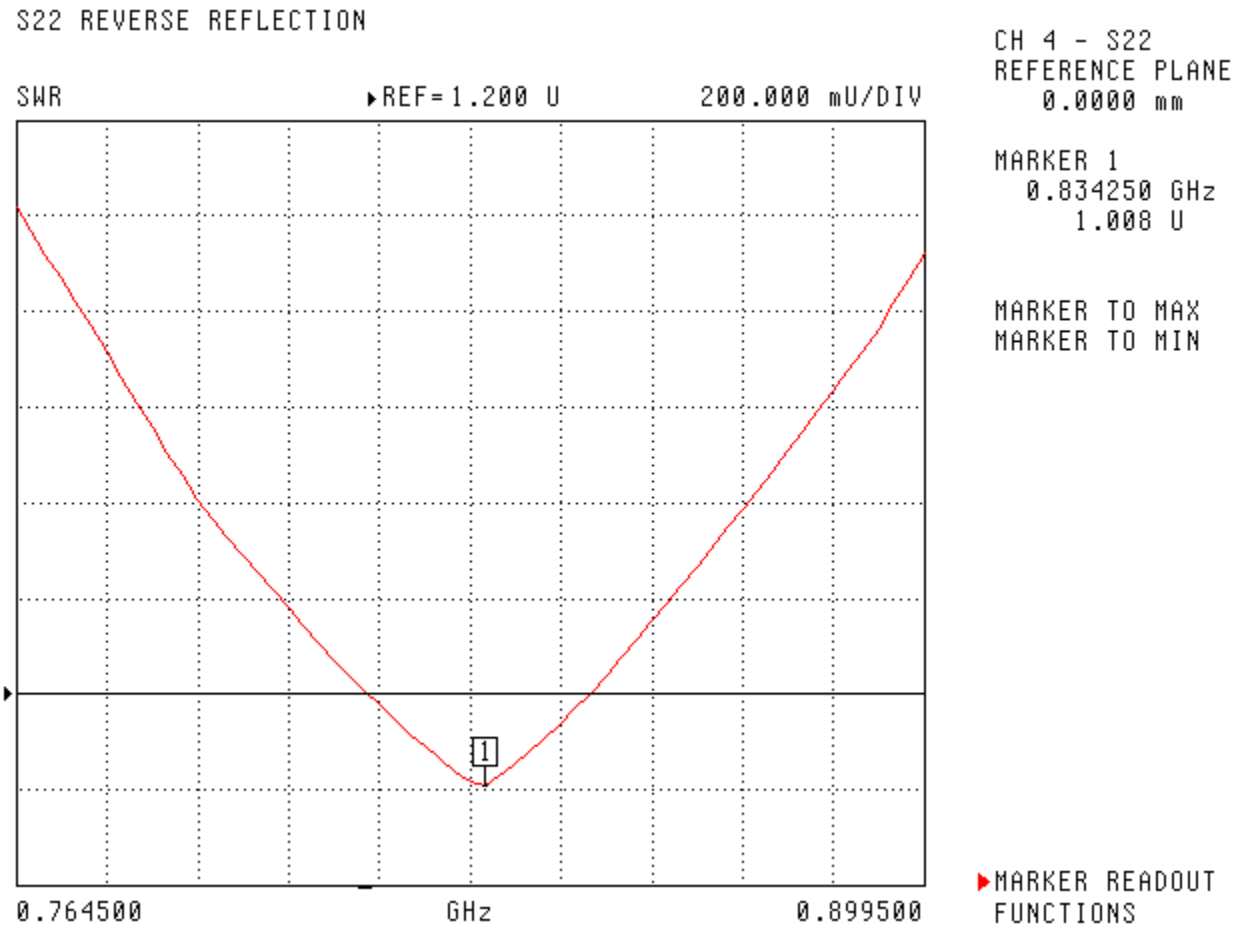
Test	Result
S11 RL	-48.6 dB
SWR	1.01 U
Impedance	49.6 Ω

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

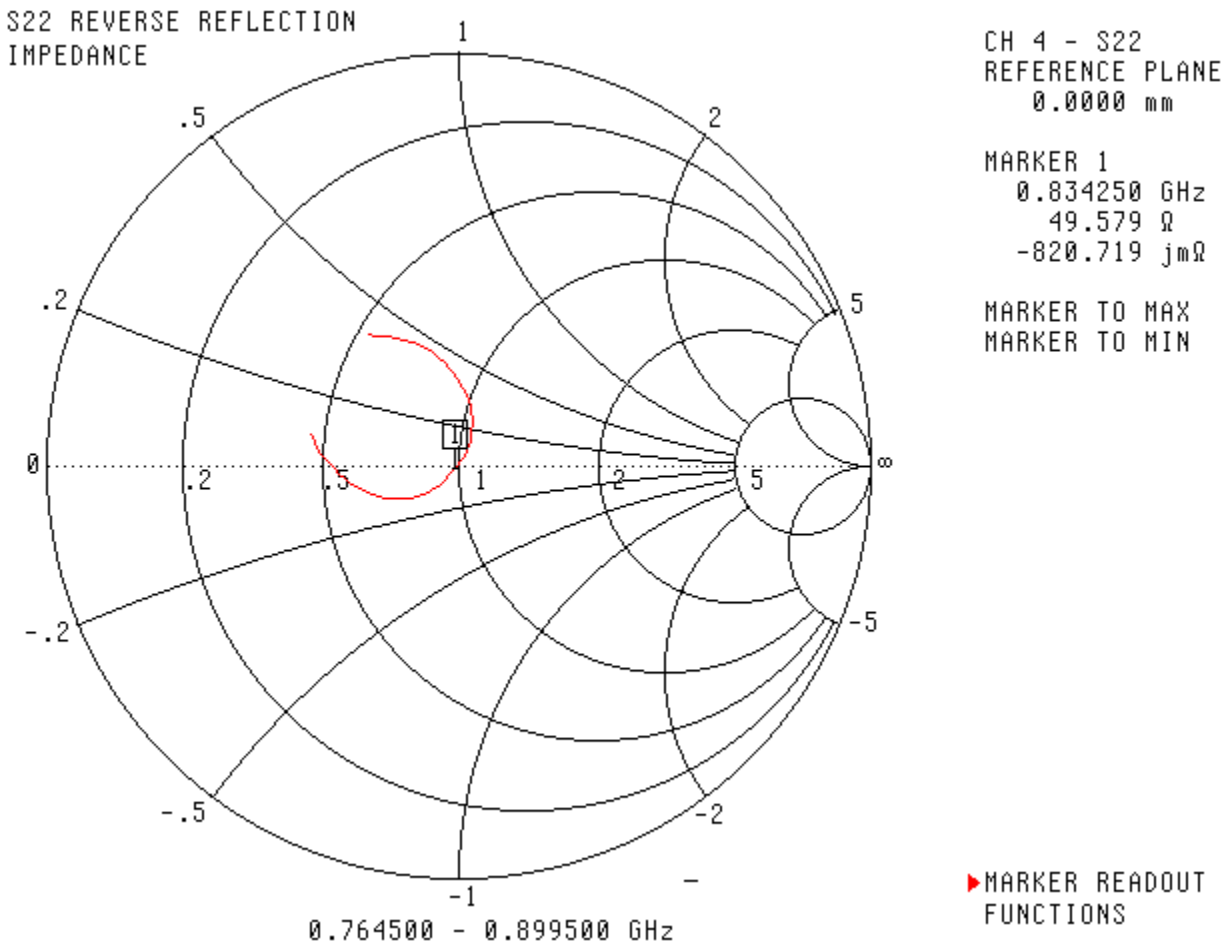
S11 Parameter Return Loss



SWR

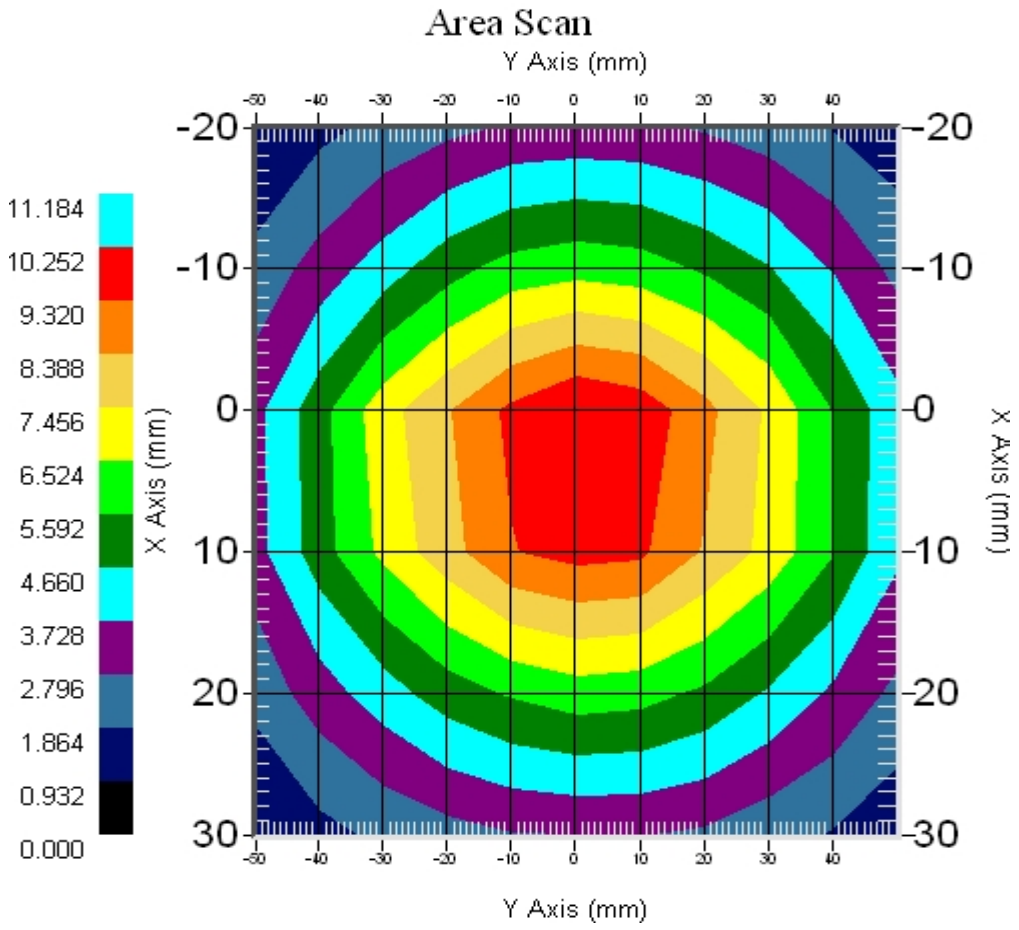


Smith Chart Dipole Impedance



System Validation Results Using the Electrically Calibrated Dipole

Head Tissue Frequency	1 Gram	10 Gram	Peak Above Feed Point
835 MHz	9.49	6.1	14.21



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.