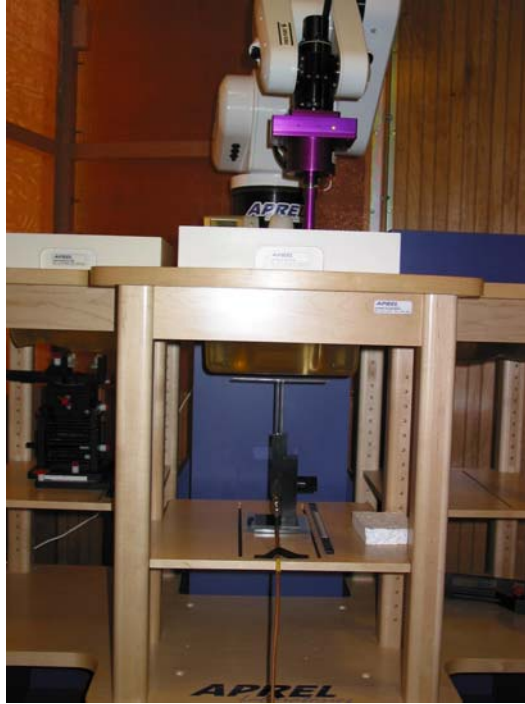
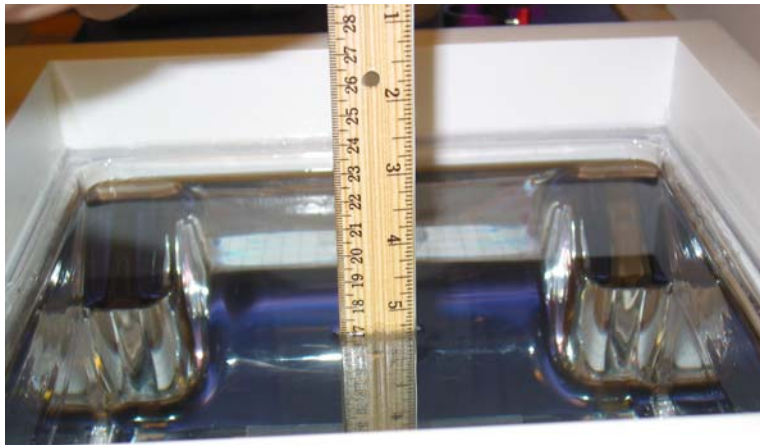


Appendix C – SAR Test Setup Photos



System Body Configuration



Body Tissue Depth



WWAN & Auxiliary Antenna WLAN Test Configuration



Main Antenna WLAN Test Configuration



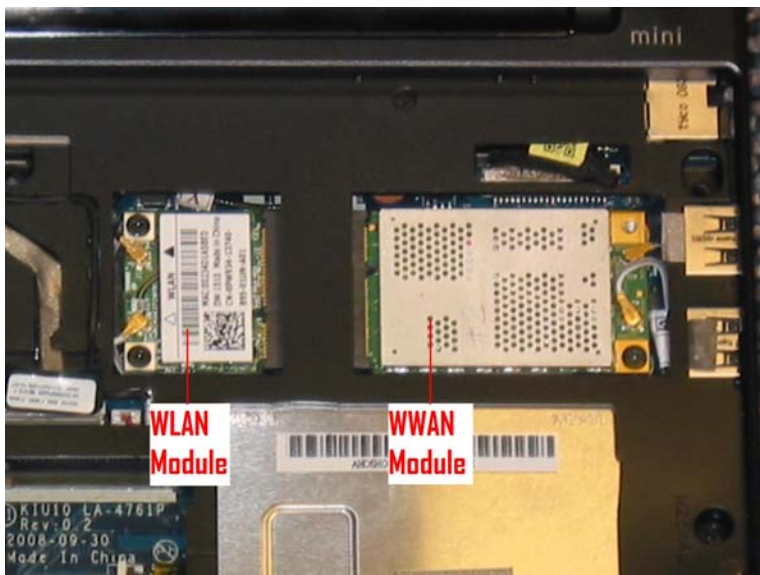
Front of Device



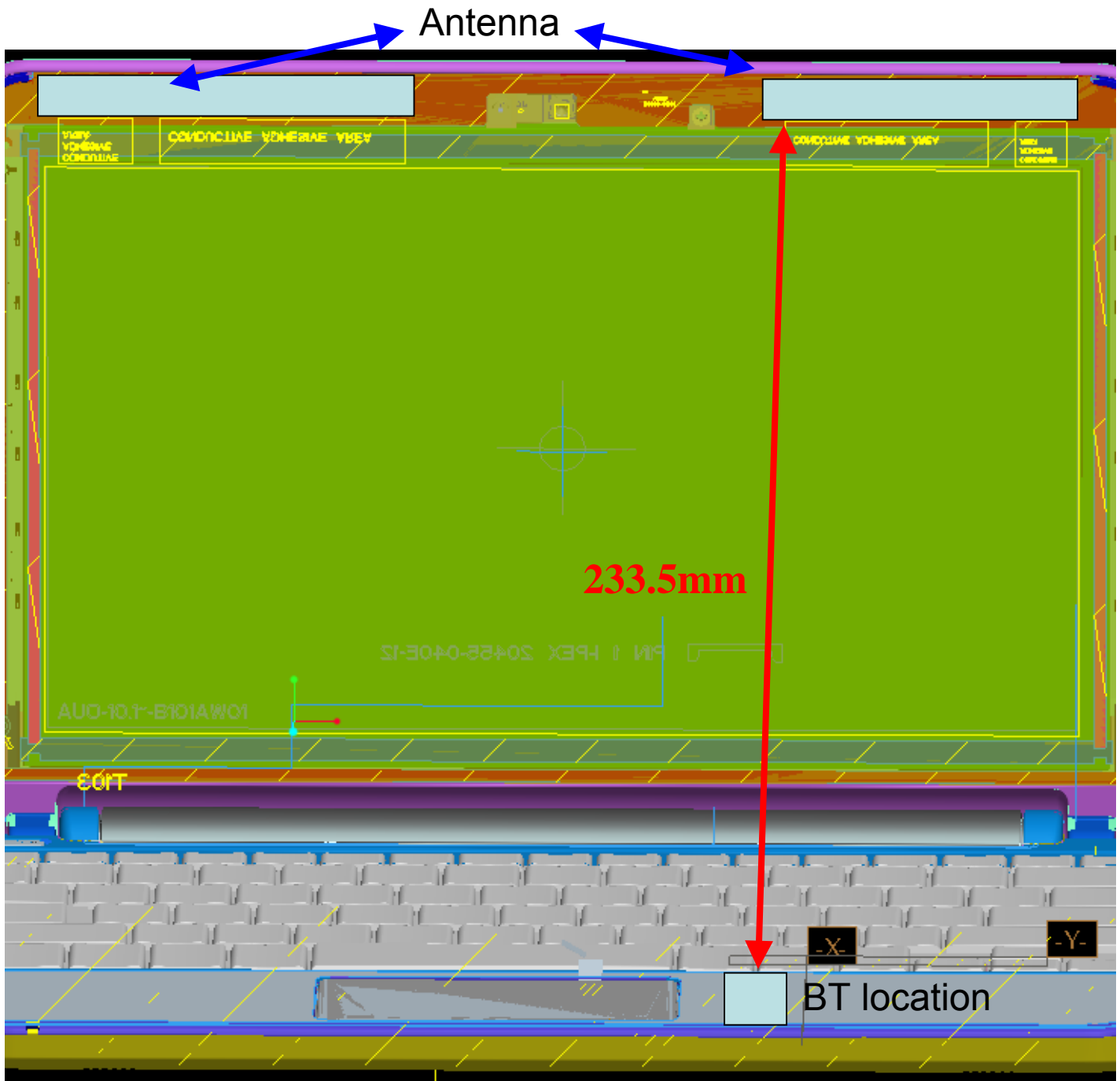
Back of Device



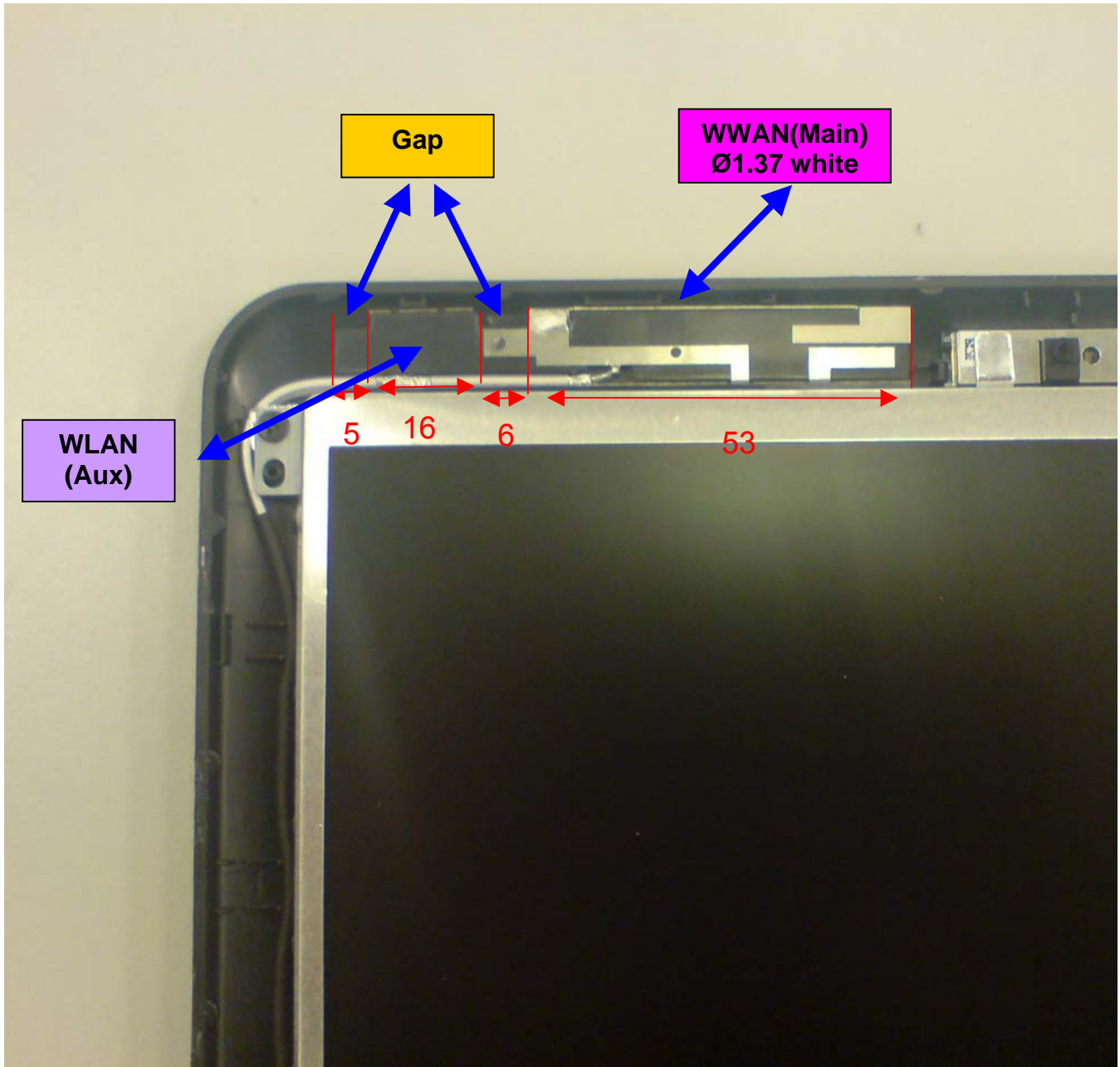
Front of Device with Keyboard Removed



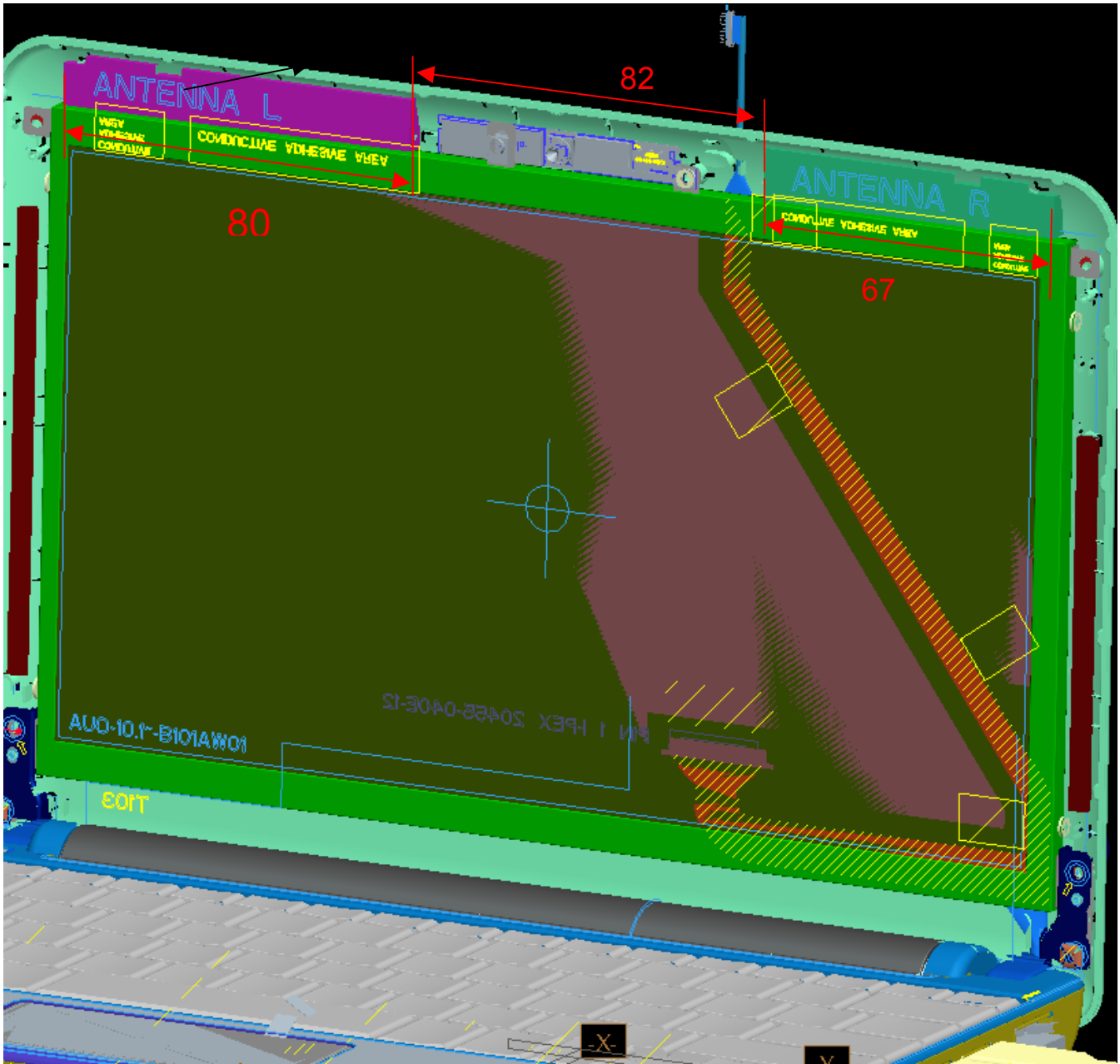
WWAN & WLAN Modules Location



Antenna to Antenna Distance and BT Distance



WWAN Main to WLAN Aux Distance



Left Antenna Module and Right Antenna Module Distance

Appendix D – Probe Calibration Data Sheets

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-926

Client.: RFEL

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated in the
NCL CALIBRATION LABORATORIES by qualified personnel following recognized
procedures and using transfer standards traceable to NRC/NIST.

Equipment: Miniature Isotropic RF Probe 835 MHz

BODY Calibration

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: 215

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

Project No: RFEL-00150-CAL-5367

Calibrated: 3rd November 2008

Released on: 3rd November 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary
This calibration has been conducted in line with the SCC ISO-IEC 17025 Scope of Accreditation
Accredited Laboratory Number 48

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-020 215.

References

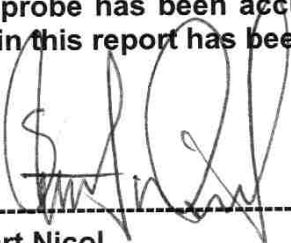
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 KHz to 40 GHz" 2005
SSI-TP-011 Tissue Calibration Procedure
IEC 62209 "Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices –Human models, instrumentation and procedures Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for handheld devices used in close proximity of the ear (frequency range of 200MHz to 3GHz)"

Conditions

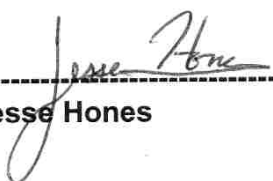
Probe 215 was a re-calibration.

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:	215
Frequency:	835 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 835 MHz

Epsilon: 55.2 (+/-5%) **Sigma:** 1.05 S/m (+/-10%)

ConvF

Channel X: 6.3

Channel Y: 6.3

Channel Z: 6.3

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

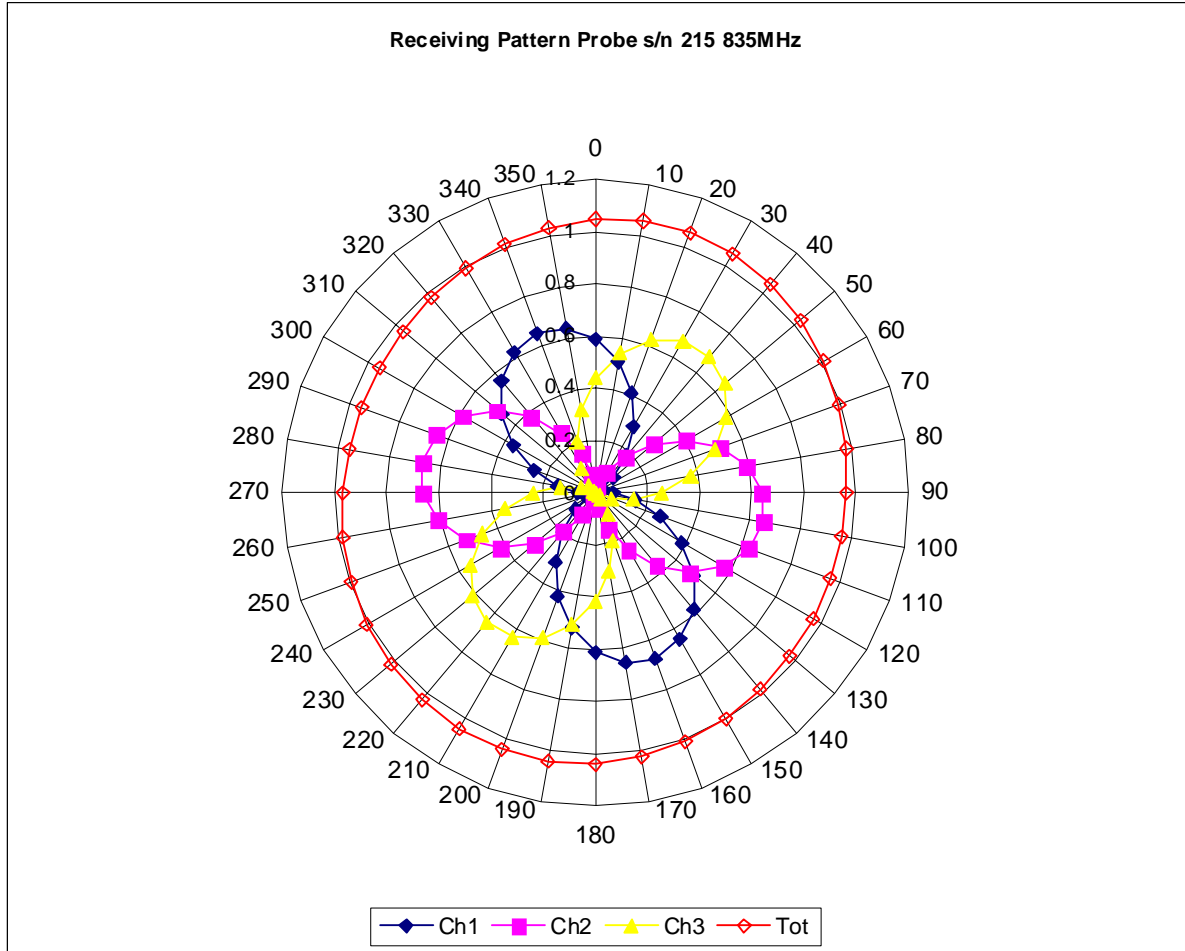
Boundary Effect:

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

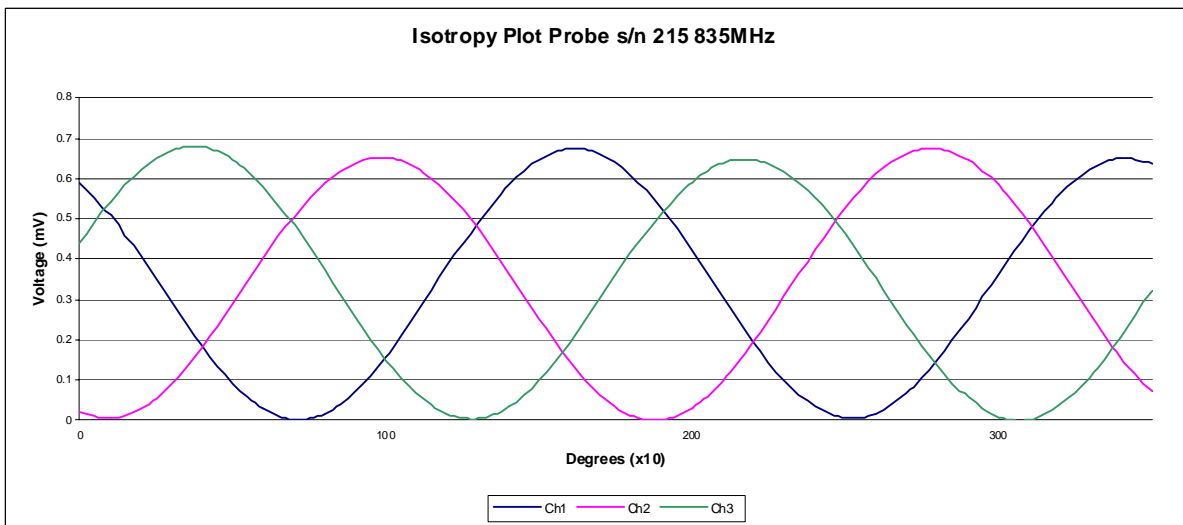
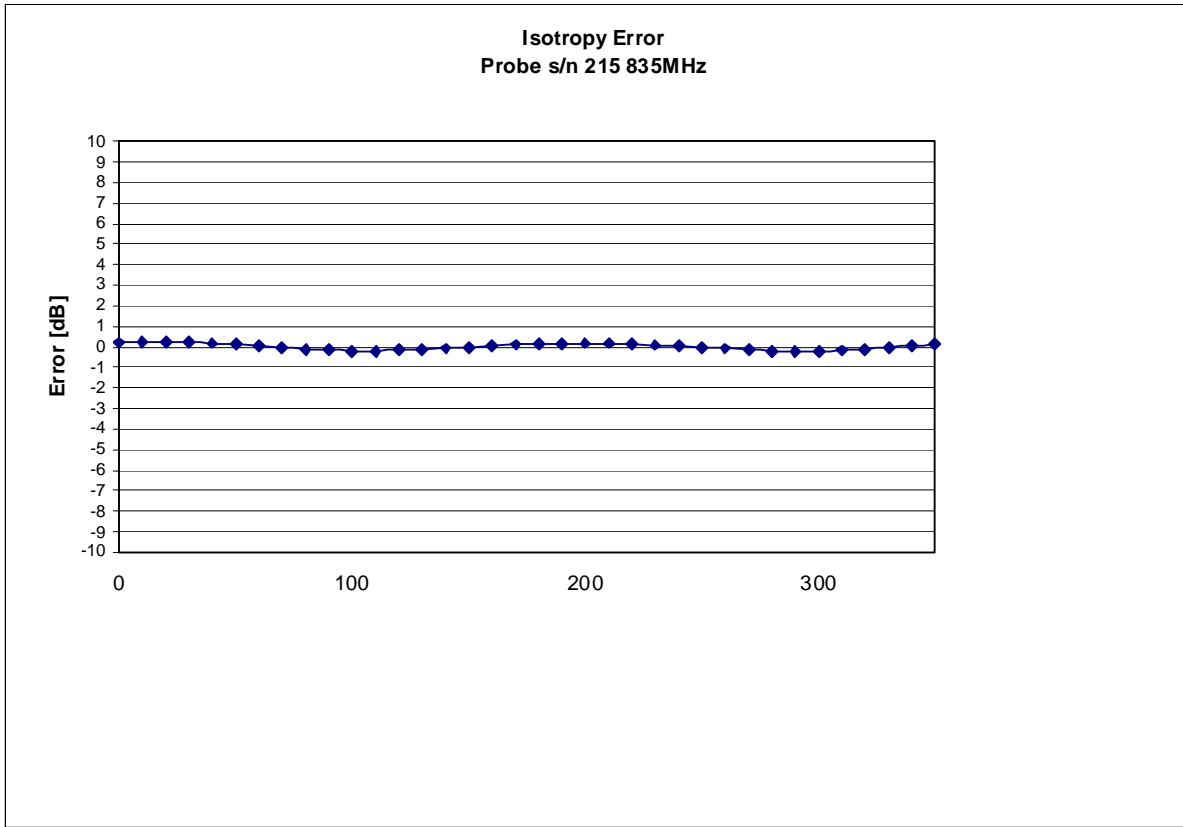
Spatial Resolution:

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

Receiving Pattern 835 MHz (Air)



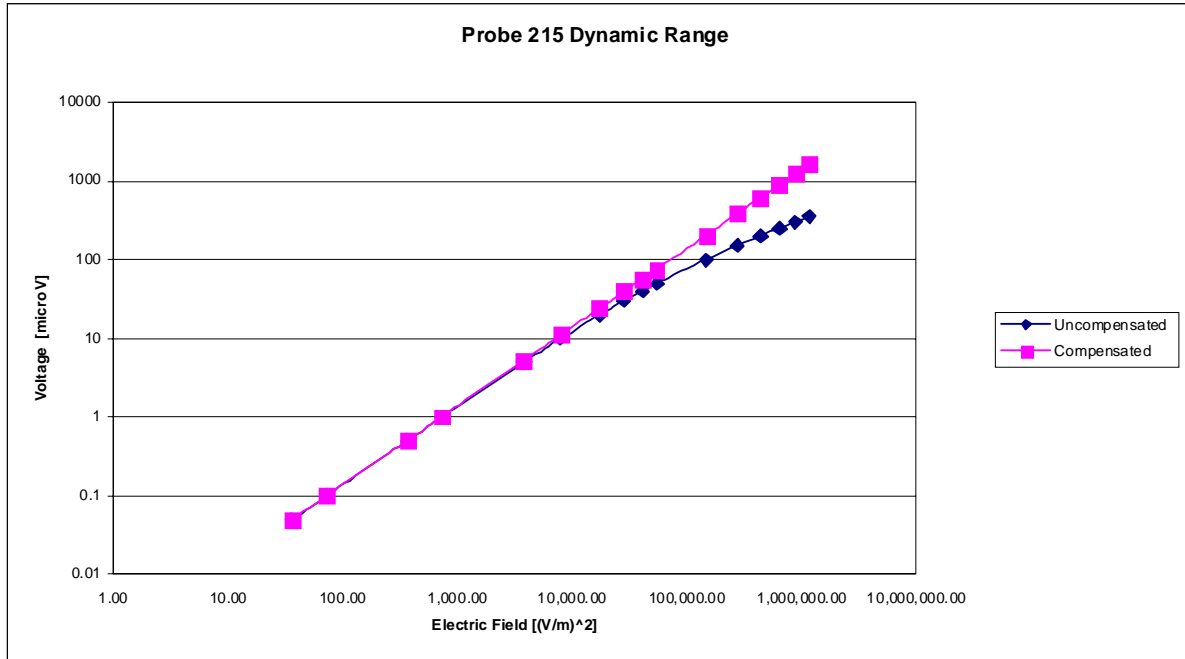
Isotropy Error 835 MHz (Air)



Isotropicity Tissue:

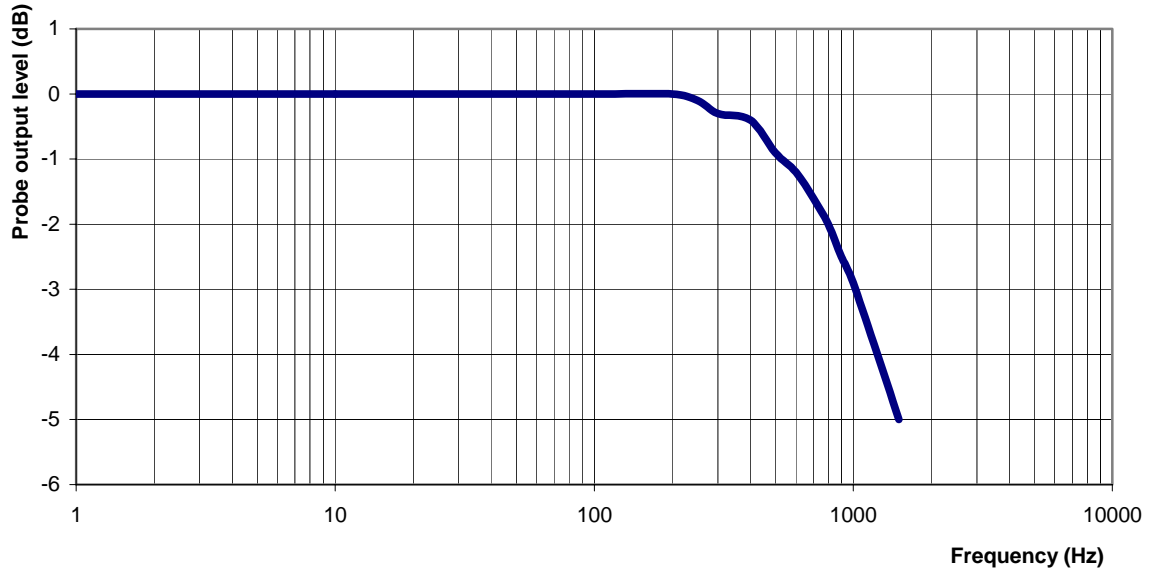
0.10 dB

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 Measured

Sensitivity in Body Tissue

Frequency: 835 MHz
Epsilon: 55.2 (+/-5%) **Sigma:** 1.05 S/m (+/-10%)

ConvF

Channel X: 6.3 7%(K=2)
Channel Y: 6.3 7%(K=2)
Channel Z: 6.3 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%.

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 2008.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-933

Client.: RFEL

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.: 215

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

Project No: RFEL-00150-CAL-5367

Calibrated: 3rd November 2008

Released on: 3rd November 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary
This calibration has been conducted in line with the SCC ISO-IEC 17025 Scope of Accreditation
Accredited Laboratory Number 48

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-020 215.

References

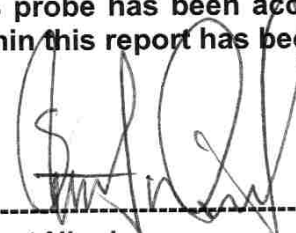
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 KHz to 40 GHz" 2005
SSI-TP-011 Tissue Calibration Procedure
IEC 62209 "Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices –Human models, instrumentation and procedures Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for handheld devices used in close proximity of the ear (frequency range of 200MHz to 3GHz)"

Conditions

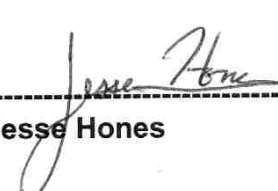
Probe 215 was a re-calibration.

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:	215
Frequency:	1900 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 1900 MHz

Epsilon: 54.2 (+/-5%) **Sigma:** 1.57 S/m (+/-5%)

ConvF

Channel X: 5.0

Channel Y: 5.0

Channel Z: 5.0

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

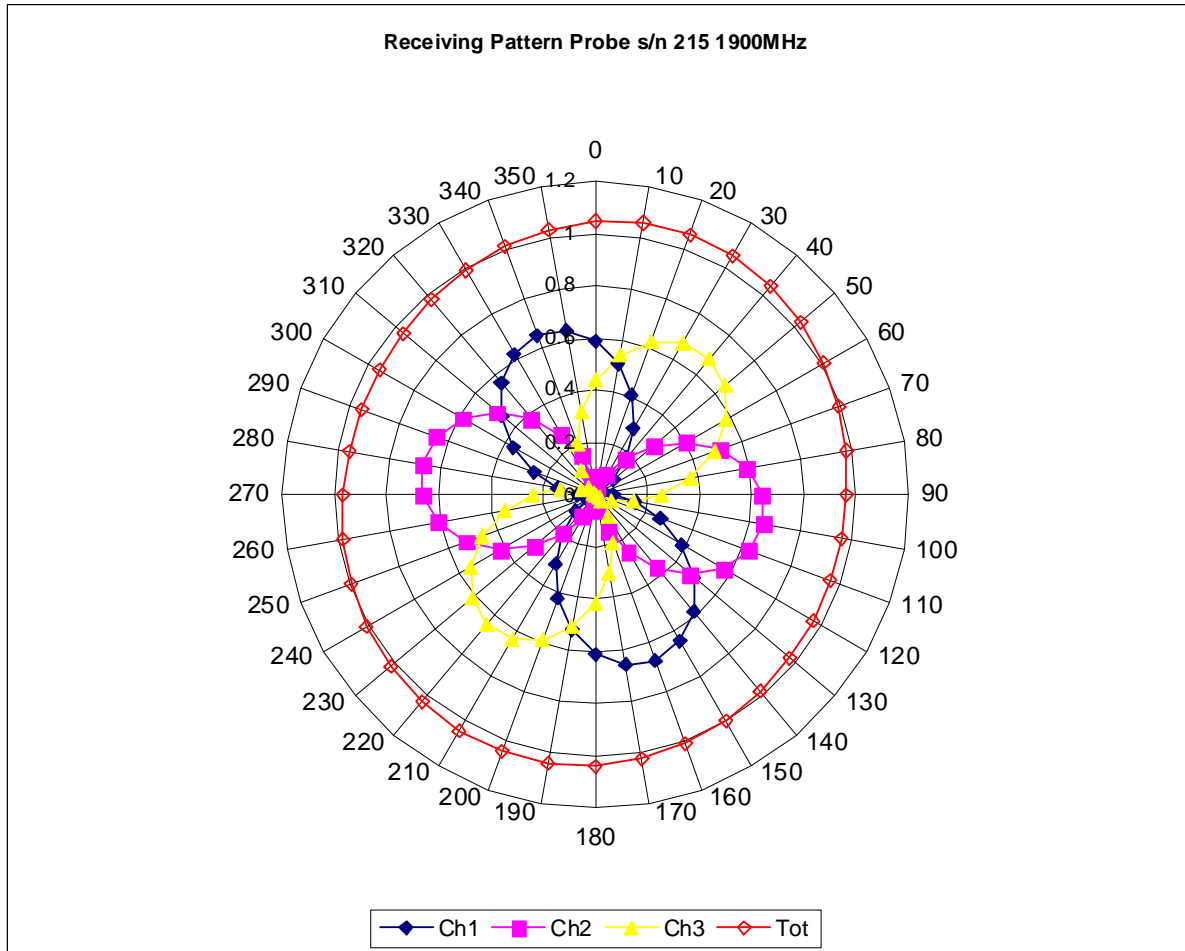
Boundary Effect:

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

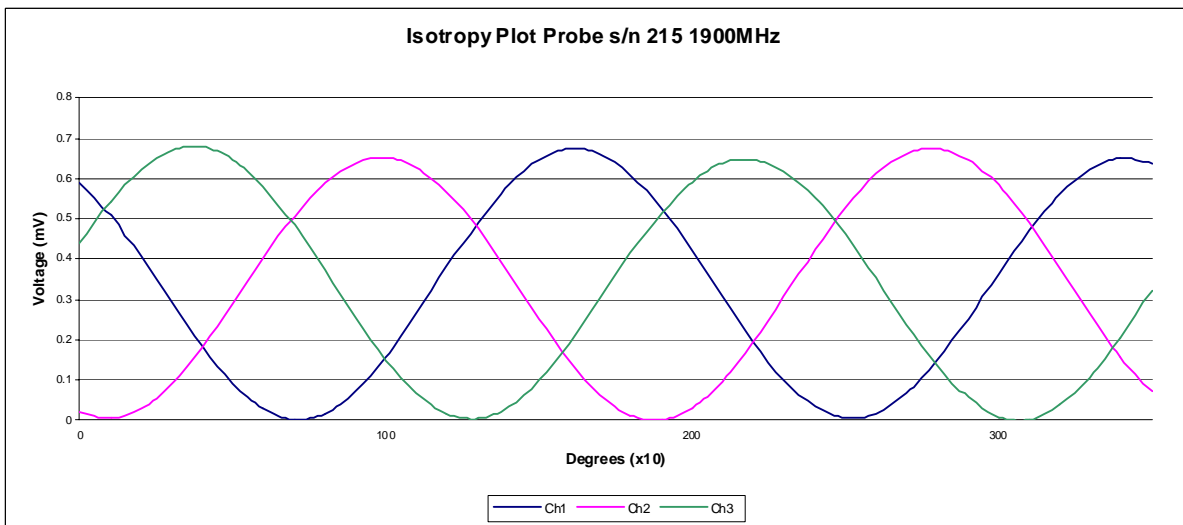
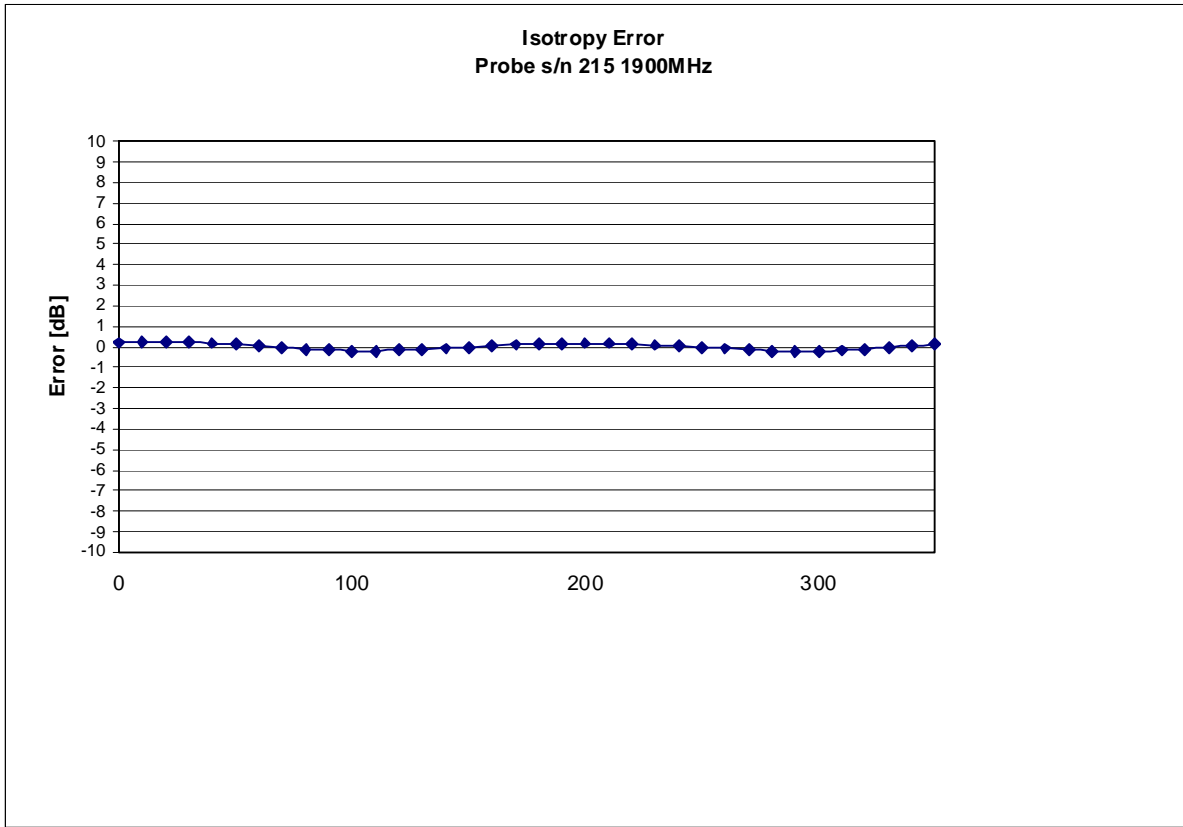
Spatial Resolution:

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

Receiving Pattern 1900 MHz (Air)



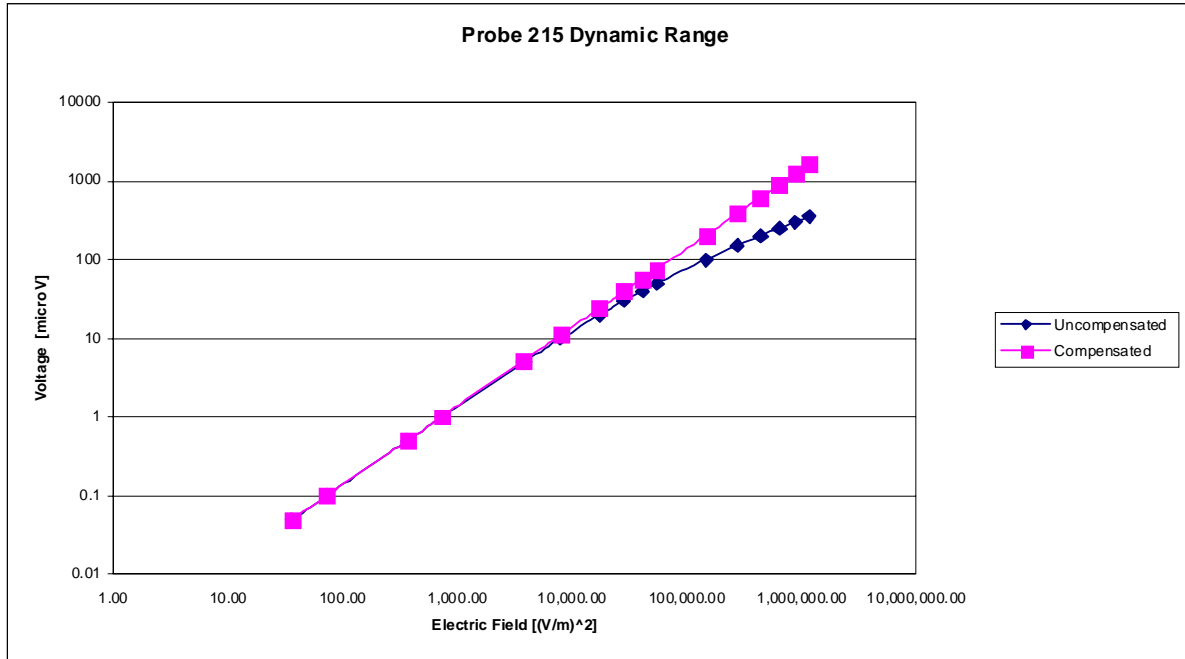
Isotropy Error 1900 MHz (Air)



Isotropicity Tissue:

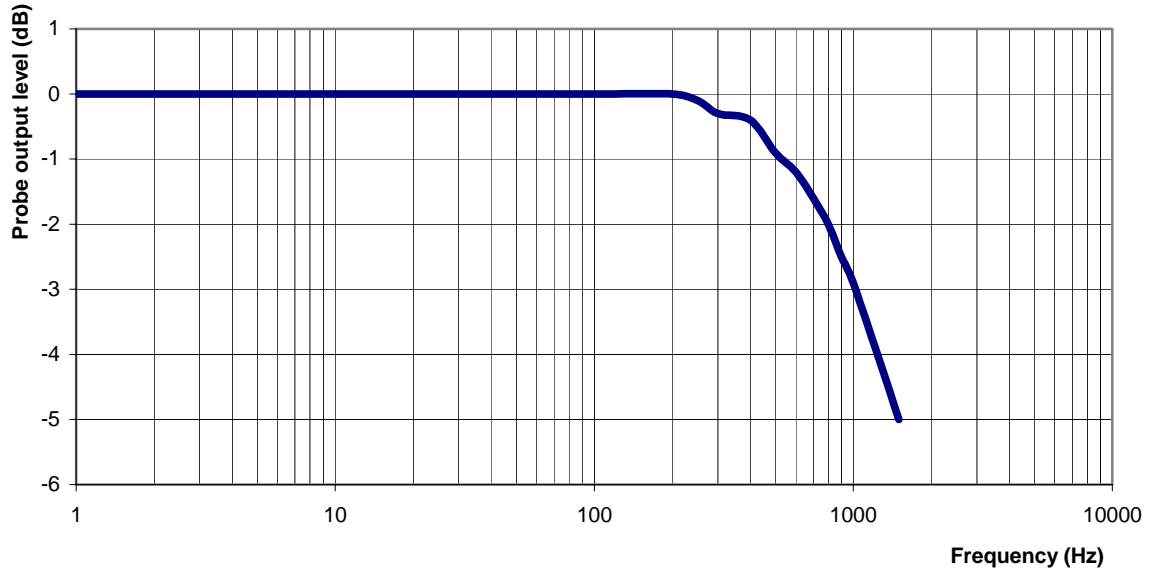
0.10 dB

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 Measured

Sensitivity in Body Tissue

Frequency: 1900 MHz

Epsilon: 54.2 (+/-5%) **Sigma:** 1.57 S/m (+/-5%)

ConvF

Channel X: 5.0 7%(K=2)

Channel Y: 5.0 7%(K=2)

Channel Z: 5.0 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 2.5mm 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 2008.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-935

Client.: RFEL

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.: 215

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

Project No: RFEL-00150-CAL-5367

Calibrated: 3rd November 2008

Released on: 3rd November 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary
This calibration has been conducted in line with the SCC ISO-IEC 17025 Scope of Accreditation
Accredited Laboratory Number 48

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-020 215.

References

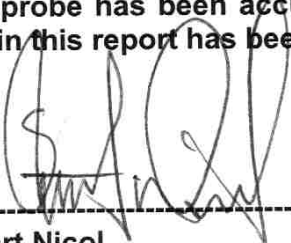
SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure
IEEE 1528 "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques"
IEEE 1309 "IEEE Standard for Calibration of Electromagnetic Field Sensors and Probes, Excluding Antennas, from 9 KHz to 40 GHz" 2005
SSI-TP-011 Tissue Calibration Procedure
IEC 62209 "Human exposure to radio frequency fields from handheld and body-mounted wireless communication devices –Human models, instrumentation and procedures Part 1 & 2: Procedure to determine the Specific Absorption Rate (SAR) for handheld devices used in close proximity of the ear (frequency range of 200MHz to 3GHz)"

Conditions

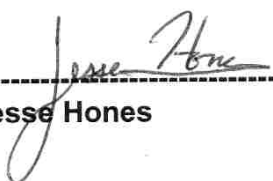
Probe 215 was a re-calibration.

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:	215
Frequency:	2450 MHz
Sensor Offset:	1.56 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Ertalyte*
Tip Diameter:	<5 mm
Tip Length:	60 mm
Total Length:	290 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 2450 MHz

Epsilon: 53.8 (+/-5%) **Sigma:** 1.99 S/m (+/-5%)

ConvF

Channel X: 4.5

Channel Y: 4.5

Channel Z: 4.5

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

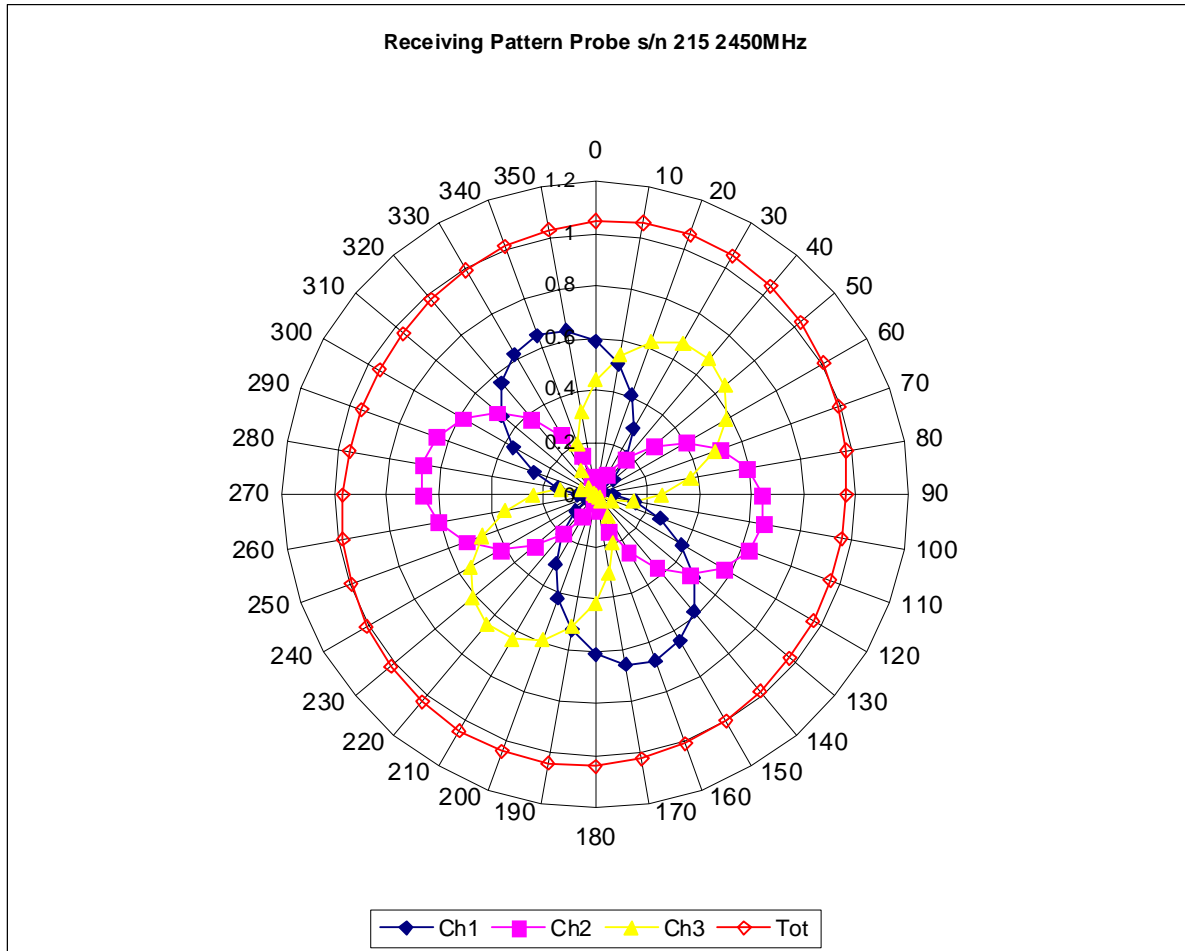
Boundary Effect:

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

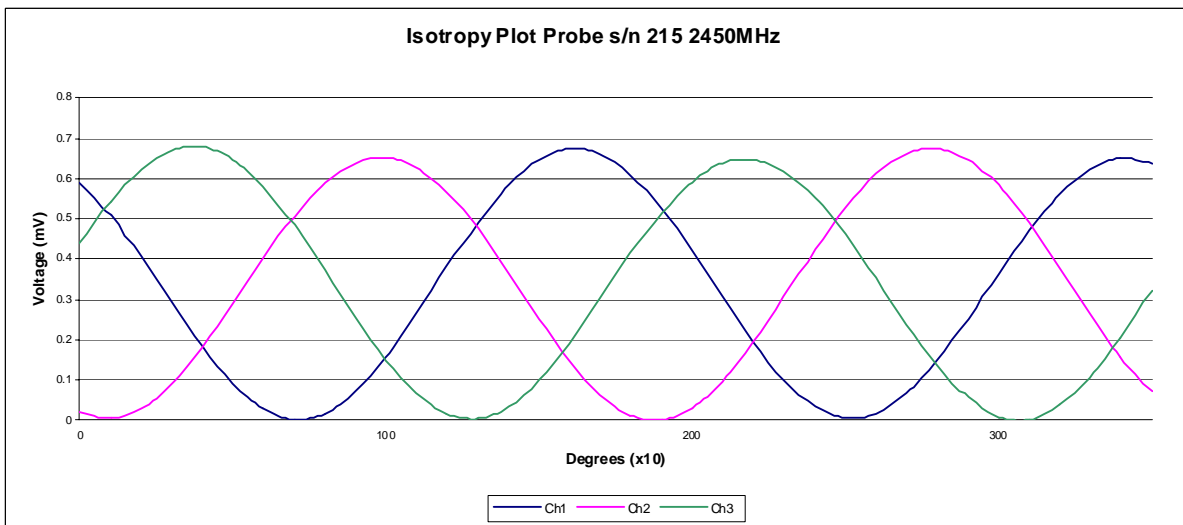
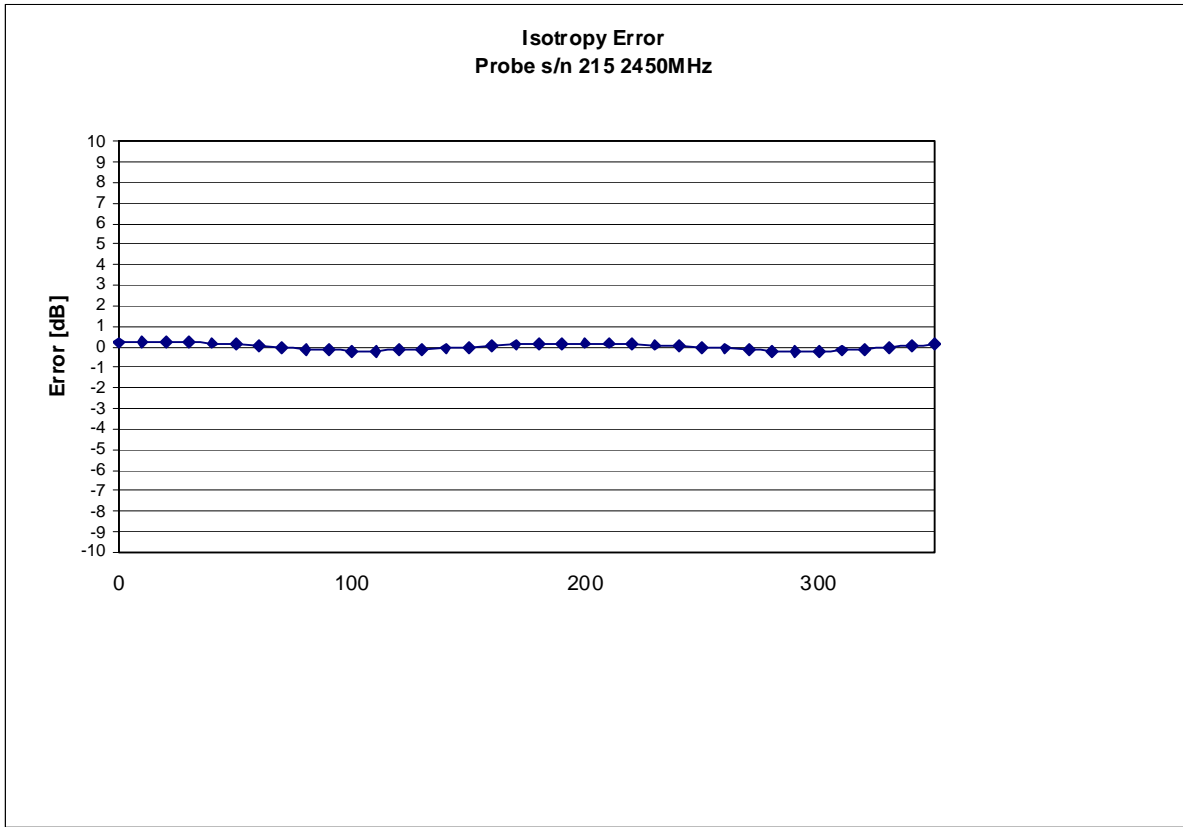
Spatial Resolution:

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

Receiving Pattern 2450 MHz (Air)



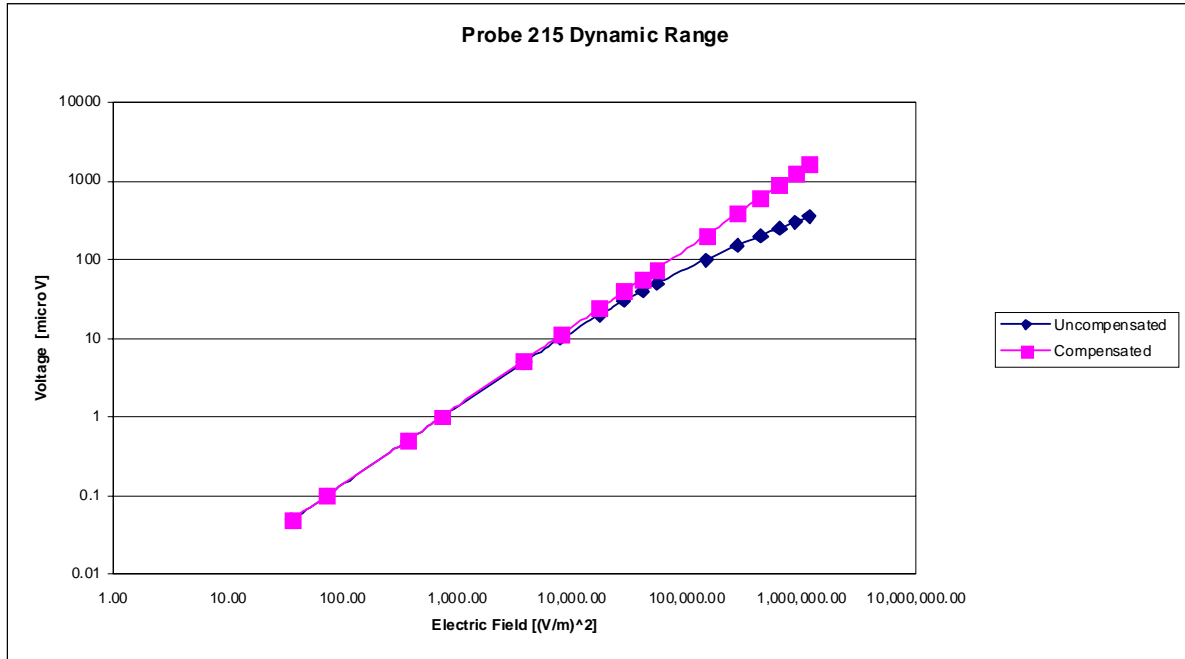
Isotropy Error 2450 MHz (Air)



Isotropicity Tissue:

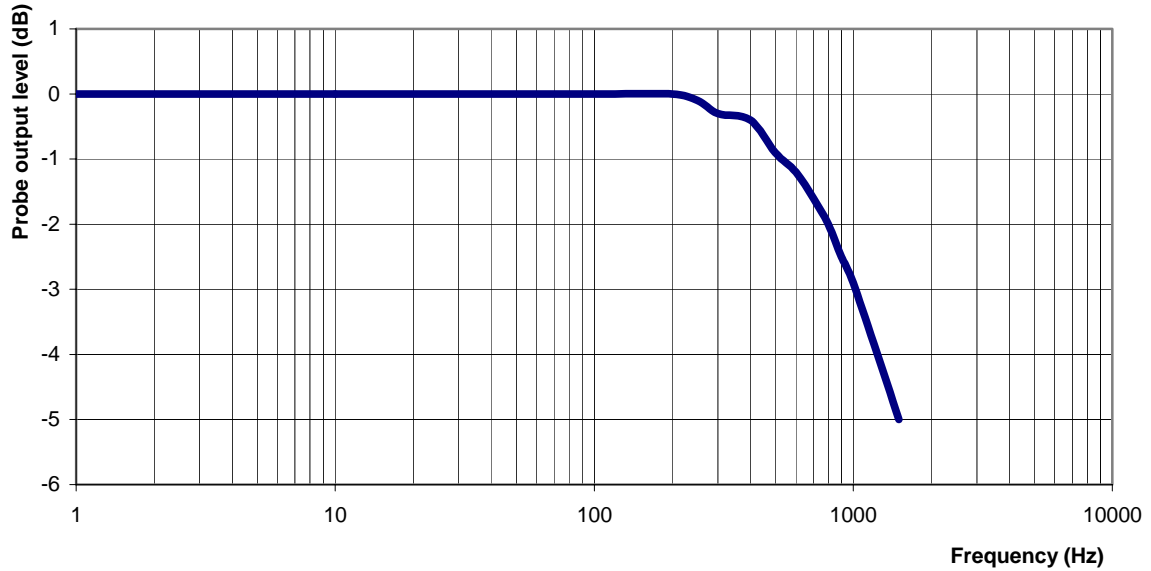
0.10 dB

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: 53.8 (+/-5%)

Sigma: 1.99 S/m (+/-5%)

ConvF

Channel X: 4.5 7%(K=2)

Channel Y: 4.5 7%(K=2)

Channel Z: 4.5 7%(K=2)

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

Boundary Effect:

For a distance of 2.5mm 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 2008.

NCL CALIBRATION LABORATORIES

Calibration File No.: CP-868

Client.: RFEL

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.: E030-001

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

Project No: RFEL-E030-5334

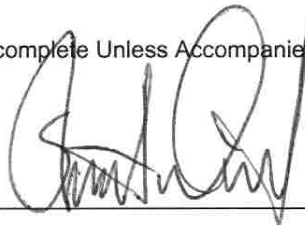
Calibrated: 14th April 2008

Released on: 14th April 2008

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 E030-001.

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 E030-001 was a new probe.

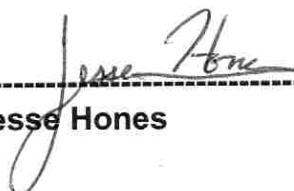
Ambient Temperature of the Laboratory: 22 °C +/- 0.5°C

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:	E030-001
Frequency:	5200 MHz
Sensor Offset:	1.06 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Composite*
Tip Diameter:	<2.5 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5200 MHz

Epsilon: 48.11 **Sigma:** 5.51 S/m

ConvF:

Channel X: 8.6

Channel Y: 8.6

Channel Z: 8.6

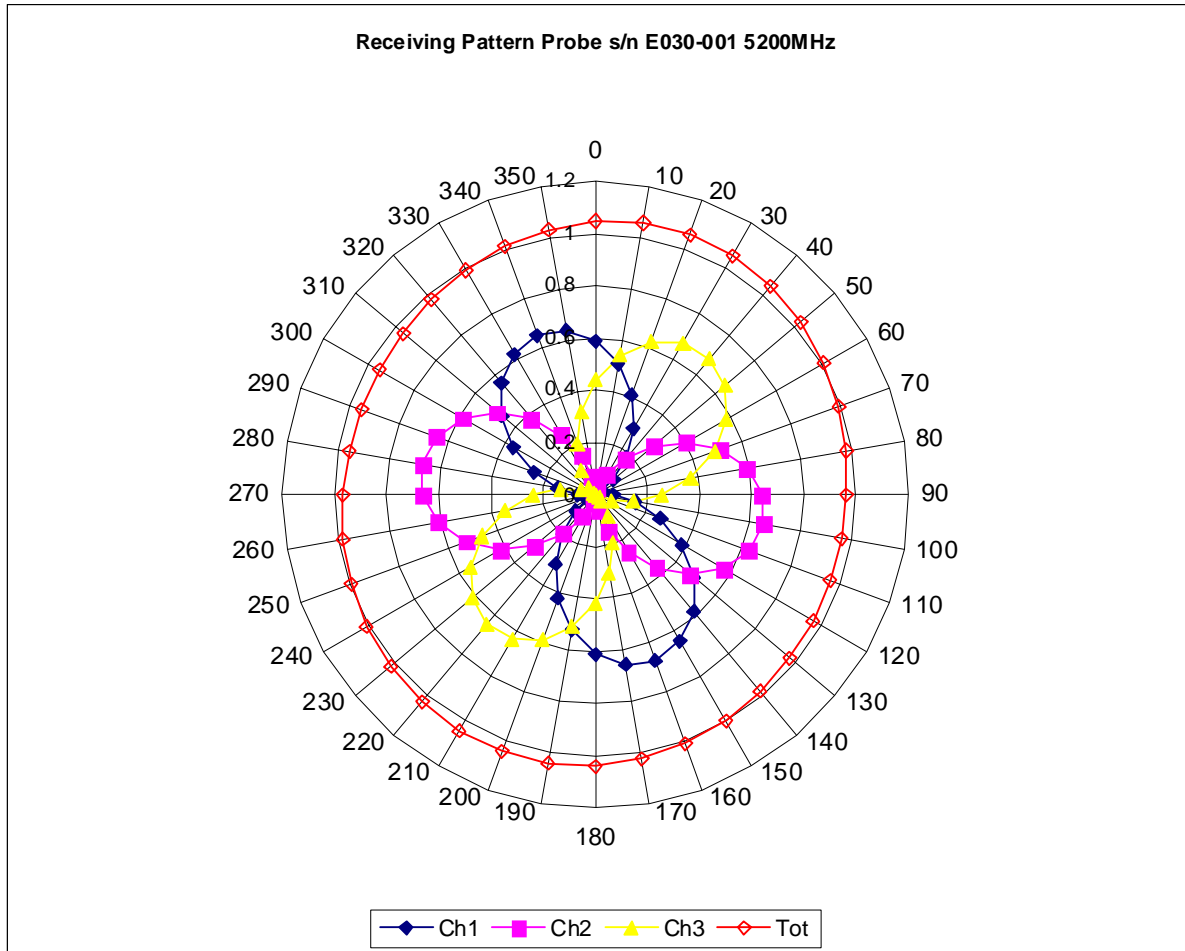
Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

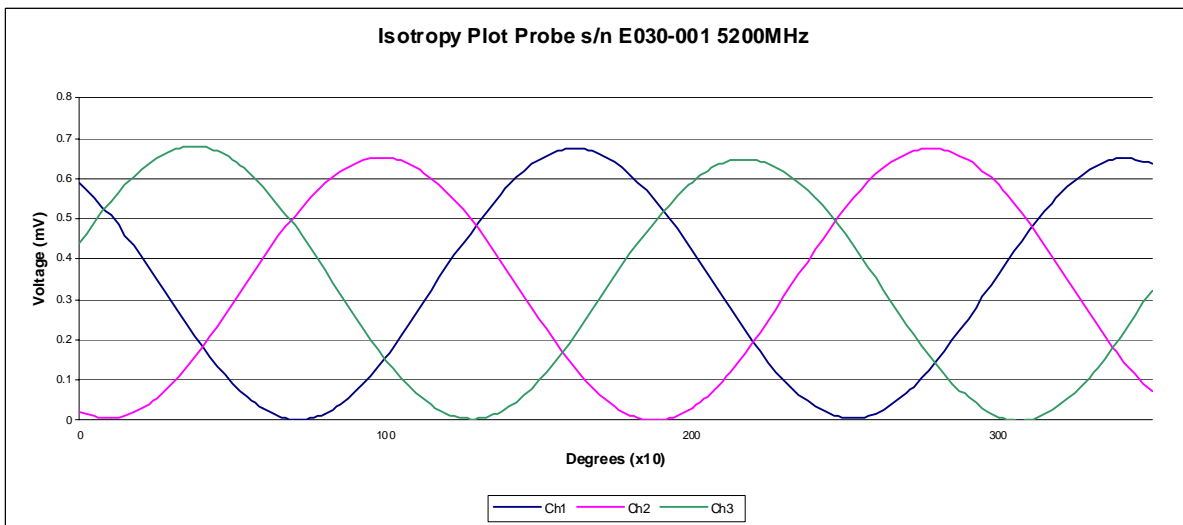
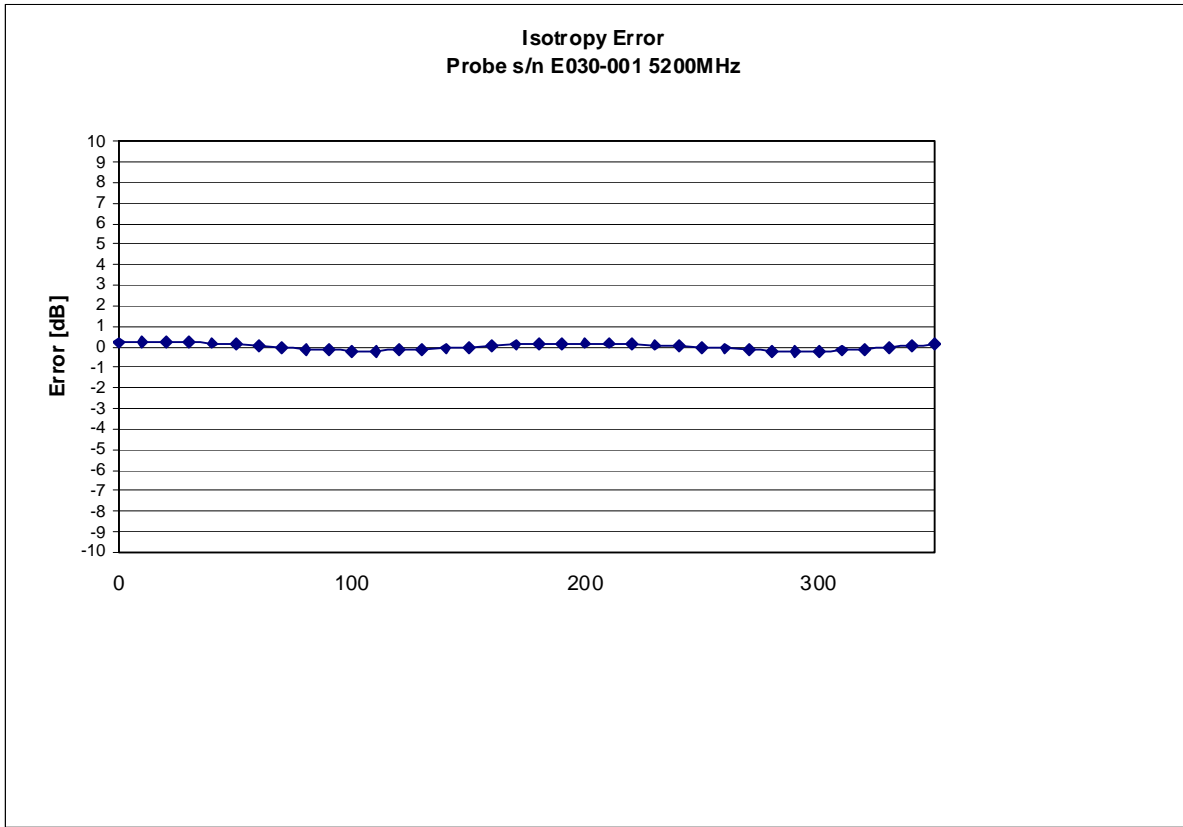
Spatial Resolution:

The measured probe tip diameter is 2.5mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 5200 MHz (Air)



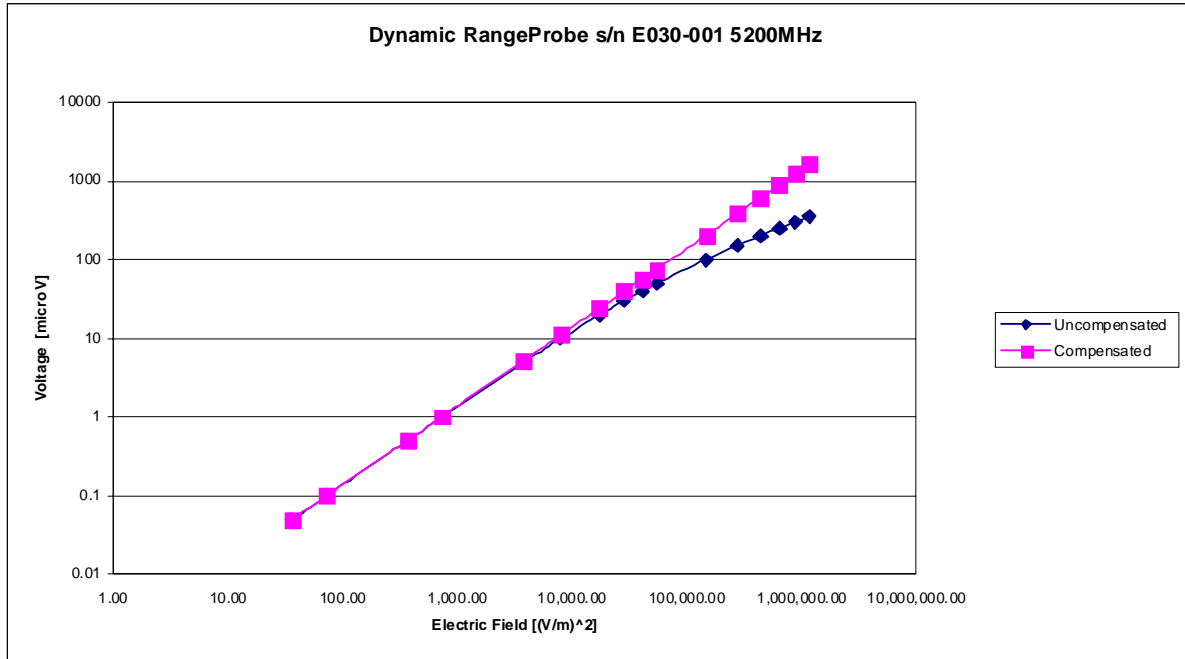
Isotropy Error 5200 MHz (Air)



Isotropicity Tissue:

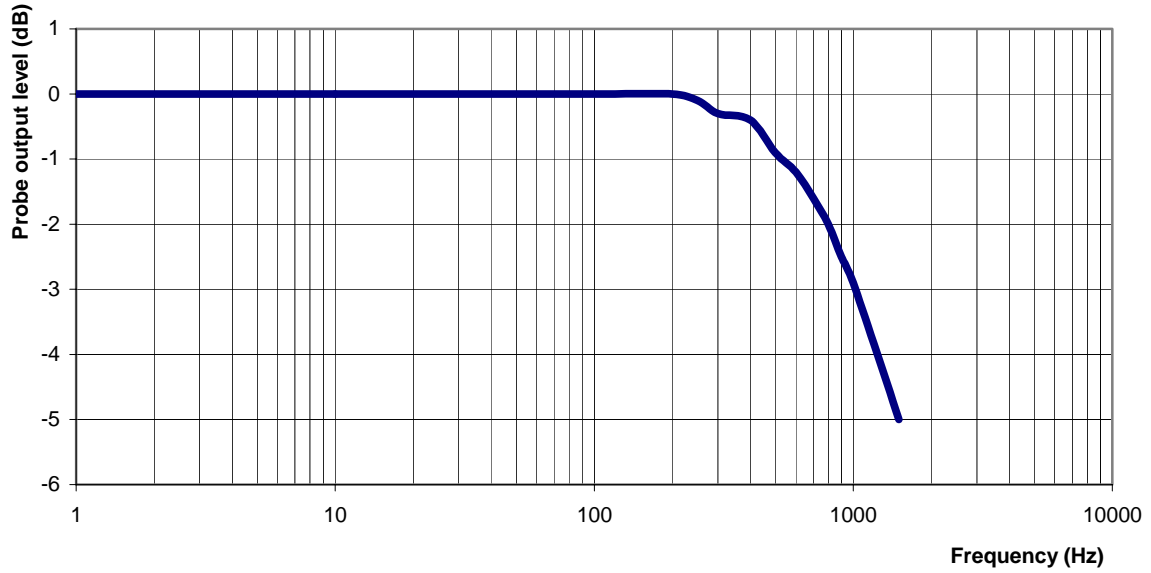
0.10 dB

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 Body Tissue Measured

Frequency:		5200 MHz	
Epsilon:	48.11	Sigma:	5.51 S/m
ConvF			
Channel X:	8.6	7%(K=2)	
Channel Y:	8.6	7%(K=2)	
Channel Z:	8.6	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 0.58mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

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-869

Client.: RFEL

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 5600 MHz

BODY Calibration

Manufacturer: APREL Laboratories

Model No.: E-020

Serial No.: E030-001

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

Project No: RFEL-E030-5334

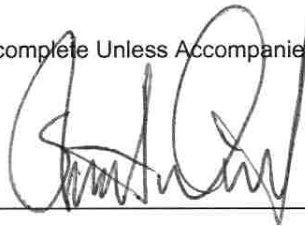
Calibrated: 14th April 2008

Released on: 14th April 2008

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 E030-001.

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 E030-001 was a new probe.

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:	E030-001
Frequency:	5600 MHz
Sensor Offset:	1.06 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Composite*
Tip Diameter:	<2.5 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5600 MHz

Epsilon: 46.43 **Sigma:** 5.87 S/m

ConvF:

Channel X: 6.1

Channel Y: 6.1

Channel Z: 6.1

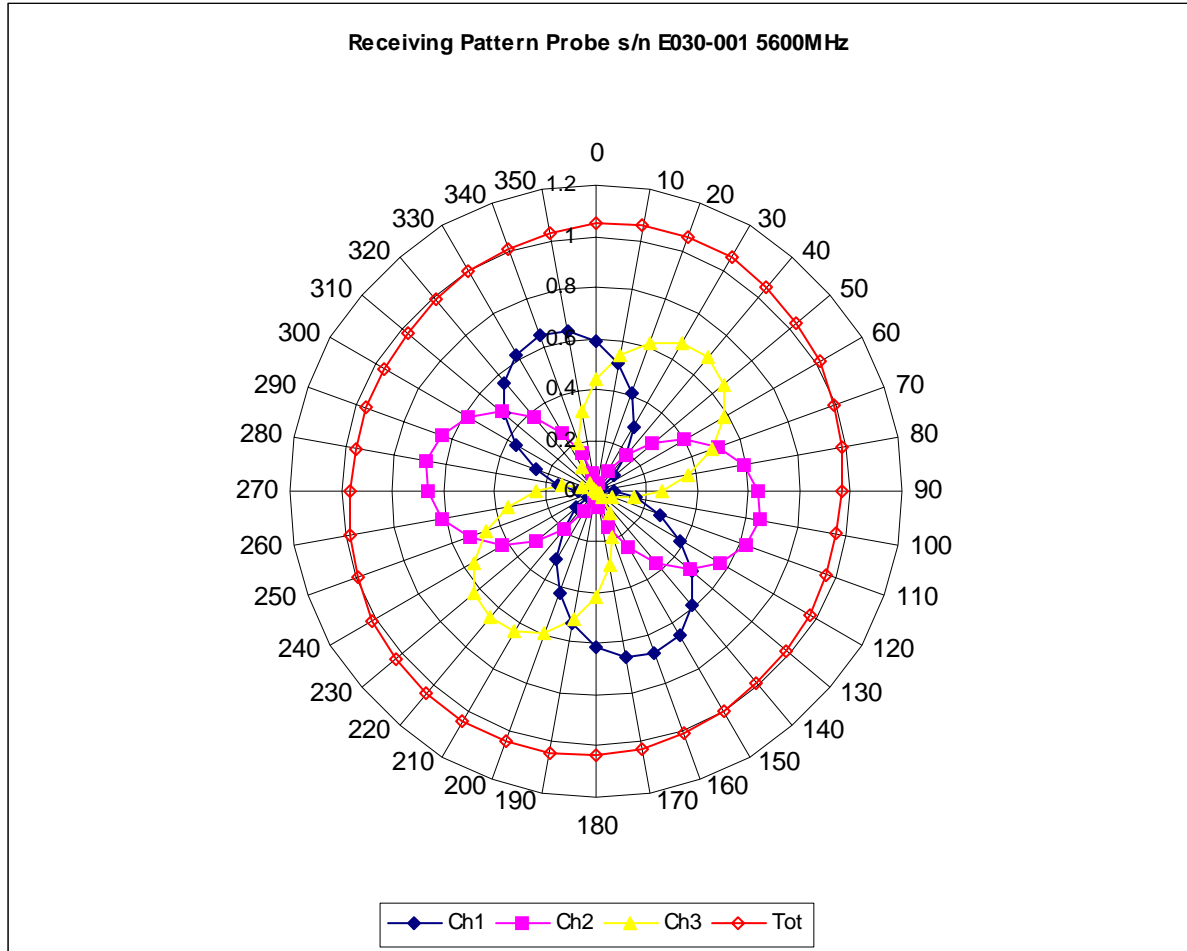
Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

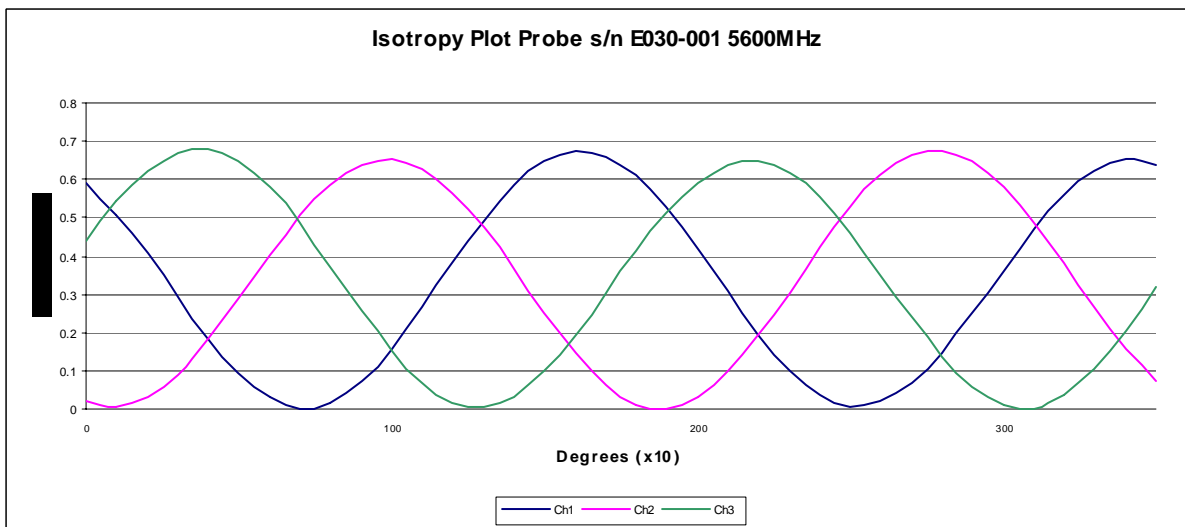
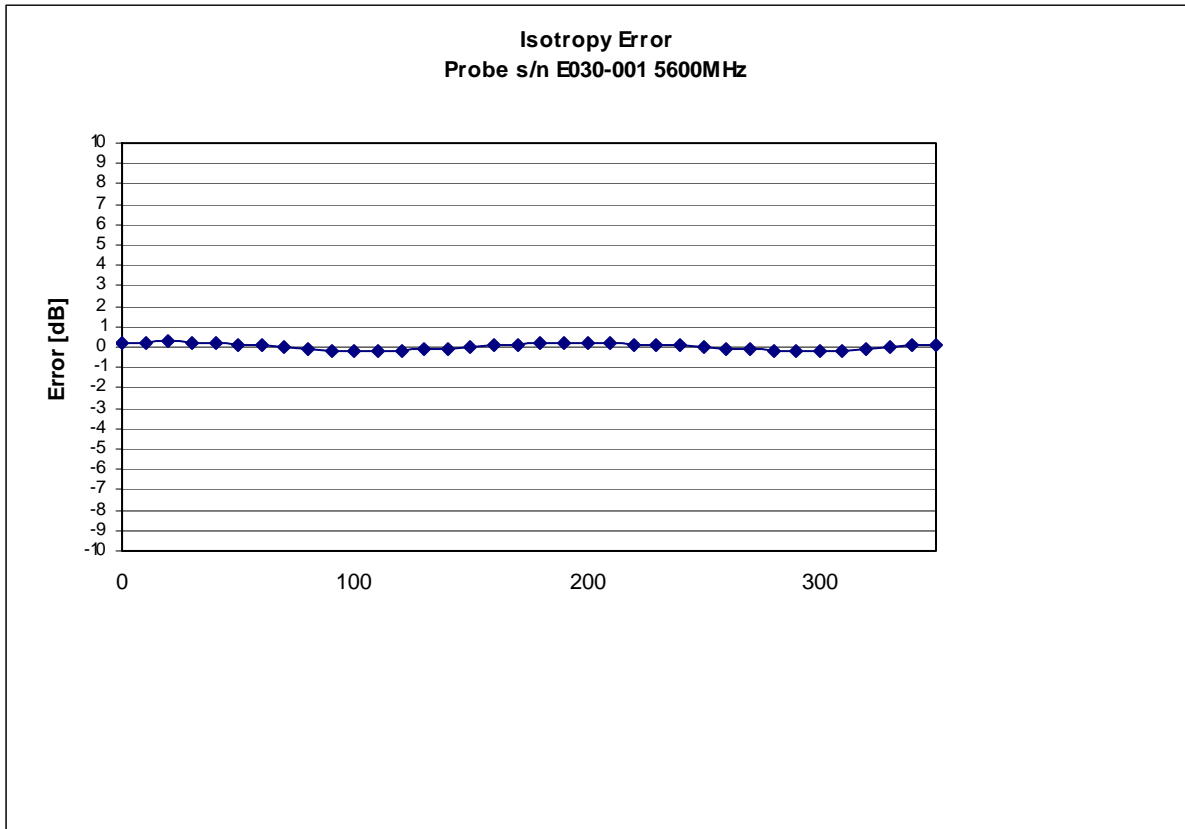
Spatial Resolution:

The measured probe tip diameter is 2.5mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 5600 MHz (Air)



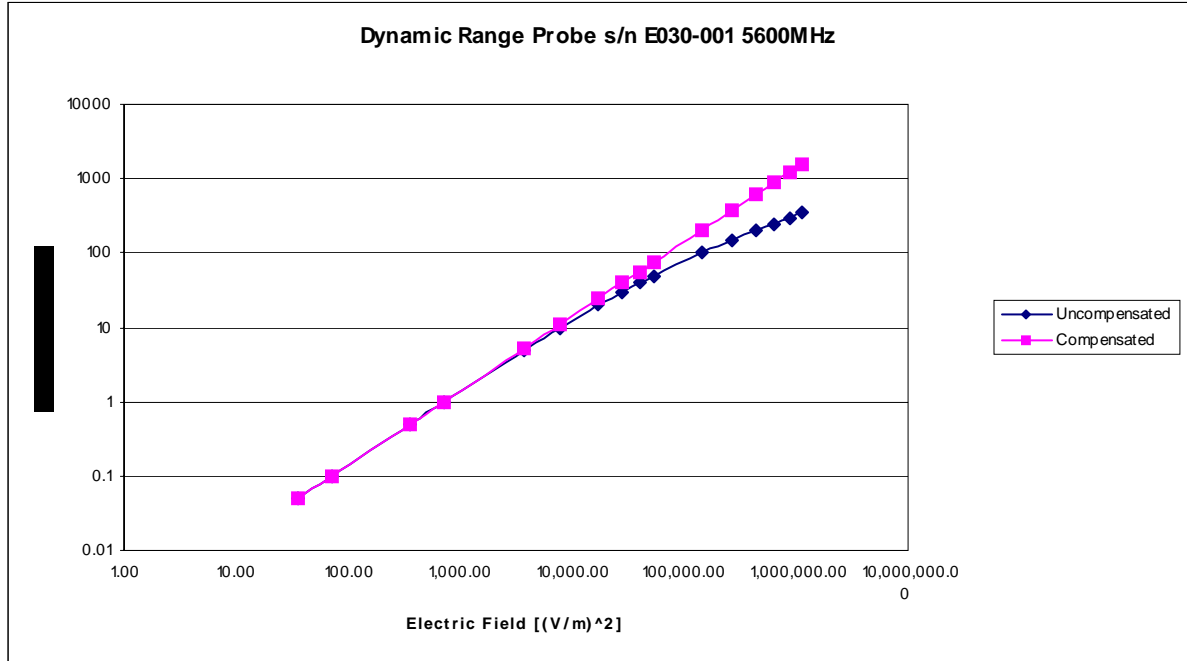
Isotropy Error 5600 MHz (Air)



Isotropicity Tissue:

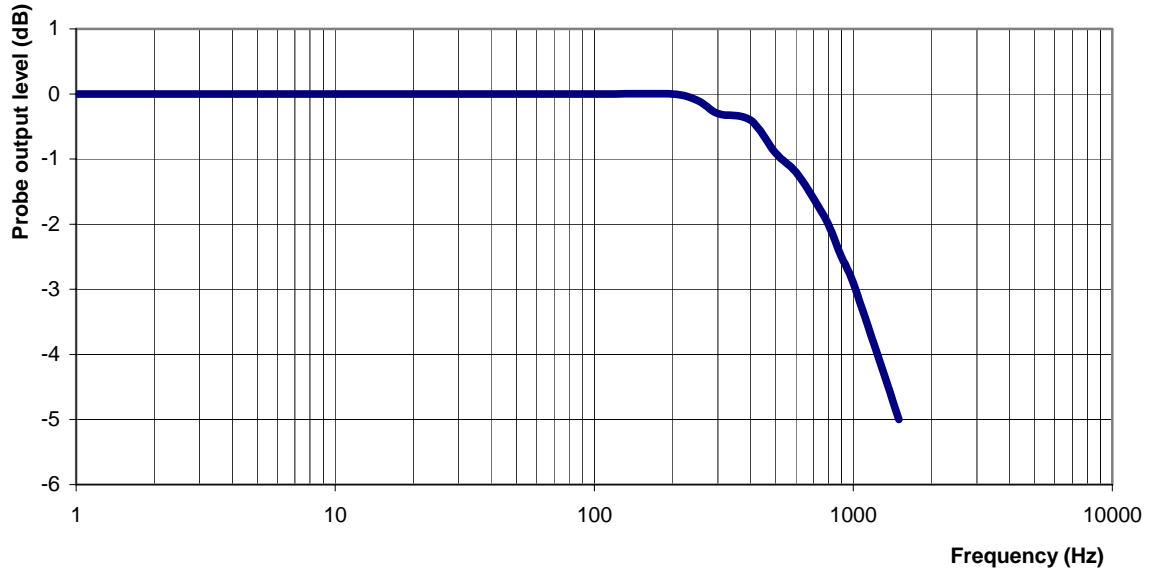
0.10 dB

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 Measured

Frequency: 5600 MHz

Epsilon: 46.43

Sigma: 5.87 S/m

ConvF

Channel X: 6.1 7%(K=2)

Channel Y: 6.1 7%(K=2)

Channel Z: 6.1 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 0.58mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

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-870

Client.: RFEL

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.: E030-001

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

Project No: RFEL-E030-5334

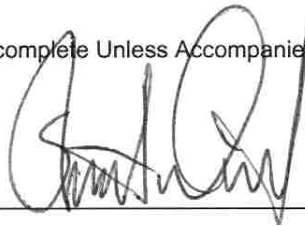
Calibrated: 14th April 2008

Released on: 14th April 2008

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 E030-001.

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 E030-001 was a new probe.

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:	E030-001
Frequency:	5800 MHz
Sensor Offset:	1.06 mm
Sensor Length:	2.5 mm
Tip Enclosure:	Composite*
Tip Diameter:	<2.5 mm
Tip Length:	55 mm
Total Length:	289 mm

*Resistive to recommended tissue recipes per IEEE-1528

Sensitivity in Air

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

Sensitivity in Body Tissue Measured

Frequency: 5800 MHz

Epsilon: 46.38 **Sigma:** 6.22 S/m

ConvF:

Channel X: 12

Channel Y: 12

Channel Z: 12

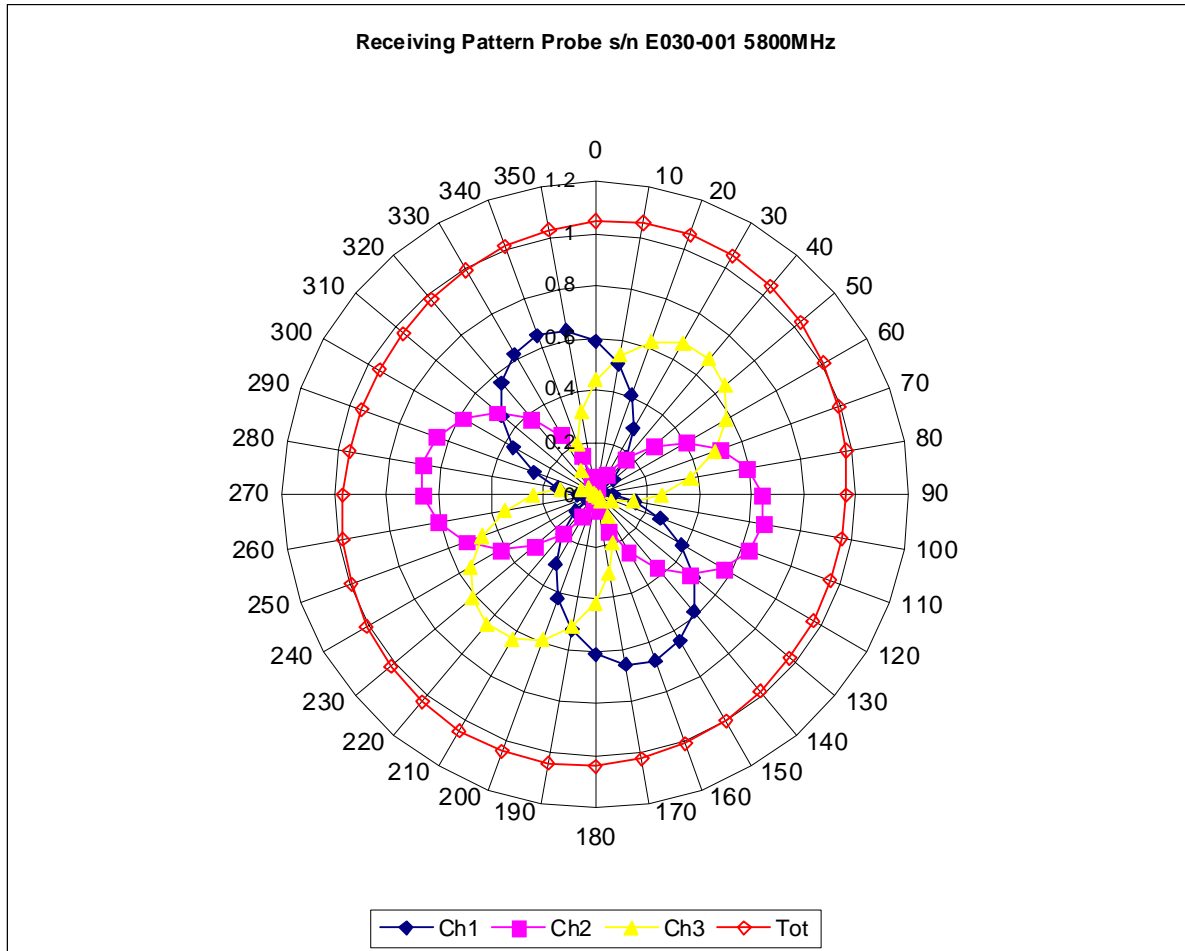
Boundary Effect:

Uncertainty resulting from the boundary effect is less than 2.1% for the distance between the tip of the probe and the tissue boundary, when less than 0.58mm.

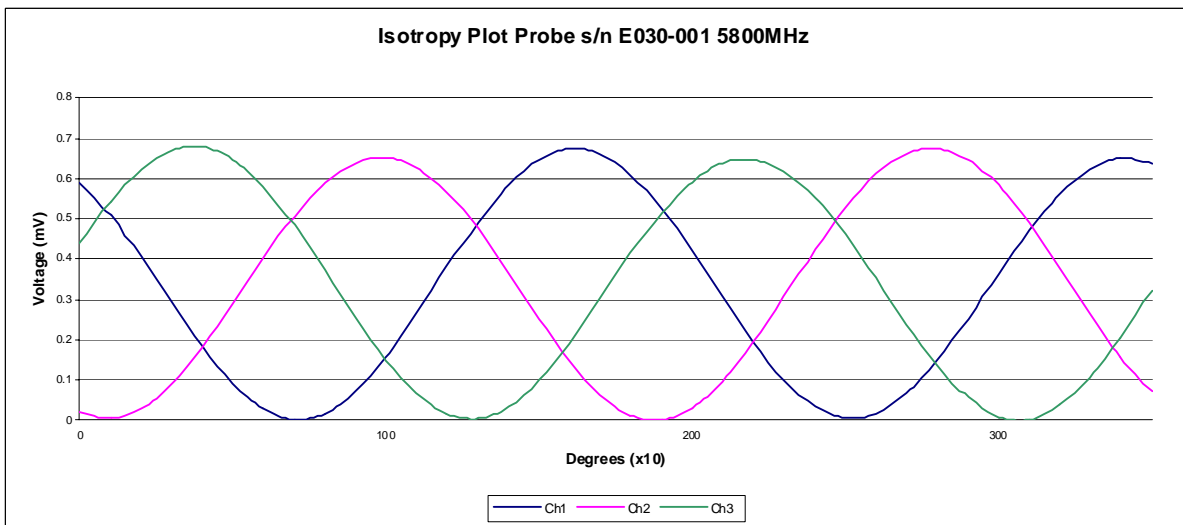
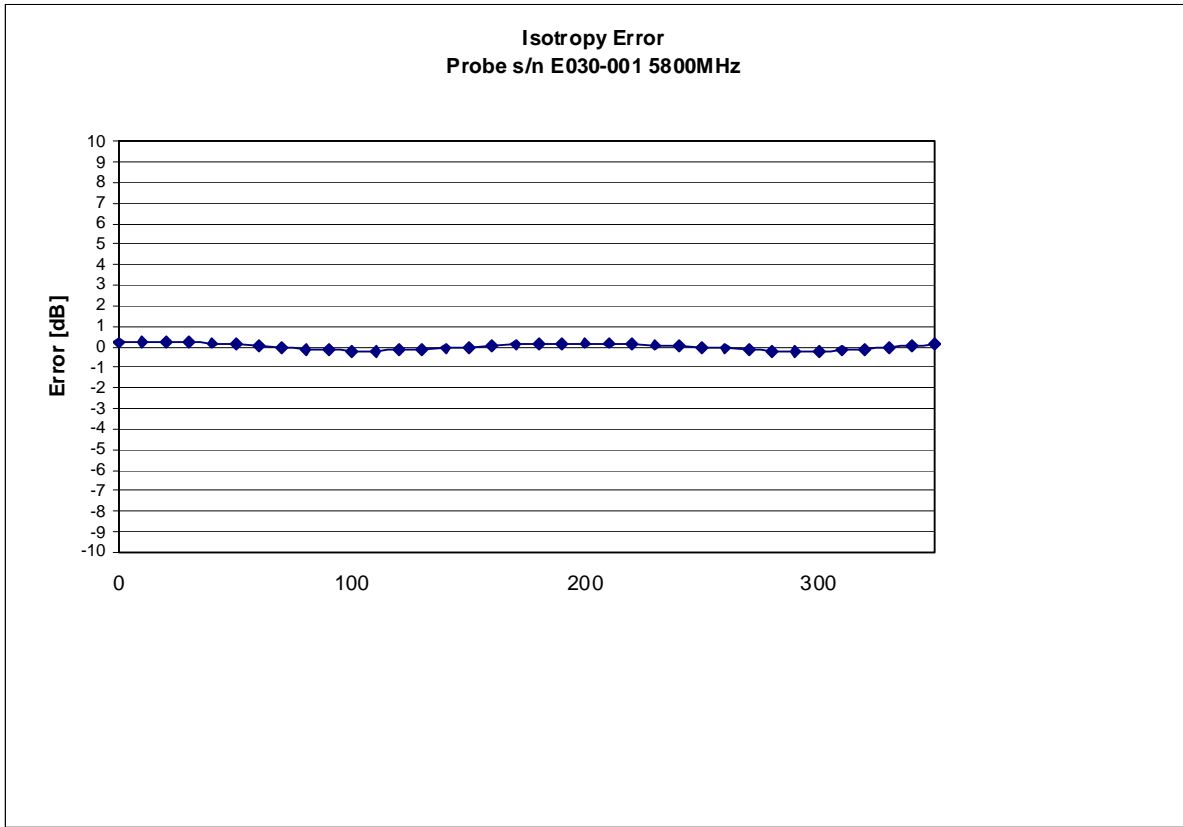
Spatial Resolution:

The measured probe tip diameter is 2.5mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

Receiving Pattern 5800 MHz (Air)



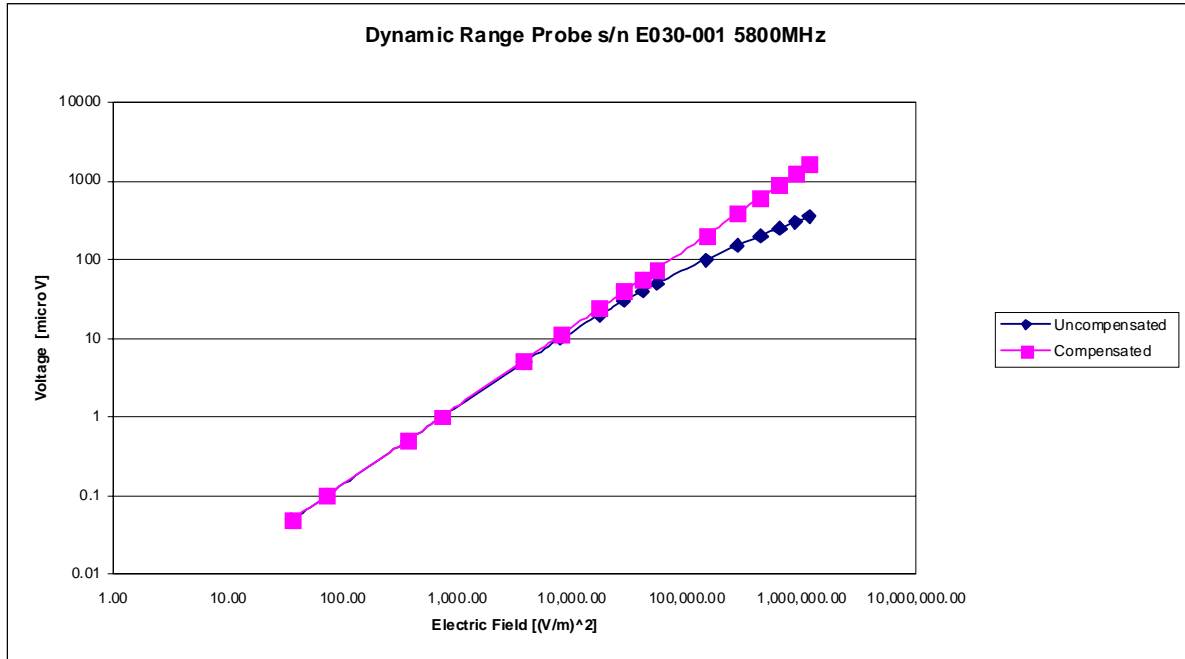
Isotropy Error 5800 MHz (Air)



Isotropicity Tissue:

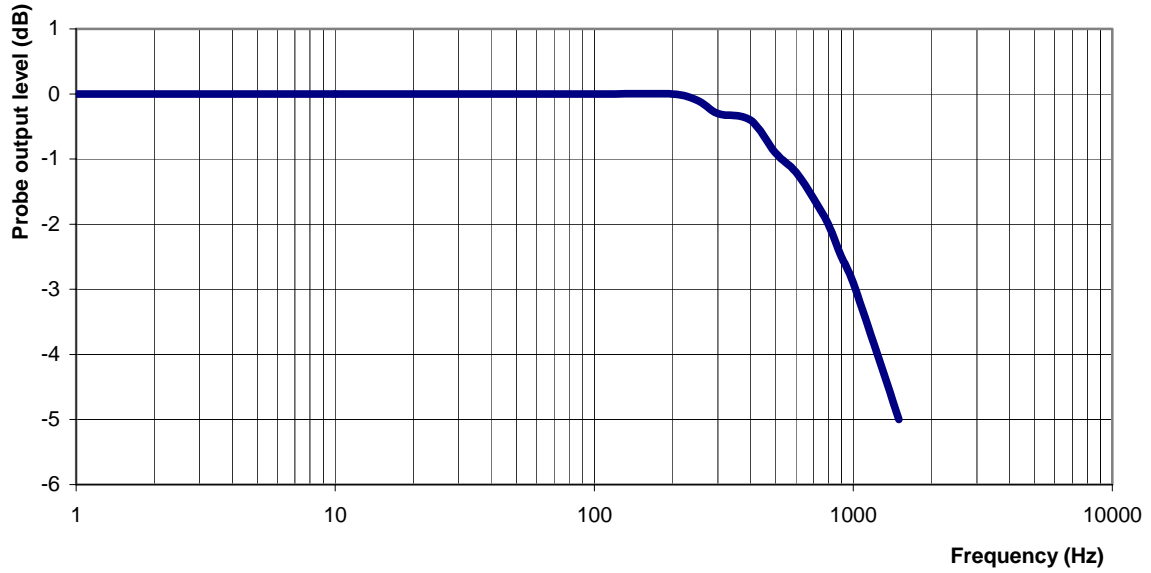
0.10 dB

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 Body Tissue Measured

Frequency: 5800 MHz

Epsilon: 46.38

Sigma: 6.22 S/m

ConvF

Channel X: 12 7%(K=2)

Channel Y: 12 7%(K=2)

Channel Z: 12 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 0.58mm the evaluated uncertainty (increase in the probe sensitivity) is less than 2.1%.

Test Equipment

The test equipment used during Probe Calibration, manufacturer, model number and, current calibration status are listed and located on the main APREL server R:\NCL\Calibration Equipment\Instrument List May 2007.

Appendix E – Dipole Calibration Data Sheets

RF Exposure Lab, LLC

Calibration File No: CAL.20080203

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated at RF Exposure Lab, LLC by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part Number: ALS-D-835-S-2

Frequency: 835 MHz

Serial No: RFE-274

Manufactured: 20 February 2004
Calibrated: 22 February 2008

Calibrated By: Signature on File
Jay Moulton – Technical Manager

Approved By: Signature on File
Tamara Moulton – Quality Manager

Measurement Uncertainty:

Repeatability:	2.3%
Tissue Uncertainty:	3.2%
Network Analyzer:	2.5%



RF EXPOSURE LAB, LLC

2867 Progress Place, Suite 4D
Escondido, CA 92029

Tel: (760) 737-3131
FAX: (760) 737-9131

Calibration Results Summary

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

Mechanical Dimensions

Length: 161.8 mm
Height: 91.1 mm

Electrical Specifications

Head

SWR: 1.1182 U
Return Loss: -27.508 dB
Impedance: 49.648 Ω

System Validation Results

Frequency	1 Gram	10 Gram
835 MHz	9.500	6.000

Body

SWR: 1.1533 U
Return Loss: -23.596 dB
Impedance: 51.395 Ω

System Validation Results

Frequency	1 Gram	10 Gram
835 MHz	9.750	6.240

Head Measurement Conditions

The measurements were performed in the Uni-Phantom filled with head simulating liquid of the following electrical parameters at 835 MHz:

Relative Dielectricity	41.48	± 5%
Conductivity	0.92 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 6.0 at 835 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

The laboratories environmental conditions were as follows during the calibration sequence.

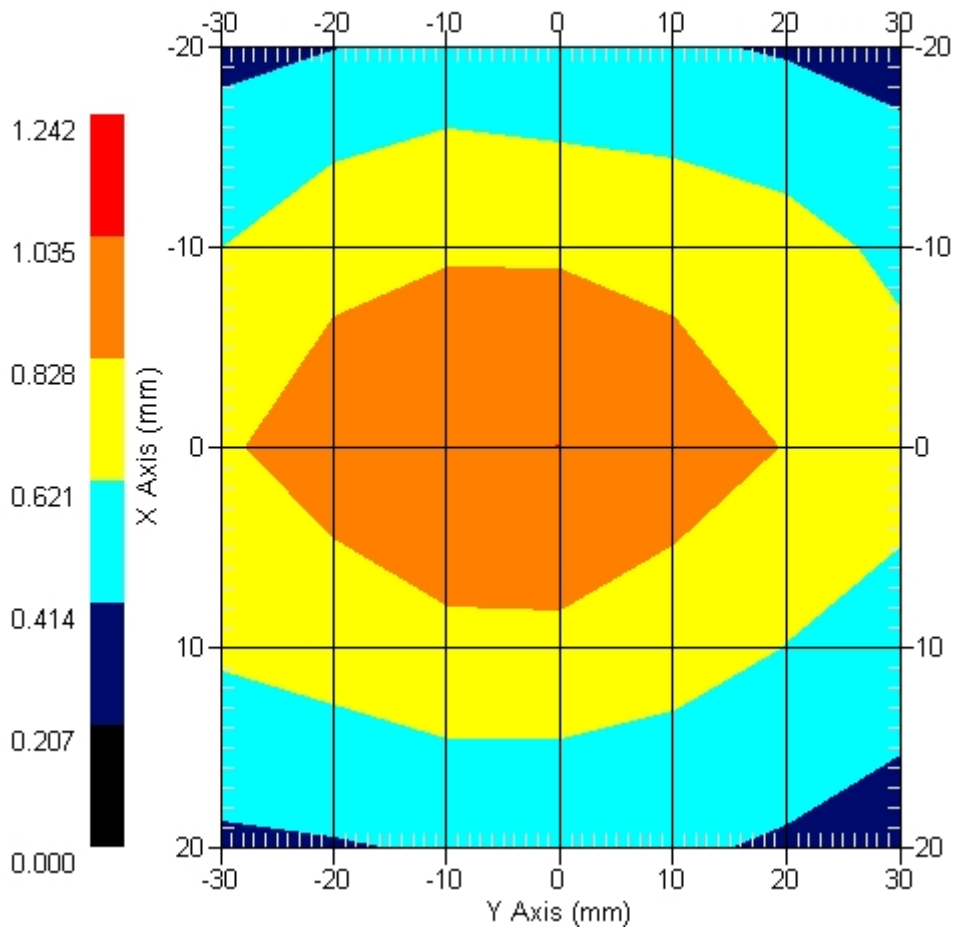
Ambient Temperature of the Laboratory:	24 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	40%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 9.500 mW/g ± 19.0% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 6.000 mW/g ± 18.5% (k=2)¹

Area Scan



1 gram SAR value : 0.950 W/kg
 10 gram SAR value : 0.600 W/kg
 Area Scan Peak SAR : 1.037 W/kg
 Zoom Scan Peak SAR : 1.541 W/kg

¹ validation uncertainty

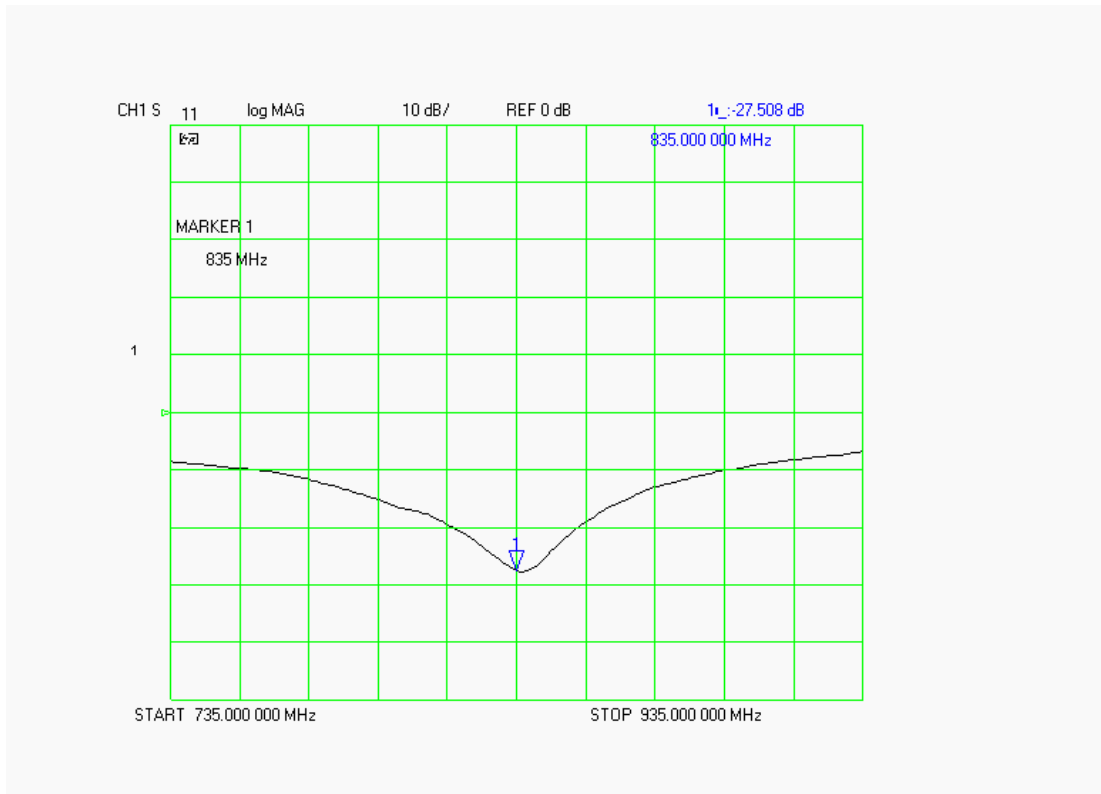
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

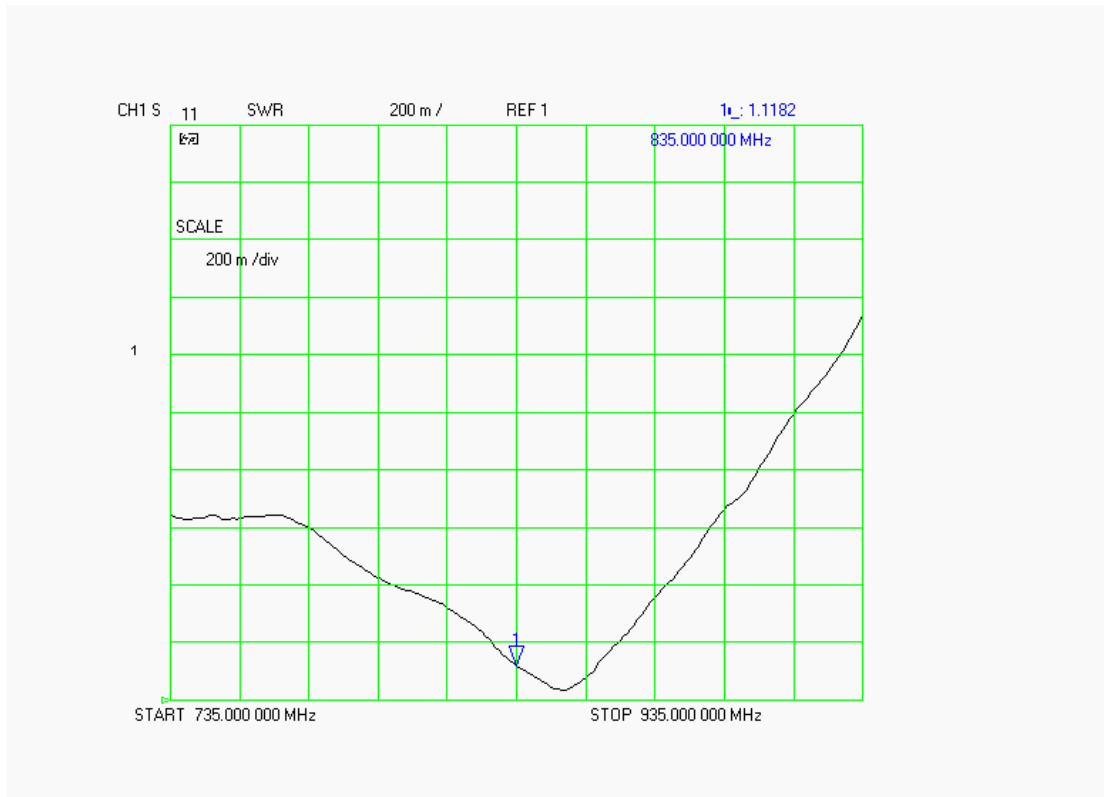
Test	Result
S11 R/L	-27.508 dB
SWR	1.1182 U
Impedance	49.648 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

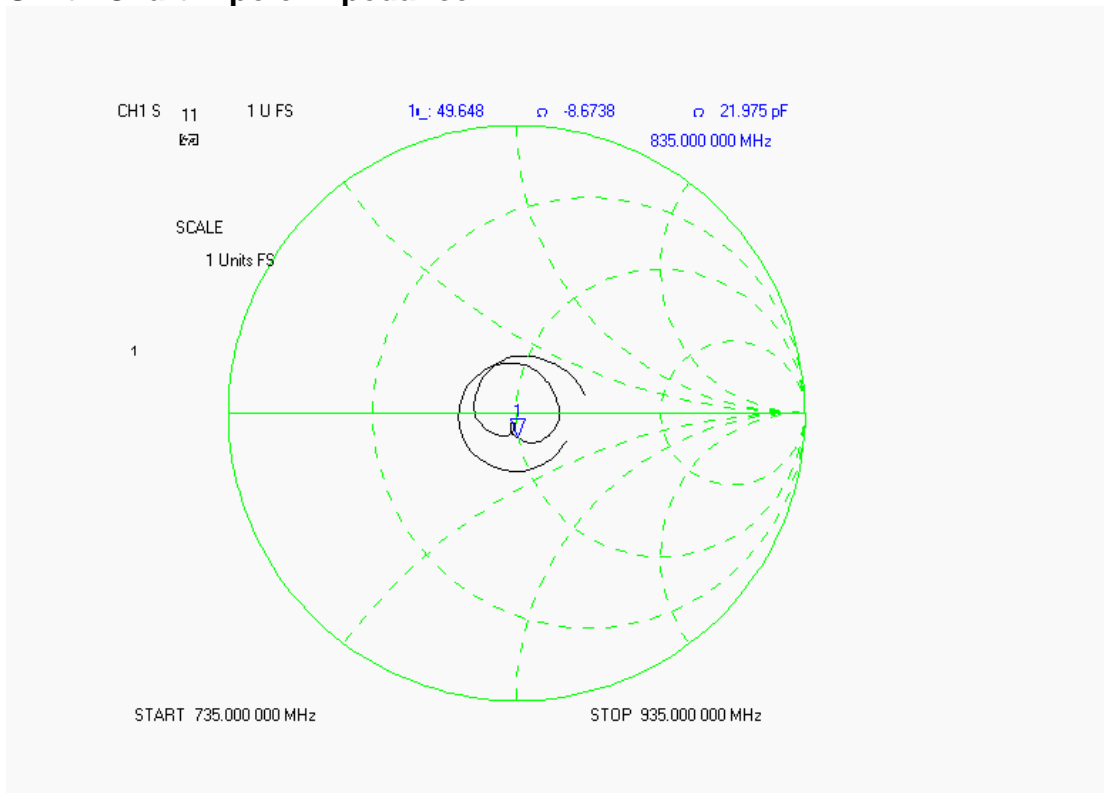
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 835 MHz:

Relative Dielectricity	55.20	± 5%
Conductivity	0.96 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 6.1 at 835 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 15mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

The laboratories environmental conditions were as follows during the calibration sequence.

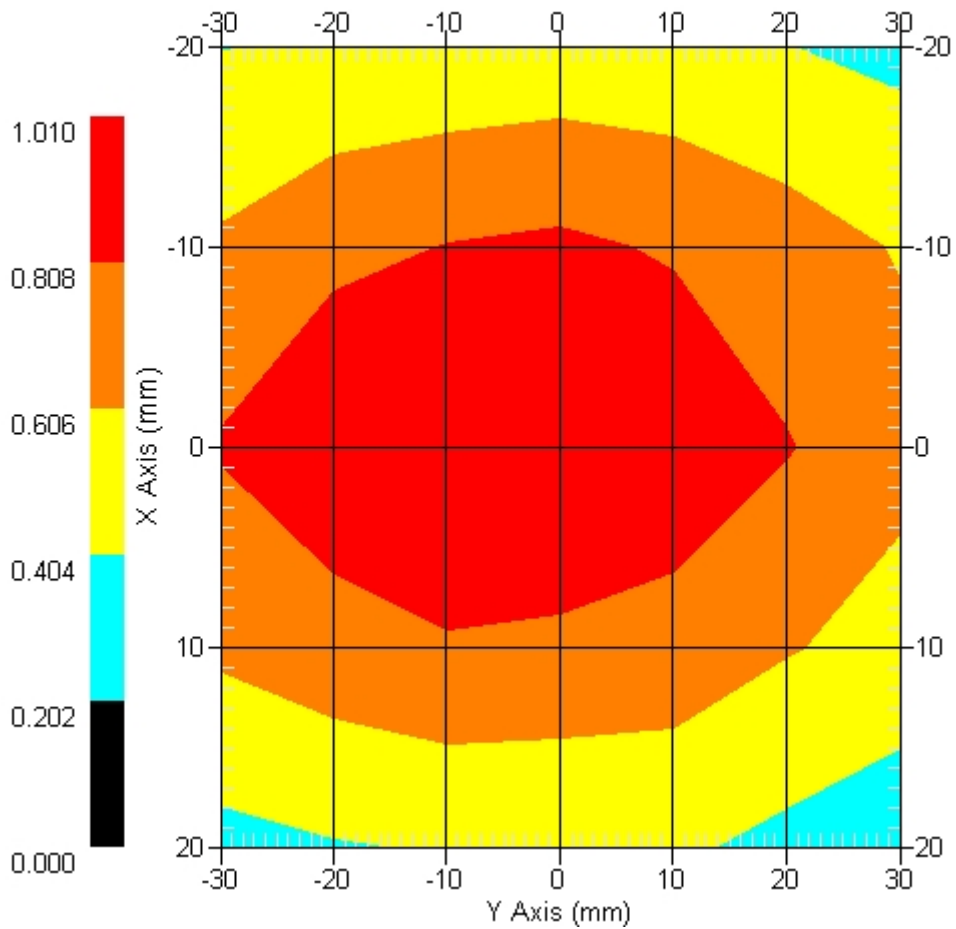
Ambient Temperature of the Laboratory:	24 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	40%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 9.750 mW/g ± 19.1% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 6.240 mW/g ± 18.6% (k=2)¹

Area Scan



1 gram SAR value : 0.975 W/kg
 10 gram SAR value : 0.624 W/kg
 Area Scan Peak SAR : 1.009 W/kg
 Zoom Scan Peak SAR : 1.571 W/kg

¹ validation uncertainty

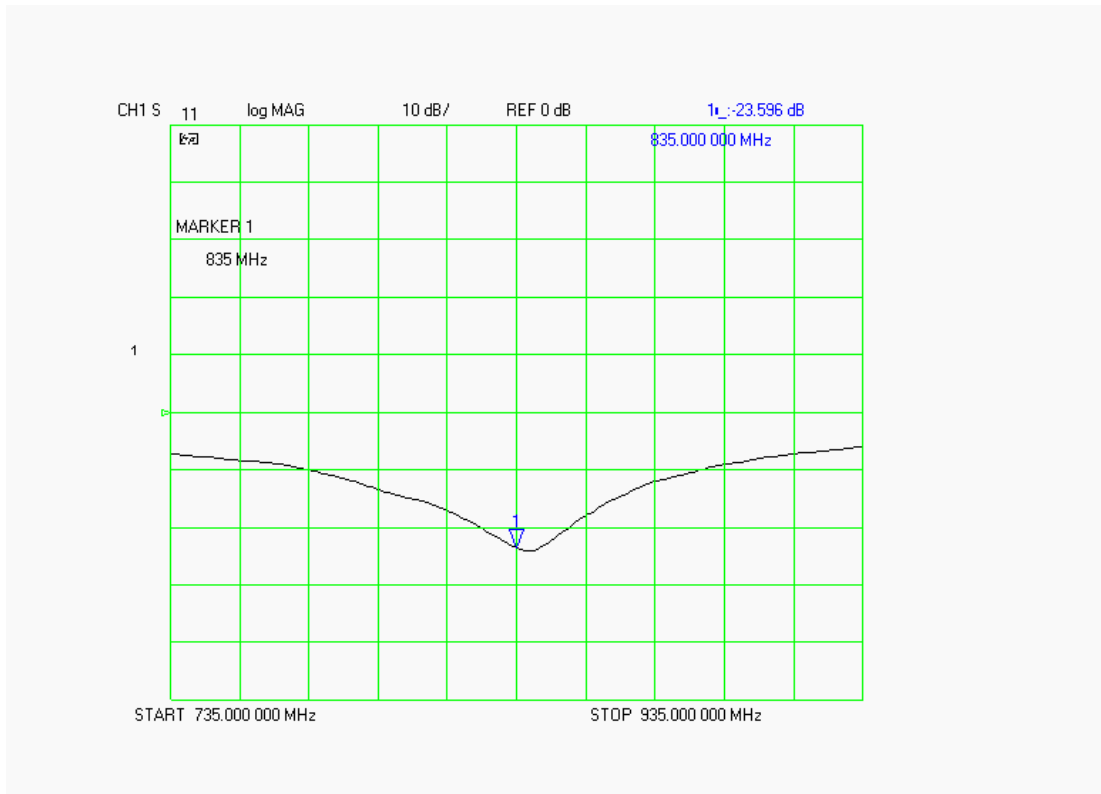
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

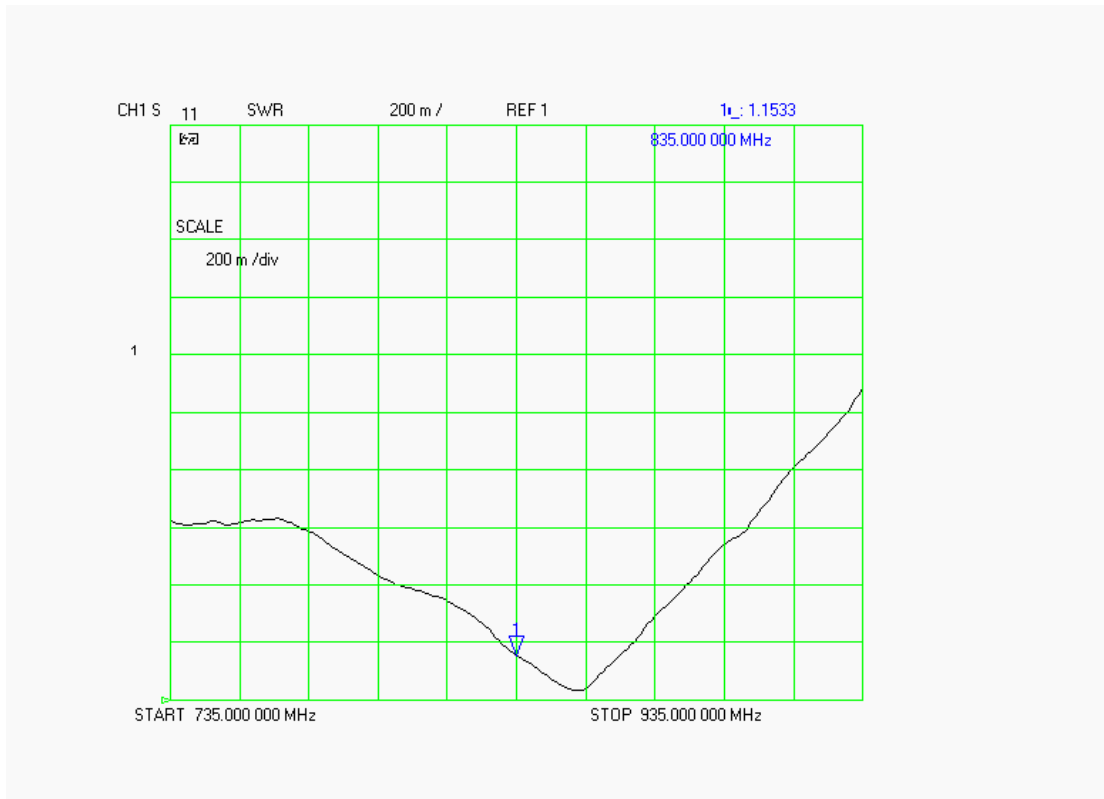
Test	Result
S11 R/L	-23.596 dB
SWR	1.1533 U
Impedance	51.395 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

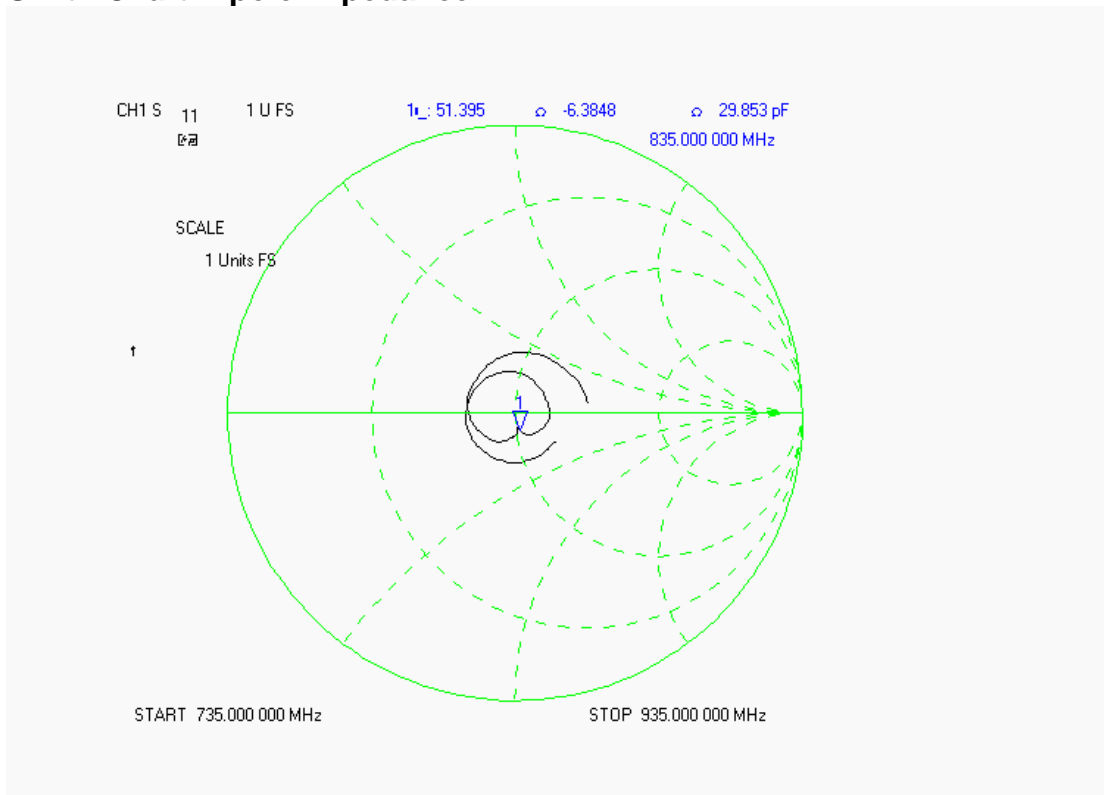
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Test Equipment List

The test equipment used during Dipole Calibration, manufacturer, model number and, current calibration status are listed and located on the RF Exposure Lab, LLC system computer C:\Test Equipment\Calibration Equipment\Instrument List February 2008.

RF Exposure Lab, LLC

Calibration File No: CAL.20080202

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated at RF Exposure Lab, LLC by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part Number: ALS-D-1900-S-2

Frequency: 1.9 GHz

Serial No: RFE-277

Manufactured: 20 February 2004
Calibrated: 21 February 2008

Calibrated By: Signature on File
Jay Moulton – Technical Manager

Approved By: Signature on File
Tamara Moulton – Quality Manager

Measurement Uncertainty:

Repeatability:	2.3%
Tissue Uncertainty:	3.2%
Network Analyzer:	2.5%



RF EXPOSURE LAB, LLC

2867 Progress Place, Suite 4D
Escondido, CA 92029

Tel: (760) 737-3131
FAX: (760) 737-9131

Calibration Results Summary

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

Mechanical Dimensions

Length: 68.0 mm
Height: 37.5 mm

Electrical Specifications

Head

SWR: 1.0793 U
Return Loss: -38.514 dB
Impedance: 49.063 Ω

System Validation Results

Frequency	1 Gram	10 Gram
1.9 GHz	39.380	20.270

Body

SWR: 1.1006 U
Return Loss: -41.682 dB
Impedance: 53.580 Ω

System Validation Results

Frequency	1 Gram	10 Gram
1.9 GHz	40.990	21.090

Head Measurement Conditions

The measurements were performed in the Uni-Phantom filled with head simulating liquid of the following electrical parameters at 1900 MHz:

Relative Dielectricity	39.97	± 5%
Conductivity	1.41 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 4.65 at 1900 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

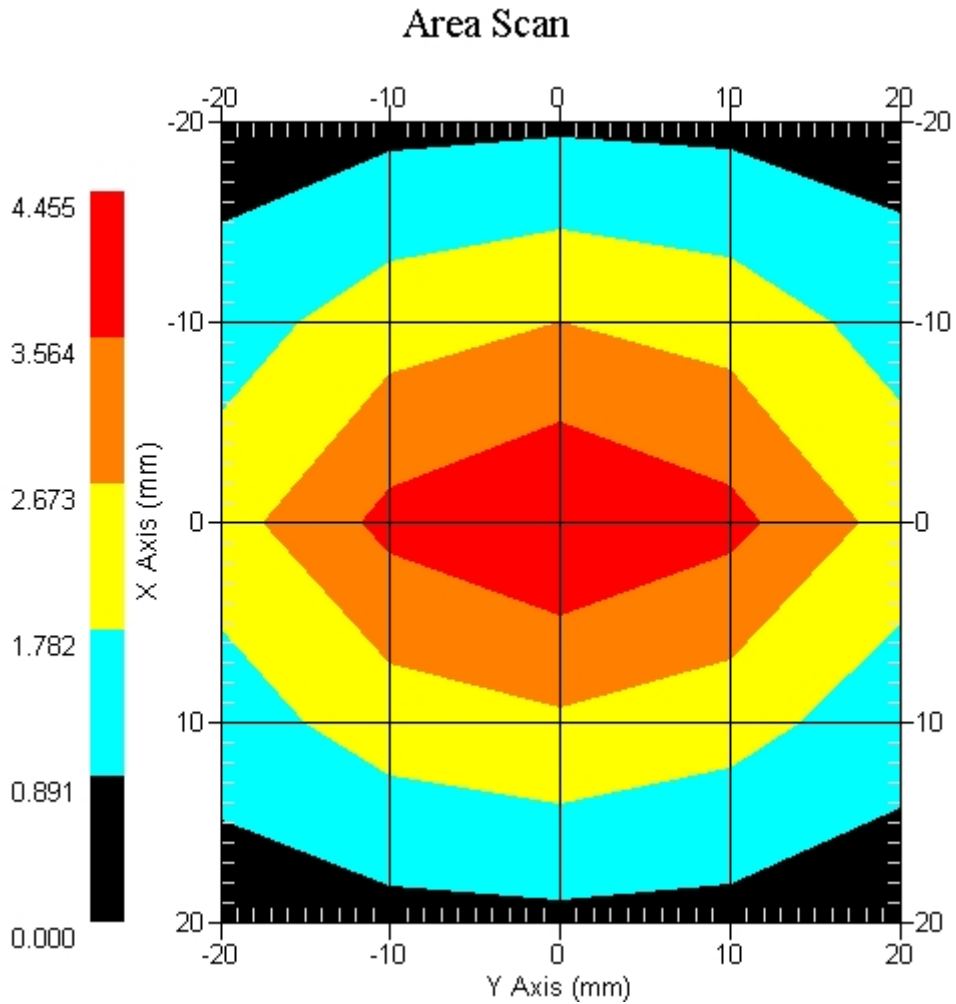
The laboratories environmental conditions were as follows during the calibration sequence.

Ambient Temperature of the Laboratory:	23 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	40%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 39.380 mW/g ± 19.2% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 20.270 mW/g ± 18.8% (k=2)¹



1 gram SAR value : 3.938 W/kg
 10 gram SAR value : 2.027 W/kg
 Area Scan Peak SAR : 4.455 W/kg
 Zoom Scan Peak SAR : 7.246 W/kg

¹ validation uncertainty

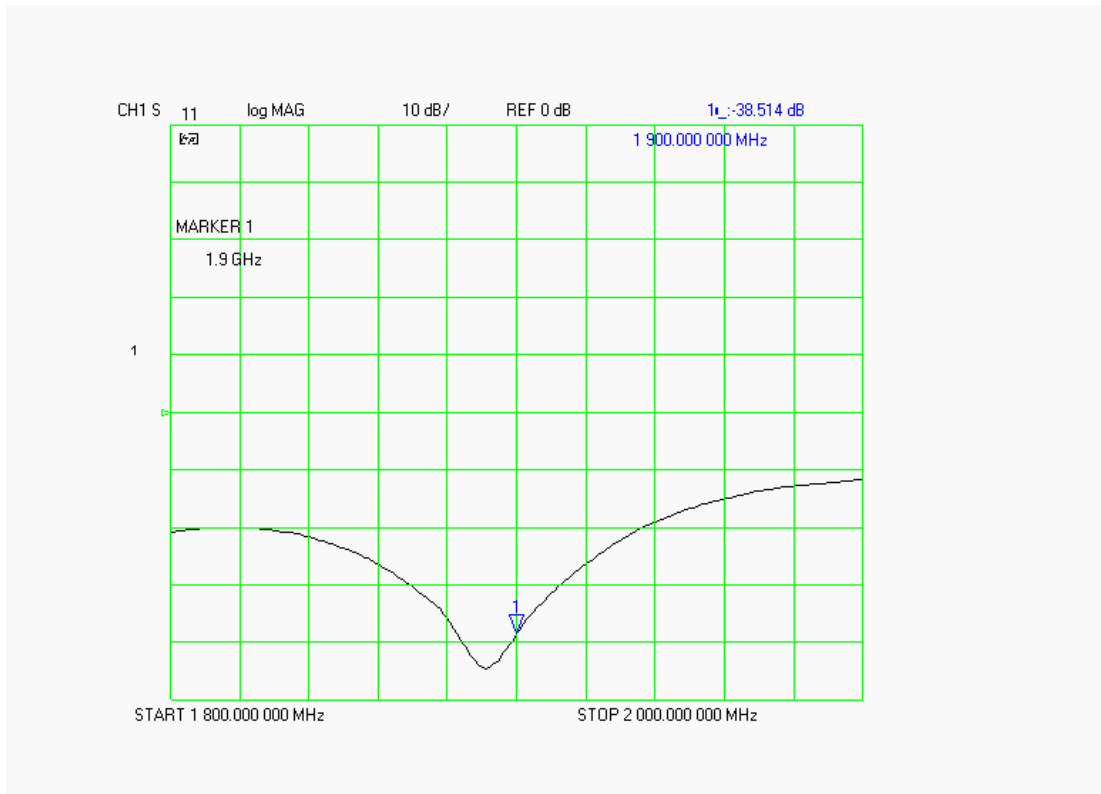
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

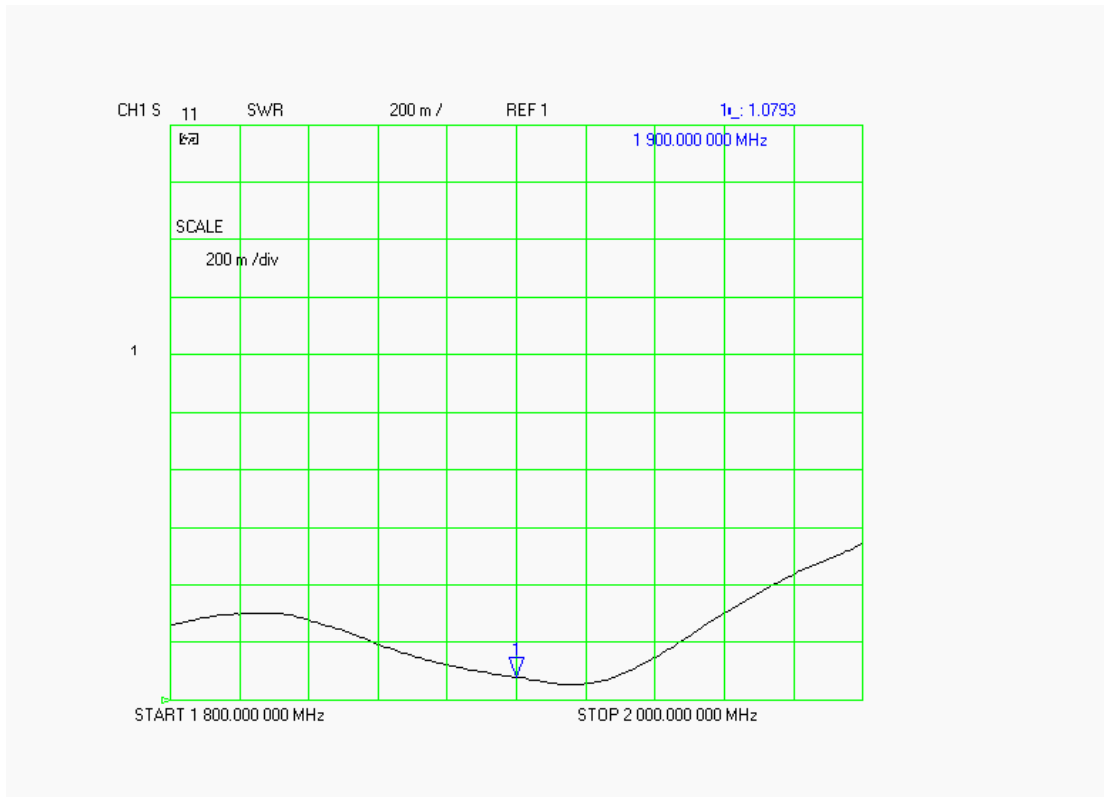
Test	Result
S11 R/L	-38.514 dB
SWR	1.0793 U
Impedance	49.063 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

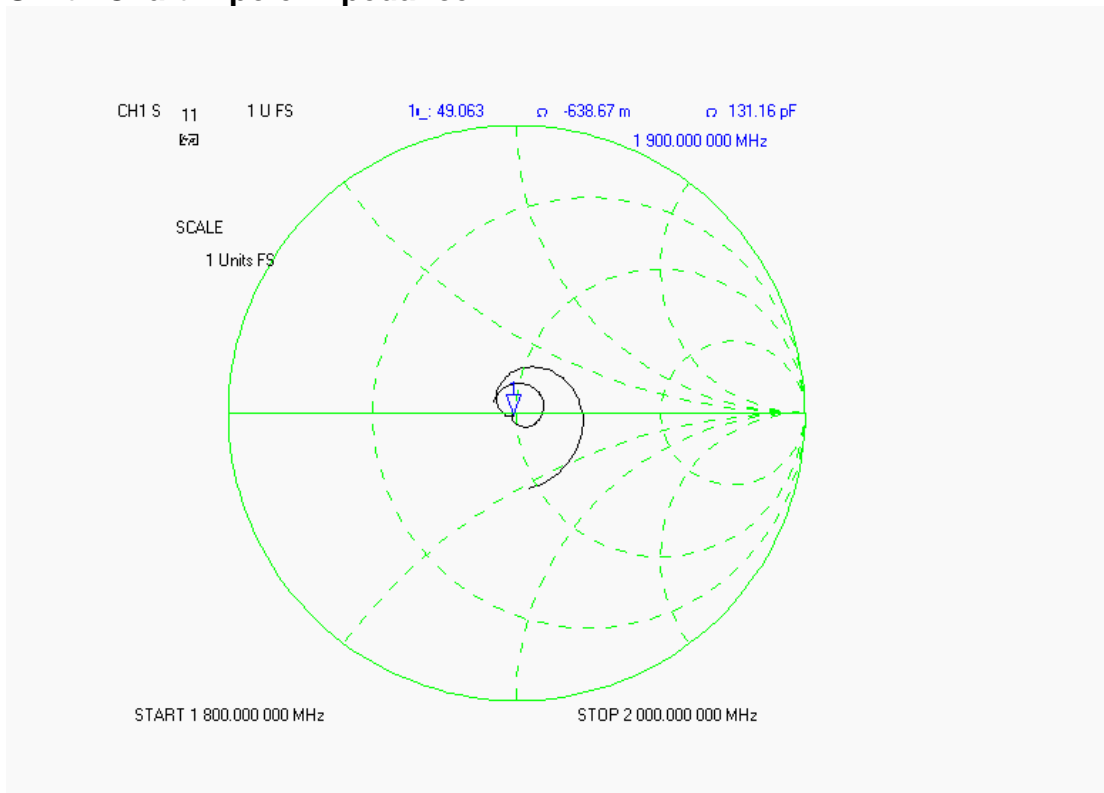
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 1900 MHz:

Relative Dielectricity	53.27	± 5%
Conductivity	1.50 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 4.85 at 1900 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

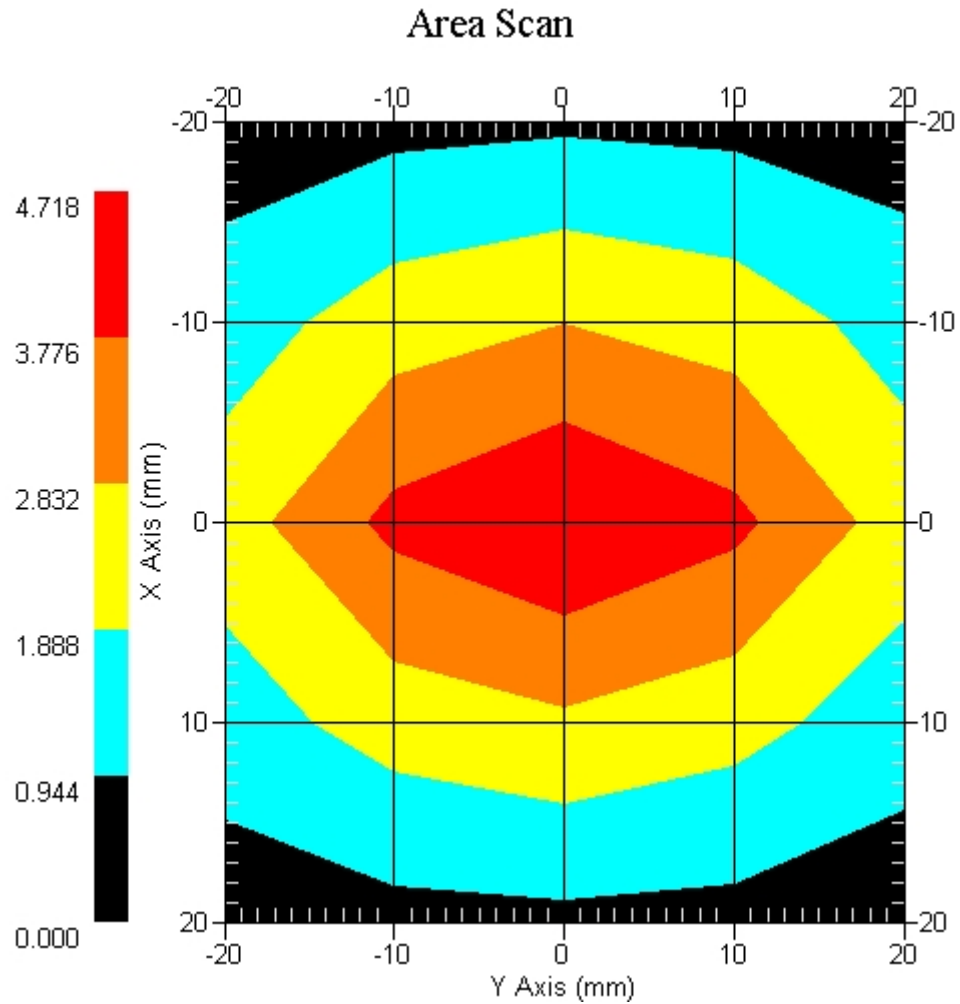
The laboratories environmental conditions were as follows during the calibration sequence.

Ambient Temperature of the Laboratory:	23 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	40%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 40.990 mW/g ± 18.9% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 21.090 mW/g ± 18.5% (k=2)¹



1 gram SAR value : 4.099 W/kg
 10 gram SAR value : 2.109 W/kg
 Area Scan Peak SAR : 4.718 W/kg
 Zoom Scan Peak SAR : 7.606 W/kg

¹ validation uncertainty

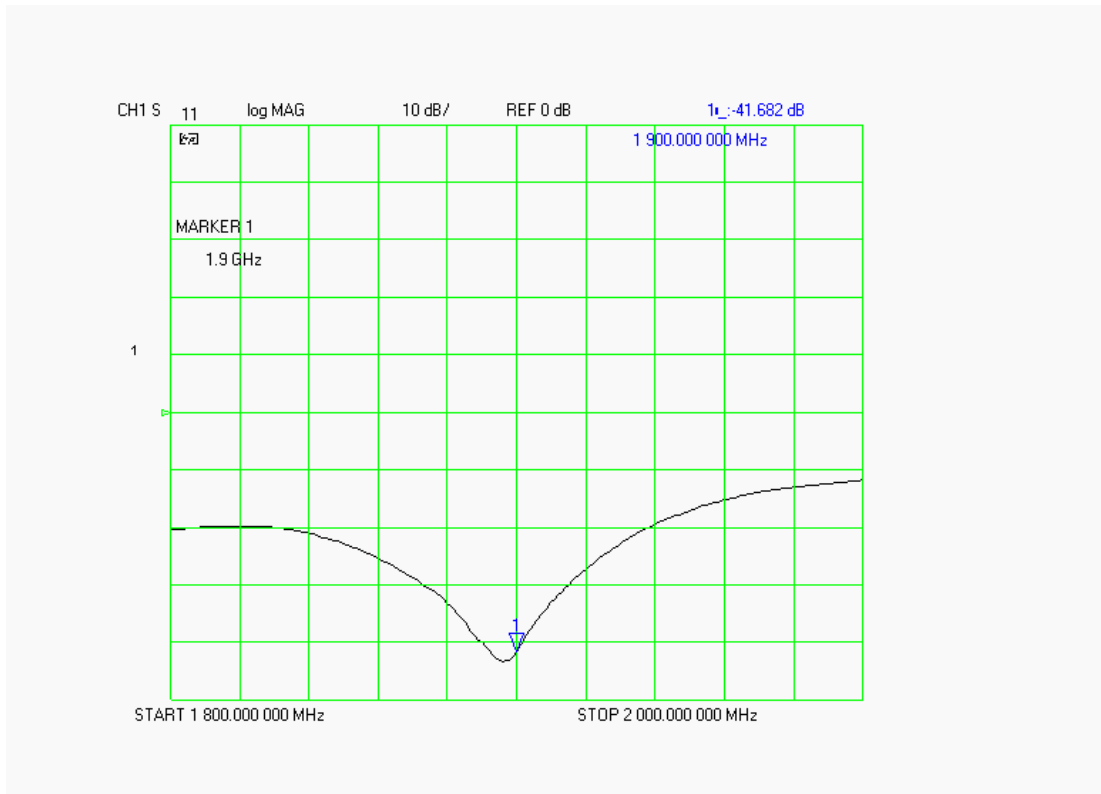
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

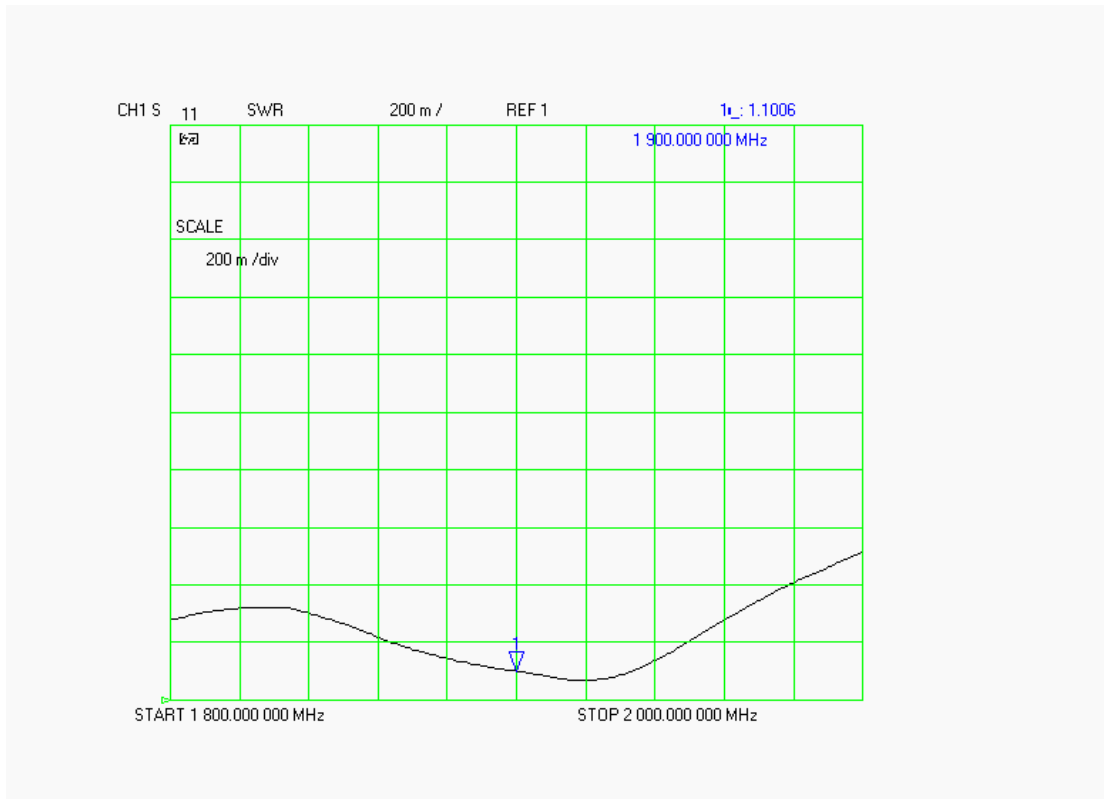
Test	Result
S11 R/L	-41.682 dB
SWR	1.1006 U
Impedance	53.580 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

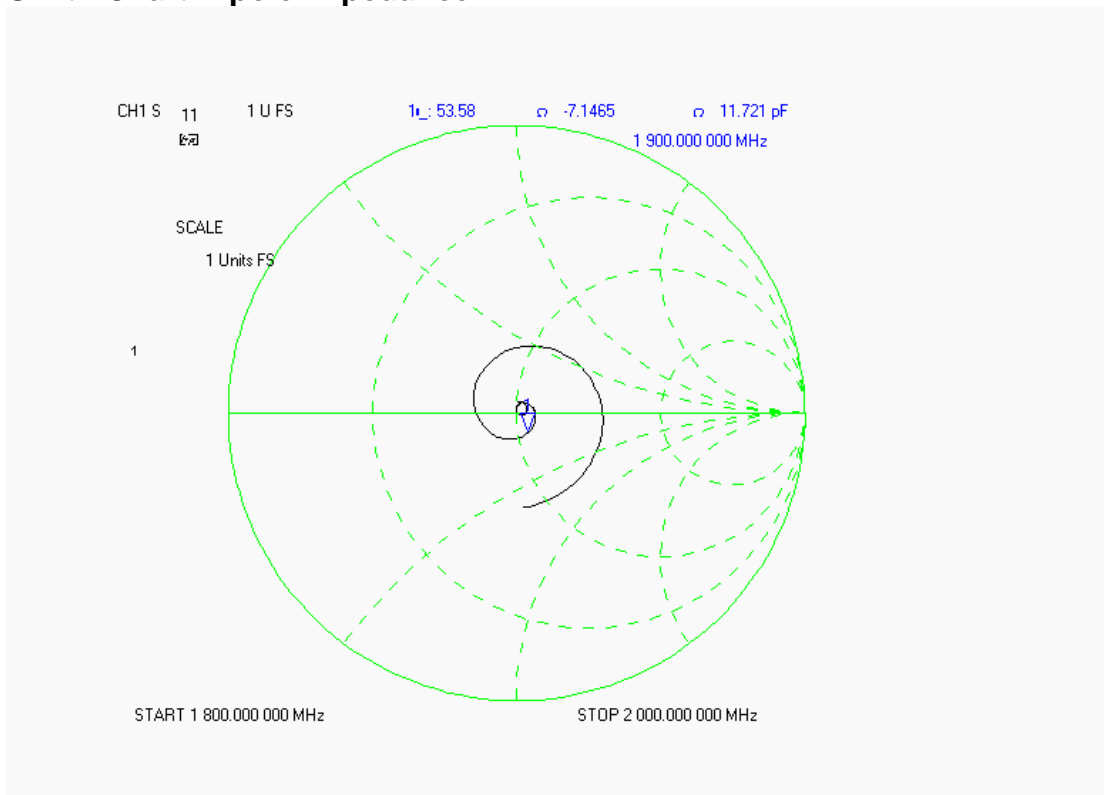
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Test Equipment List

The test equipment used during Dipole Calibration, manufacturer, model number and, current calibration status are listed and located on the RF Exposure Lab, LLC system computer C:\Test Equipment\Calibration Equipment\Instrument List February 2008.

RF Exposure Lab, LLC

Calibration File No: CAL.20080201

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated at RF Exposure Lab, LLC by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part Number: ALS-D-2450-S-2

Frequency: 2.4 GHz

Serial No: RFE-278

Manufactured: 20 February 2004
Calibrated: 20 February 2008

Calibrated By: Signature on File
Jay Moulton – Technical Manager

Approved By: Signature on File
Tamara Moulton – Quality Manager

Measurement Uncertainty:

Repeatability:	2.3%
Tissue Uncertainty:	3.2%
Network Analyzer:	2.5%



RF EXPOSURE LAB, LLC

2867 Progress Place, Suite 4D
Escondido, CA 92029

Tel: (760) 737-3131
FAX: (760) 737-9131

Calibration Results Summary

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

Mechanical Dimensions

Length: 51.5 mm
Height: 30.5 mm

Electrical Specifications

Head

SWR: 1.0953 U
Return Loss: -29.601 dB
Impedance: 53.854 Ω

System Validation Results

Frequency	1 Gram	10 Gram
2.45 GHz	52.880	24.500

Body

SWR: 1.1354 U
Return Loss: -31.173 dB
Impedance: 54.146 Ω

System Validation Results

Frequency	1 Gram	10 Gram
2.45 GHz	53.550	24.710

Head Measurement Conditions

The measurements were performed in the Uni-Phantom filled with head simulating liquid of the following electrical parameters at 2450 MHz:

Relative Dielectricity	39.37	± 5%
Conductivity	1.78 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 3.4 at 2450 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

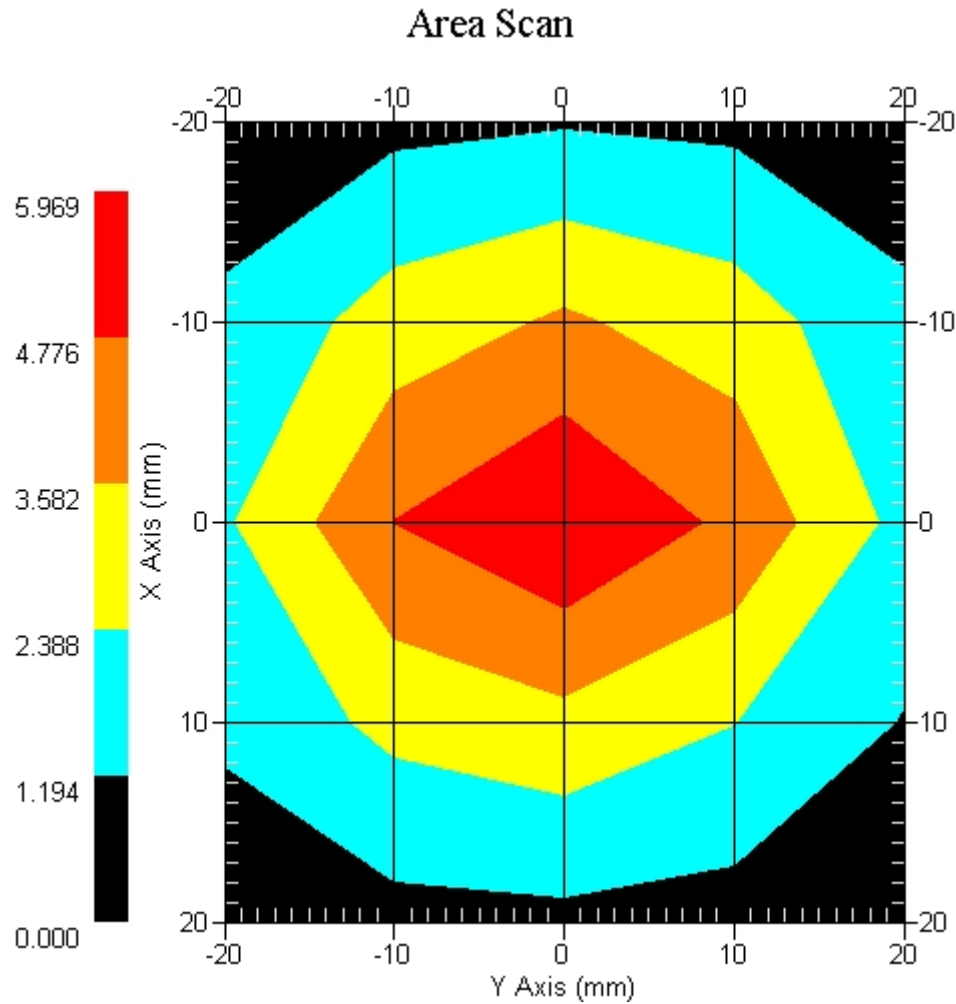
The laboratories environmental conditions were as follows during the calibration sequence.

Ambient Temperature of the Laboratory:	24 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	41%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 52.880 mW/g ± 19.7% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 24.500 mW/g ± 19.4% (k=2)¹



1 gram SAR value : 5.288 W/kg
 10 gram SAR value : 2.450 W/kg
 Area Scan Peak SAR : 5.969 W/kg
 Zoom Scan Peak SAR : 10.890 W/kg

¹ validation uncertainty

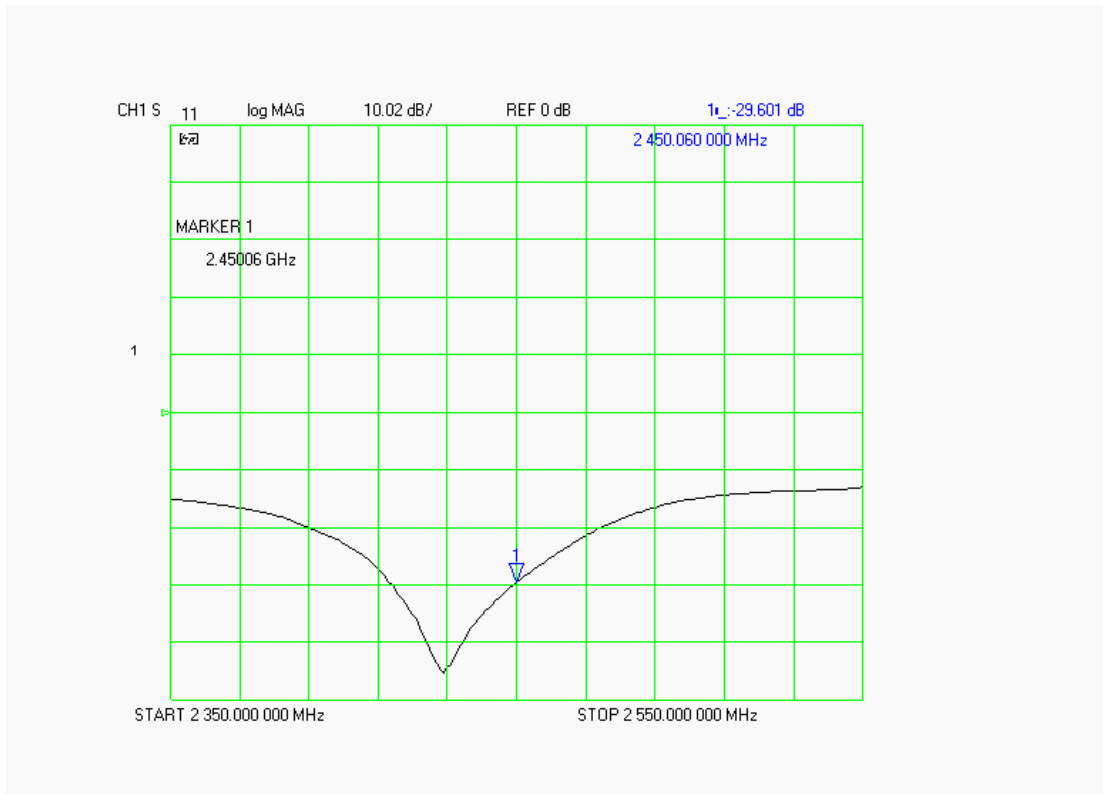
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

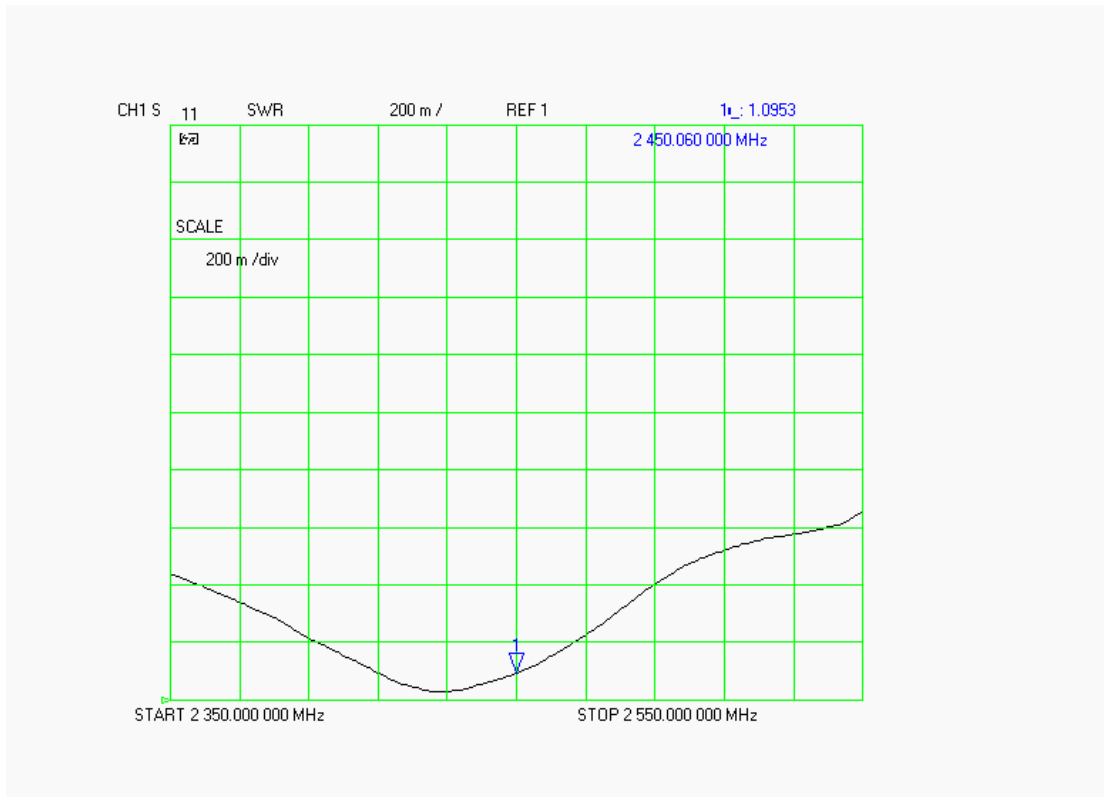
Test	Result
S11 R/L	-29.601 dB
SWR	1.0953 U
Impedance	53.854 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

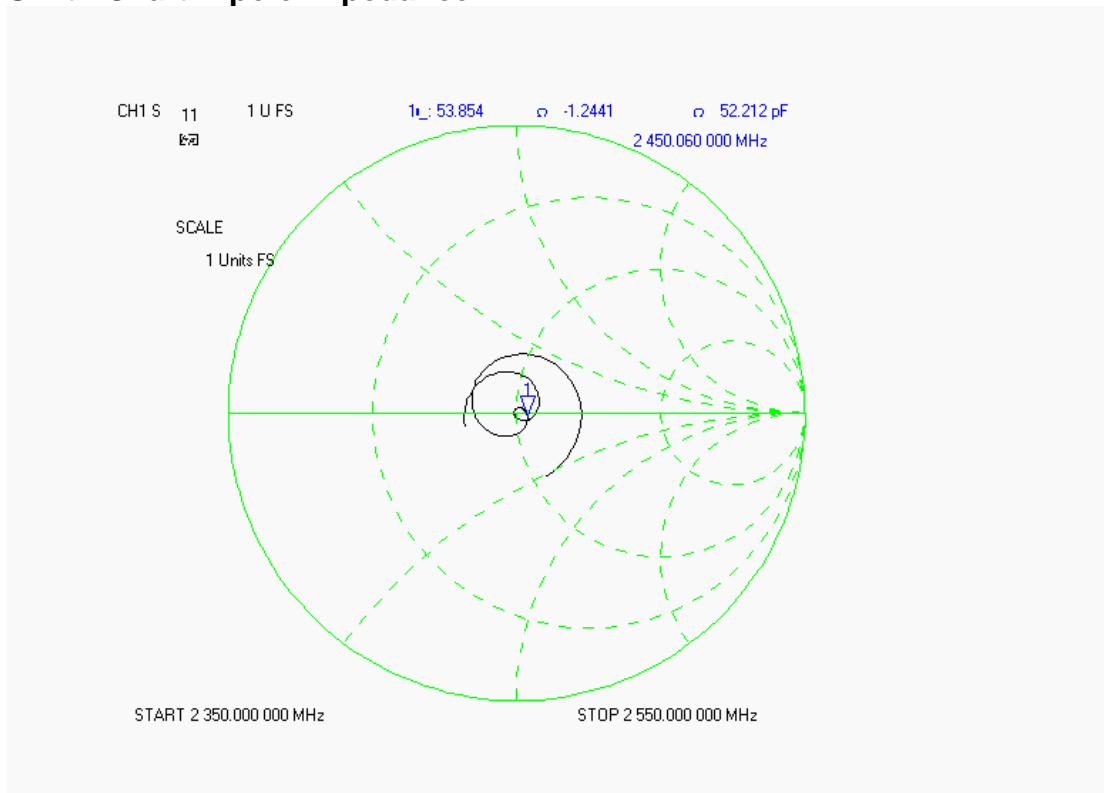
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 2450 MHz:

Relative Dielectricity	52.59	± 5%
Conductivity	1.92 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-020 (SN:217, Conversion factor 3.61 at 2450 MHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 5x5x8 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

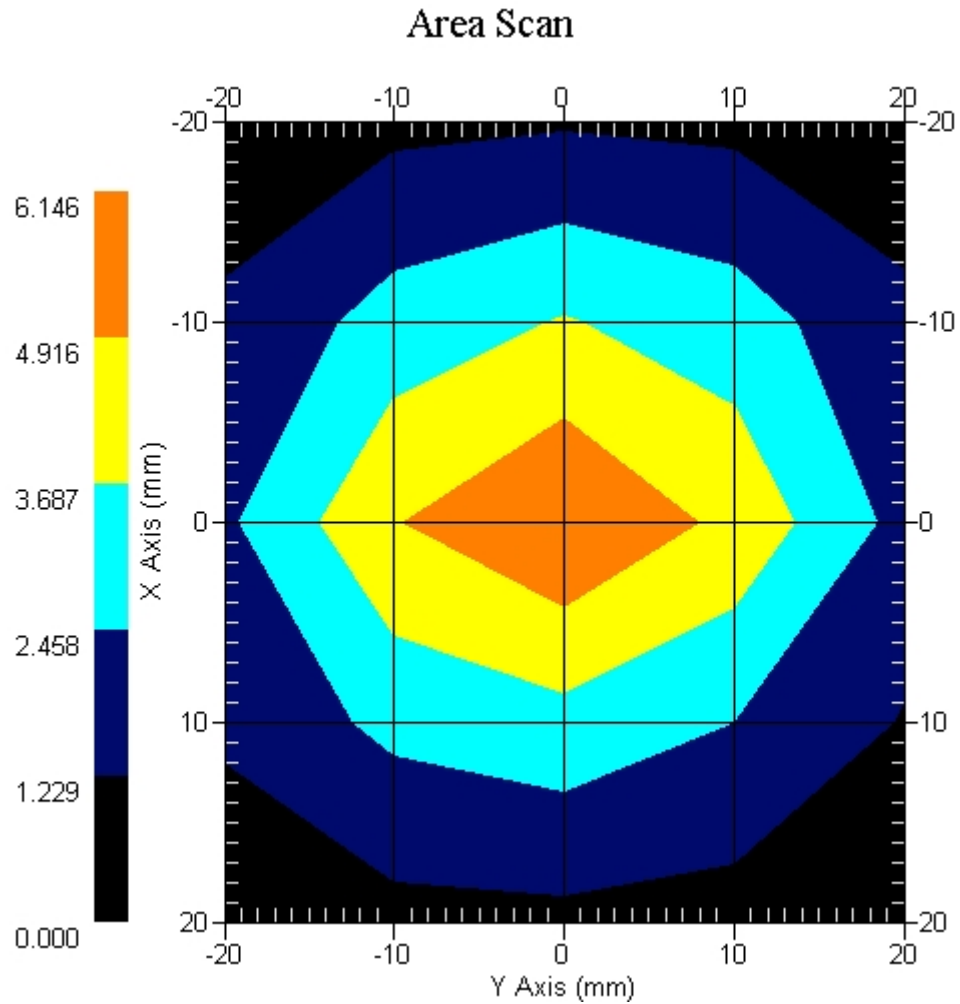
The laboratories environmental conditions were as follows during the calibration sequence.

Ambient Temperature of the Laboratory:	24 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	41%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-020 SN:217 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 53.550 mW/g ± 18.8% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 24.710 mW/g ± 18.4% (k=2)¹



1 gram SAR value : 5.355 W/kg
 10 gram SAR value : 2.471 W/kg
 Area Scan Peak SAR : 6.146 W/kg
 Zoom Scan Peak SAR : 11.090 W/kg

¹ validation uncertainty

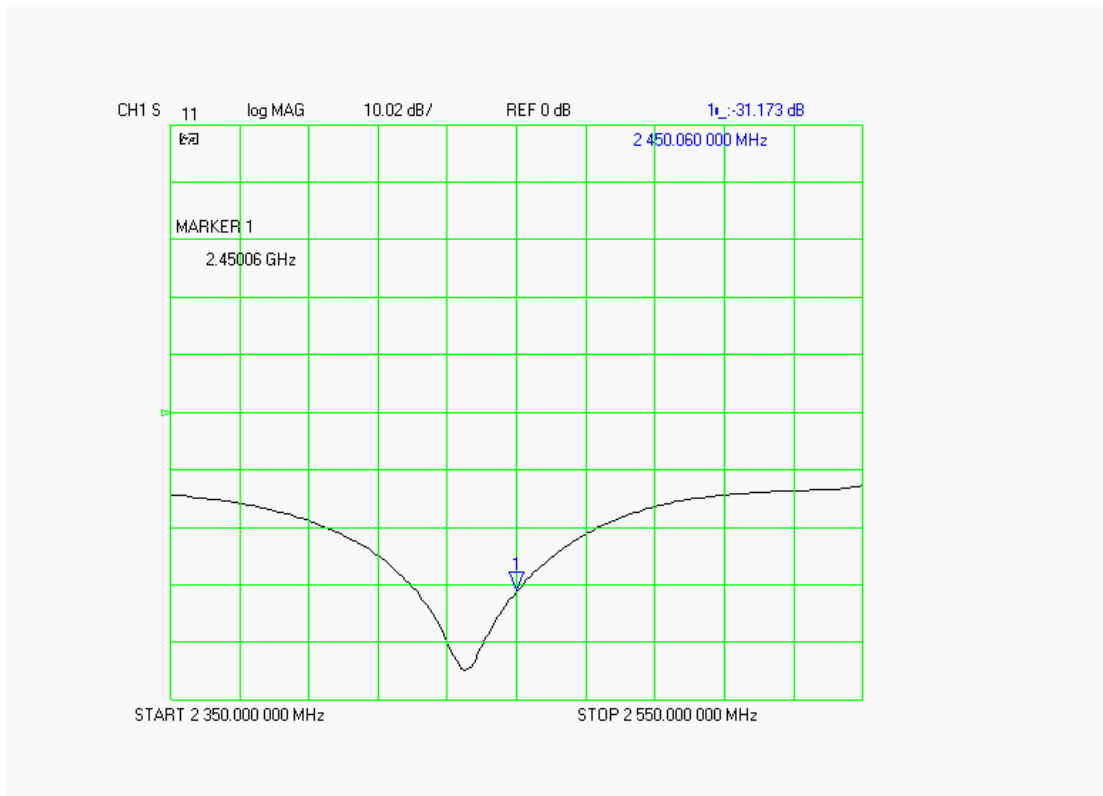
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

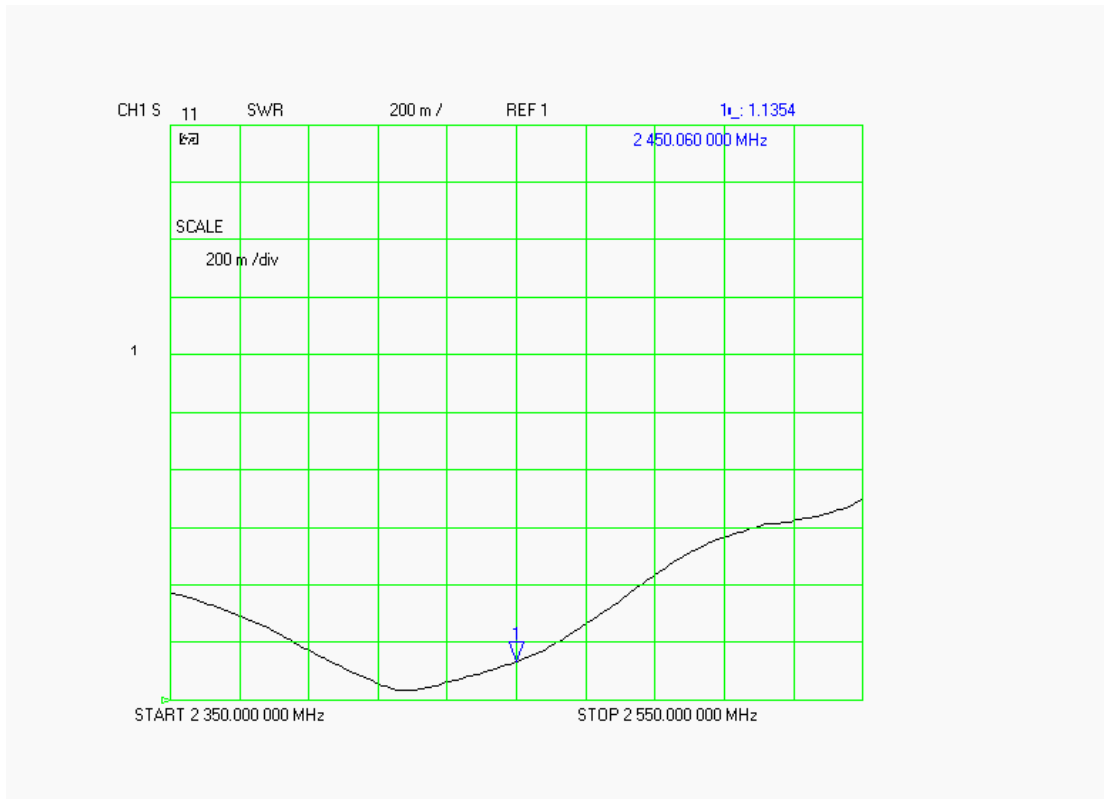
Test	Result
S11 R/L	-31.173 dB
SWR	1.1354 U
Impedance	54.146 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

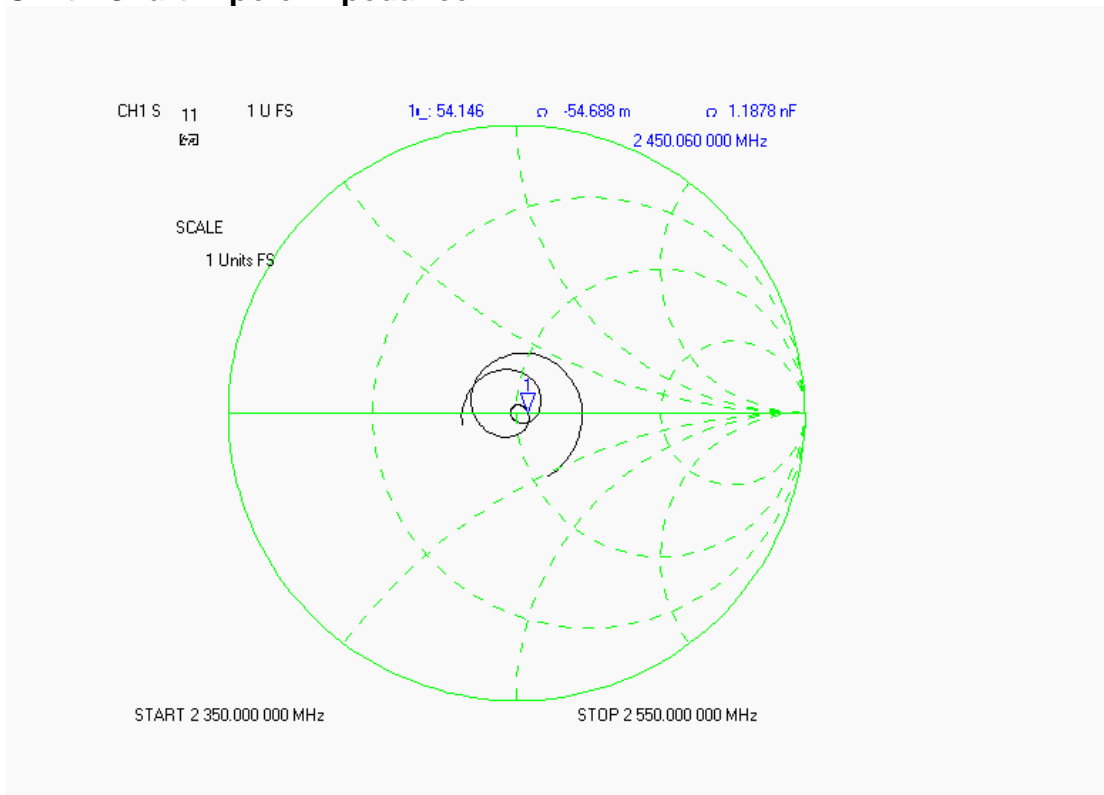
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Test Equipment List

The test equipment used during Dipole Calibration, manufacturer, model number and, current calibration status are listed and located on the RF Exposure Lab, LLC system computer C:\Test Equipment\Calibration Equipment\Instrument List February 2008.

RF Exposure Lab, LLC

Calibration File No: CAL.20070501

CERTIFICATE OF CALIBRATION

It is certified that the equipment identified below has been calibrated at RF Exposure Lab, LLC by qualified personnel following recognized procedures and using transfer standards traceable to NRC/NIST.

Validation Dipole

Manufacturer: APREL Laboratories

Part Number: ALS-D-BB-S-2

Frequency: 5.2 GHz to 5.8 GHz

Serial No: 235-00801

Manufactured: 22 May 2005
Calibrated: 23 May 2007

Calibrated By: Signature on File
Jay Moulton – Technical Manager

Approved By: Signature on File
Tamara Moulton – Quality Manager

Measurement Uncertainty:

Repeatability:	2.3%
Tissue Uncertainty:	3.2%
Network Analyzer:	2.5%



RF EXPOSURE LAB, LLC

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Tel: (760) 737-3131
FAX: (760) 737-9131

Calibration Results Summary

The following results relate to 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 Specifications

5.2 GHz Body

SWR: 1.8749 U
Return Loss: -17.057 dB
Impedance: 54.252 Ω

System Validation Results

Frequency	1 Gram	10 Gram
5.2 GHz	62.98	15.44

5.6 GHz Body

SWR: 1.2178 U
Return Loss: -18.513 dB
Impedance: 45.365 Ω

System Validation Results

Frequency	1 Gram	10 Gram
5.6 GHz	59.92	15.30

5.8 GHz Body

SWR: 1.8551 U
Return Loss: -10.237 dB
Impedance: 45.014 Ω

System Validation Results

Frequency	1 Gram	10 Gram
5.8 GHz	58.92	15.05

5.2 GHz Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 5.2 GHz:

Relative Dielectricity	49.19	± 5%
Conductivity	5.40 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-030 (SN:AL-E3P1, Conversion factor 13.0 at 5.2 GHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

The laboratories environmental conditions were as follows during the calibration sequence.

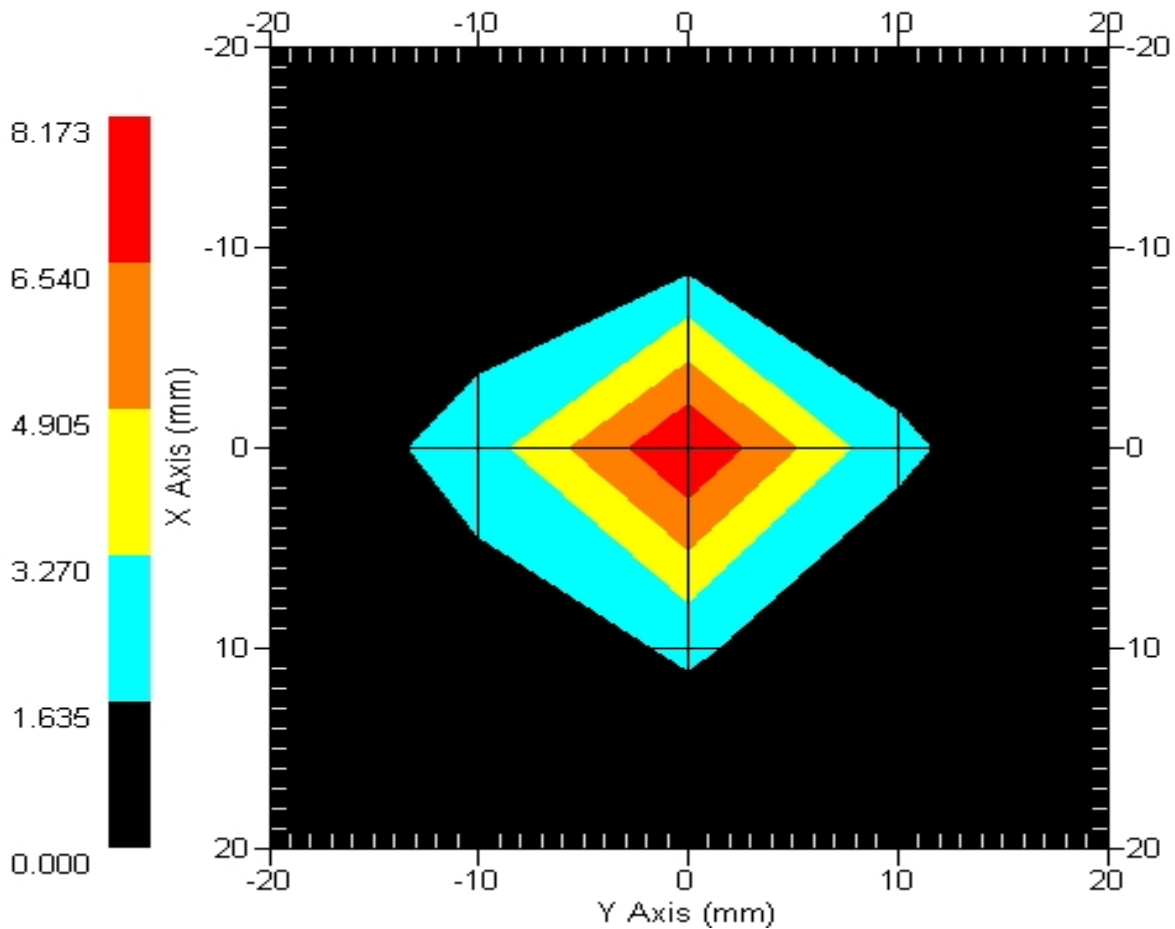
Ambient Temperature of the Laboratory:	23 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	52%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-030 SN:AL-E3P1 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 62.98 mW/g ± 19.1% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 15.44 mW/g ± 18.8% (k=2)¹

Area Scan



1 gram SAR value : 6.298 W/kg
 10 gram SAR value : 1.544 W/kg
 Area Scan Peak SAR : 8.173 W/kg
 Zoom Scan Peak SAR : 21.817 W/kg

¹ validation uncertainty

5.6 GHz Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 5.6 GHz:

Relative Dielectricity	48.22	± 5%
Conductivity	5.68 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-030 (SN:AL-E3P1, Conversion factor 13.5 at 5.6 GHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

The laboratories environmental conditions were as follows during the calibration sequence.

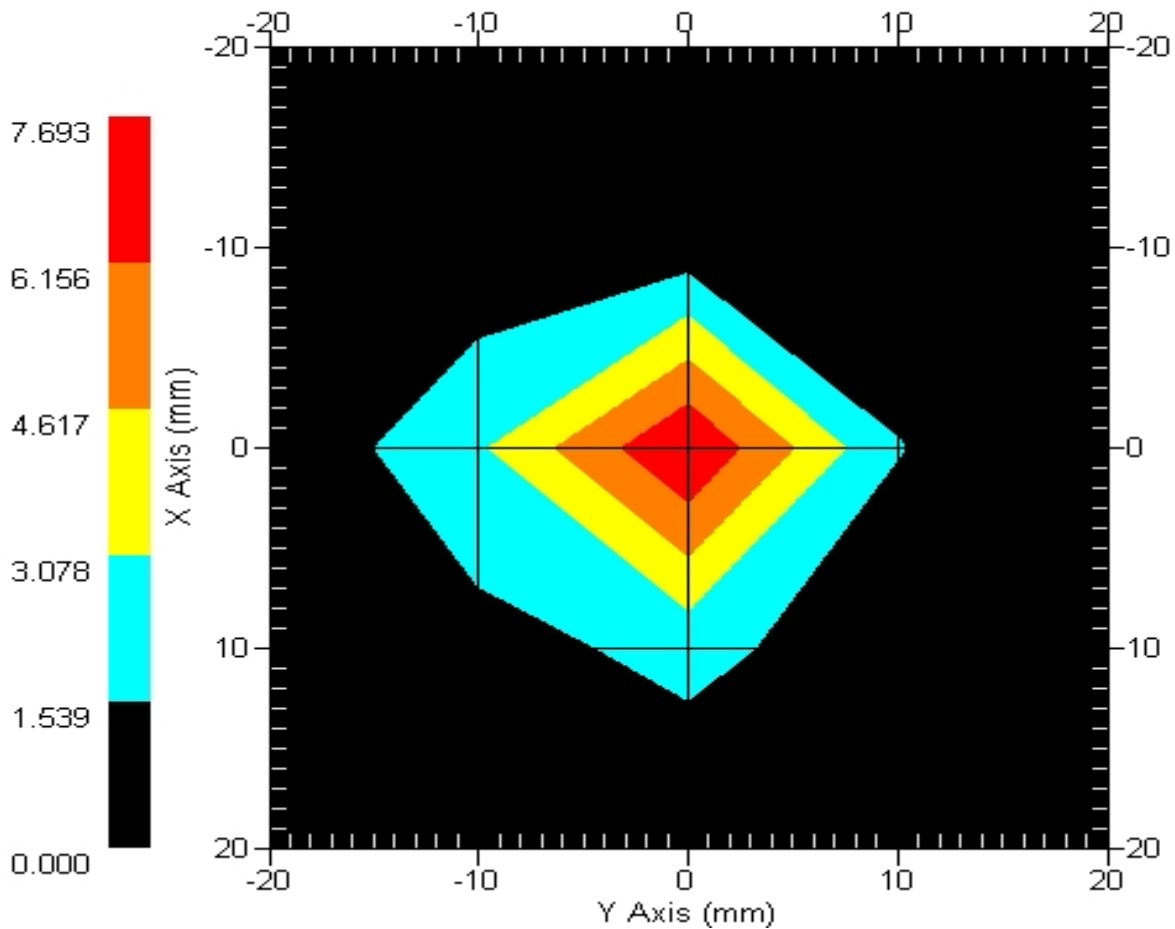
Ambient Temperature of the Laboratory:	23 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	52%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-030 SN:AL-E3P1 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 59.92 mW/g ± 19.1% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 15.30 mW/g ± 18.8% (k=2)¹

Area Scan



1 gram SAR value : 5.992 W/kg
 10 gram SAR value : 1.530 W/kg
 Area Scan Peak SAR : 7.693 W/kg
 Zoom Scan Peak SAR : 19.415 W/kg

¹ validation uncertainty

5.8 GHz Body Measurement Conditions

The measurements were performed in the Uni-Phantom filled with body simulating liquid of the following electrical parameters at 5.8 GHz:

Relative Dielectricity	48.53	± 5%
Conductivity	5.95 mho/m	± 5%

The APREL Laboratories ALSAS system with a dosimetric E-field probe E-030 (SN:AL-E3P1, Conversion factor 14.0 at 5.8 GHz) was used for the measurements.

The dipole was mounted so that the dipole feed point was positioned below the center marking of the flat phantom and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from the dipole center to the solution surface.

The coarse grid with a grid spacing of 10mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration. The dipole input power (forward power) was 100mW ± 3%. The results are normalized to 1W input power.

The laboratories environmental conditions were as follows during the calibration sequence.

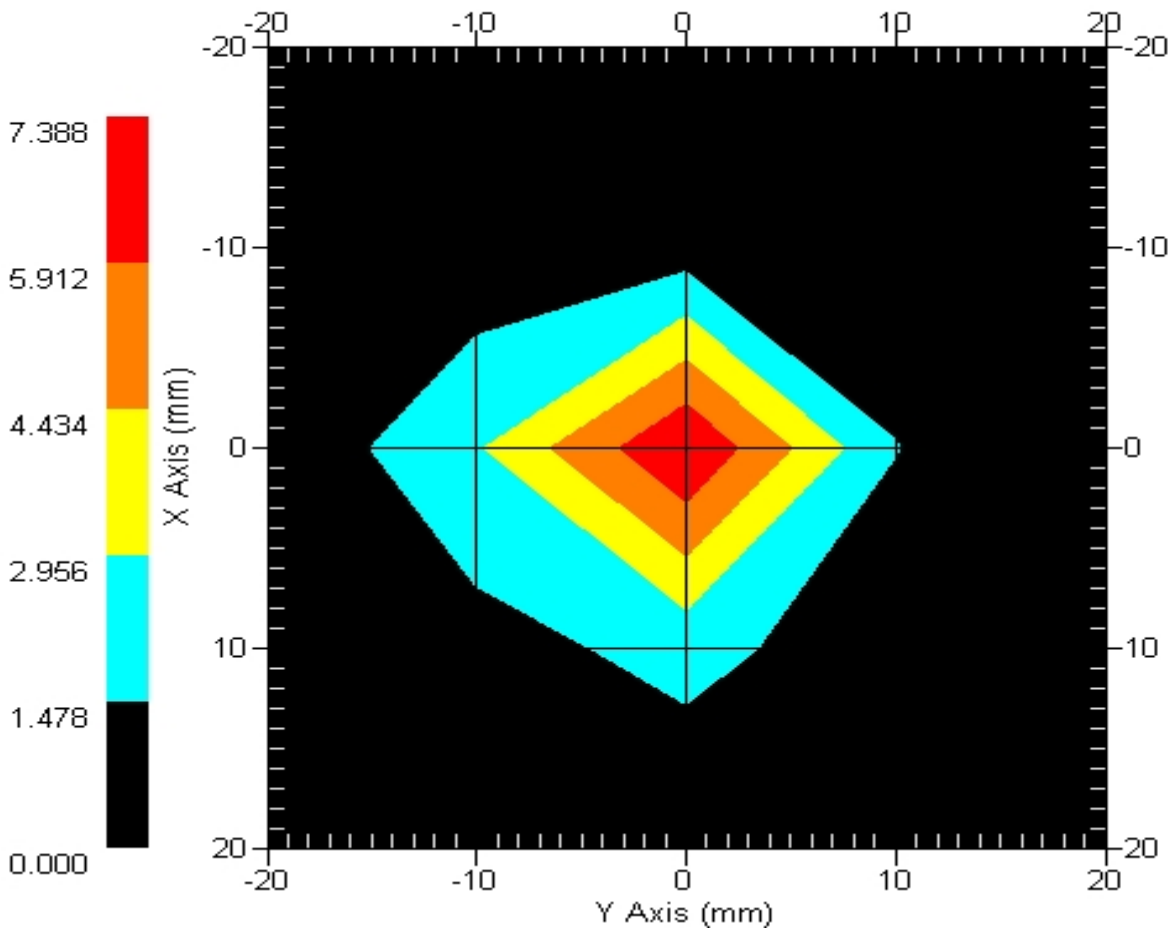
Ambient Temperature of the Laboratory:	23 °C ± 1.0 °C
Temperature of the Tissue:	20 °C ± 1.0 °C
Relative Humidity:	52%

SAR Measurement

Standard SAR measurements were performed according to the measurement conditions described above. The results have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR values measured with the dosimetric probe E-030 SN:AL-E3P1 and applying the advanced extrapolation are:

Averaged over 1 cm³ (1 g) of tissue: 58.92 mW/g ± 19.1% (k=2)¹
 Averaged over 10 cm³ (10 g) of tissue: 15.05 mW/g ± 18.8% (k=2)¹

Area Scan



1 gram SAR value : 5.892 W/kg
 10 gram SAR value : 1.505 W/kg
 Area Scan Peak SAR : 7.388 W/kg
 Zoom Scan Peak SAR : 19.315 W/kg

¹ validation uncertainty

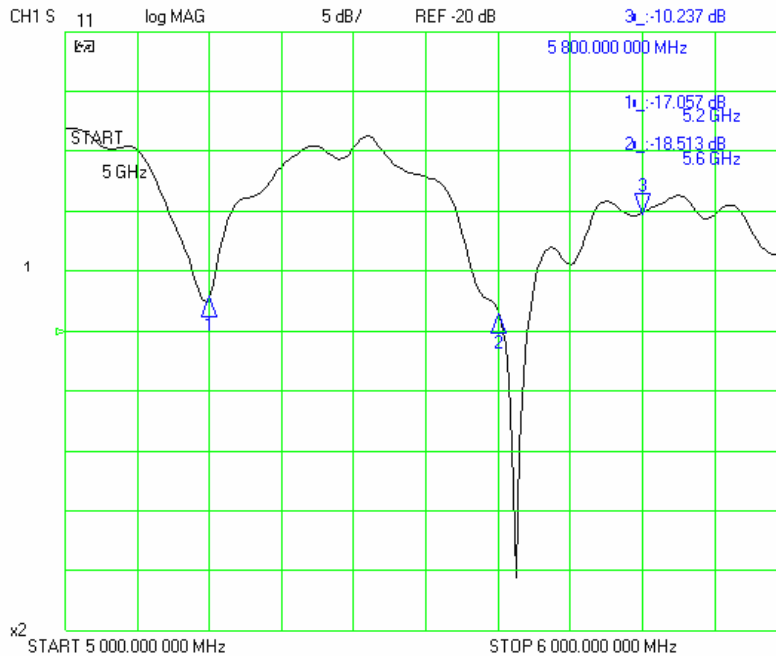
Dipole Impedance and Return Loss

The impedance was measured at the SMA connector with a network analyzer. The dipole was positioned at the flat phantom sections according to measurement conditions stated above during impedance measurements.

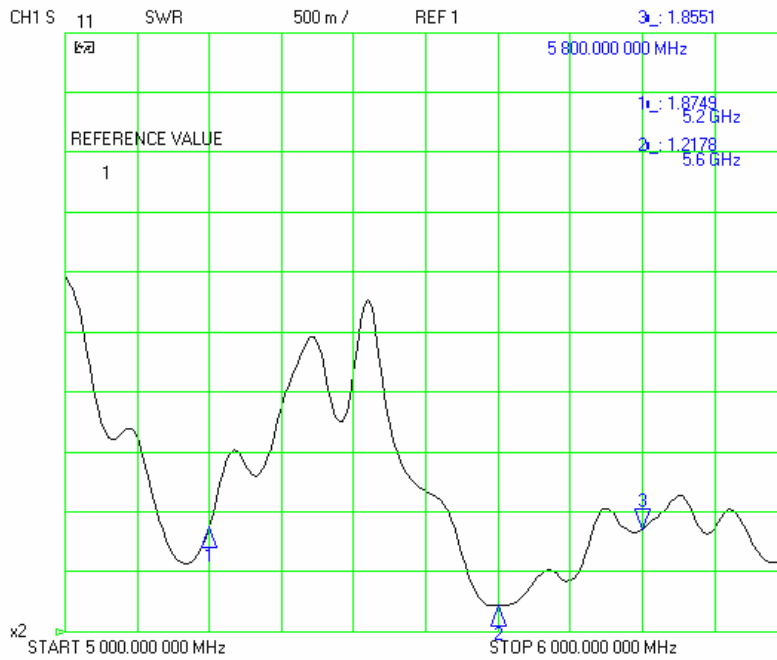
Test	Result – 5.2 GHz	Result – 5.6 GHz	Result – 5.8 GHz
S11 R/L	-17.057 dB	-18.513 dB	-10.237 dB
SWR	1.8749 U	1.2178 U	1.8551 U
Impedance	54.252 Ω	45.365 Ω	45.014 Ω

The following graphs are the results as displayed on the Vector Network Analyzer.

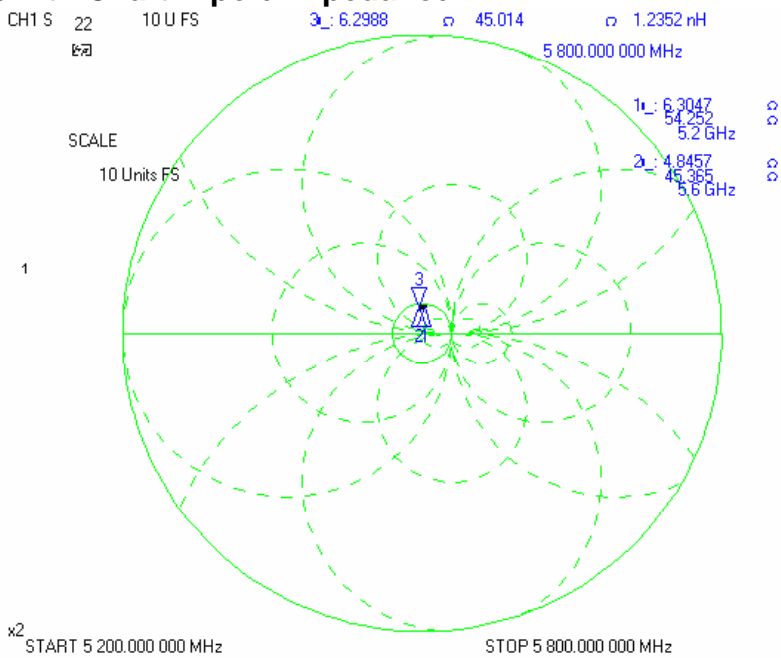
S11 Parameter Return Loss



SWR



Smith Chart Dipole Impedance



Test Equipment List

The test equipment used during Dipole Calibration, manufacturer, model number and, current calibration status are listed and located on the RF Exposure Lab, LLC system computer C:\Test Equipment\Calibration Equipment\Instrument List May 2007.

Appendix F – Phantom Calibration Data Sheets

NCL CALIBRATION LABORATORIES

Calibration File No.: RFE-273

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 National Standards.

Thickness of the UniPhantom is 2 mm \pm 10%
Pinna thickness is 6 mm \pm 10%

Resolution:	0.01 mm	Calibrated to:	0.0 mm
Stability:	OK	Accuracy:	< 0.1 mm

Calibrated By: Karen K. Feb 17/04.

NCL CALIBRATION LABORATORIES

51 SPECTRUM WAY
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