

## Appendices

### Calibration documents

### Antenna Information



## NCL CALIBRATION LABORATORIES

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

## C E R T I F I C A T E   O F   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

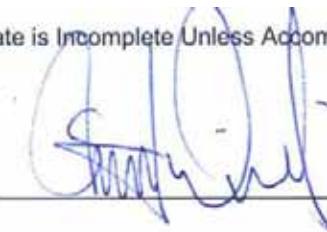
Manufacturer: APREL Laboratories  
Part number: ALS-D-5258-S-2  
Frequency: 5.2GHz to 5.8GHz  
Serial No: 5258-235-00802

Customer: APREL

Serial Number: ALS-BB-001

Calibrated: 24<sup>th</sup> May 2008  
Released on: 24<sup>th</sup> May 2008

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) 820-4162

## **NCL Calibration Laboratories**

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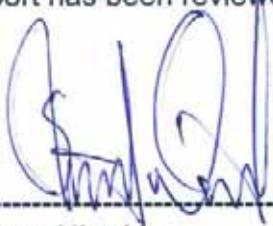
Division of APREL Laboratories.

### **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



C. Teodorian

## Calibration Results Summary

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

### Mechanical Dimensions

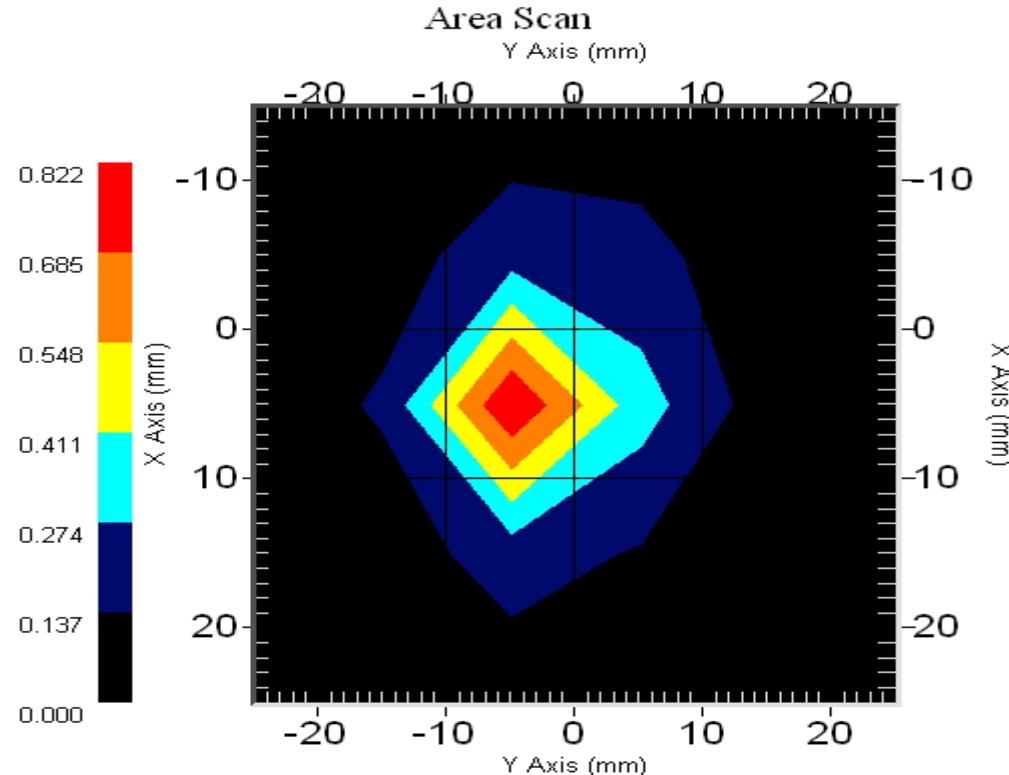
**Length:** 23.3 mm  
**Height:** 20.3 mm

### Electrical Specification

**SWR:** 1.22 U  
**Return Loss:** -20.0 dB  
**Impedance:** 50.0  $\Omega$

### System Validation Results

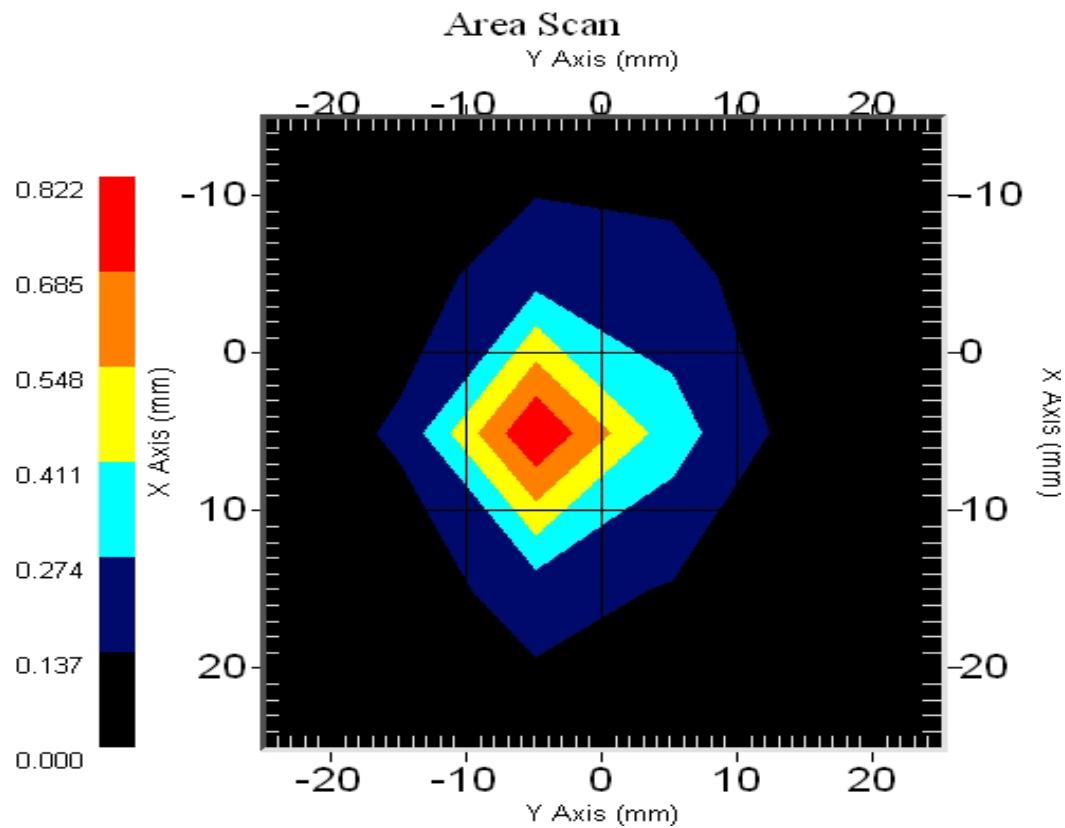
Frequency	1 Gram	10 Gram	Peak
5200 MHz	51.9	17.9	223.1



# NCL Calibration Laboratories

Division of APREL Laboratories.

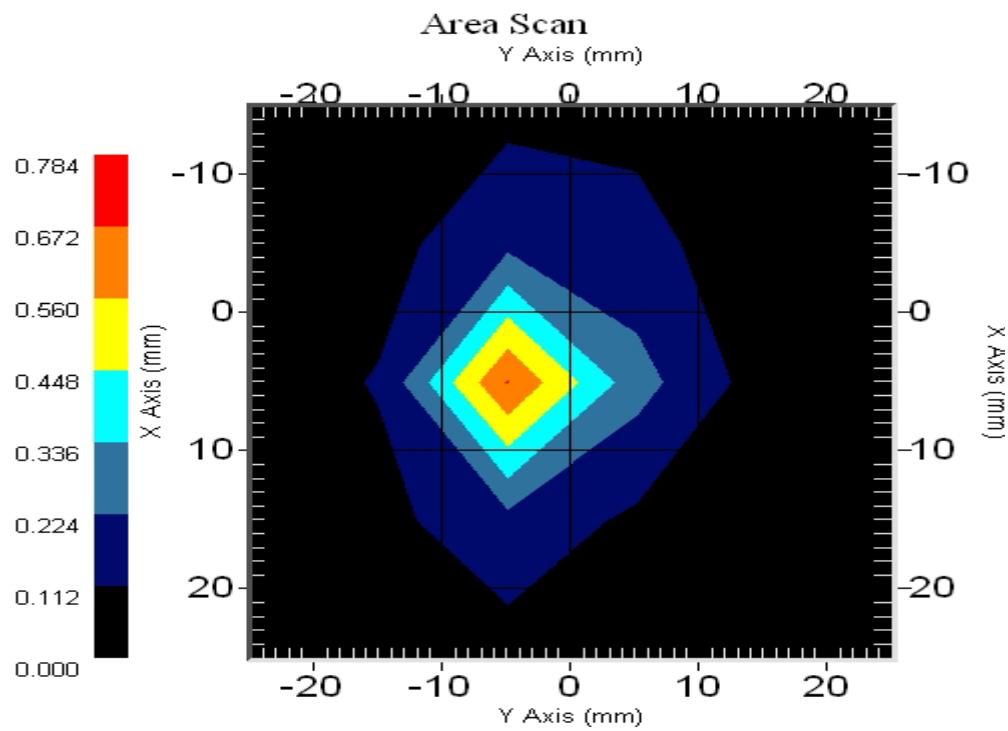
Frequency	1 Gram	10 Gram	Peak
5600 MHz	52.97	18.2	243.1



# NCL Calibration Laboratories

Division of APREL Laboratories.

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

# **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Dipole Calibration Results**

### **Tissue Validation**

<b>Head Tissue 5200 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	47.0
<b>Conductivity, <math>\sigma</math> [S/m]</b>	5.30

<b>Head Tissue 5600 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	46.1
<b>Conductivity, <math>\sigma</math> [S/m]</b>	5.78

<b>Head Tissue 5800 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	46.7
<b>Conductivity, <math>\sigma</math> [S/m]</b>	6.22

### **Mechanical Verification**

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
23.1 mm	20.7 mm	23.3 mm	20.3 mm

### **Electrical Calibration**

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

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

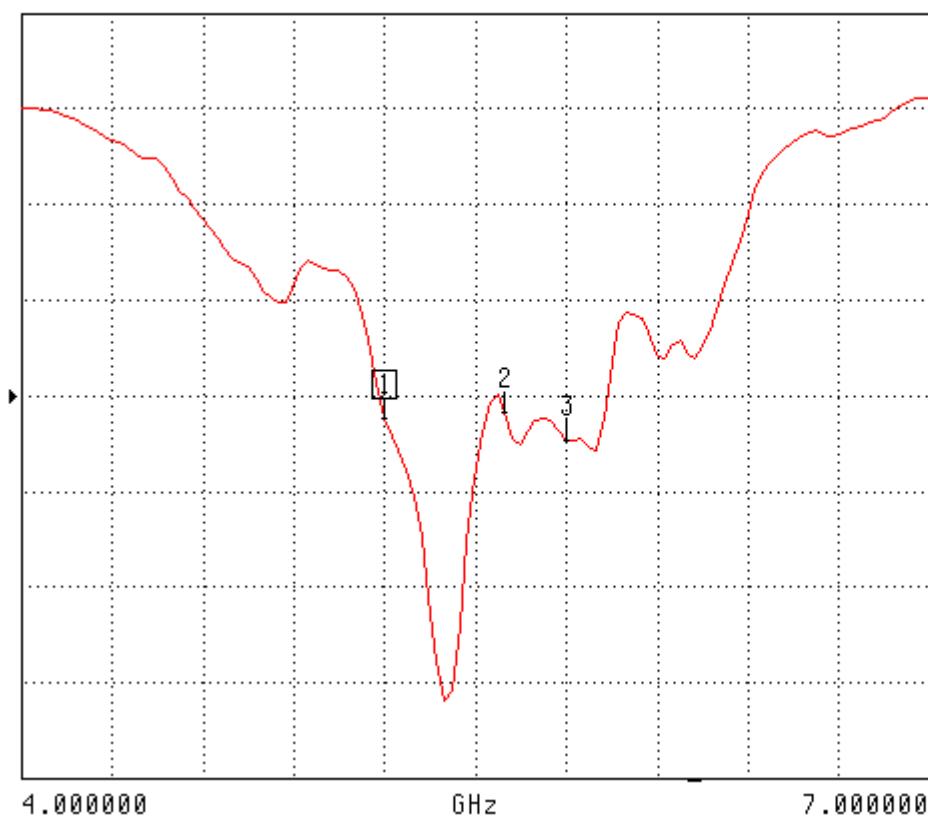
**S11 Parameter Return Loss**

S22 REVERSE REFLECTION

LOG MAGNITUDE

REF = -20.000 dB

5.000 dB/DIV

CH 4 - S22  
REFERENCE PLANE  
0.0000 mmMARKER 1  
5.200000 GHz  
-21.160 dBMARKER TO MAX  
► MARKER TO MIN2 5.600000 GHz  
-20.906 dB3 5.800000 GHz  
-22.337 dBMARKER READOUT  
FUNCTIONS

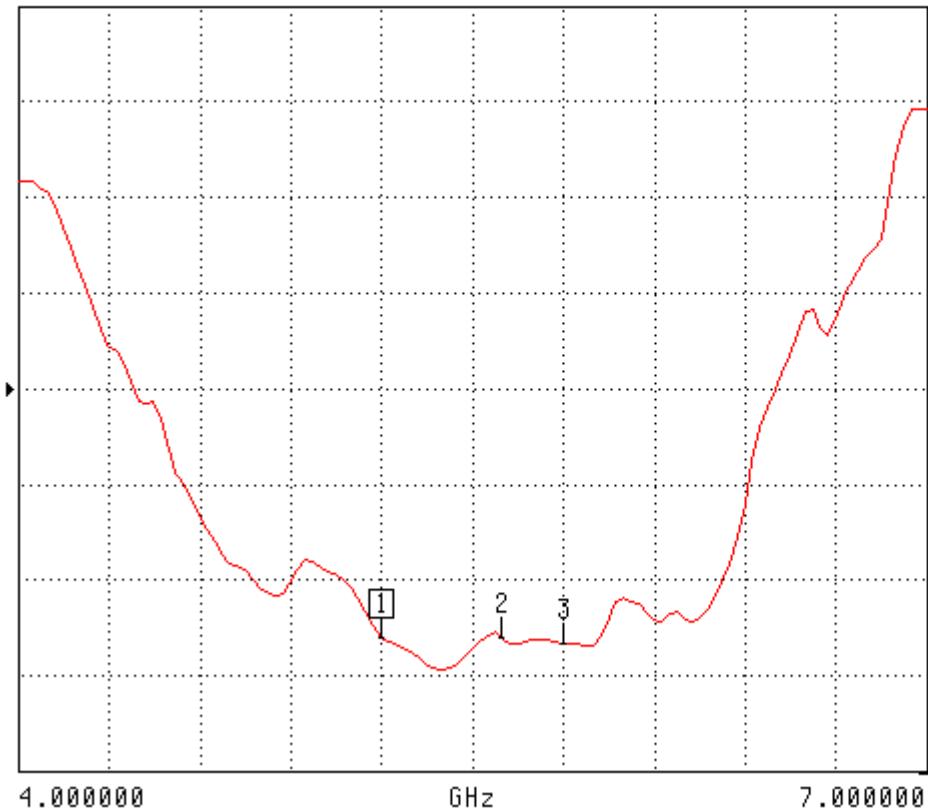
**SWR**

S22 REVERSE REFLECTION

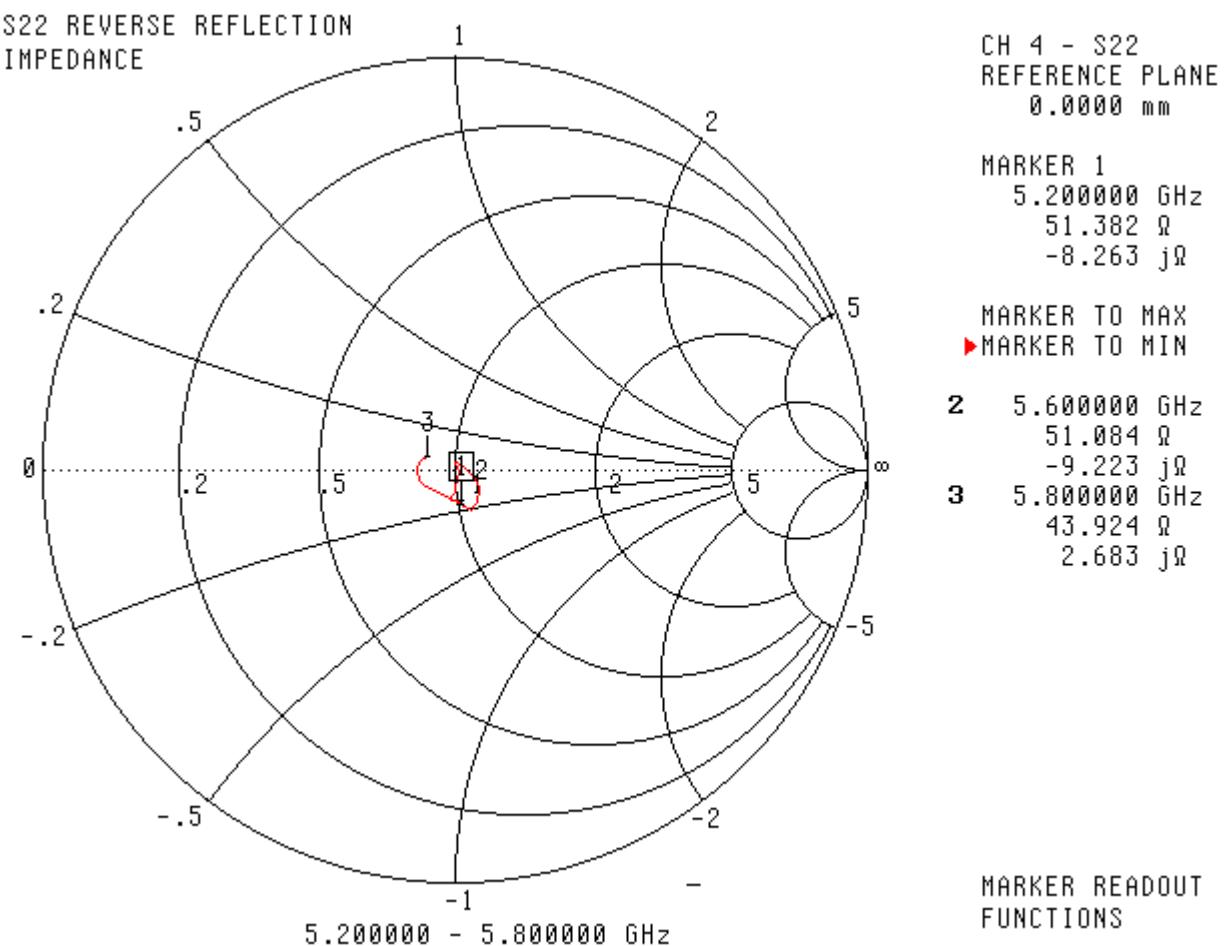
SWR

►REF=2.500 U

500.000 mU/DIV



## 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 2008.

## NCL CALIBRATION LABORATORIES

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

## C E R T I F I C A T E   O F   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

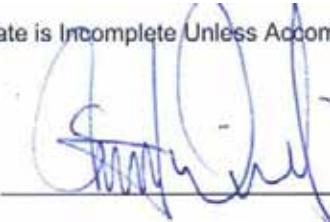
Serial No: 301581

Customer: APREL

Calibrated: 4<sup>th</sup> May 2008  
Released on: 4<sup>th</sup> May 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_



## NCL CALIBRATION LABORATORIES

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

## **NCL Calibration Laboratories**

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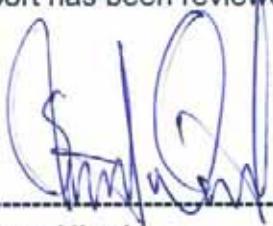
Division of APREL Laboratories.

### **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



C. Teodorian

## Calibration Results Summary

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

## **Mechanical Dimensions**

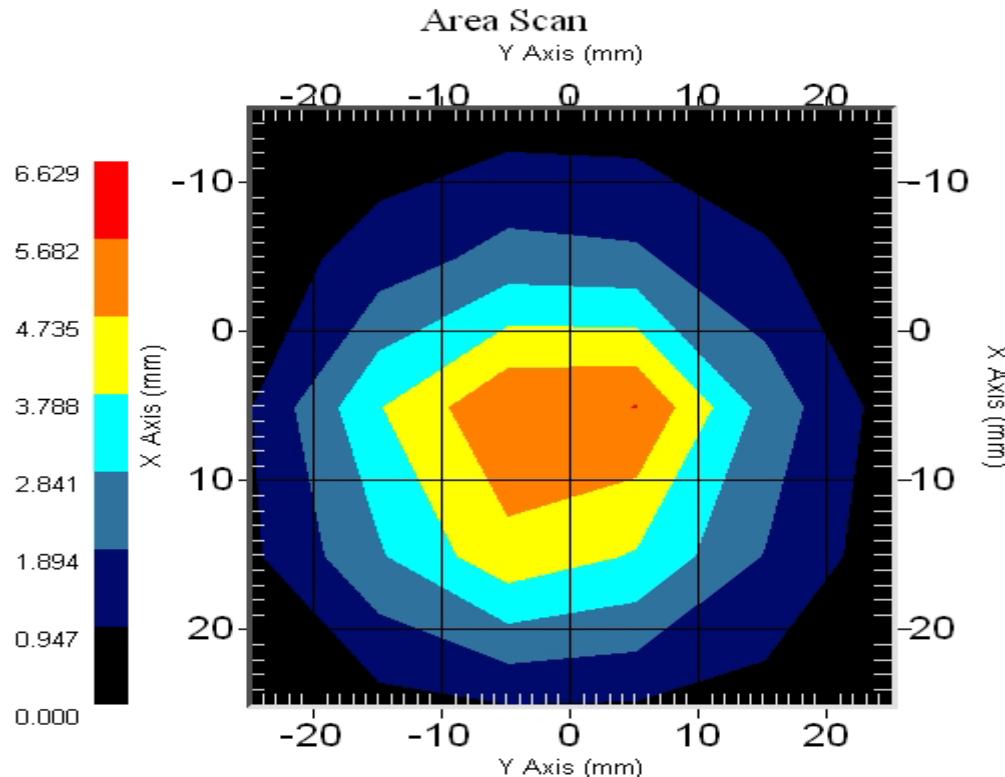
**Length:** 52.4 mm  
**Height:** 30.3 mm

## Electrical Specification

**SWR:** 1.056 U  
**Return Loss:** -32.0 dB  
**Impedance:** 50.2  $\Omega$

## 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

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Dipole Calibration Results**

### **Mechanical Verification**

<b>APREL Length</b>	<b>APREL Height</b>	<b>Measured Length</b>	<b>Measured Height</b>
51.5 mm	30.4 mm	52.4 mm	30.3 mm

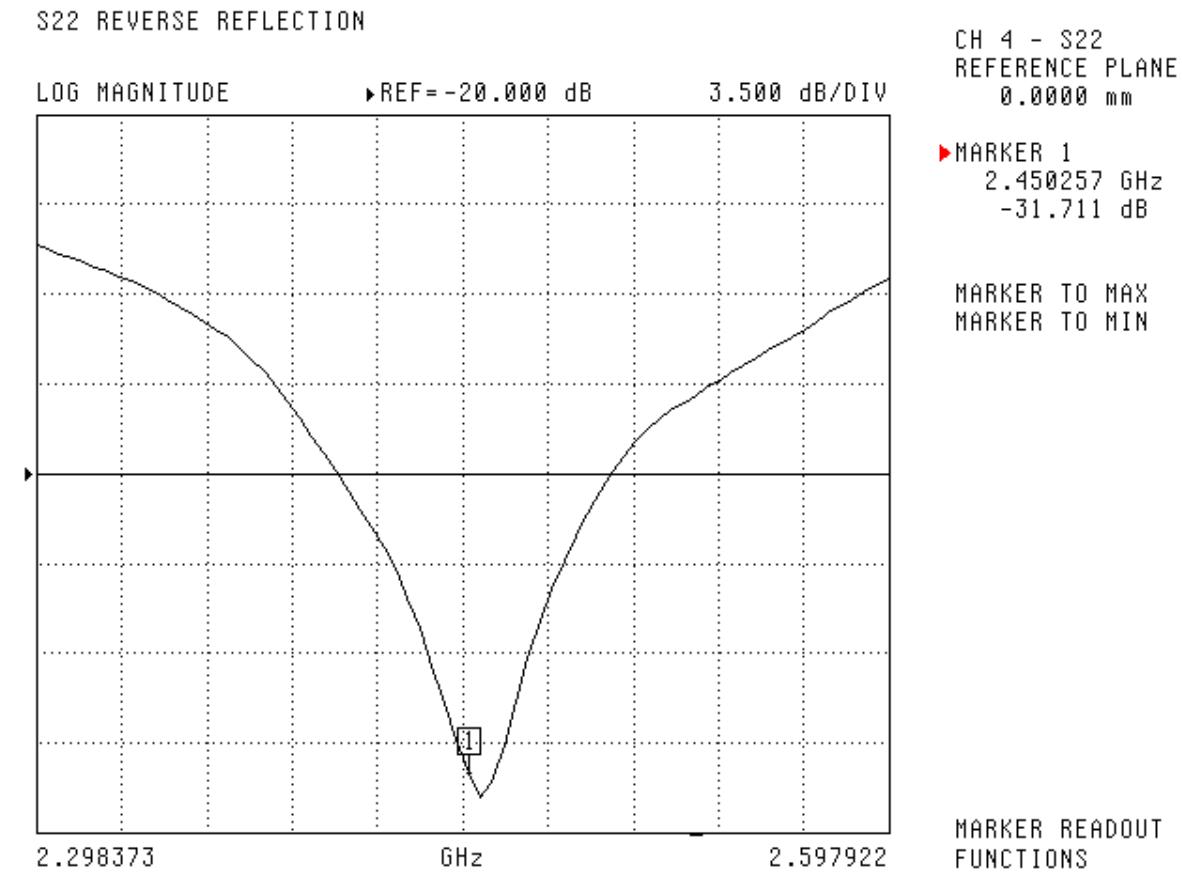
### **Tissue Validation**

<b>Head Tissue 2450 MHz</b>	<b>Measured</b>
<b>Dielectric constant, <math>\epsilon_r</math></b>	39.2
<b>Conductivity, <math>\sigma</math> [S/m]</b>	1.80

**Electrical Calibration**

Test	Result
S11 R/L	-32.0 dB
SWR	1.05 U
Impedance	50.2 $\Omega$

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

**S11 Parameter Return Loss**

# NCL Calibration Laboratories

Division of APREL Laboratories.

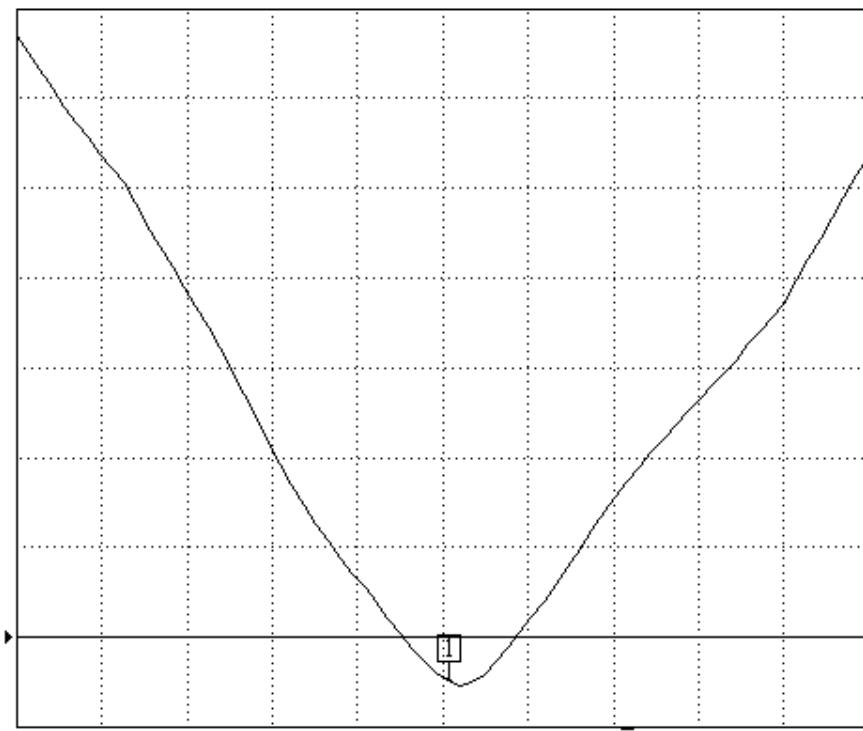
## SWR

S22 REVERSE REFLECTION

SWR

►REF= 1.100 U

100.000 mU/DIV



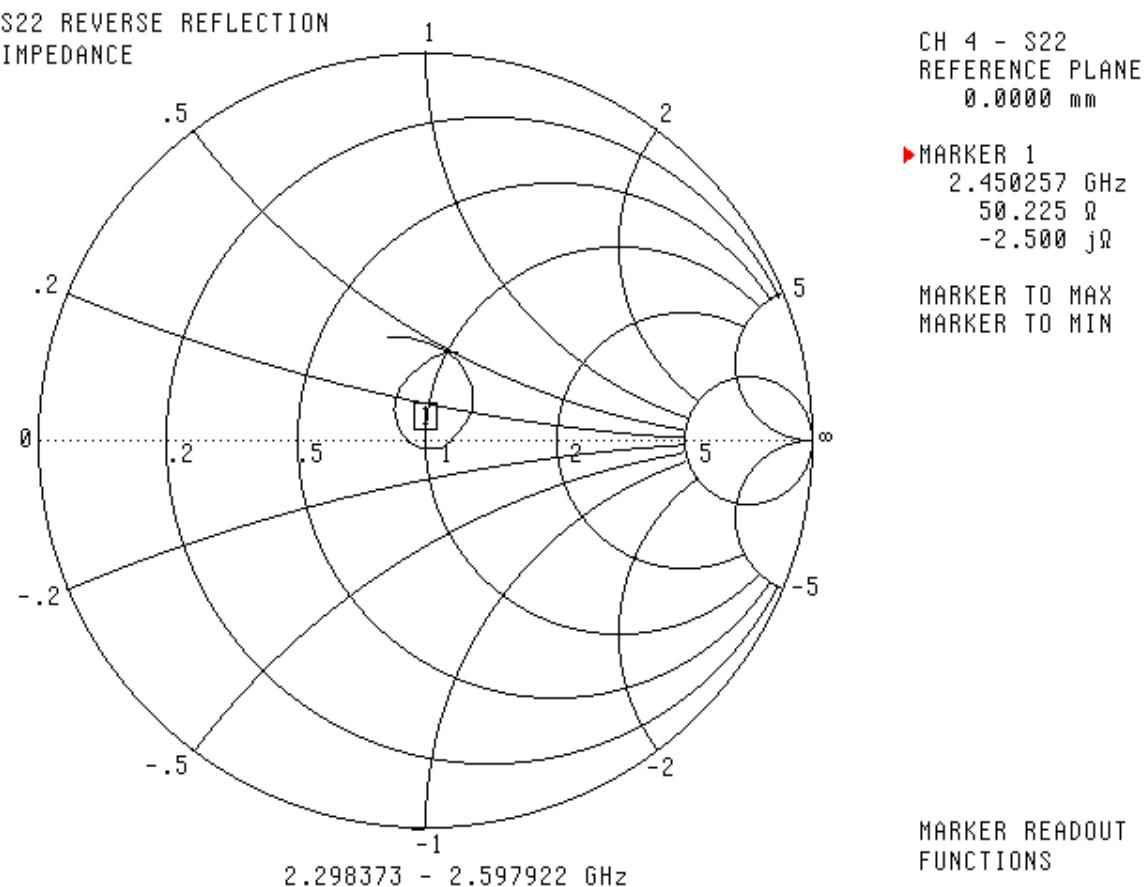
CH 4 - S22  
REFERENCE PLANE  
0.0000 mm

►MARKER 1  
2.450257 GHz  
1.051 U

MARKER TO MAX  
MARKER TO MIN

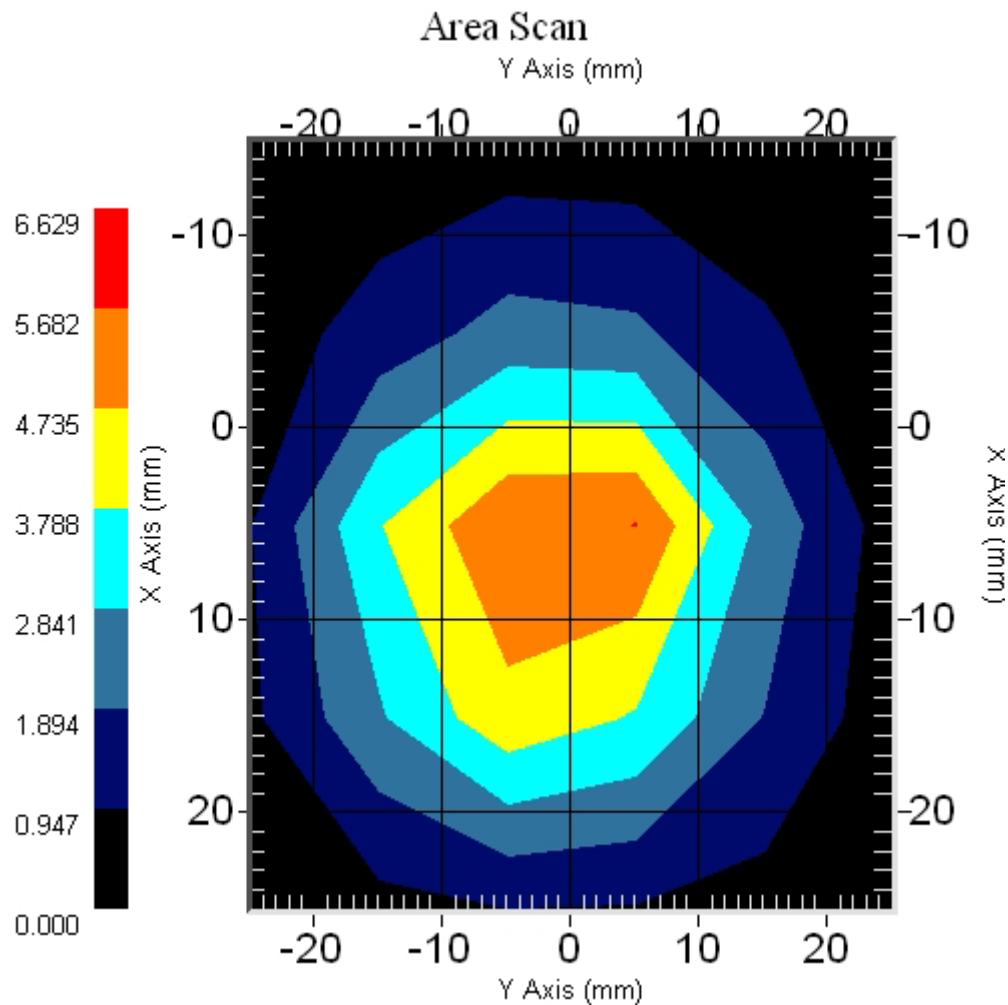
MARKER READOUT  
FUNCTIONS

## 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 2008.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-887

Client.: APREL

## C E R T I F I C A T E   O F   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.: 018

Calibration in Body Tissue

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

Project No: Internal APREL

Calibrated: 3<sup>rd</sup> May 2008  
Released on: 3<sup>rd</sup> May 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

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

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-030 018.

## **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 018 was a new probe 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 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:** 018

**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:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$

**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:** 46.0 (+/-10%) **Sigma:** 5.85 S/m (+/-10%)**ConvF****Channel X:** 3.3**Channel Y:** 3.3**Channel Z:** 3.3

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:**

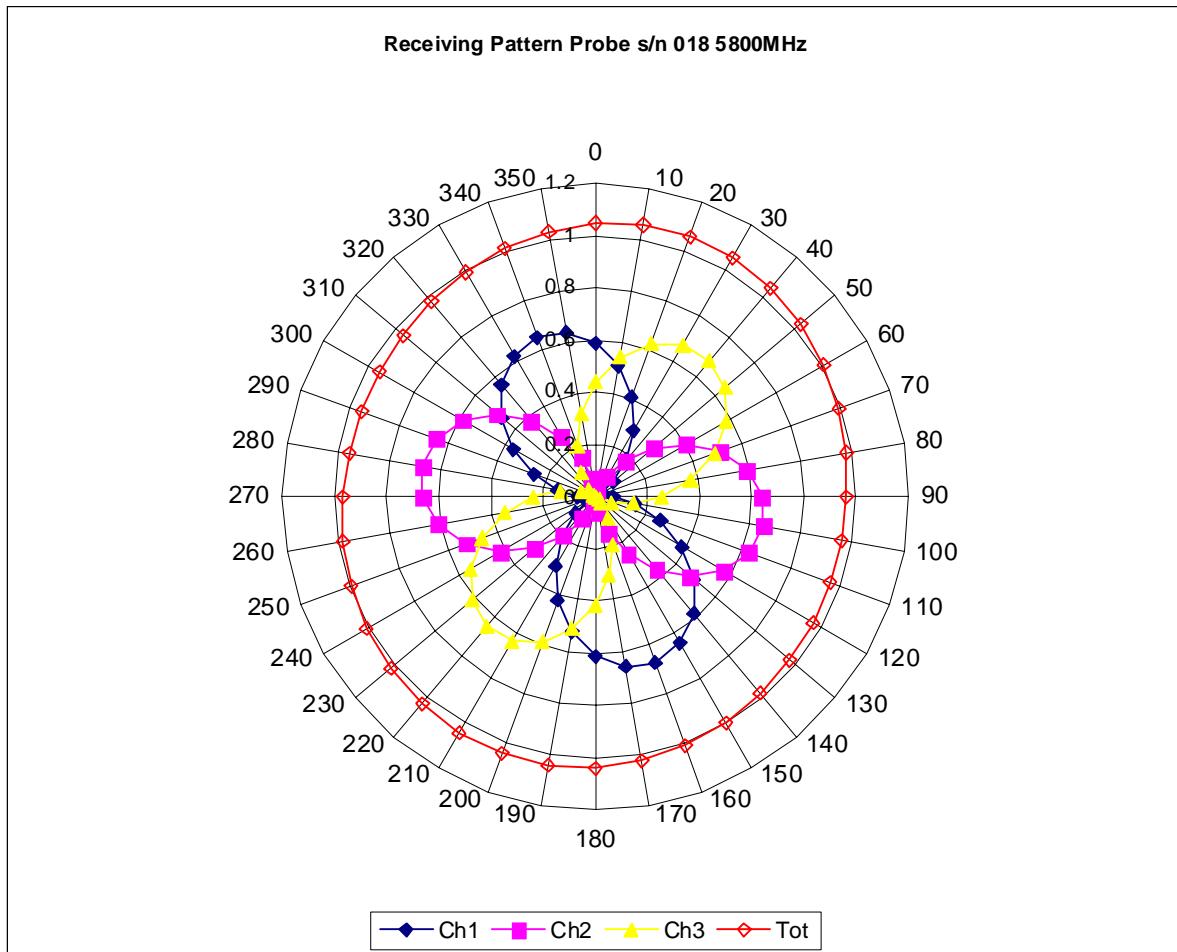
The measured probe tip diameter is 2.9 mm (+/- 0.01 mm) and therefore meets the requirements of SSI/DRB-TP-D01-032 for spatial resolution.

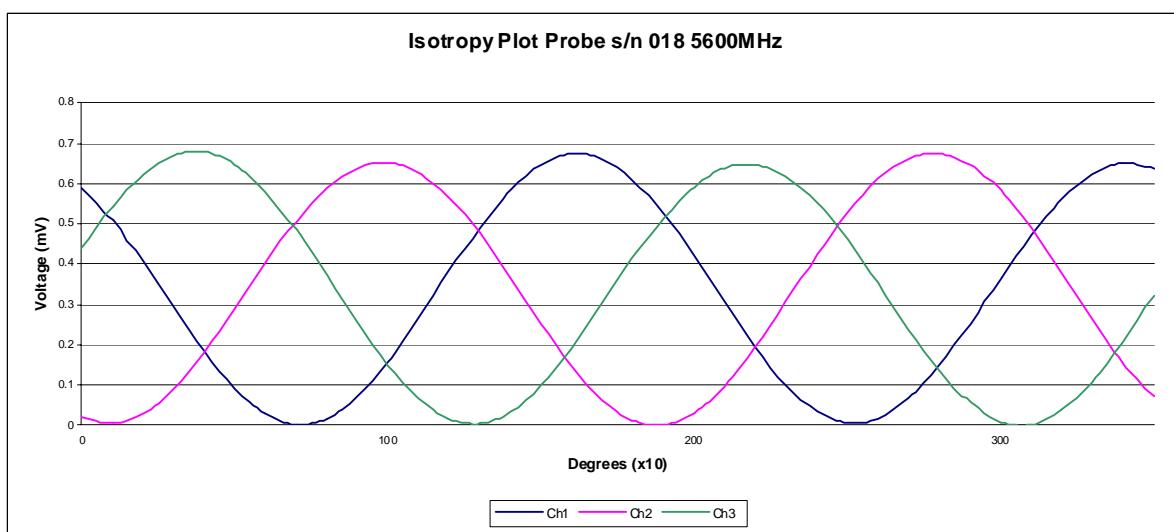
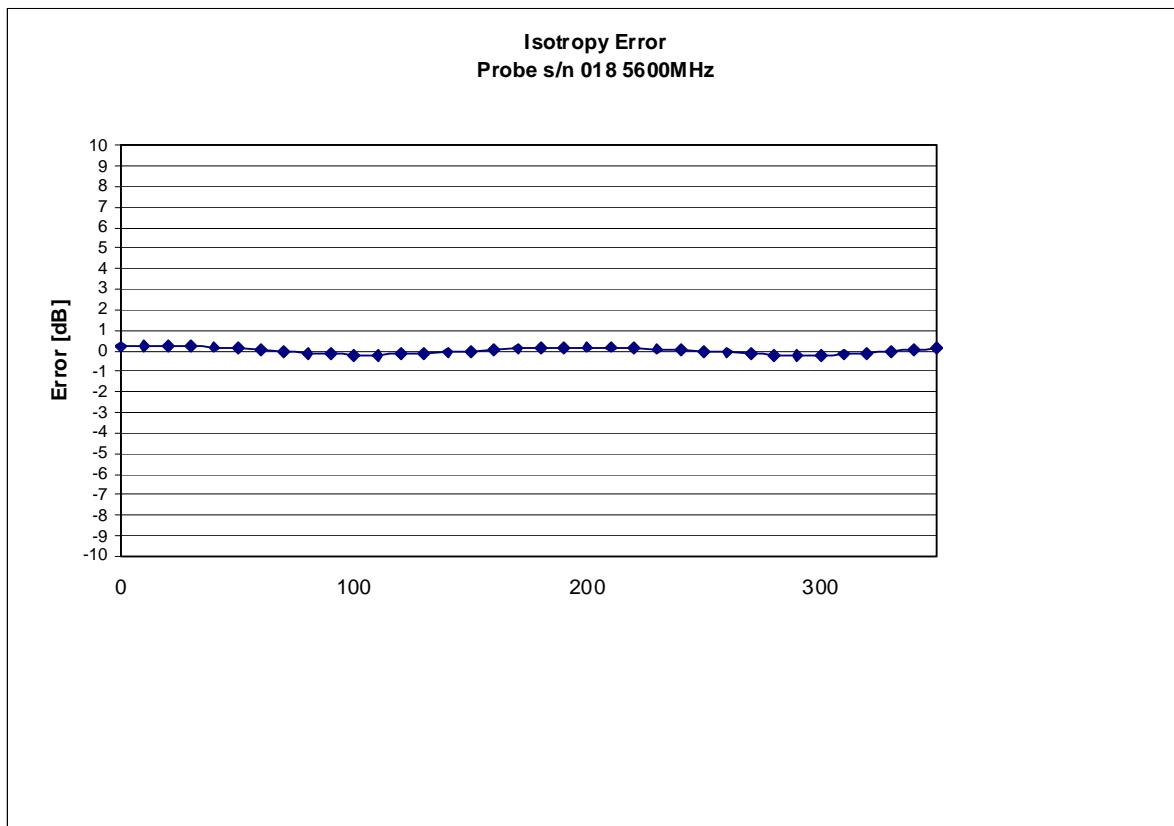
**Broad Band Calibration:**

The probe was assessed for sensitivity and conversion factor using a +/- 40MHz deviation from the centre frequency.

**Deviation at -40MHz:** -3.77%**Deviation at +40MHz:** +4.28%

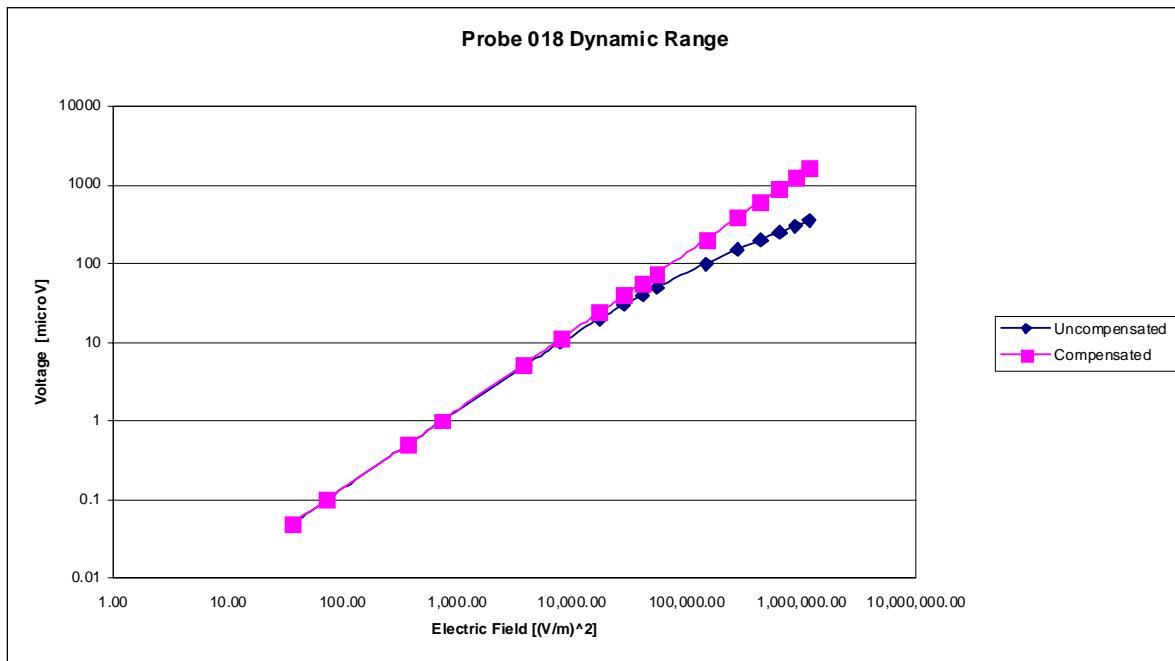
## Receiving Pattern 5600 MHz (Air)



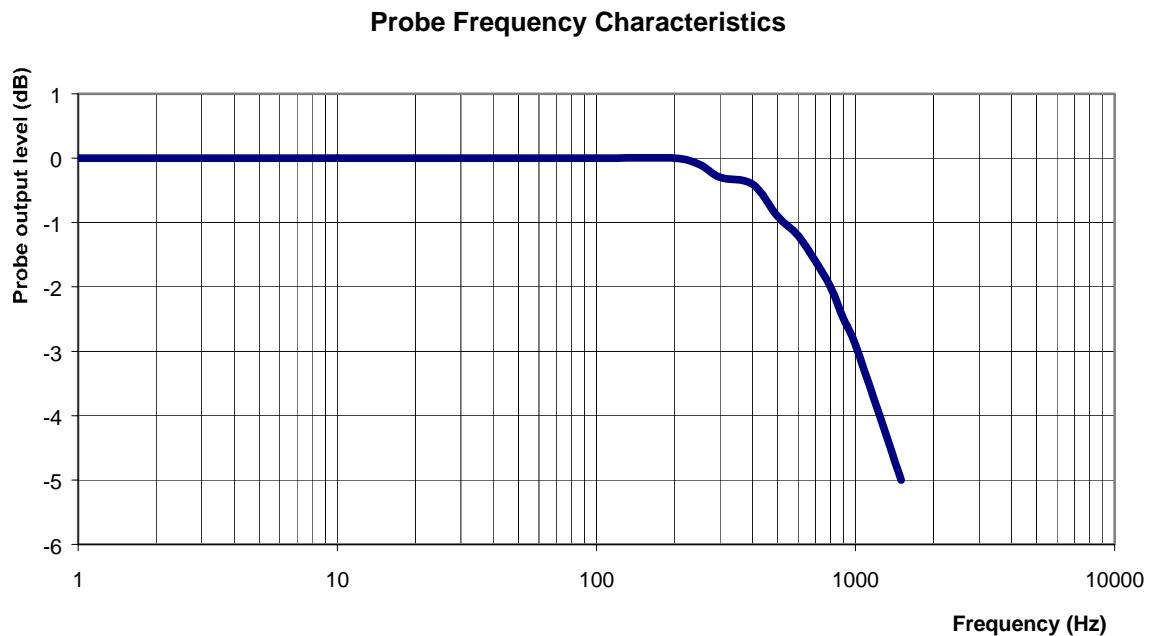
**Isotropy Error 5600 MHz (Air)****Isotropicity in Tissue:**

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:** 46.0 (+/-10%) **Sigma:** 5.85 S/m (+/-10%)

#### **ConvF**

**Channel X:** 3.3 7%(K=2)

**Channel Y:** 3.3 7%(K=2)

**Channel Z:** 3.3 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 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 2008.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-886

Client.: APREL

## C E R T I F I C A T E   O F   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.: 018

Calibration in Body Tissue

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

Project No: Internal APREL

Calibrated: 3<sup>rd</sup> May 2008  
Released on: 3<sup>rd</sup> May 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

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

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-030 018.

## **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 018 was a new probe 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 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:** 018

**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:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$

**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**

**Frequency:** 5200 MHz

**Epsilon:** 43.0 (+/-10%) **Sigma:** 5.75 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.

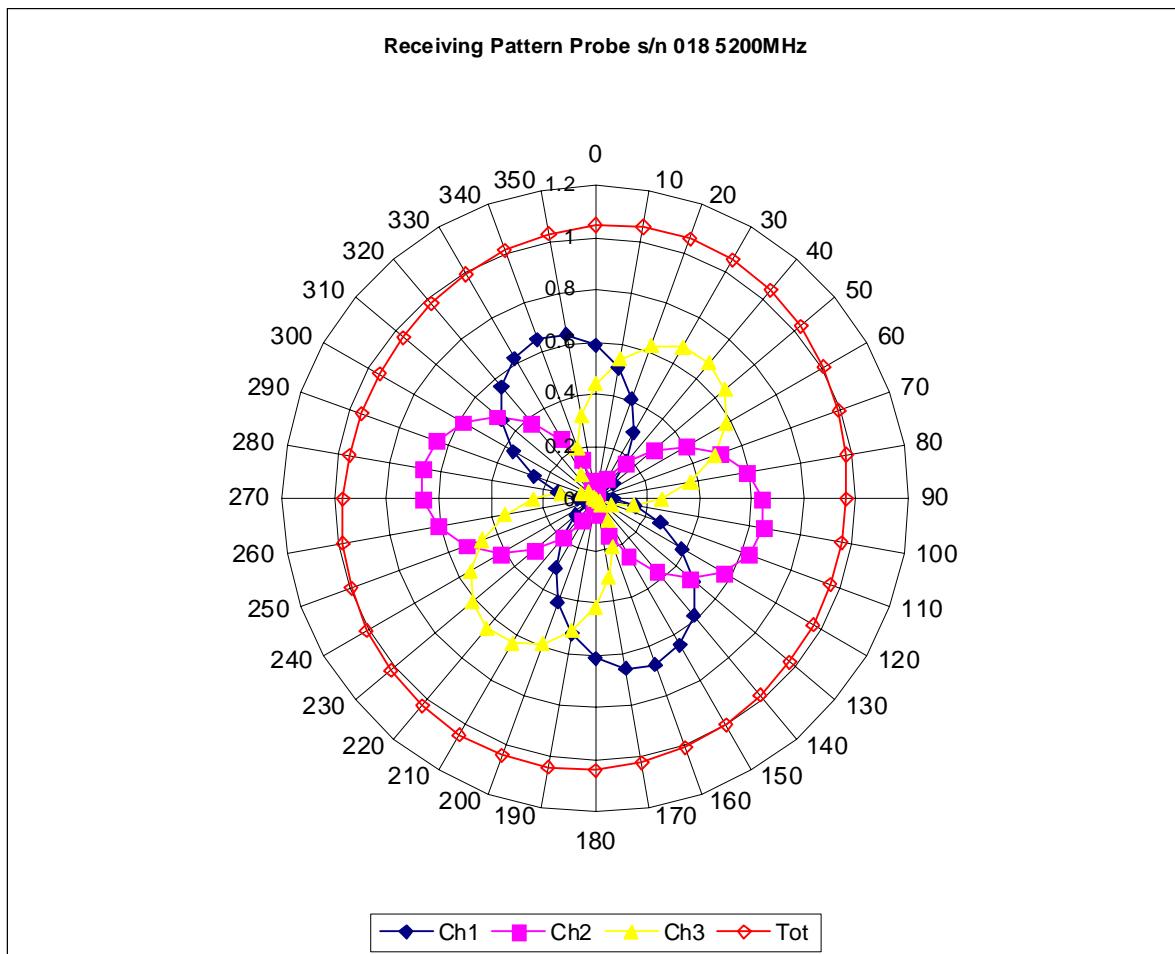
### **Broad Band Calibration:**

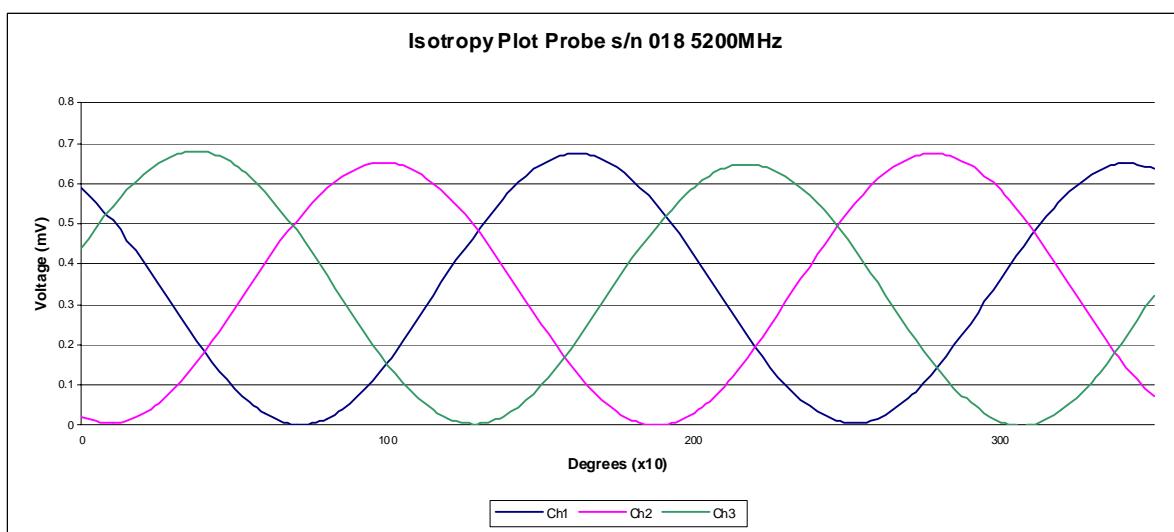
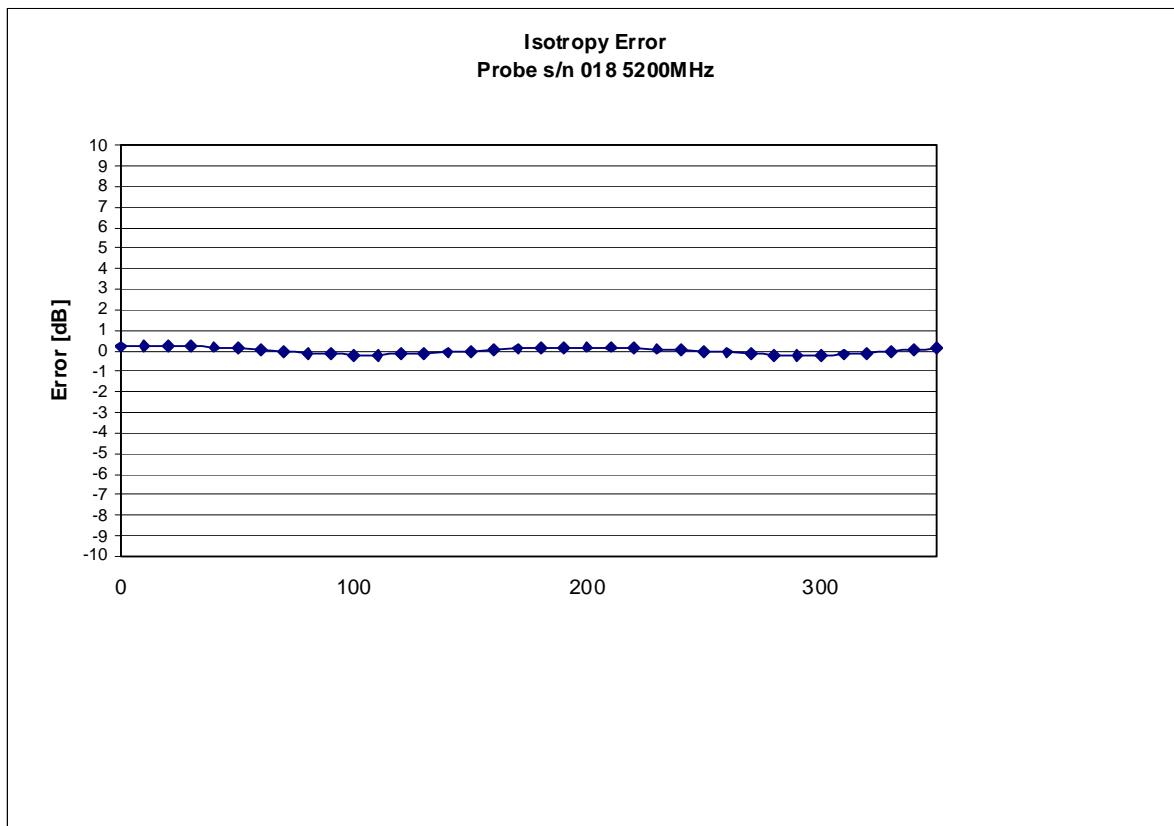
The probe was assessed for sensitivity and conversion factor using a +/- 40MHz deviation from the centre frequency.

**Deviation at -40MHz:** -4.16%

**Deviation at +40MHz:** +2.78%

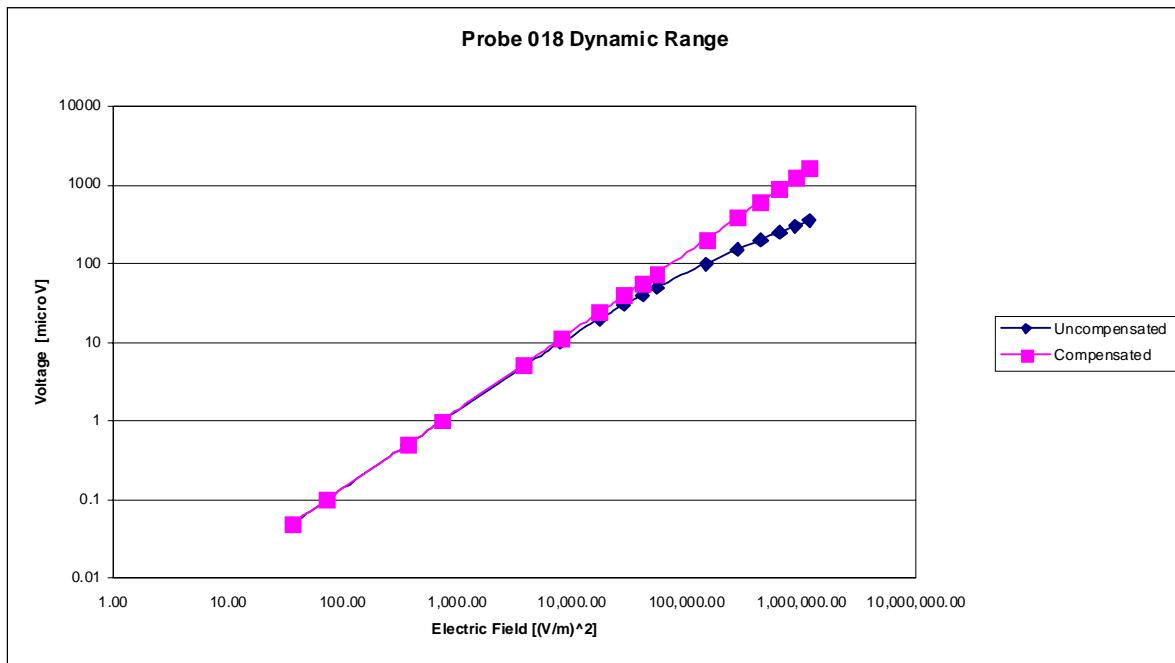
## Receiving Pattern 5200 MHz (Air)



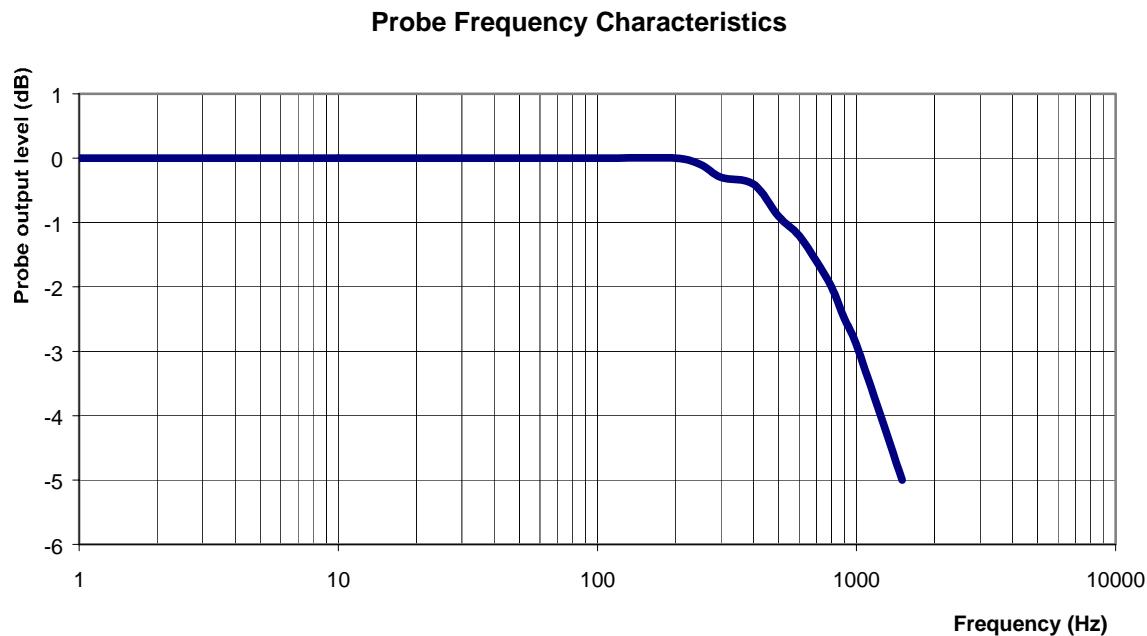
**Isotropy Error 5200 MHz (Air)****Isotropicity in Tissue:**

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**

**Frequency:** 5200MHz

**Epsilon:** 43.0 (+/-10%) **Sigma:** 5.75 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 2008.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-885

Client.: APREL

## C E R T I F I C A T E   O F   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.: 018

Calibration in Body Tissue

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

Project No: Internal APREL

Calibrated: 3<sup>rd</sup> May 2008  
Released on: 3<sup>rd</sup> May 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

51 SPECTRUM WAY  
NEPEAN, ONTARIO  
CANADA K2R 1E6

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

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-030 018.

## **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 018 was a new probe 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 probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.**

Stuart Nicol

Jesse Hones

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Calibration Results Summary**

**Probe Type:** E-Field Probe E-030

**Serial Number:** 018

**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:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$

**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

**Frequency:** 2450 MHz

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

### ConvF

**Channel X:** 4.01

**Channel Y:** 4.01

**Channel Z:** 4.01

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.

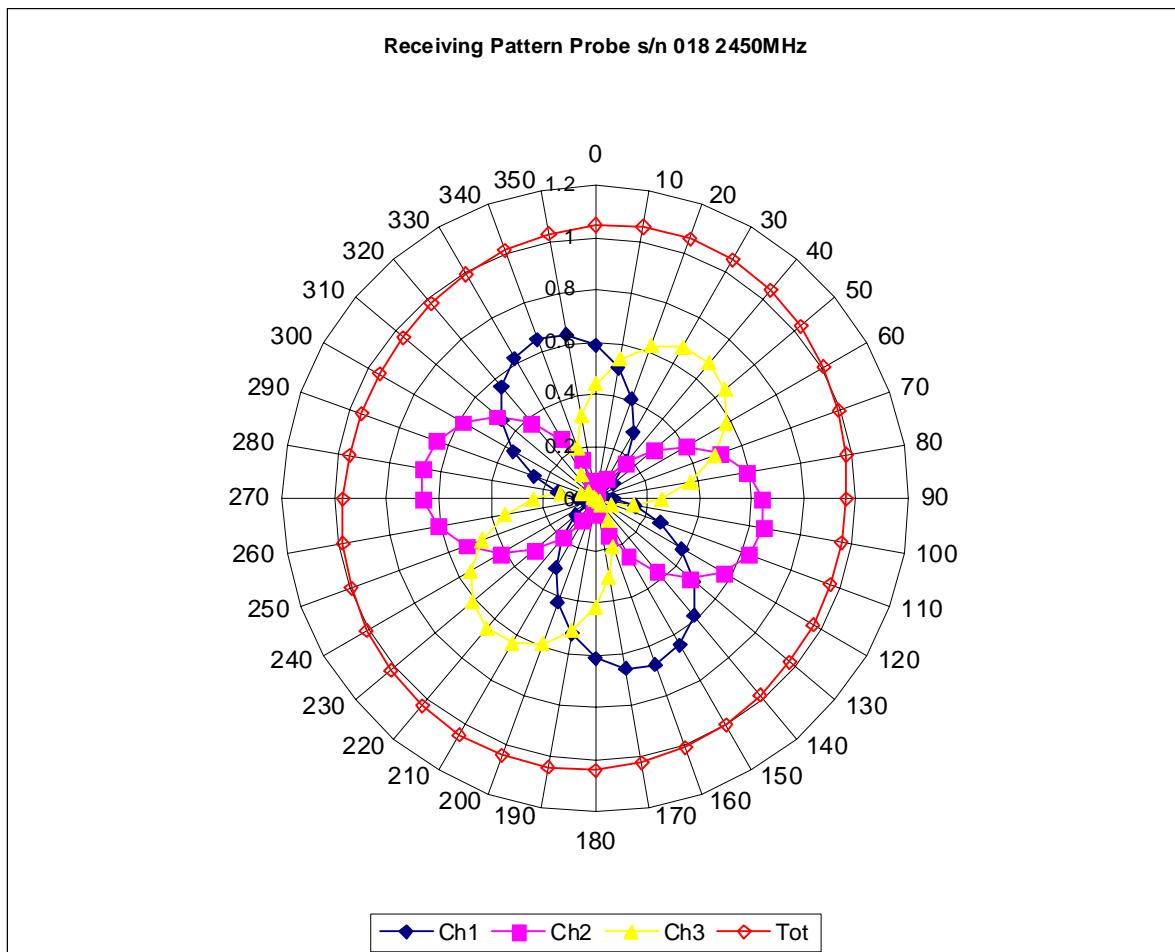
### Broad Band Calibration:

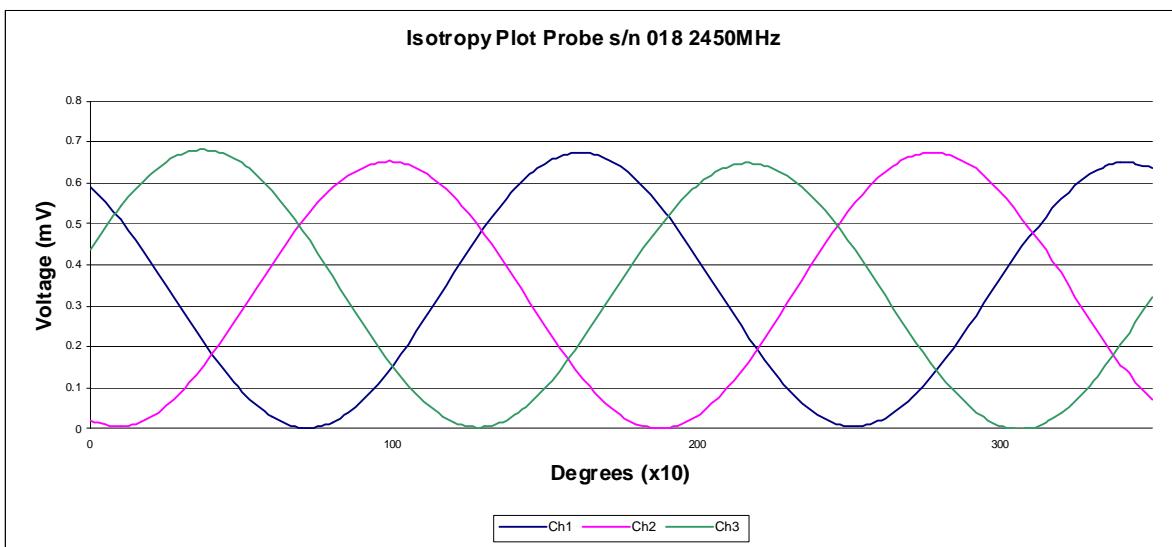
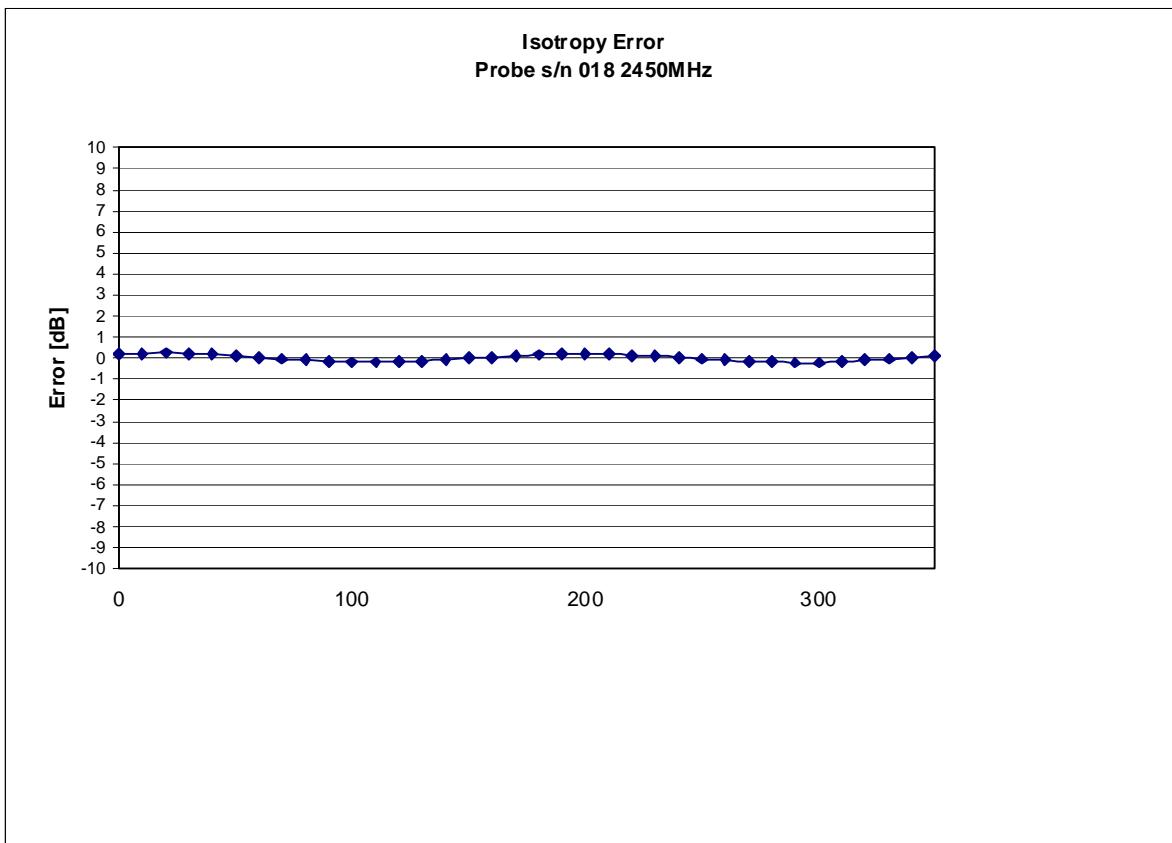
The probe was assessed for sensitivity and conversion factor using a +/- 40MHz deviation from the centre frequency.

**Deviation at -40MHz:** -1.56%

**Deviation at +40MHz:** +1.3%

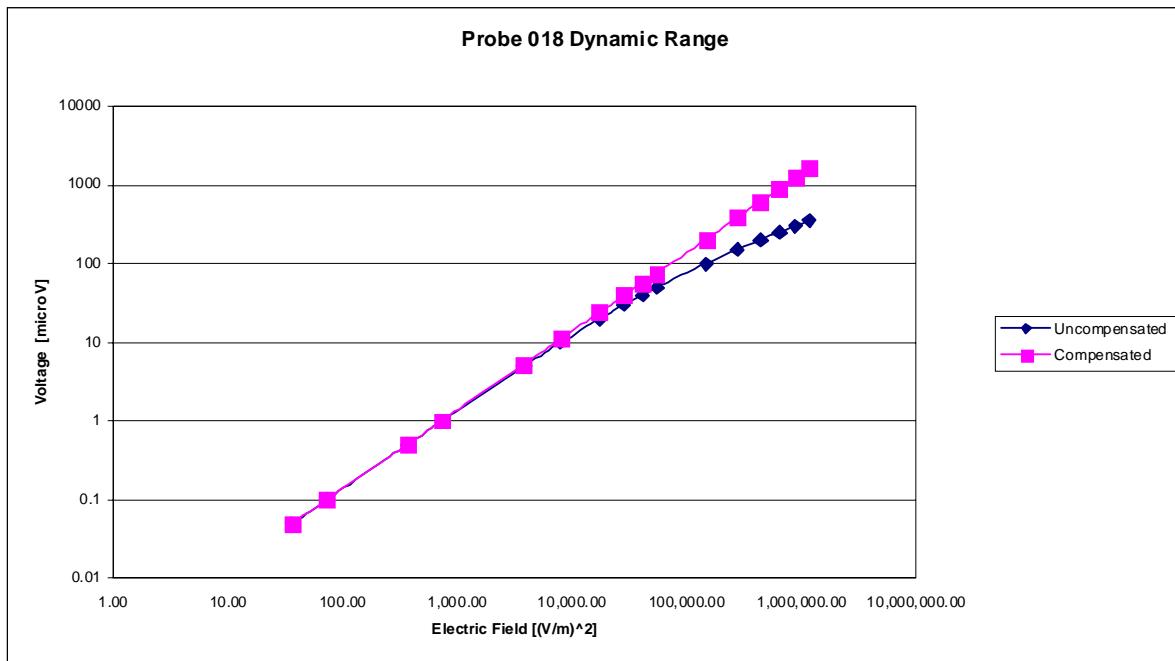
## Receiving Pattern 2450 MHz (Air)



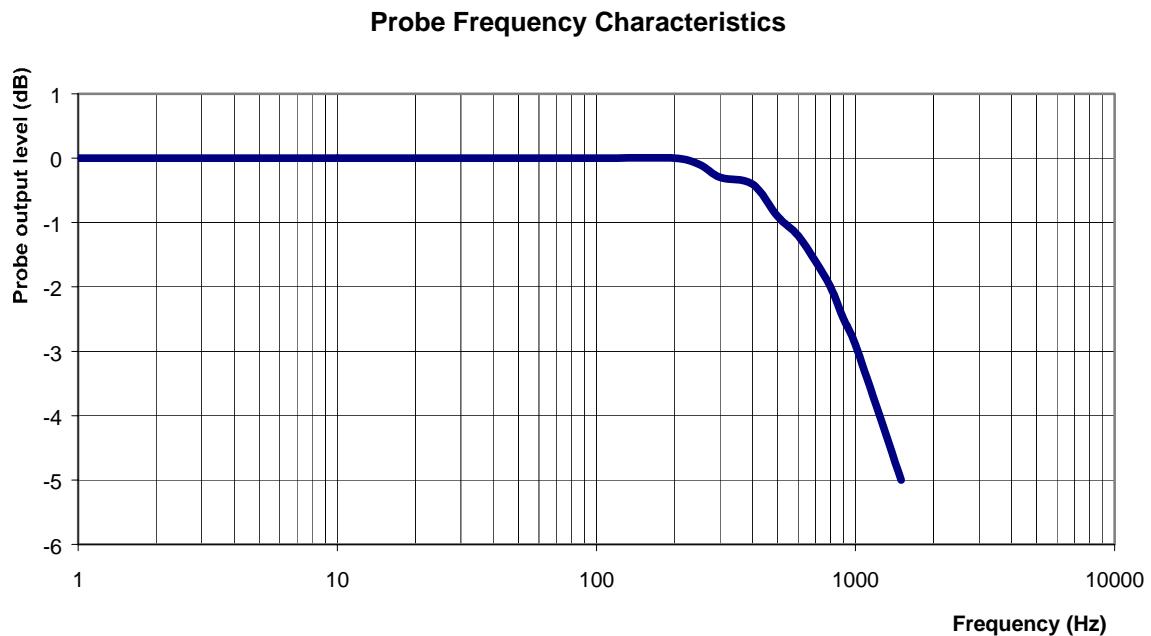
**Isotropy Error 2450 MHz (Air)****Isotropicity in Tissue:**

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**

**Frequency:** 2450MHz

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

### **ConvF**

**Channel X:** 4.01 7%(K=2)

**Channel Y:** 4.01 7%(K=2)

**Channel Z:** 4.01 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 2008.

# NCL CALIBRATION LABORATORIES

Calibration File No.: CP-888

Client.: APREL

## C E R T I F I C A T E   O F   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.: 018

Calibration in Body Tissue

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

Project No: Internal APREL

Calibrated: 3<sup>rd</sup> May 2008  
Released on: 3<sup>rd</sup> May 2008

This Calibration Certificate is Incomplete Unless Accompanied with the Calibration Results Summary

Released By: \_\_\_\_\_

**NCL CALIBRATION LABORATORIES**

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

## **NCL Calibration Laboratories**

Division of APREL Laboratories.

## **Introduction**

This Calibration Report reproduces the results of the calibration performed in line with the SSI/DRB-TP-D01-032-E020-V2 E-Field Probe Calibration Procedure. The results contained within this report are for APREL E-Field Probe E-030 018.

## **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 018 was a new probe 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 probe has been accurately conducted and that all information contained within this report has been reviewed for accuracy.**

Stuart Nicol

Jesse Hones

## **NCL Calibration Laboratories**

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Division of APREL Laboratories.

### **Calibration Results Summary**

**Probe Type:** E-Field Probe E-030

**Serial Number:** 018

**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:**  $1.2 \mu\text{V}/(\text{V}/\text{m})^2$

**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

**Frequency:** 5800 MHz

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

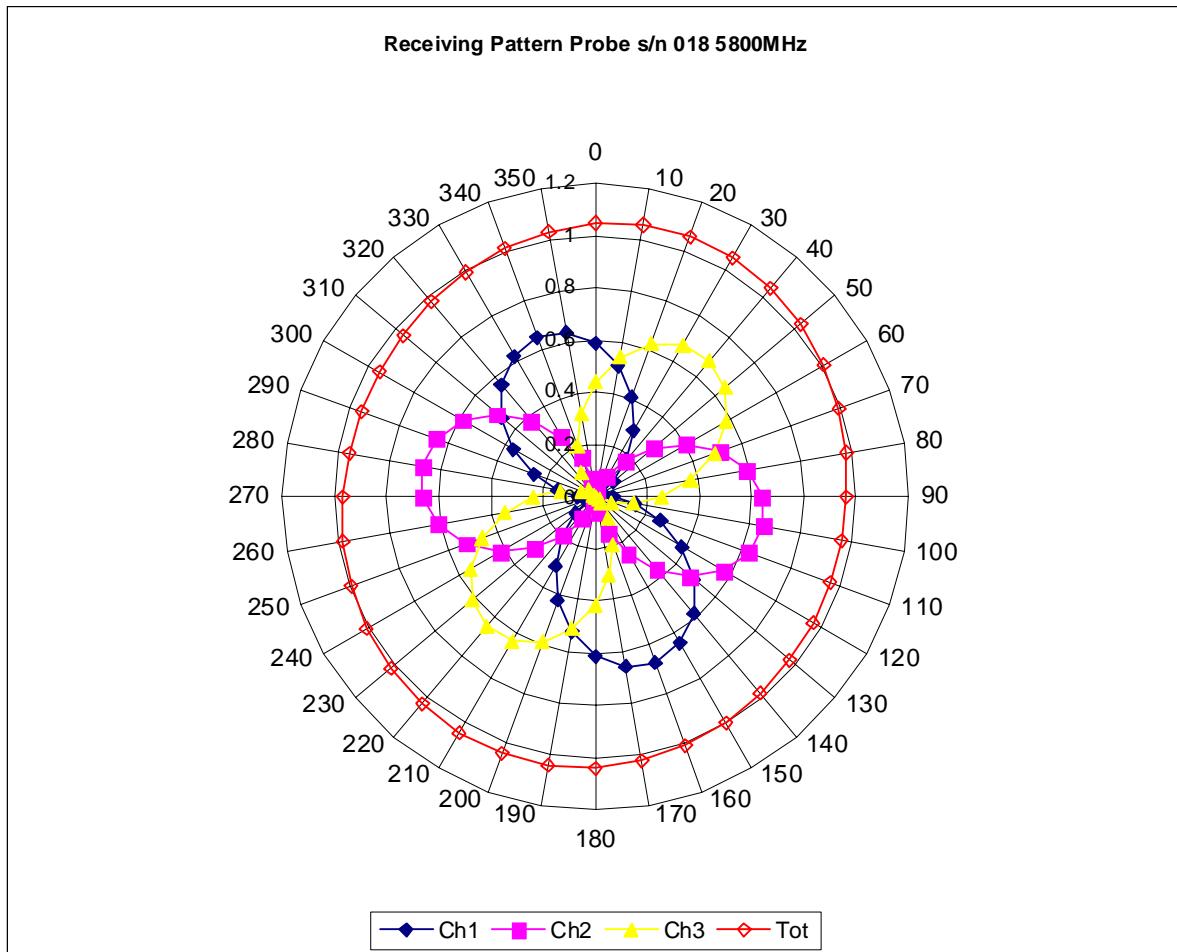
### Broad Band Calibration:

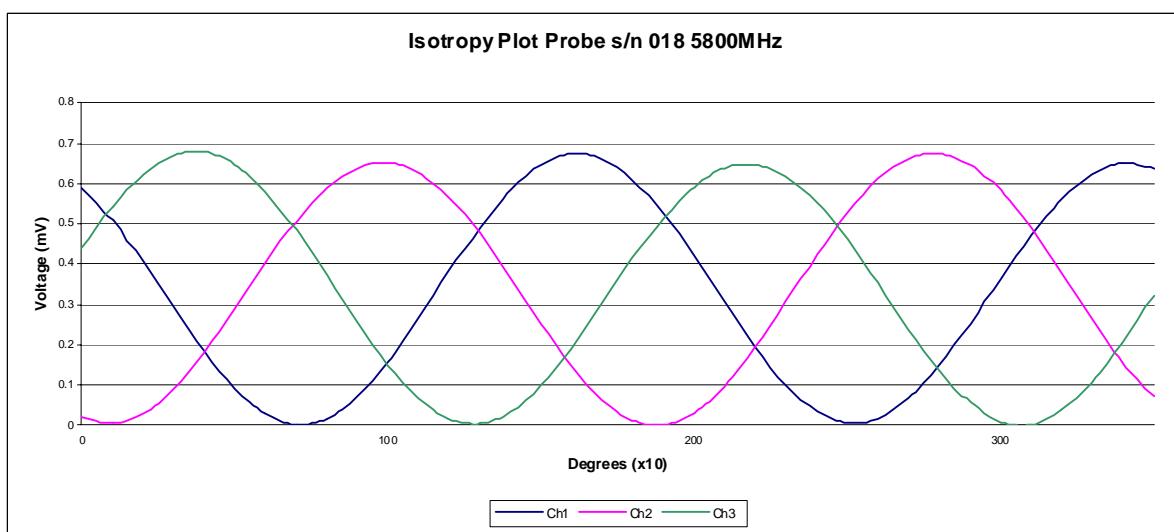
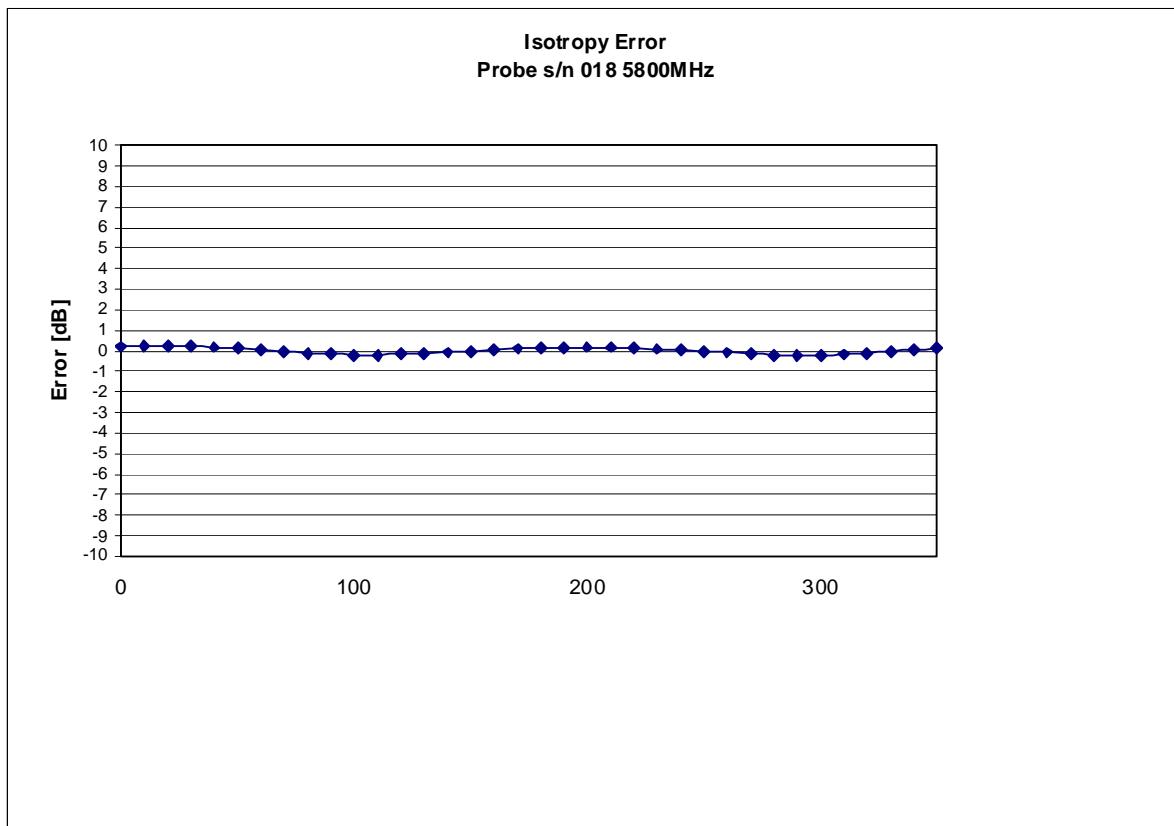
The probe was assessed for sensitivity and conversion factor using a +/- 40MHz deviation from the centre frequency.

**Deviation at -40MHz:** -3.07%

**Deviation at +40MHz:** +3.22%

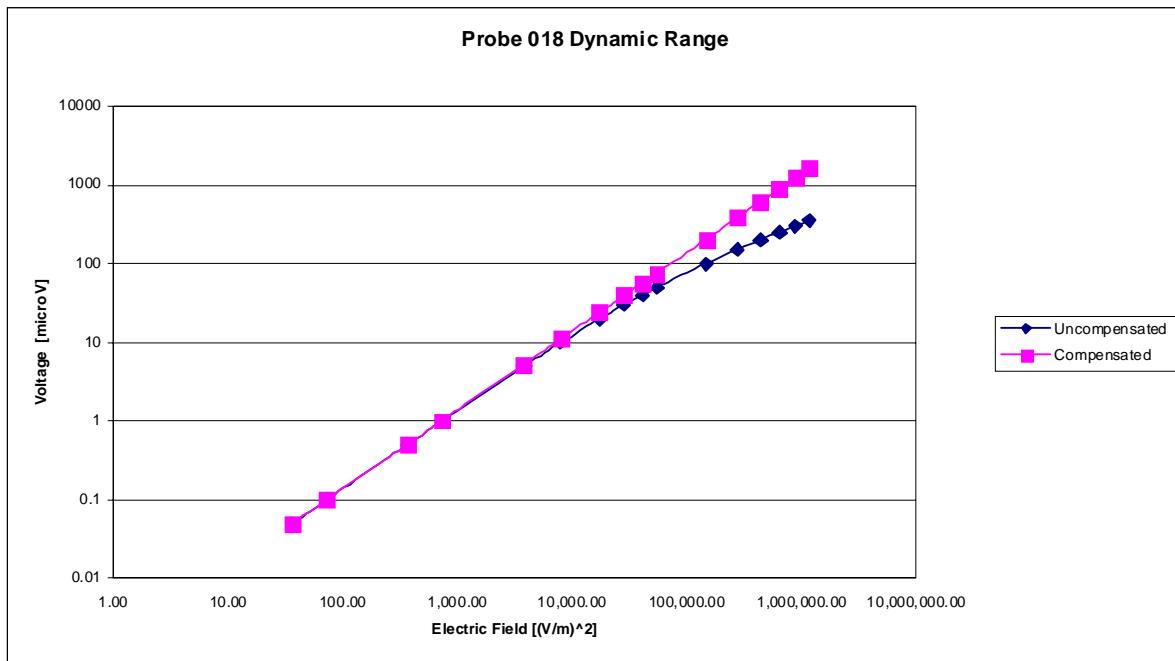
## Receiving Pattern 5800 MHz (Air)



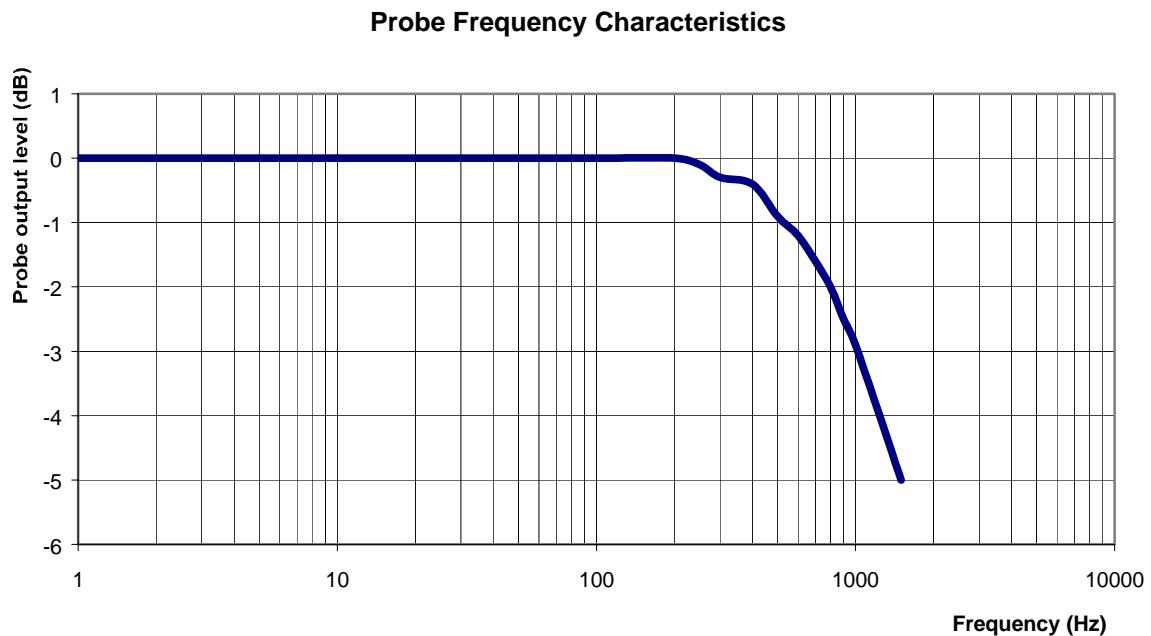
**Isotropy Error 5800 MHz (Air)****Isotropicity in Tissue:**

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**

**Frequency:** 5800MHz

**Epsilon:** 48.2 (+/-10%) **Sigma:** 6.0 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 2008.

# Regulatory WLAN Antenna Information

## 2.4/5GHz Dell Diaz Series Multiple Band Antennas

### with Cable & Connector For IEEE802.11 a/g/n

(English Language Required for Intel Regulatory Review / Approval)

Platform	
Platform Owner	DELL
Brand Name	DELL
Model Name	Diaz
ODM	
Target Launch Date	2008/02/22
Antenna	
Brand Name	
Part Number	<input checked="" type="checkbox"/> Tx1 Antenna: Main -2023816-1 <input checked="" type="checkbox"/> Tx2 Antenna:Aux – 2023816-1 <input checked="" type="checkbox"/> Tx3 (or Rx3) Antenna : MIMO – 2023816-1
Module	<input checked="" type="checkbox"/> 512AN_HMW
With WLAN Module (Check Box)	<input checked="" type="checkbox"/> 533AN_HMW

# Antenna Sample / Antenna Data Requirements for worldwide regulatory approval

Section	Description of Required OEM / ODM Antenna Information	US / IC	EU	Japan	Taiwan	S.Korea
1A	Part Number for Antenna only	Required	Required	Required	Required	Required
1B	Antenna Manufacturer Name	Required	Required	Required	Required	Required
1C	Description of Antenna Type	Required	N/A	N/A	N/A	N/A
1D	Part number of Antenna Assembly / cable impedance, length & diameter.	Required	Desired	Desired	Desired	Desired
1E	Tx1, Tx2 & Tx3 antenna (Peak Gain W/ cable loss) *	Required	Required	Required	Required	Required
	1E OR 1F, 1G, 1H					
1F	Tx1, Tx2 & Tx3 antenna (Peak Gain only) *	Required	Required	Required	Required	Required
1G	VSWR of cable including connector	Required	Required	Required	Required	Required
1H	Tx1, Tx2 & Tx3 antenna (Cable loss W/ connector) *	Required	Required	Required	Required	Required
2	Dimensioned Photographs <u>and</u> Drawings of Tx1, Tx2, and Tx3 (or Rx3) antennas	Required	Required	Required	Required	Required
3	Radiation patterns of antennas loaded in the host platform.	Required	Desired	Required	N/A	Required
4	Platform model name / number - correlated to antenna manufacturer and antenna part number	Required	Required	Desired	Required	Desired
5	Photograph(s) or Drawings showing location of antennas in platform. <u>(S. Korea requires photographs of antennas for approval submission).</u> <u>Taiwan requires pictures of each antenna type shown in the system.</u>	Required	Required	Desired	<u>Required (Photos)</u>	<u>Required (Photos)</u>
6	Mech. drawings / photos with dimensions of antenna locations and distance from end-user (For evaluation of SAR testing requirement).	Required	N/A	N/A	N/A	N/A
7	Photograph(s) or Drawings showing the location of all antennas (WLAN, other) and distance between those transmitting antennas. Information will be used to evaluate whether co-location testing is required.	Required	N/A	N/A	N/A	N/A
8	Local representative contact information for LMA/ PARS process.	Required	N/A	N/A	N/A	N/A

**NOTE:**

(\*) if 3<sup>rd</sup> antenna is Rx only (e.g. receive only for 4965AGN) then peak gain and cable loss not required

# Antenna Information

## Section 1. Antenna Assembly Specifications

### Antenna Assembly Summary:

1A Antenna Part Number	1B Manufacture	1C Antenna Type	1D Cable Assembly Part Number and Information	1E *Peak Gain W/ Cable loss (dBi)	1F Peak Gain w/o Cable Loss (dBi)	1G VSWR	1H Cable Loss (dBi)
2023816-1 Tx1 Antenna Main White	TYCO Electronics	PIFA	(P/N: U.FL-LP-068) 50 ohm coaxial length: 475mm diameter: 1.13mm Connector: U.FL White	2412-2462MHz <b>-0.67</b> dBi (peak) 2500-2700MHz <b>0.58</b> dBi (peak) 5150-5470MHz <b>0.72</b> dBi (peak) 5725-5850MHz <b>1.21</b> dBi (peak)	2412-2462MHz <b>1.83</b> dBi (peak) 2500-2700MHz <b>3.08</b> dBi (peak) 5150-5470MHz <b>4.32</b> dBi (peak) 5725-5850MHz <b>4.81</b> dBi (peak)	2412-2462MHz <b>2</b> max 2500-2700MHz <b>2</b> max 5150-5470MHz <b>2</b> max 5725-5850MHz <b>2</b> max	2412-2462MHz <b>2.5</b> dBi (peak) 2500-2700MHz <b>2.5</b> dBi (peak) 5150-5470MHz <b>3.6</b> dBi (peak) 5725-5850MHz <b>3.6</b> dBi (peak)
2023816-1 Tx2 antenna Aux Black	TYCO Electronics	PIFA	(P/N: U.FL-LP-068) 50 ohm coaxial length: 475mm diameter: 1.13mm Connector: U.FL black	2412-2462MHz <b>0.58</b> dBi (peak) 2500-2700MHz <b>1.73</b> dBi (peak) 5150-5470MHz <b>0.37</b> dBi (peak) 5725-5850MHz <b>0.11</b> dBi (peak)	2412-2462MHz <b>3.08</b> dBi (peak) 2500-2700MHz <b>4.23</b> dBi (peak) 5150-5470MHz <b>3.97</b> dBi (peak) 5725-5850MHz <b>3.71</b> dBi (peak)	2412-2462MHz <b>2</b> max 2500-2700MHz <b>2</b> max 5150-5470MHz <b>2</b> max 5725-5850MHz <b>2</b> max	2412-2462MHz <b>2.5</b> dBi (peak) 2500-2700MHz <b>2.5</b> dBi (peak) 5150-5470MHz <b>3.6</b> dBi (peak) 5725-5850MHz <b>3.6</b> dBi (peak)
2023816-1 Tx3 (or Rx3) antenna Gray MIMO	TYCO Electronics	PIFA	(P/N: U.FL-LP-068) 50 ohm coaxial length: 275mm diameter: 1.13mm Connector: U.FL Gray	2412-2462MHz <b>0.16</b> dBi (peak) 2500-2700MHz dBi (peak) 5150-5470MHz <b>2.16</b> dBi (peak) 5725-5850MHz <b>2.30</b> dBi (peak) *	2412-2462MHz <b>2.66</b> dBi (peak) 2500-2700MHz dBi (peak) 5150-5470MHz <b>5.76</b> dBi (peak) 5725-5850MHz <b>5.9</b> dBi (peak) *	2412-2462MHz <b>2</b> max 2500-2700MHz dBi (peak) 5150-5470MHz <b>2</b> max 5725-5850MHz <b>2</b> max *	2412-2462MHz <b>2.5</b> dBi (peak) 2500-2700MHz dBi (peak) 5150-5470MHz <b>3.6</b> dBi (peak) 5725-5850MHz <b>3.6</b> dBi (peak) *

NOTE:

(\*) If Rx3 only (3<sup>rd</sup> antenna receives only, e.g. for 4965AGN) then the information marked with \* is not required

**Antenna Peak Gain Table:**

Freq. (MHz)	WLAN Antenna–White(MAIN)			WLAN Antenna–Black(AUX)			MIMO Antenna–Gray		
	H	V	H + V	H	V	H + V	H	V	H + V
	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>	dB <sub>i</sub>
2412	−3.46	−3.60	−0.77	−3.81	−4.16	−2.50	−2.21	−0.97	0.16
2437	−3.35	−3.22	−0.71	−2.55	−2.55	−0.82	−2.32	−0.60	0.01
2462	−3.08	−2.80	−0.67	−1.78	−1.28	0.58	−2.66	−0.66	0.11
2500	−2.36	−2.92	0.13	−1.71	−0.26	1.10			
2600	−1.34	−1.95	0.58	−1.33	−0.55	0.63			
2700	−1.20	−1.43	0.15	−0.40	0.30	1.73			
5150	−1.65	−7.40	−1.49	−0.47	−7.58	−0.11	−0.47	−1.03	1.12
5350	−0.50	−5.89	−0.25	−0.08	−5.49	0.37	0.20	0.03	2.16
5470	0.66	−3.53	0.72	−0.58	−4.65	0.11	0.11	−0.58	1.57
5725	1.04	−4.00	1.21	−1.66	−3.61	−0.35	−3.17	−0.35	0.83
5875	0.40	−2.92	0.59	−1.43	−2.56	0.11	−0.04	0.34	2.30

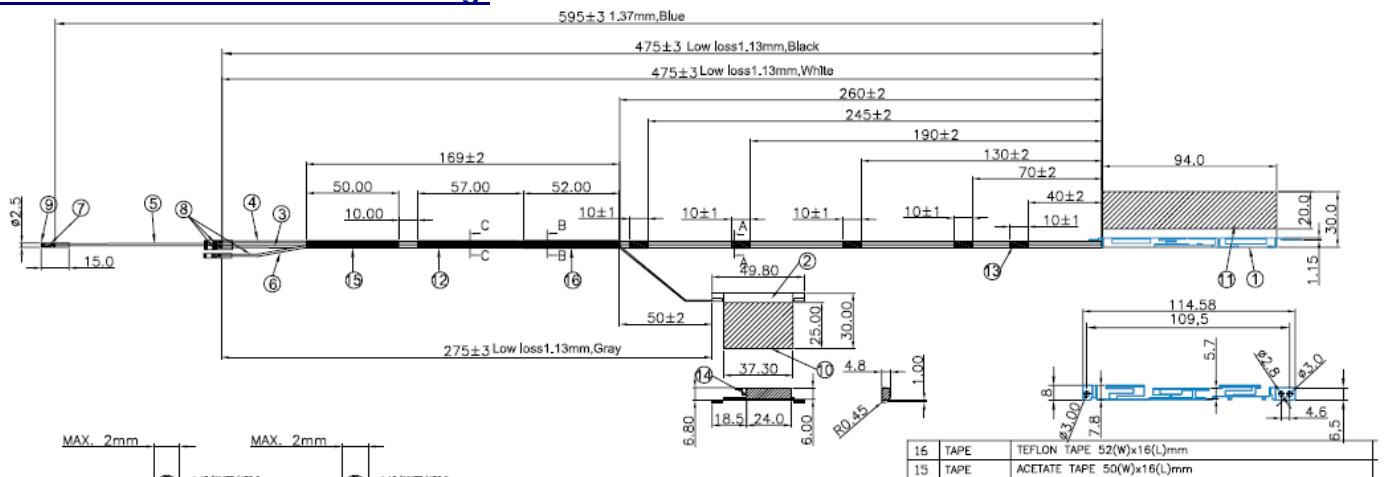
Antenna Peak Gain required being test in system basis.

- 1E frame contend absolutely peak antenna gain include H/V
- If Rx3 only (3<sup>rd</sup> antenna receives only, e.g. for 4965AGN) then the information is not required for Rx3.

## Section 2. Dimensioned Photos or Drawings of Antennas

**Include a dimensioned photo and dimensioned drawing of Tx1 antenna here.**

## Tx1 Antenna Dimensioned Drawing:

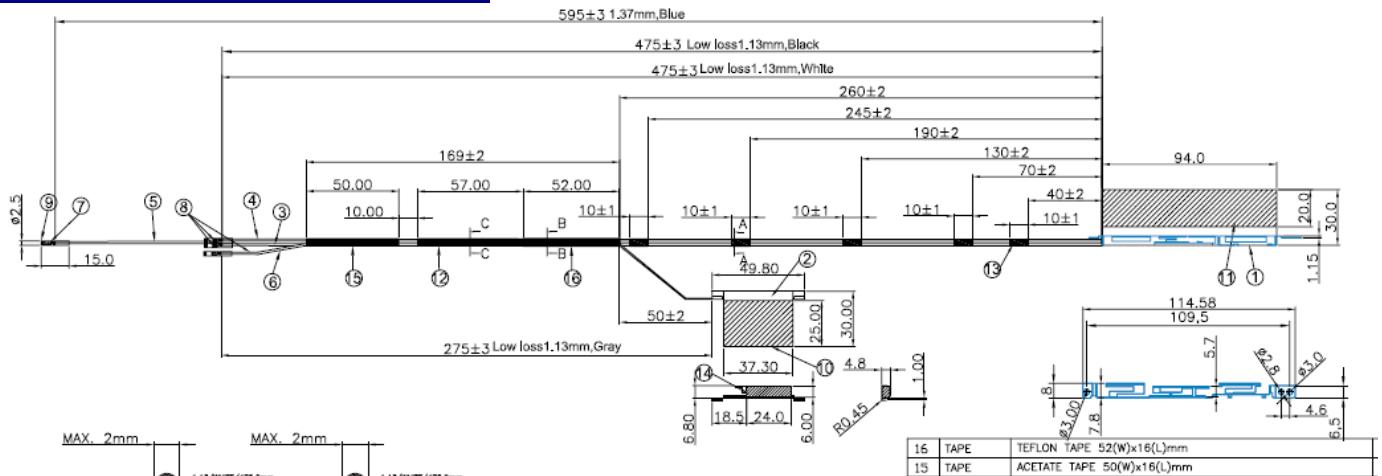


## Tx1 Antenna Photo:-MAIN

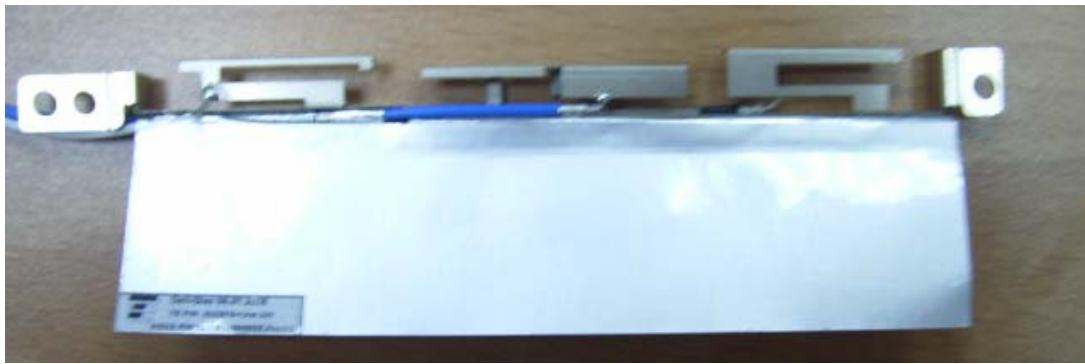


**Include a dimensioned photo and dimensioned drawing of Tx2 antenna here.**

## **Tx2 Antenna Dimensioned Drawing:**

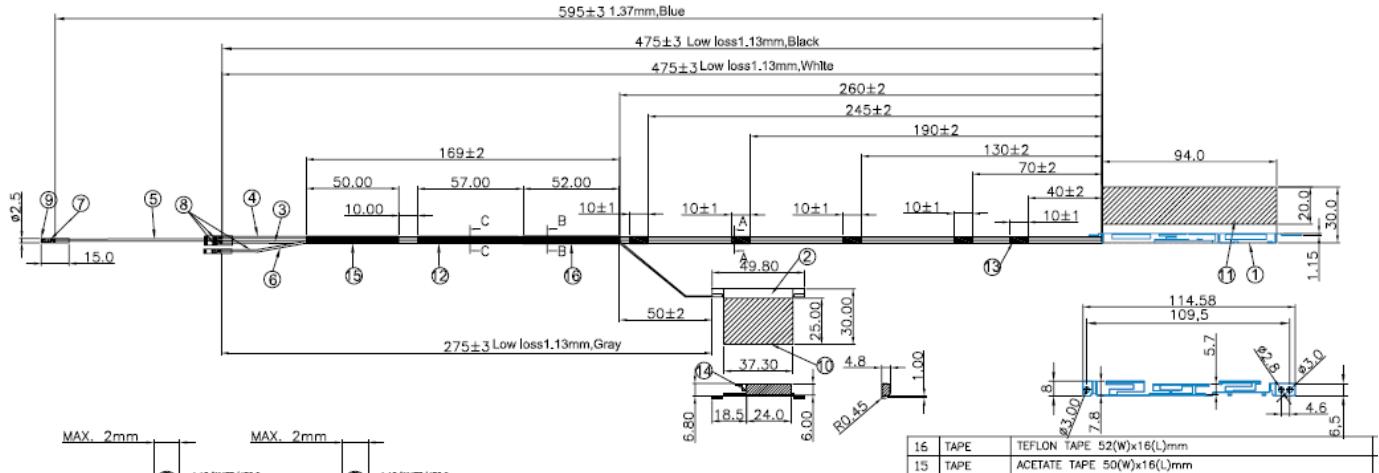


## Tx2 Antenna Photo: AUX



**Include a dimensioned photo and dimensioned drawing of Tx3 (or Rx3) antenna here.**

## Tx3 (or Rx3) Antenna Dimensioned Drawing:



### Tx3 (or Rx3) Antenna Photo:



**Include front view photo of all 3 antennas here.**

Antenna Manufacturer: Tyco Electronics

Antenna Part Number:

(Tx1), 2023816-1

(Tx2), 2023816-1

(Rx3), 2023816-1



**Include back view photo of all 3 antennas here.**

Antenna Manufacturer: Tyco Electronics

Antenna Part Number:

(Tx1), 2023816-1

(Tx2), 2023816-1

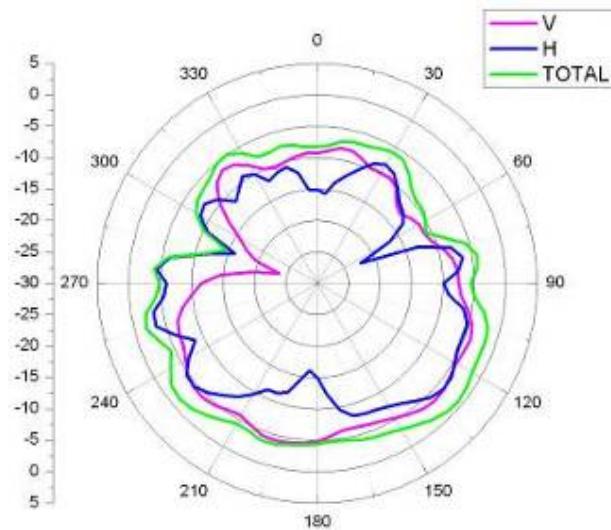
(Rx3), 2023816-1



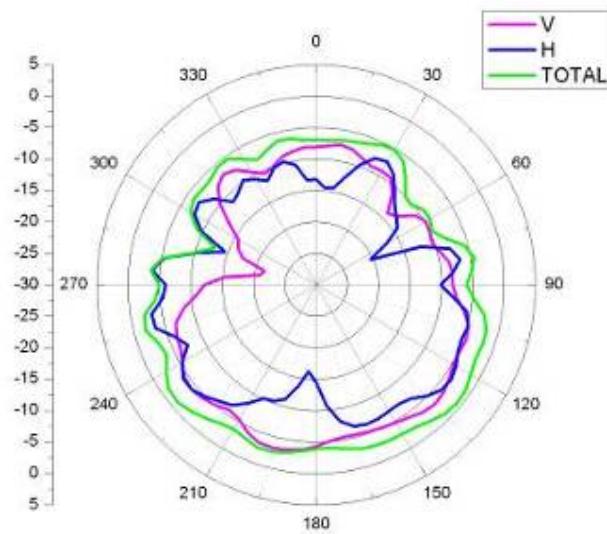
## Section 3. Radiation characteristics of antennae Loaded in Host Platform

### 2412-2562MHz radiation characteristic

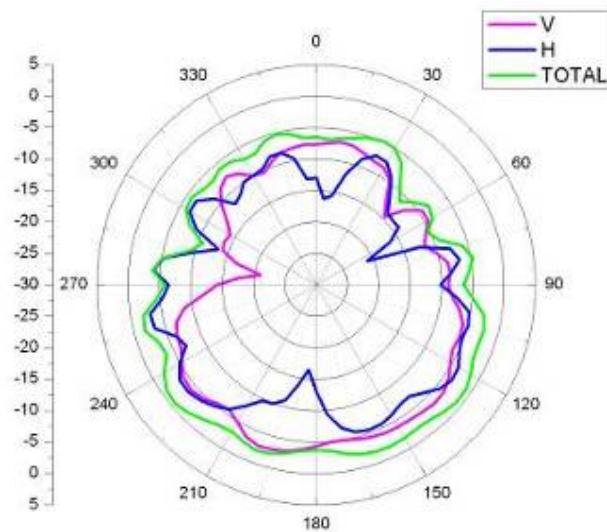
MAIN antenna: 2412 MHz



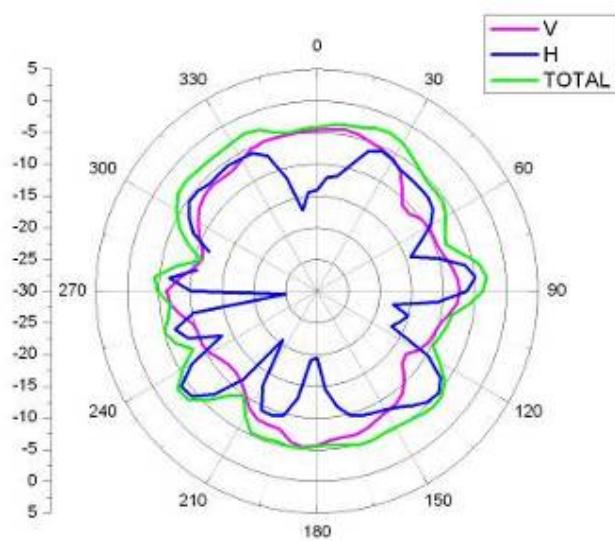
Center Frequency	<b>2412 MHz</b>
Horizontal (dBi) peak	<b>-3.46</b>
Vertical (dBi) peak	<b>-3.59</b>
H+V (dBi) peak	<b>-0.76</b>

**MAIN antenna: 2437 MHz**

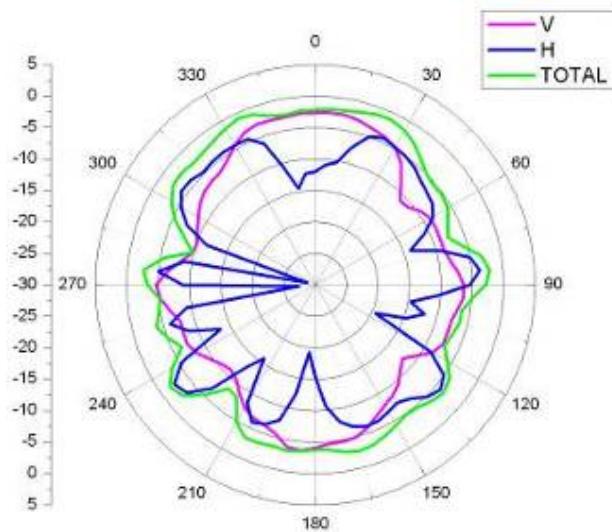
Center Frequency	<b>2437 MHz</b>
Horizontal (dBi) peak	<b>-3.35</b>
Vertical (dBi) peak	<b>-3.22</b>
H+V (dBi) peak	<b>-0.70</b>

**MAIN antenna: 2462 MHz**

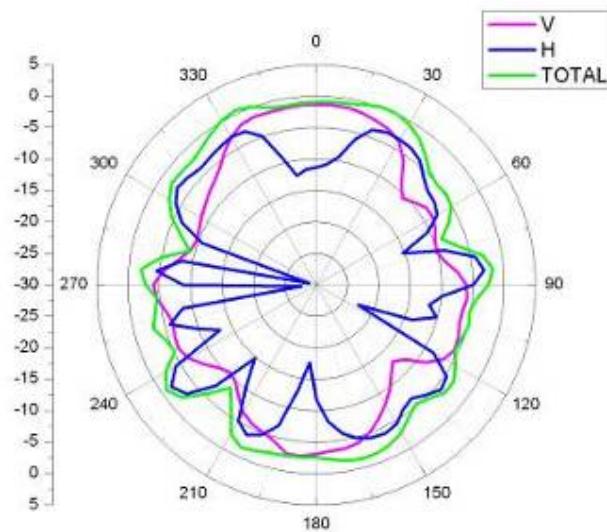
Center Frequency	<b>2462 MHz</b>
Horizontal (dBi) peak	<b>-3.06</b>
Vertical (dBi) peak	<b>-2.80</b>
H+V (dBi) peak	<b>-0.66</b>

**AUX antenna: 2412 MHz**

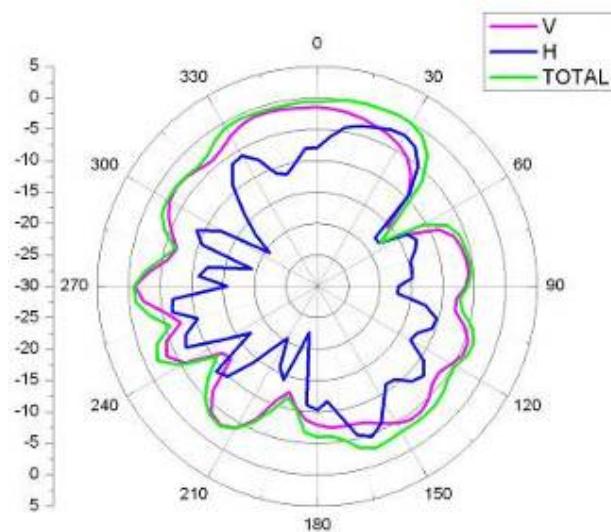
Center Frequency	<b>2412 MHz</b>
Horizontal (dBi) peak	<b>-3.81</b>
Vertical (dBi) peak	<b>-4.16</b>
H+V (dBi) peak	<b>-2.50</b>

**AUX antenna: 2437MHz**

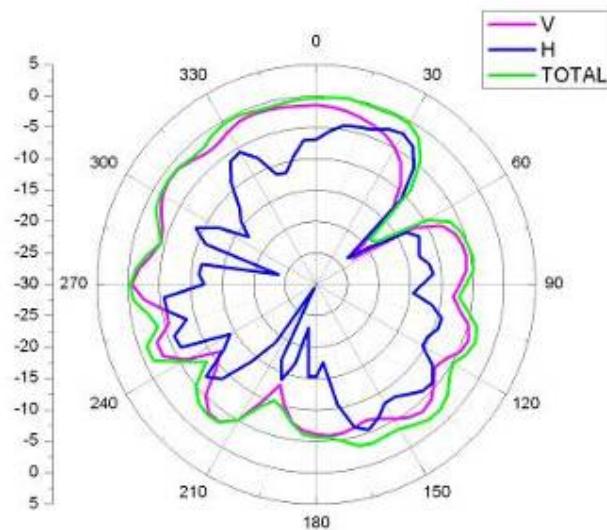
Center Frequency	<b>2437 MHz</b>
Horizontal (dBi) peak	<b>-2.55</b>
Vertical (dBi) peak	<b>-2.54</b>
H+V (dBi) peak	<b>-0.82</b>

**AUX antenna: 2462 MHz**

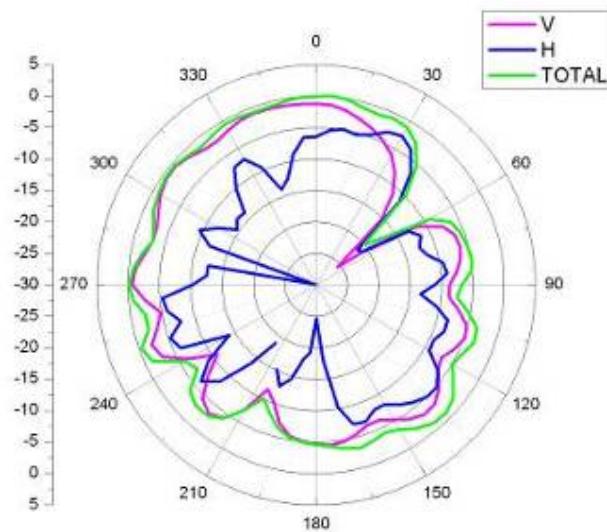
Center Frequency	<b>2462 MHz</b>
Horizontal (dBi) peak	<b>-1.78</b>
Vertical (dBi) peak	<b>-1.28</b>
H+V (dBi) peak	<b>0.57</b>

**MIMO antenna: 2412MHz**

Center Frequency	<b>2412 MHz</b>
Horizontal (dBi) peak	<b>-2.21</b>
Vertical (dBi) peak	<b>-0.96</b>
H+V (dBi) peak	<b>0.15</b>

**MIMO antenna: 2437 MHz**

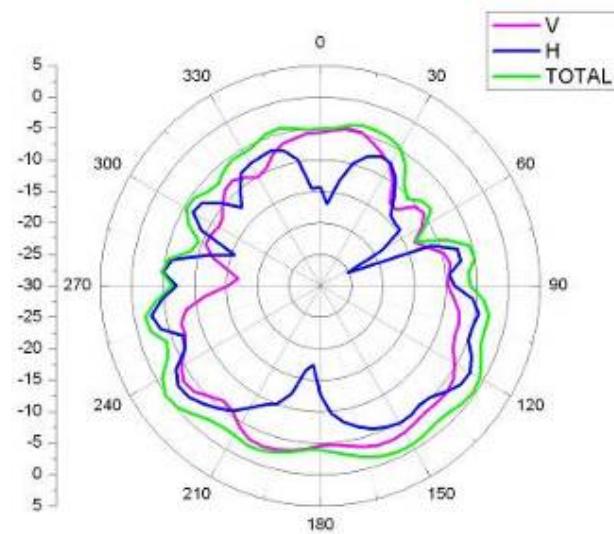
Center Frequency	<b>2437 MHz</b>
Horizontal (dBi) peak	<b>-2.31</b>
Vertical (dBi) peak	<b>-0.59</b>
H+V (dBi) peak	<b>0.01</b>

**MIMO antenna: 2462 MHz**

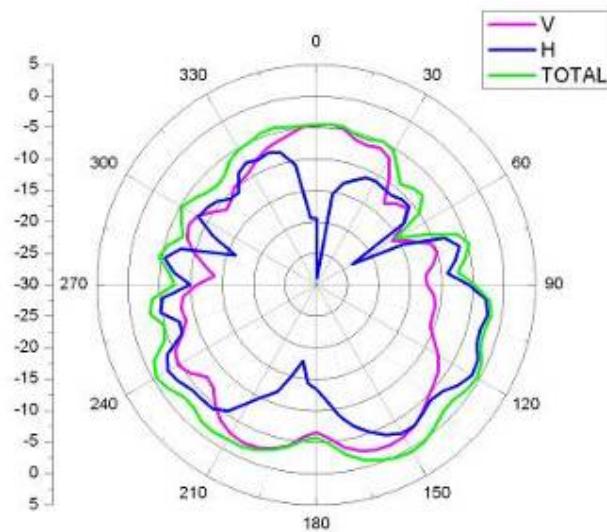
Center Frequency	<b>2462 MHz</b>
Horizontal (dBi) peak	<b>-2.66</b>
Vertical (dBi) peak	<b>-0.66</b>
H+V (dBi) peak	<b>0.11</b>

2500-2700MHz radiation characteristic

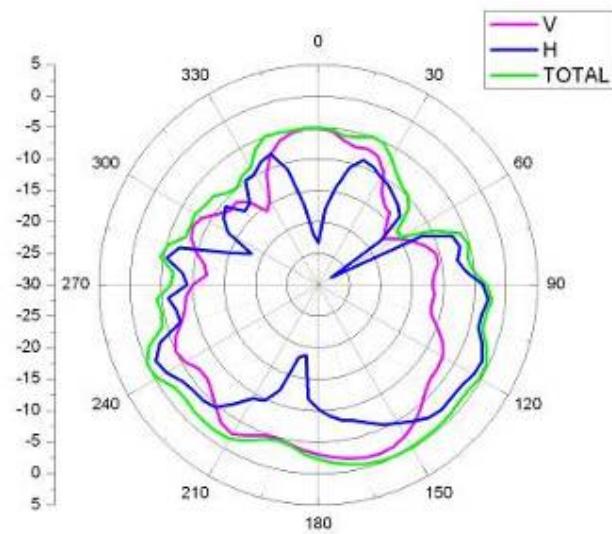
## MAIN antenna: 2500MHz



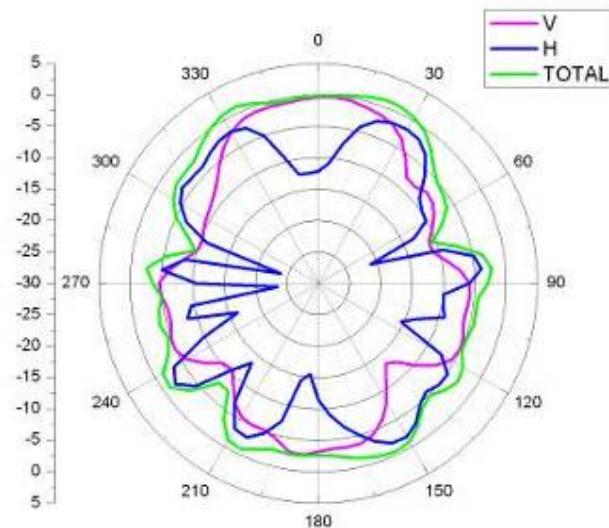
Center Frequency	<b>2500 MHz</b>
Horizontal (dBi) peak	<b>-2.36</b>
Vertical (dBi) peak	<b>-2.91</b>
H+V (dBi) peak	<b>0.12</b>

**MAIN antenna: 2600 MHz**

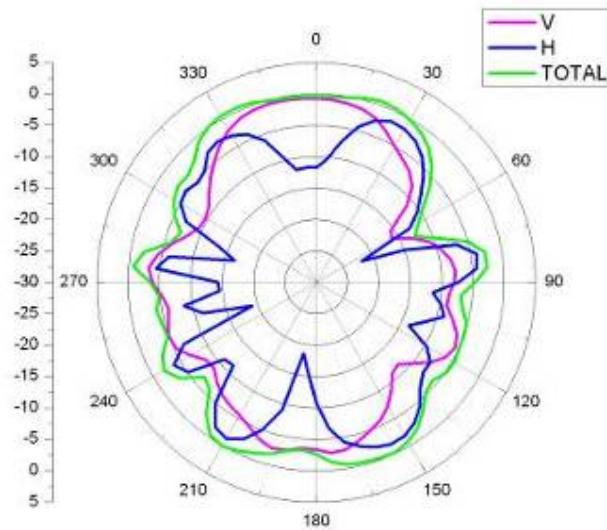
Center Frequency	<b>2600 MHz</b>
Horizontal (dBi) peak	<b>-1.33</b>
Vertical (dBi) peak	<b>-1.94</b>
H+V (dBi) peak	<b>0.58</b>

**MAIN antenna:2700 MHz**

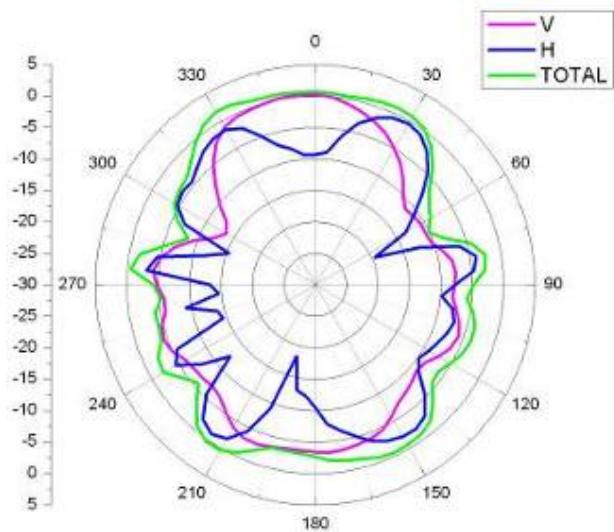
Center Frequency	<b>2700 MHz</b>
Horizontal (dBi) peak	<b>-1.19</b>
Vertical (dBi) peak	<b>-1.42</b>
H+V (dBi) peak	<b>0.14</b>

**AUX antenna: 2500 MHz**

Center Frequency	<b>2500 MHz</b>
Horizontal (dBi) peak	<b>-1.70</b>
Vertical (dBi) peak	<b>-0.26</b>
H+V (dBi) peak	<b>1.10</b>

**AUX antenna: 2600 MHz**

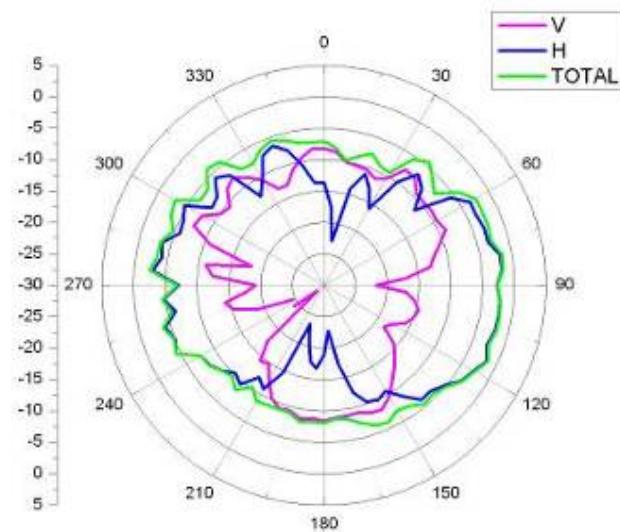
Center Frequency	<b>2600 MHz</b>
Horizontal (dBi) peak	<b>-1.33</b>
Vertical (dBi) peak	<b>-0.54</b>
H+V (dBi) peak	<b>0.62</b>

**AUX antenna: 2700 MHz**

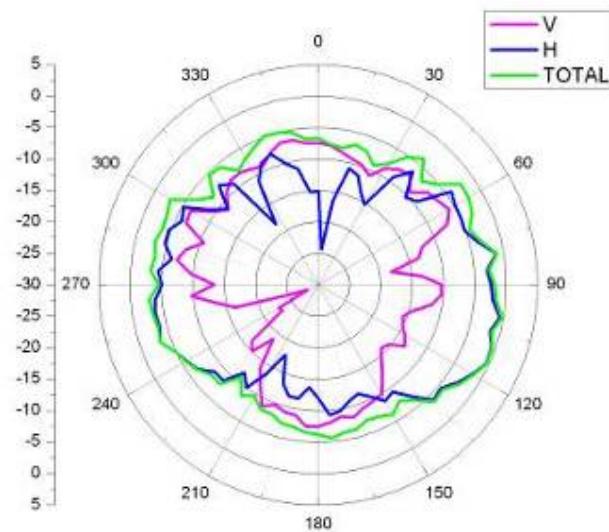
Center Frequency	<b>2700 MHz</b>
Horizontal (dBi) peak	<b>-0.39</b>
Vertical (dBi) peak	<b>0.30</b>
H+V (dBi) peak	<b>1.72</b>

## 5150-5470 MHz radiation characteristic

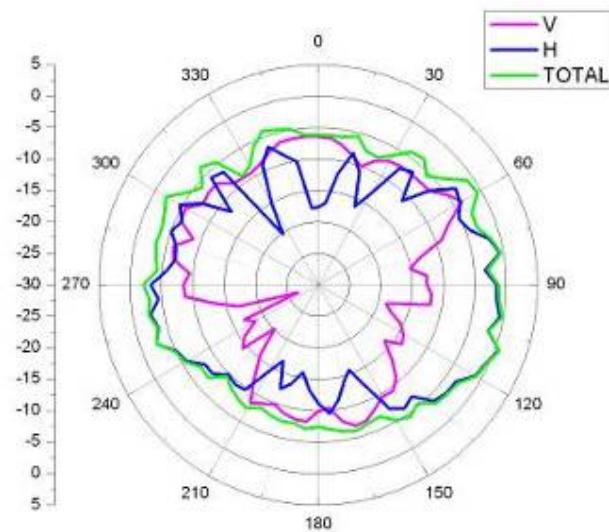
### MAIN antenna: 5150 MHz



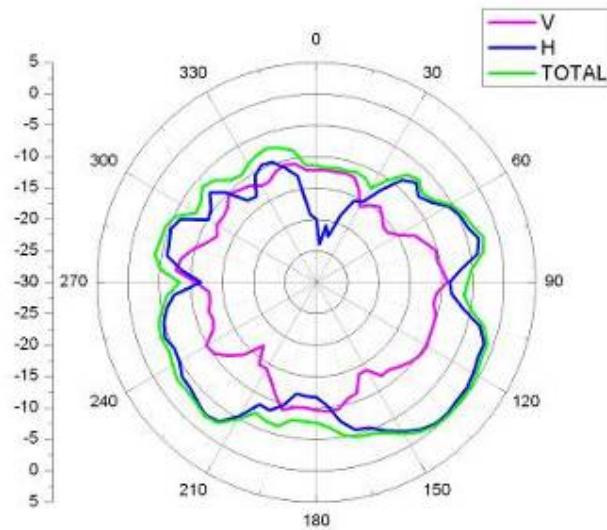
Center Frequency	<b>5150 MHz</b>
Horizontal (dBi) peak	<b>-1.64</b>
Vertical (dBi) peak	<b>-7.40</b>
H+V (dBi) peak	<b>-1.48</b>

**MAIN antenna: 5350 MHz**

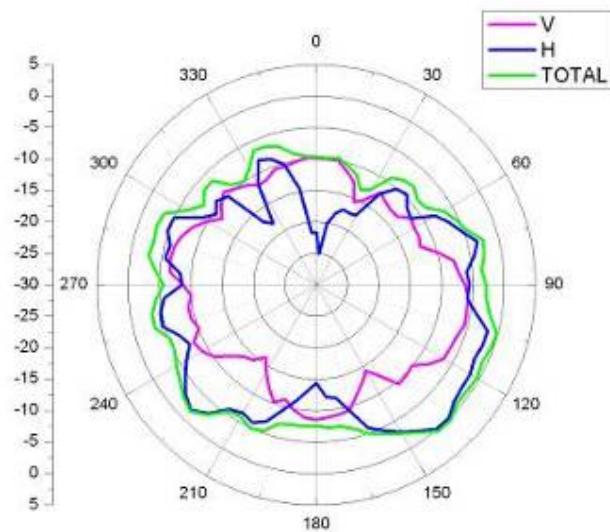
Center Frequency	<b>5350 MHz</b>
Horizontal (dBi) peak	<b>-0.50</b>
Vertical (dBi) peak	<b>-5.89</b>
H+V (dBi) peak	<b>-0.24</b>

**MAIN antenna: 5470 MHz**

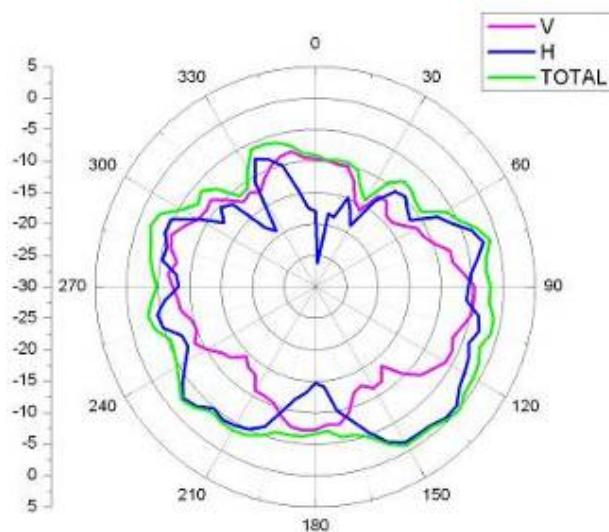
Center Frequency	<b>5470 MHz</b>
Horizontal (dBi) peak	<b>0.65</b>
Vertical (dBi) peak	<b>-3.52</b>
H+V (dBi) peak	<b>0.71</b>

**AUX antenna: 5150 MHz**

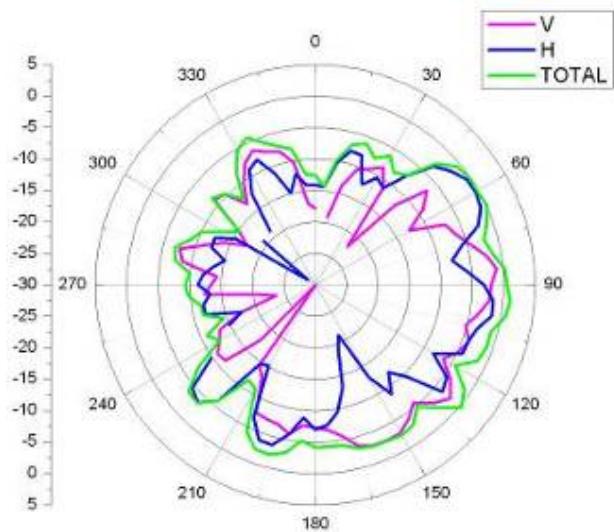
Center Frequency	<b>5150 MHz</b>
Horizontal (dBi) peak	<b>-0.47</b>
Vertical (dBi) peak	<b>-7.58</b>
H+V (dBi) peak	<b>-0.10</b>

**AUX antenna: 5350 MHz**

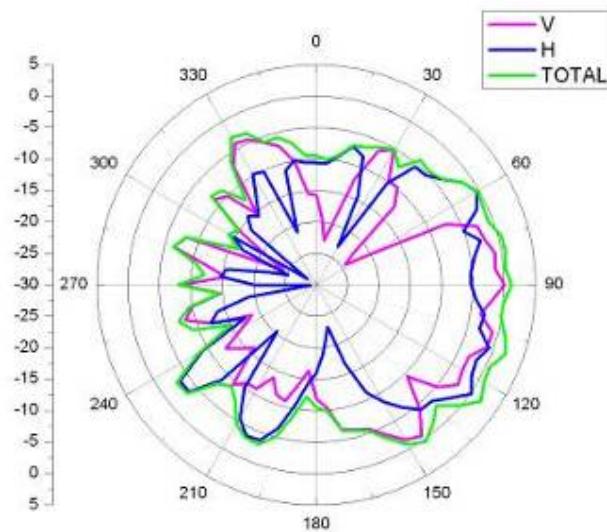
Center Frequency	<b>5350 MHz</b>
Horizontal (dBi) peak	<b>-0.07</b>
Vertical (dBi) peak	<b>-5.49</b>
H+V (dBi) peak	<b>0.36</b>

**AUX antenna: 5470 MHz**

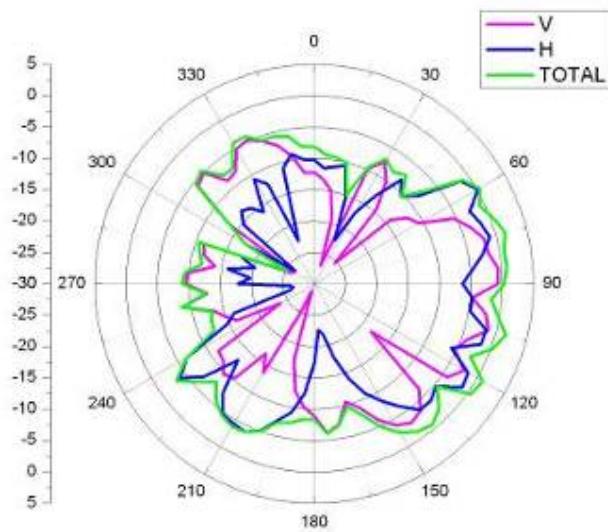
Center Frequency	<b>5470 MHz</b>
Horizontal (dBi) peak	<b>-0.57</b>
Vertical (dBi) peak	<b>-4.65</b>
H+V (dBi) peak	<b>0.11</b>

**MIMO antenna: 5150 MHz**

Center Frequency	<b>5150 MHz</b>
Horizontal (dBi) peak	<b>-0.47</b>
Vertical (dBi) peak	<b>-1.02</b>
H+V (dBi) peak	<b>1.12</b>

**MIMO antenna: 5350 MHz**

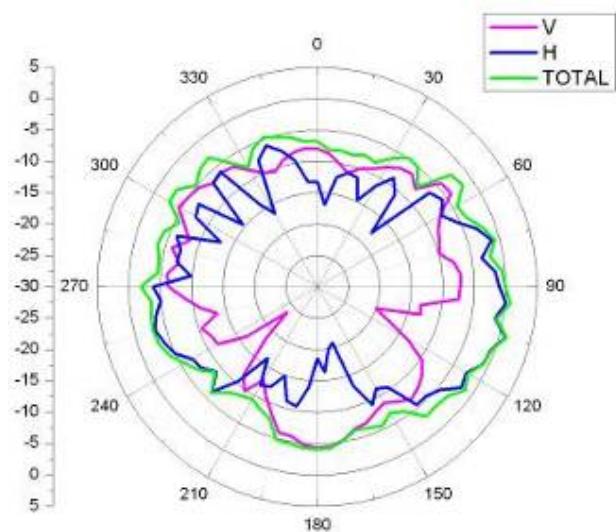
Center Frequency	<b>5350 MHz</b>
Horizontal (dBi) peak	<b>0.19</b>
Vertical (dBi) peak	<b>0.02</b>
H+V (dBi) peak	<b>2.15</b>

**MIMO antenna: 5470 MHz**

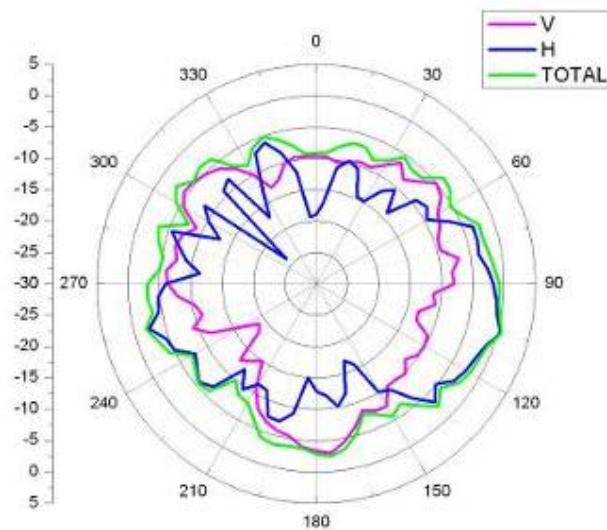
Center Frequency	<b>5470 MHz</b>
Horizontal (dBi) peak	<b>0.10</b>
Vertical (dBi) peak	<b>-0.57</b>
H+V (dBi) peak	<b>1.56</b>

## 5725-5875 MHz radiation characteristic

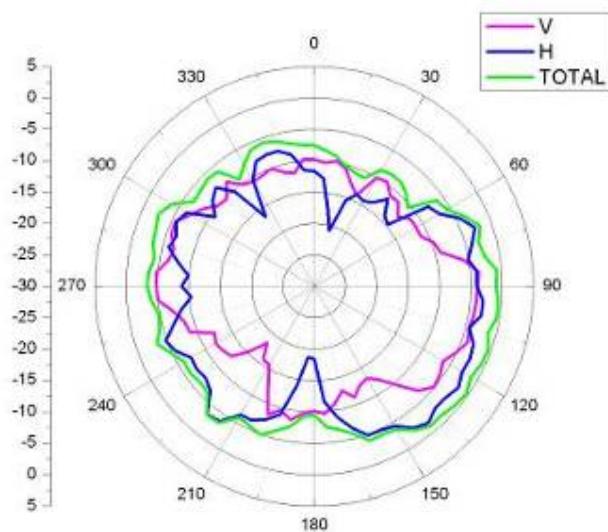
### MAIN antenna : 5725 MHz



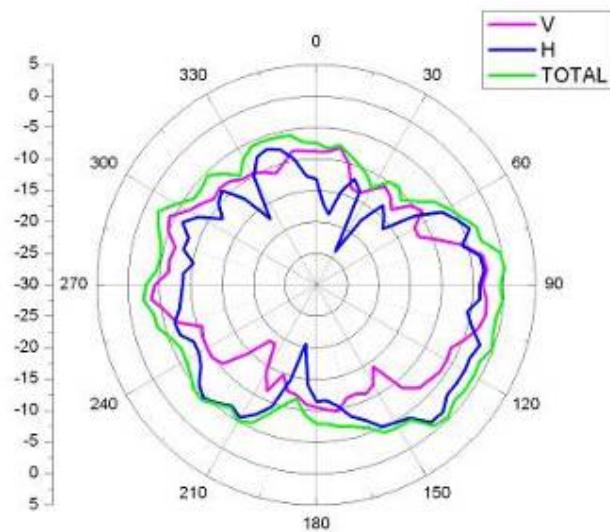
Center Frequency	<b>5725 MHz</b>
Horizontal (dBi) peak	<b>1.04</b>
Vertical (dBi) peak	<b>-3.99</b>
H+V (dBi) peak	<b>1.21</b>

**MAIN antenna: 5875 MHz**

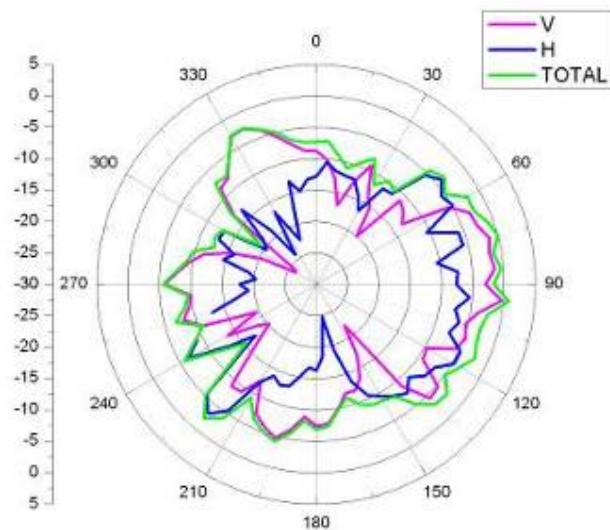
Center Frequency	<b>5875 MHz</b>
Horizontal (dBi) peak	<b>0.39</b>
Vertical (dBi) peak	<b>-2.91</b>
H+V (dBi) peak	<b>0.58</b>

**AUX antenna : 5725 MHz**

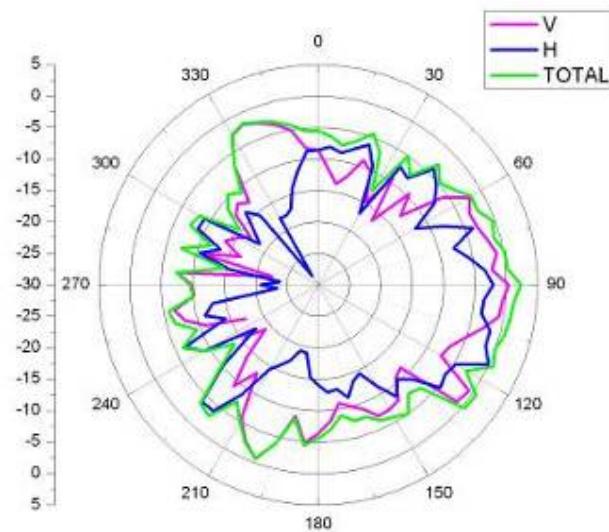
Center Frequency	<b>5725 MHz</b>
Horizontal (dBi) peak	<b>-1.65</b>
Vertical (dBi) peak	<b>-3.60</b>
H+V (dBi) peak	<b>-0.35</b>

**AUX antenna : 5875 MHz**

Center Frequency	<b>5875 MHz</b>
Horizontal (dBi) peak	<b>-1.42</b>
Vertical (dBi) peak	<b>-2.55</b>
H+V (dBi) peak	<b>0.11</b>

**MIMO antenna : 5725 MHz**

Center Frequency	<b>5725 MHz</b>
Horizontal (dBi) peak	<b>-3.16</b>
Vertical (dBi) peak	<b>-0.34</b>
H+V (dBi) peak	<b>0.83</b>

**MIMO antenna : 5875 MHz**

Center Frequency	<b>5875 MHz</b>
Horizontal (dBi) peak	<b>-0.03</b>
Vertical (dBi) peak	<b>0.33</b>
H+V (dBi) peak	<b>2.29</b>

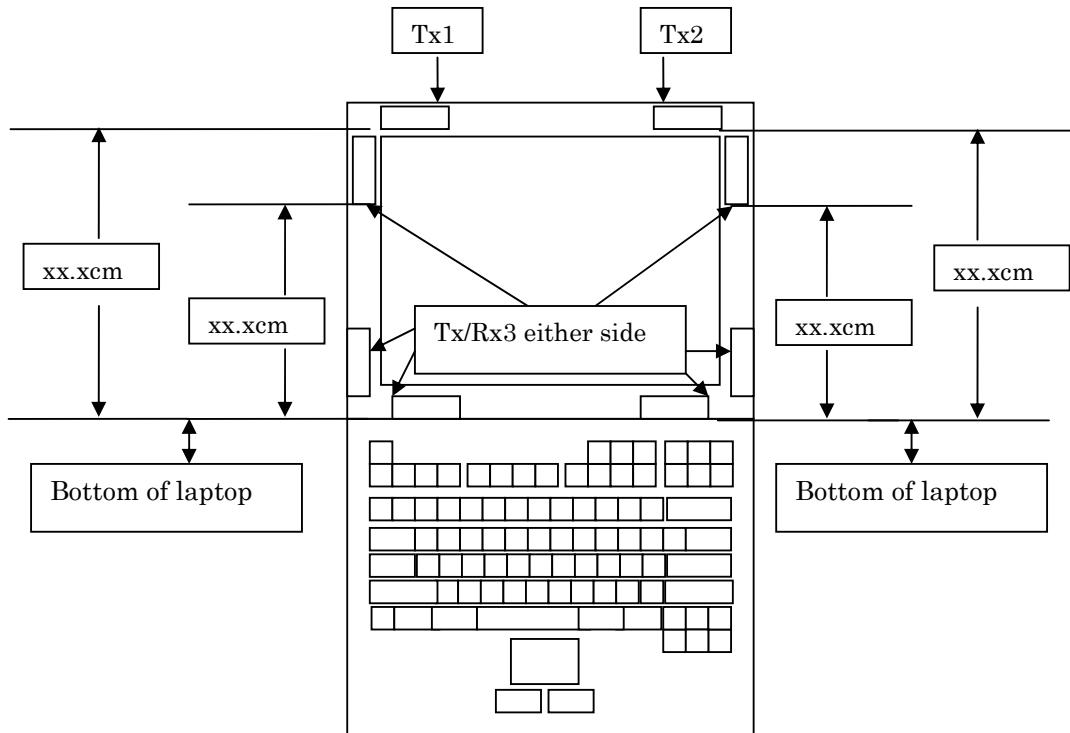
## Section 4. Host Platform Information

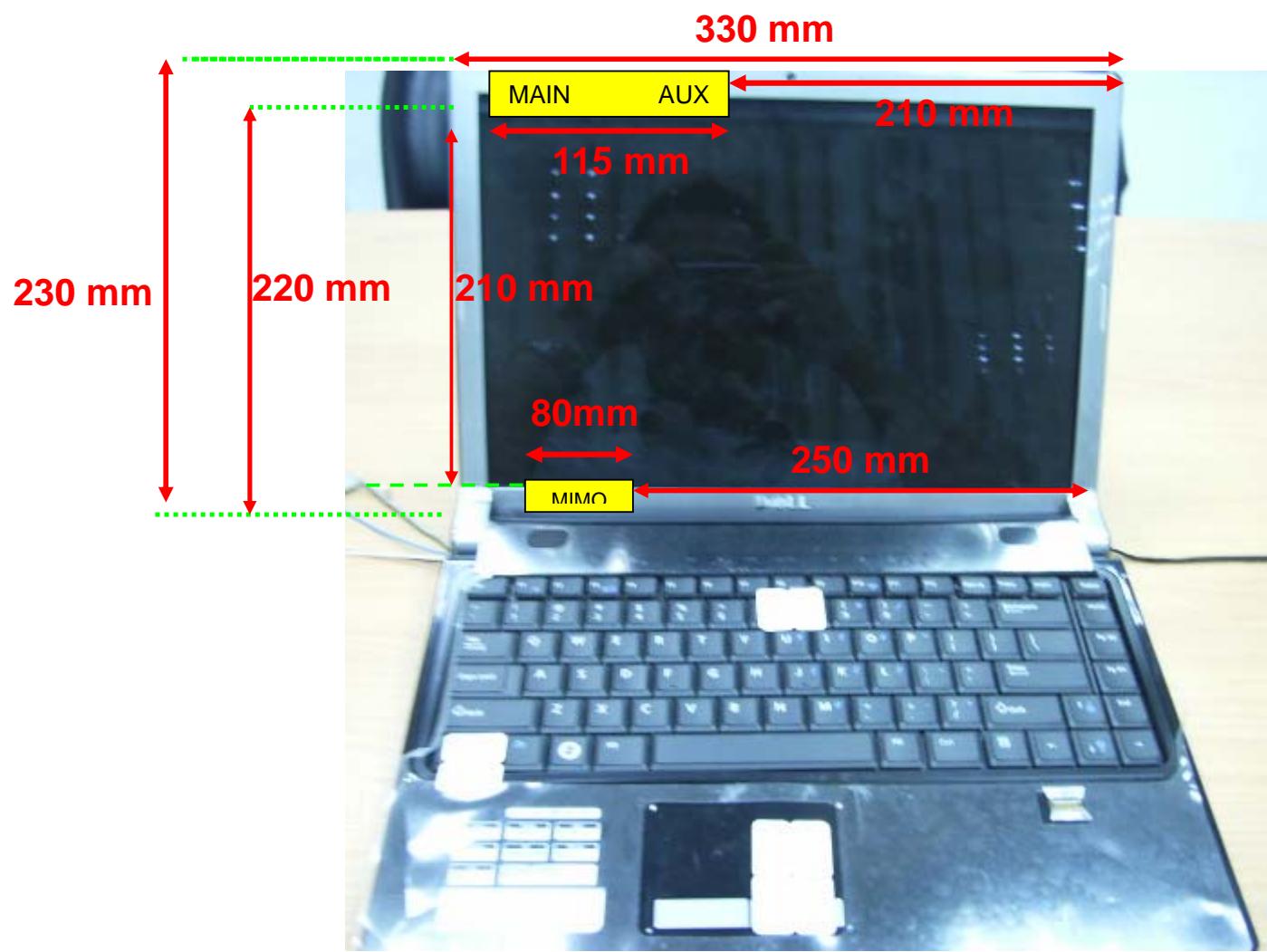
OEM / ODM Host platform: (XXXXXXX) platform correlated to antenna data

Rating Label Photo:

## Section 5. Antenna Host Platform Location Information

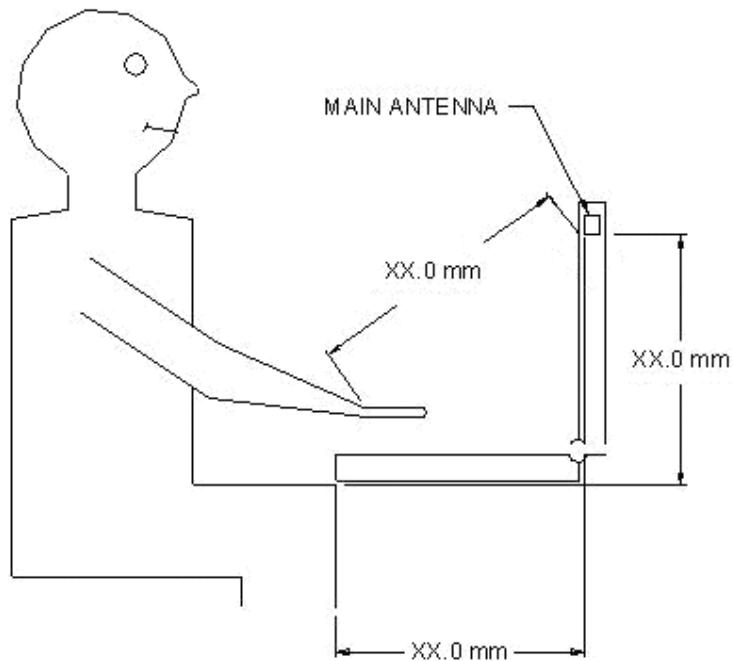
Include a **dimensioned photo or dimensioned drawing** of Tx1, Tx2 and Tx3 antenna placements (measurements are not required for receive-only antenna). Any antenna that transmits must show dimensions to bottom of laptop.





## Section 6. Antenna dimensional information for SAR evaluation

Include a **dimensioned photo or dimensioned drawing** showing the distance (mm) between the transmit antennas and the user (excluding hands, wrist, feet, lap/ thigh, and ankle)

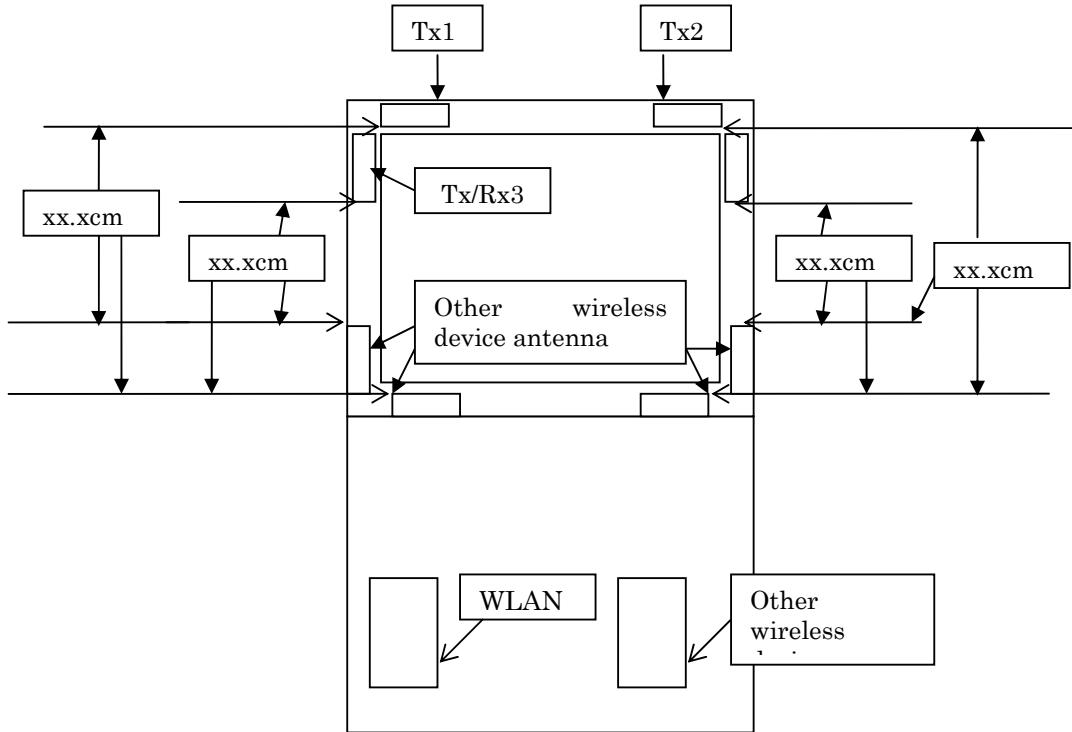


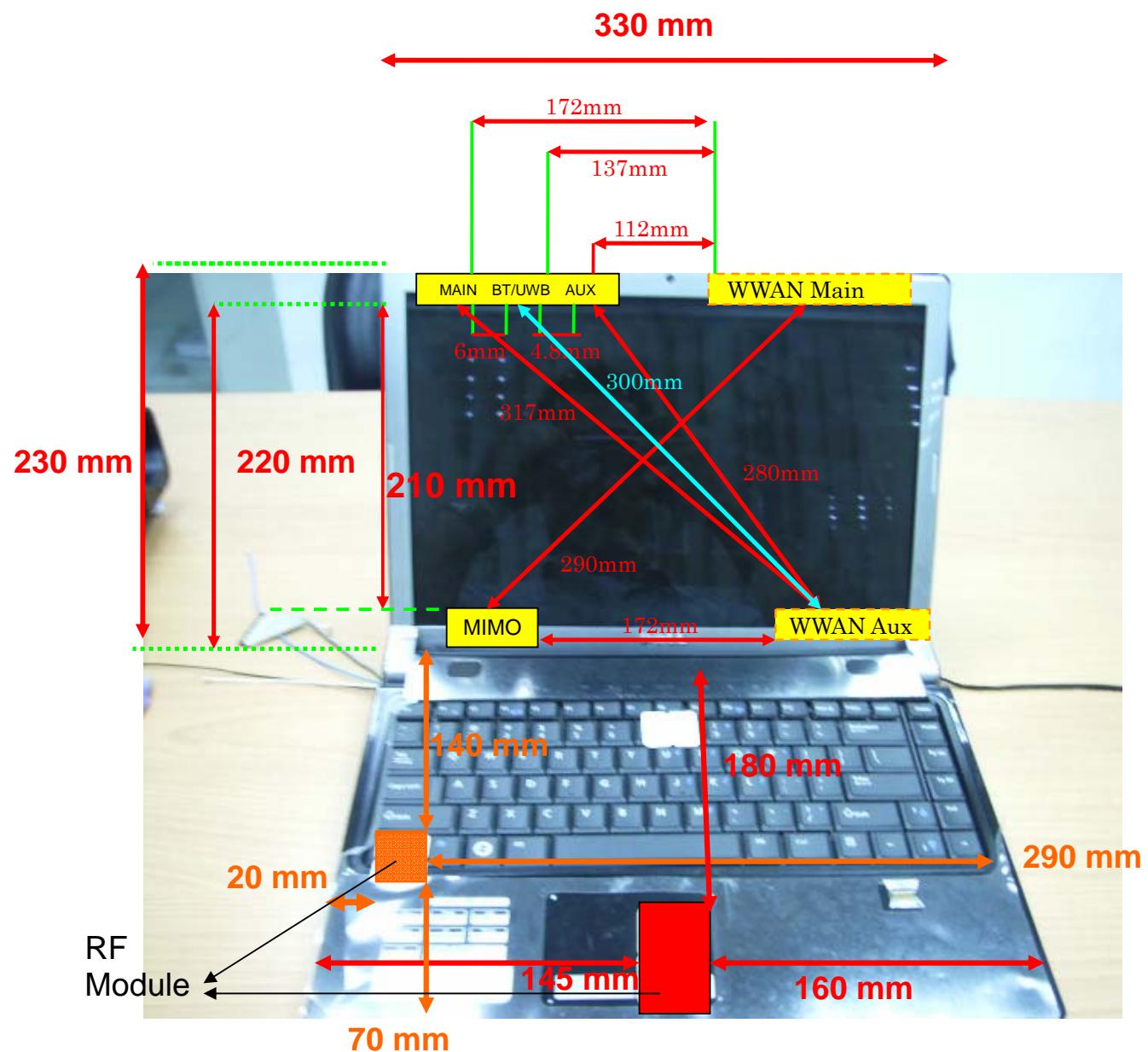
**Antenna distance to Keyboard <7&8>**  
 $L_{main} = 275\text{mm}$   
 $L_{aux} = 270\text{ mm}$   
 $L_{mimo} = 150\text{mm}$

## Section 7. Diagram Example of Co-Location Antenna Separation

Include a **dimensioned photo** or **dimensioned drawing** showing the distance (mm) between all WLAN transmit antennas and other co-located radiator transmit antenna such as Bluetooth, WWAN,...

(Note: Due to the evolving rules regarding co-location, each platform will need to be reviewed on a case by case basis)





## Section 8. Local representative contact information

Joseph\_hoo@asus.com.tw

**Local representative contact information is required for regulatory support for target countries below.**